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ANII
NATIONAL RESEARCH
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RESULTS OF THE **FIRST SURVEY ON ENVIRONMENT, CLIMATE CHANGE AND INNOVATION.**

INNOVATION ACTIVITIES SURVEY (2019-2021)

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FIRST SURVEY ON ENVIRONMENT, CLIMATE CHANGE AND INNOVATION
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Authors:

Daniel Bukstein (Evaluation and Monitoring Unit, National Agency for Research and Innovation)
Virginia Chiesa (National Directorate of Environmental Quality and Evaluation, Ministry of Environment)
Garine Guerguerian (National Directorate of Environmental Quality and Assessment, Ministry of Environment)
Elisa Hernandez (Evaluation and Monitoring Unit, National Agency for Research and Innovation)
Lorena Marquez (National Directorate of Climate Change, Ministry of Environment)
Daniel Quiñones (National Directorate for Climate Change, Ministry of Environment)
Ximena Usher (Evaluation and Monitoring Unit, National Agency for Research and Innovation)

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For inquiries, please contact: eym@anii.org.uy

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Introduction

This paper aims to analyze the behavior of companies regarding environment, climate change and innovation, based on the Innovation Activities Survey for the 2019-2021 period. For the first time, this edition of the survey includes a section that collects information on company strategies for the introduction of innovations with environmental benefits.

The Ministry of Environment[1] is responsible for the implementation of the national policies of environment, environmental management, sustainable development, and of conservation and use of natural resources established by the Executive Branch. To fulfill its duties, and through its different national directorates, the ME coordinates actions to advance the transition to a sustainable Uruguay with a multiplicity of national, provincial and municipal public institutions based on their respective competencies: private, academic and civil society organizations; and international organizations.

The National Research and Innovation Agency promotes research and the application of new knowledge to the productive and social realities of the country, offering grants for research and innovation projects, national and international postgraduate scholarships, and programs to promote an innovative and entrepreneurial culture. For some years now, environmental issues have taken on importance in the programs developed by the Agency, becoming a strategic line across all its instruments.

This document is structured as follows: Chapter 1 presents a brief review of the policy framework and a selection of instruments for the environment and climate change based on the results of the survey; Chapter 2 conceptualizes the link between innovation, environment, and climate change; Chapter 3 describes the survey methodology, Chapter 4 presents the analysis of the results and finally Chapter 5 presents a summary of the main results.

1 Created by Article 291 of Law 19889 on July 9, 2020.

1

Framework of environmental, climate change and innovation policies and instruments related to the Innovation Survey

The following is a brief presentation of some of the fields of action in the area of national environmental policy, selected according to the topics addressed in the Innovation Activities Survey. This framework is designed to facilitate a proper interpretation of the survey results.

1.1. National Environmental Plan for Sustainable Development [2]

In 2018, the National Directorate of the Environment (DINAMA by its Spanish acronym) and the National Environmental System (SNA by its Spanish acronym) convened a national and territorial inter-institutional process for the development of this plan, as an integrated construction supported by both technical and scientific criteria, as well as a process of communication and consensus building. This plan is proposed as a strategic and adaptive instrument that identifies the country's main environmental challenges in order to guide policies and actions in the coming years. It seeks to harmonize, deepen and create intermediate agreements with a 2030 horizon.

One of its main objectives is to actively promote the development of environmentally sustainable production and consumption models and practices, and to incorporate the environmental dimension into current and future socioeconomic activities.

1.2. National Water Policy

Under the framework of the National Water Policy Law of 2009 (Law 18610), the National Water Plan is coordinated by the National Water Directorate (DINAGUA by its Spanish acronym) and is the product of a process of construction by multiple organizations. It is a technical and political instrument for water planning and management that considers the various uses of this resource. The Plan was approved by Executive Order 205/017 of July 31, 2017. Its main objectives are the use of water for sustainable development, access to water and sanitation as a human right, flood and drought risk management (which in turn is linked to adaptation to climate change and variability). Regarding water availability and its use by the productive sector, the ME authorizes the extraction of raw water through permits based on the availability of the country's different hydrographic basins.

2 Approved by Executive Order 222/019 of August 5, 2019: https://www.impo.com.uy/bases/decretos/222-2019

1.3. Integrated waste management and circular economy

Uruguay is currently developing the National Circular Economy Strategy (ENEC by its Spanish acronym), with the general objective of "Promoting sustainable production and consumption systems oriented towards the circular use of resources, maintaining/generating value, and the regeneration of natural systems." Its specific objectives are: To strengthen public policies, including monitoring systems and the context to promote circular production and consumption systems; to promote R&D&I initiatives towards circular models such as eco-design, life extension, recovery of materials, energy and water, the use of cascading of biomass, and resource sharing; to promote circular business models and circular cities; to promote a cultural change towards circular consumption and production.

This process is led by a working group formed by ministries of Industry, Energy and Mining; Environment; Cattling, Agriculture and Fisheries; and Economy and Finance. Other relevant actors are included in discussion spaces according to the prioritized flow.

Specifically regarding waste, the Ministry of Environment (ME) promotes a paradigm shift in the understanding of and relationship with waste, based on a circular economy, participation and shared responsibility approach. This circularity promotes the understanding of waste as resources, the identification of opportunities to transform them, their revaluation, and their minimization as a first step. Circularity also challenges and invites us to rethink our consumption habits, our practices, and our responsibility. But above all, circularity calls us to act, to be part of the cultural change.

The Act No. 19829 of 2019 establishes the national waste policy and provides the guidelines for the management of different solid waste types. It promotes a transformation based on a circular economy model, and aims to improve the environmental quality of waste management. In turn, this act seeks to influence the production and consumption model and reinsert resources into new production cycles, within the framework of formal and inclusive processes.

Within this framework, an inter-institutional working group prepared the National Waste Management Plan (PNGR by its Spanish acronym), which was published in December 2021. This is a national-level strategic planning document, with guidelines and goals for waste management for the next ten years, in the transition to a more circular Uruguay. The PNGR is structured by 10 global results. In particular, global result 7 is entitled "Technological Incorporation, Research and Innovation."

With the understanding that knowledge must be the driving force for the development of the PNGR, this global result aims to promote research, technological development and innovation in waste generation and management. Some of the priority areas identified for the promotion of R&D&I are eco-design, development of alternative materials, prevention and reduction of food losses and waste, single-use plastics and microplastics, social aspects of waste management, high quality recycling, waste value addition, biotechnology applied to waste, and environmental footprint (life cycle analysis).

1.4. Environmental impact monitoring and assessment

Uruguay has developed a wide range of environmental regulations, starting with Law 17283 on General Environmental Protection. In relation to production and consumption activities, the most relevant regulations are the instruments of Environmental Impact Assessment (EIA)[3] and environmental authorizations regulated by Executive Order 349/005. Likewise, a series of environmental regulatory services have been put in place, including authorizations, permits, standards, obligations, prohibitions, registrations, and information declaration requirements specific to various production sectors, waste streams, and scales of activity. Some of these services are part of a broader framework, the Environmental Control Program for Activities that Affect the Environment.

1.5. Climate change

The National Climate Change Response Plan (2010), the National Climate Change Policy (2017), and the first and second Nationally Determined Contribution (NDC) for 2025 and 2030[4] were developed within the framework of the National System of Response to Climate Change and Variability (SNRCC by its Spanish acronym), which is coordinated by the ME. Finally, in 2021 the country presented its Long-Term Climate Strategy (LTCS)[5] , through which the country committed to an aspirational scenario of carbon dioxide (CO_2) neutrality given the available knowledge and technologies, that is, to achieving a zero balance between CO_2 emissions and their capture by 2050. With respect to methane gas (CH_4), which is mainly generated by agricultural activities, and in order to continue contributing to world food production, Uruguay's LTCS proposes an ambitious scenario of stability of CH_4 emissions by 2050.

Given its conditions of vulnerability to climate change, Uruguay has made it a political priority to implement measures to increase the adaptive capacity and resilience of its society, productive systems and ecosystems, and to reduce vulnerability to adverse climate events in all the policy instruments mentioned above.

Climate change:
is defined as a change in climate that persists over long periods of time, generally decades or longer, attributed directly or indirectly to human activity, which, by generating greenhouse gases (GHG), alters the composition of the global atmosphere and adds to the natural variability of climate observed over comparable time periods (UN, 1992).

3 Environmental impact is the modification of the environment caused by human or natural action.
4 https://www.gub.uy/ministerio-ambiente/CDNUy
5 https://www.gub.uy/ministerio-ambiente/politicas-y-gestion/estrategia-climatica-largo-plazo-uruguay

1.6. Innovation Instruments

There is a growing consensus that innovation is the main driver of long-term economic growth (Fajnzylber, 1988; Ocampo, 1991; Sutcliffe, 1995; Jaramillo, Lugones and Salazar, 2001). At present, the empirical evidence for this assertion is sufficiently robust and shows a stable and lasting relationship between innovation investment, productivity, and country growth.

The OECD Oslo Manual is an important reference for the definition and collection of innovation data. The Manual states that an innovation is a new or improved product or process that differs significantly from the company's previous products or processes, and that is made available to potential users or has been put into use by the company.

One of the ANII's main objectives is to promote innovation in the productive sector. To this end, the ANII has designed and implemented instruments in six lines of action:

1. **Strengthening of innovation capabilities:** tools for companies to increase and strengthen their internal capabilities to innovate, so that they are better prepared to design and implement innovation projects.
2. **Support for business innovation:** horizontal instruments aimed at sharing the innovation risk of individual companies.
3. **Academy-business articulation:** instruments aimed at fostering articulation between the actors of the National Innovation System.
4. **Public and private challenges:** s finding solutions to problems or demands of the productive sector and the government, through the development of innovative projects.
5. **Sectoral funds:** vertical instruments jointly implemented by the ANII and its partners.
6. **Inclusive innovation in companies:** instrument that supports the generation of innovations to improve the quality of life and social integration of marginalized populations.

In recent years, the ANII has been working to include incentives in its main instruments to ensure that proposals submitted by the productive sector contribute to environmental protection and climate change mitigation and adaptation.

2

Conceptual framework: Link between innovation, environment, and climate change

According to the OECD (2010), innovation has become a key factor for a country's sustainable development. Today, companies face several environmental challenges, such as global warming, pollution control, and the dwindling stock of natural resources. In this context, there is increasing pressure to develop new products and services or to incorporate environmentally "friendly" processes.

According to the literature, by integrating environmental innovations into its strategy, a company can increase its sales, enter new markets, improve its competitive advantage, improve its financial performance, enrich its business, differentiate its products and, at the same time, improve the environment (Arundel and Kemp, 2009; Brouwers & Jacke, 2010; Chiou et al., 2011; Dangelico & Pontrandolfo, 2013; del Rio et al., 2013; Guoyou et al., 2013; Salon & Wagner, 2012; Porter & Van der Linde, 1995; Vachon & lassen, 2008).

Innovation with environmental benefits:
a new or significantly improved product or process of a company that generates lower environmental impacts compared to the company's previous products or processes, and that has been made available to potential users or has been put into use. Environmental benefits can be the main objective of innovation or a by-product of other objectives.

2.1. Factors that determine the adoption of innovations with environmental benefits by companies

Several theoretical approaches attempt to explain the motivations of companies to innovate with environmental benefits. These theories imply different drivers of environmental innovations and can be classified according to the origin of these motivations.

Internal factors

One of these theories is based on factors that are internal to companies, inherent to their productive process, using the concept of "competitive advantage". The theory based on competitive advantages holds that competitive processes do not occur throughout the industry, but rather in segments or niches of the industry. In this sense, the "green consumer" can be considered a niche market. By adopting innovations with environmental benefits and positioning itself as environmentally committed, a company produces an offer that is more valuable to consumers compared to its competitors (Hunt, 2011b).

From this perspective, environmental innovations play an important role in the creation of competitive advantages, and the preference of companies towards this type of innovation is endogenous and inherent to the competition process.

Another internal driver for companies to introduce innovations with environmental benefits is associated with cost savings (Kesidou & Demire, 2012). Companies can save costs by investing in cleaner production technologies, as they reduce the cost of raw and other materials, energy, pollution control, waste treatment and cleanup, and regulatory compliance (Ashford, 1994, p. 7).

External factors

On the other hand, there is a theoretical approach that attempts to explain the behavior of companies regarding environmental innovation through external factors. This theory, known as the Stakeholder Theory, suggests that to survive and grow, companies must satisfy stakeholder demands (Kassinis & Vafeas, 2006). Among others, Lin et al. (2014), Renning & Rammer (2011), and Horbach (2008) have shown that pressures from regulators, consumers, suppliers, and competitors drive environmental innovation.

This is due to the systemic and complex nature of environmental innovations, which increases the need for cooperation between companies and their environment. The stronger this relationship is, the greater the company's access to knowledge about: 1) consumer perceptions and demand (Green et al, 1994); 2) the ability of suppliers to provide more environmentally friendly raw materials (Buttol et al., 2012, Green et al., 1994); 3) the experience of competitors, and 4) the intellectual capital of universities (Cianelli et al, 2012; Dangelico & Pontrandolfo, 2013). Wagner (2007) has found that firms' collaboration with environmentally concerned stakeholders is an important determinant of innovation with environmental benefits.

Consumers of environmentally friendly products play an important role in innovations with environmental benefits. Gestelberger et al. (2013) note that customers have begun to pressure companies to improve their environmental performance. Horte & Halila (2008) argue that consumer perception and corporate social responsibility is sufficient to induce companies to develop, adapt and use more environmentally friendly products, processes, and management systems.

Regarding the influence of regulatory factors, many authors such as Del Río et al. (2013), Gestelberger at al. (2013), and Porter & Van der Linde (1995) argue that regulation is an important driver of innovation with environmental benefits. Public policy can encourage companies to participate in innovation with environmental benefits by using "carrots" (subsidies), and punish them for not participating by using "sticks" (environmental sanctions).

The two theoretical approaches:
mentioned above are complementary and explain the intention of companies to carry out environmental innovations. The theory based on competitive advantages presents the internal motives of a company, while the stakeholder theory explains its external drivers.
Sarkis et al. (2010)

2.2. Innovation and climate change

Innovations with environmental benefits are important because they make it possible to address the present and projected impacts of climate change, and the GHG emission reduction targets of both countries and organizations.

In general, companies may be exposed to multiple risks linked to the impacts of climate change. Managing these risks and impacts can present specific opportunities for innovation, particularly regarding changes in water availability, supply and quality, food safety, and impacts on infrastructure, operations, and the production chain. In this sense, Horbarch & Rammer (2022) analyzed data from the 2020 edition of the European CIS and found that the German companies that reported being more affected by climate change were more likely to introduce environmental innovations.

Similarly, they identified that the efforts made by companies to mitigate the effects of climate change generate the conditions for innovation development. Su & Moaniba (2017) analyzed patent data from 70 countries and found a positive correlation between the adoption of environmental innovations in firms and their level of carbon dioxide emissions. Wang et al. (2020) found similar results for China.

Indeed, the management of GHG emissions has become a central issue for company performance and competitiveness. In addition to frequently increasing efficiency and reducing costs, the ability to estimate and reduce the carbon footprint can be an opportunity to enter new markets, access financing with better conditions, differentiate the company from its competitors, increase its market value, and strengthen its reputation, among others.

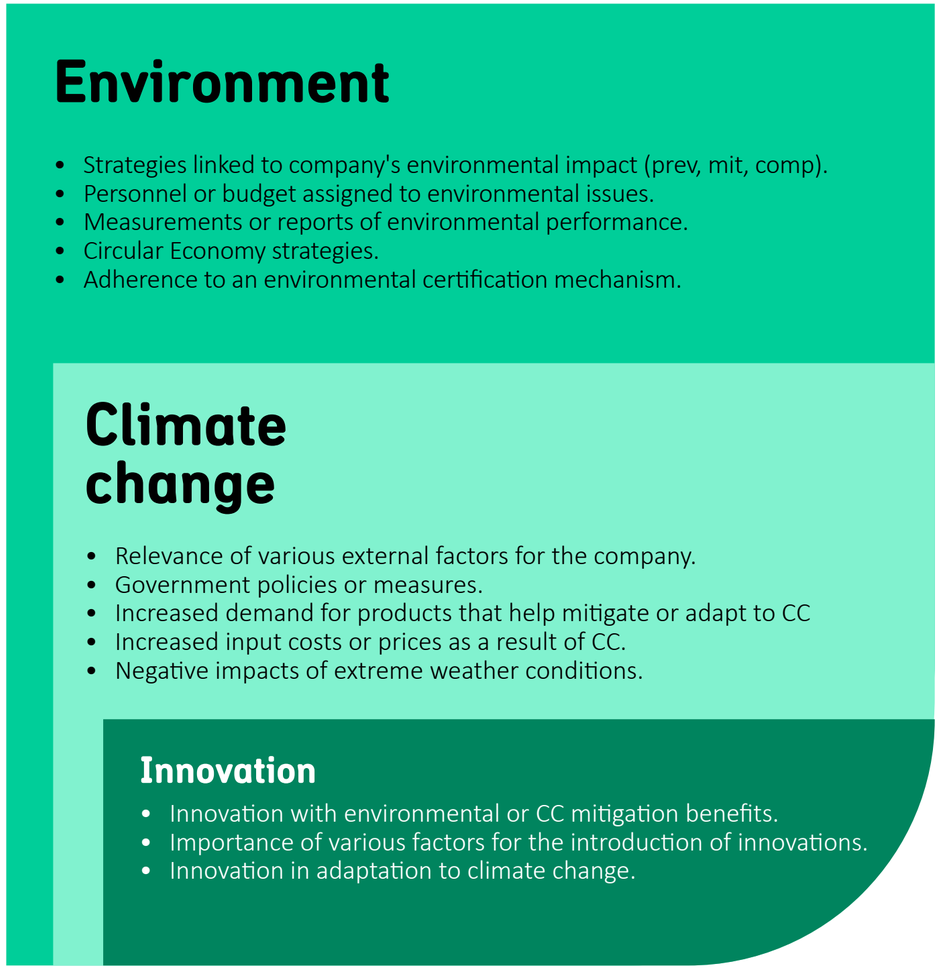
3

Methodology of this study

3.1. Design of the "Environment, Climate Change and Innovation" module in the Innovation Activities Survey

As mentioned in the introduction, the specific Environment and Climate Change module form was developed by following the OECD and EUROSTAT guidelines, and consulting with experts from various institutions: the Ministry of Industry, Energy and Mining; the ME, and the IDB in Uruguay. In addition, the ME and the ANII trained the interviewers for this survey module.

FIGURE 1. Structure of the Environment, Climate change and Innovation module of the survey



Questions on the Environment and Climate Change dimension

First, the Innovation Activities Survey addresses the environment and asks companies if they have implemented strategies to manage the environmental impact of their activities.

These strategies can be classified into three types, depending on when they are implemented:

- Prevention strategies are aimed at avoiding the appearance of negative environmental effects and are normally implemented in the design phase of the process or product. An example is the correct design of surface and groundwater drainage.
- Mitigation strategies are actions to reduce the extent of the impact of the waste created in the process. This is what we call end-of-pipe treatment. Some examples are effluent treatment, plant screens, diversions, and alternative routes.
- Compensation strategies are actions that tend to offset negative impacts. They are implemented when the impact is unavoidable or very difficult to prevent/mitigate. Examples of this strategy are the relocation of communities or providing aid for acoustic insulation of homes.

The environmental component is further analyzed by asking the company if it has specific personnel or budget allocated to environmental issues, if it measures or reports on its environmental performance, if it has implemented circular economy strategies, and if it has adhered to an environmental certification mechanism. See details of the definitions in the Annex.

Second, the Innovation Activities Survey addresses climate change. This section inquires about how relevant the following activities are for the company: implementing government policies or actions on climate change, increased customer demand for products, services, and inputs that help mitigate or adapt to climate change; increased input costs or prices as a result of climate change, and the negative impacts of extreme weather conditions.

Questions on innovation with environmental benefits and innovation in mitigation and adaptation to climate change

Third, the survey asks about the introduction of environmental innovations, including those related to climate change mitigation, and the factors that led to their adoption (in line with the drivers mentioned above.) The survey addresses the external factors for adopting environmentally beneficial innovations and inquires about the importance of current or expected market demand for environmental innovations, improved company reputation, and various government policy components such as government subsidies or other financial incentives for environmental innovation and existing environmental taxes, charges, or fees. Regarding internal or supply-side factors, the companies are asked about their parent company's requirements, the cost of production inputs, or the voluntary initiatives to adopt good environmental practices.

Finally, the Innovation Survey addresses the introduction of innovations to adapt to current and future conditions caused by climate change. The strategies to address the effects of climate change are adapting to water scarcity and extreme weather events, reducing vulnerability, and developing products/services that promote climate change adaptation.

3.2. Survey methodology sheet [6]

Universe: selected manufacturing and service companies with five or more employees and/or sales greater than 189 million current Uruguayan pesos (about 4.75 million US dollars), and whose main economic activity is included in the following sections[7] according to the International Standard Industrial Classification (ISIC) Revision 4:

- A. Manufacturing
- B. Electricity, gas, steam, and air conditioning supply
- C. Water supply, sewerage, waste management and sanitation activities (excluding divisions 37 and 39)
- D. Transportation and storage
- E. Accommodation and food service activities
- F. Information and communication
- G. Financial and insurance activities (divisions 64 to 66 only)
- H. Professional, scientific and technical activities
- I. Administrative and support service activities, and
- J. Human health and social work activities (excluding divisions 87 and 88)..

6 This section is based on the document entitled "2019-2021 Sample design for the Innovation Activities Survey" ("Diseño muestral de la Encuesta de Actividades de Innovación, 2019-2021," in Spanish), developed by the National Statistics Institute (INE).

7 As reference, the sectors included in the survey universe represent about 50% of the country's GDP and employ approximately 30% of the economically active population.

Sample: The sample for 2019–2021 includes all the eligible companies that participated in the previous survey (2016–2018) and still meet the eligibility criteria, plus a subset of new companies that are selected based on the 2021 company directory, using the same sampling design as in previous editions, i.e., a direct, randomized, stratified design. This subset of new firms is called the *refresh* sample, so the panel of firms in the survey is called the *refreshed* panel.

This aims to provide, using the full sample (panel plus *refresh*), reliable estimates for the period 2019-2021 (cross-sectional estimates) while reducing the impact of attrition (cumulative non-response) that all panels suffer, as well as reducing the cohort effect suffered by all pure panels (without *refresh*)[8].

Response rate: 89%.

Fieldwork methodology: structured self-administered questionnaire and telephone follow-up, which was completed between June 2022 and February 2023.

Cases surveyed: The total survey included 2,408 companies representing 11,969 companies nationwide. As for the sector of activity, the survey is representative by two-digit ISIC subsector. These companies are mostly service companies (72%), small (63%), located in Montevideo (65%), non-exporting (86%), and do not have foreign capital (93%).

8 As this survey has a refreshed panel design, many of the companies remain from one period to the next. This time, the percentage rose to 88%. This means that the companies in the current edition are not significantly different from the companies from the previous period.

4

Survey Results

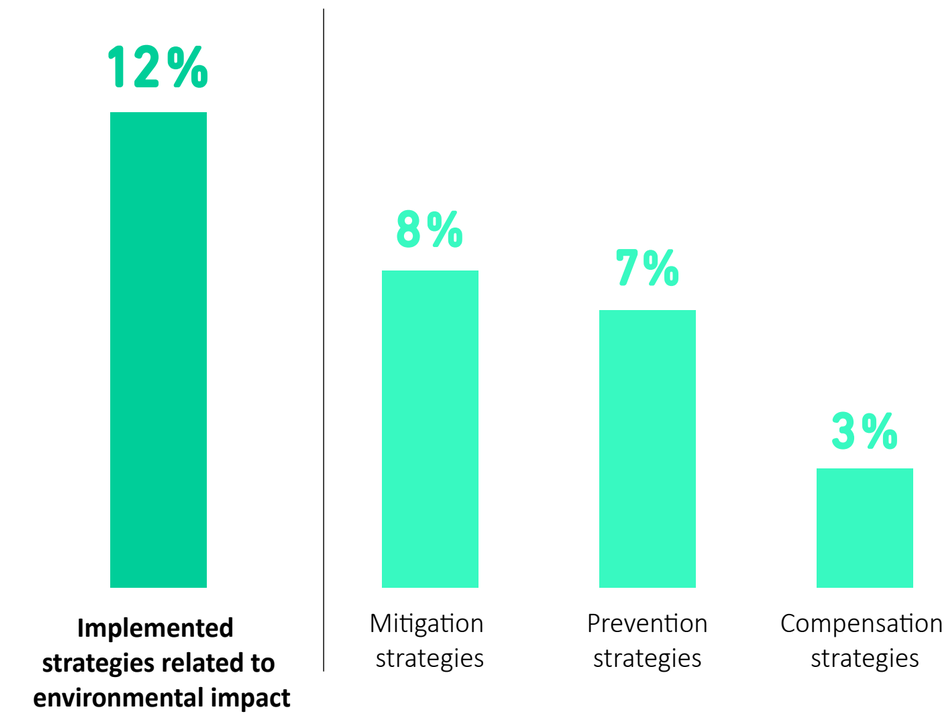
The Environment, Climate Change, and Innovation module results of the Innovation Activities Survey are presented below grouped into three sections. First, the questions on environmental impact and climate change strategies are analyzed. This first part of the module was applied to all the companies surveyed, i.e. 11,969 companies in manufacturing and selected services.

Second, the innovations with environmental benefits module is analyzed. These questions were asked only to the companies stating that they did innovation work (15% of the total). Finally, we analyze the answers provided by respondents to an open question about their opinions on the subject.

4.1. Implementation of strategies related to environmental impact

Twelve percent of the companies implemented at least one strategy for managing the environmental impact of their activities in the 2019–2021 period. While all productive activities have environmental impacts, these can be prevented, mitigated, minimized, or offset. Most of the companies' actions focused on mitigation (8% of the total number of companies) and prevention (7%) of environmental impacts, and to a lesser extent offsetting (3%).

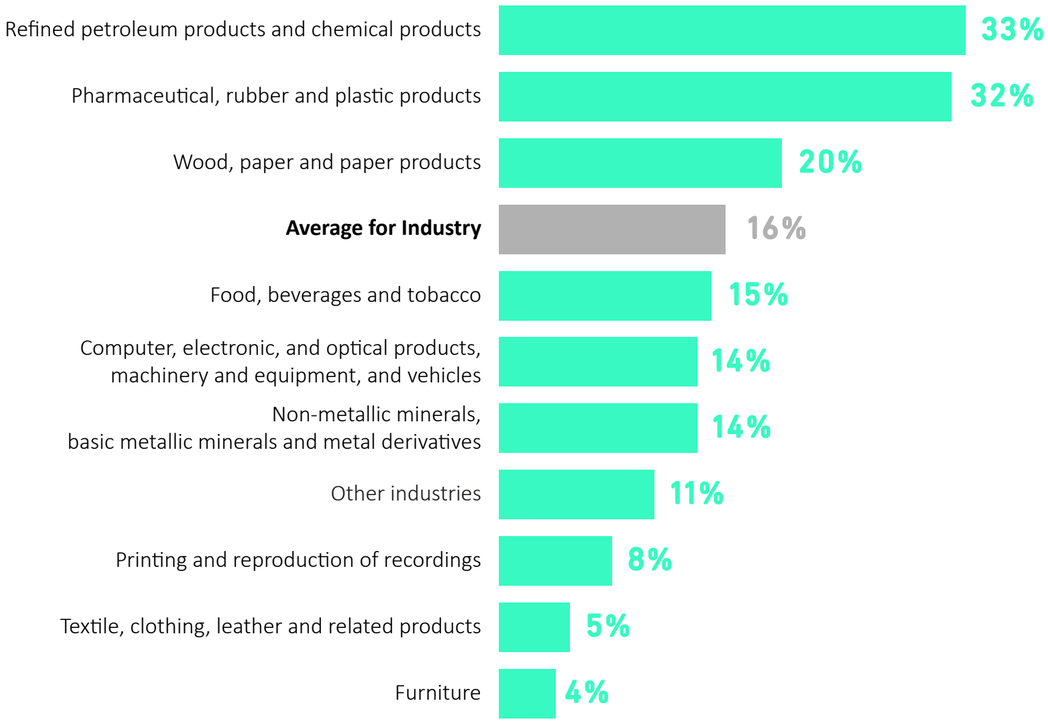
GRAPH 1. Companies that implemented strategies related to the environmental impact of their activities (% of total companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies: 11,969. During 2019-2021, has the company implemented strategies linked to the environmental impact derived from its activities?

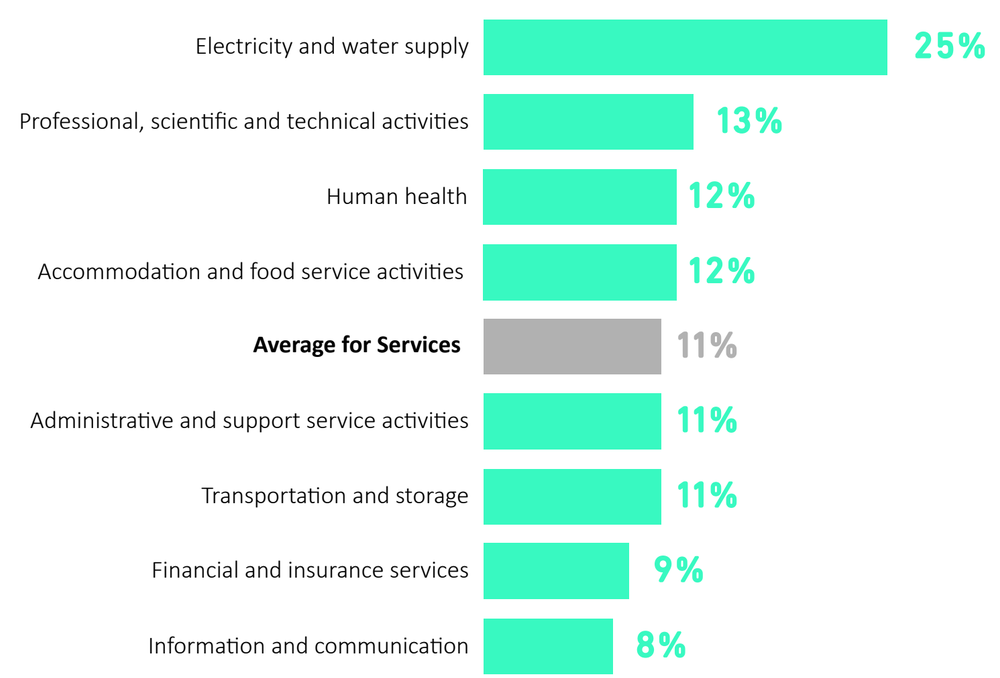
Manufacturing companies implement slightly more strategies for managing the environmental impact of their activities than those in the selected service industries (16% compared to 11%). At the industrial subsector level, Refined petroleum products and chemicals and Pharmaceuticals have the highest rate of strategies for managing environmental impact (see Chart 2). In the services sector, electricity and water supply companies have the highest rate of implementation of strategies for managing environmental impact, almost doubling the rate in the other areas of the services sector. The rest of the companies have similar values, as shown in Chart 3.

GRAPH 2. Companies that implemented strategies related to the environmental impact of their activities in the manufacturing industry (% of the total of manufacturing companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies: 3,353.

GRAPH 3. Companies that implemented strategies related to the environmental impact of their activities in the selected service industries (% of the total of selected service companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies: 8,616.

What are the actions carried out by companies to address the environmental impact of their activities?

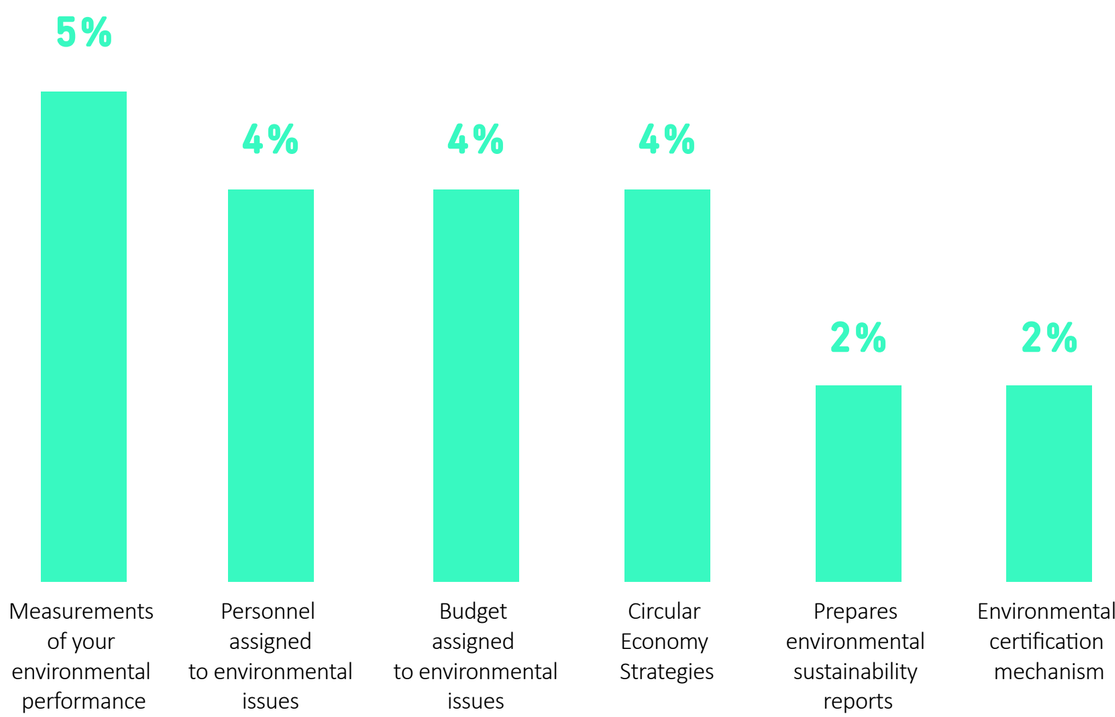
Five percent of the companies stated that they measure their environmental performance. This is the category with the highest number of mentions. These measurements are taken, for instance, to collect information to facilitate decision making on the company's environmental performance, and to assess the impact mitigation actions taken by the organization to satisfy customers and other stakeholders by showing an objective reduction in these measurements.

Second, 4% of the companies allocate budget funds to manage the environmental impact of their activities, and the same percentage of companies assign staff members to this end. Also, 4% of the companies implement circular economy actions. Data analysis shows a statistically significant and positive correlation between budget, assigned personnel, and the implementation of circular economy strategies.

Certification is the least taken path to address environmental issues (2%). Most of these companies are ISO 14001 (Environmental Management Systems) certified.

In general terms, the analysis of questions by sector of activity shows that companies in the industrial sector take actions to manage their environmental impacts more often than services companies. This result is consistent with some studies (Mi et al., 2017) that posit that industrial companies tend to adopt more prominent environmental strategies due to the nature of their operations and environmental impact. In Uruguay, this is also related to existing national environmental regulations applicable to the industrial sector.

GRAPH 4. Strategies adopted by the companies in relation to the environmental impact of their activities (% of the total of companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies 11,969. Does the company have staff assigned to environmental issues? Does the company have a budget assigned to environmental issues? Does the company measure its environmental performance? Does the company prepare environmental sustainability reports? Has the company implemented circular economy strategies? Has the company been adhered to any environmental certification mechanism?

What importance do companies attach to factors linked to climate change?

According to the conceptual framework, climate change can directly and indirectly affect businesses through several channels, resulting in cost increases related to resource scarcity, tighter regulations, climate risk, unstable supply chains, and the need to invest in sustainable technologies and practices.

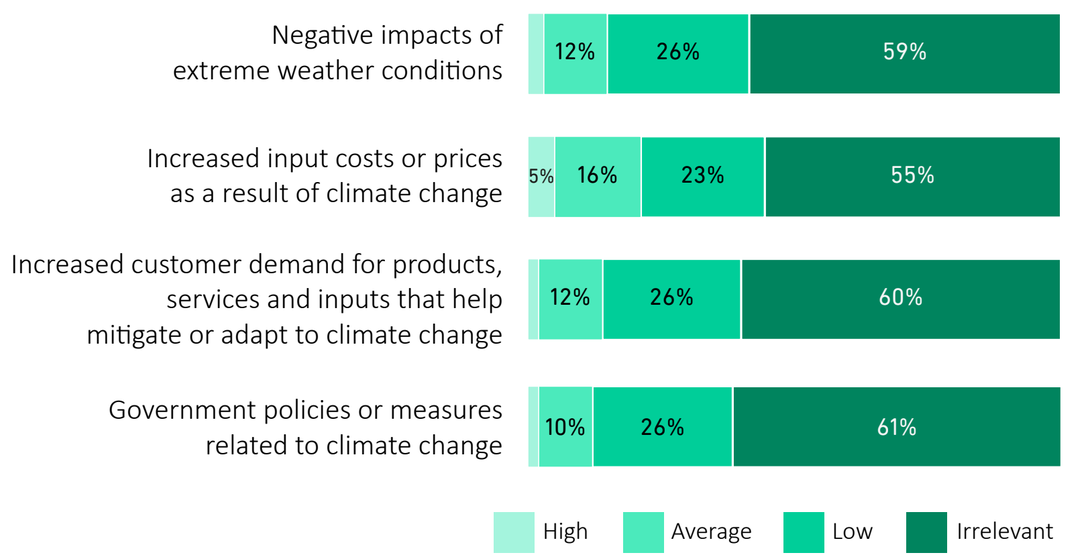
One of the first conclusions is that almost half of the companies (49.8%) marked the four climate change factors as "irrelevant." Furthermore, the factor-by-factor analysis shows that, in all four cases, over half the companies find them irrelevant. Broadly speaking, when importance is assigned to these factors, it is predominantly low.

In contrast, the percentage of companies prioritizing climate change factors (high importance) is low. The factor with the highest number of responses giving it high importance was "Increased input costs," which accounted for 5% of the ratings.

Second, 3% of companies stated that the "Negative impacts of extreme weather conditions" are crucial. Climate change exposes companies to two types of climate-related risks: physical risks and transition risks. Physical risks are a result of the increased severity of extreme weather events and changes in weather patterns, temperature, and rising sea levels. Transition risks include technology, market (including commodity prices), political, and reputational risks (Task Force on Climate related Financial Disclosures, 2017), It needs to be noted that the survey was conducted before the severe water crisis in the Santa Lucía river basin[9] that Uruguay recently went through, and thus it will be interesting to see the results of future editions of this survey.

9 Emergency declared from June until August 2023 (https://www.gub.uy/presidencia/politicas-y-gestion/situacion-hidrica-montevideo-zona-metropolitana). The impact of the agricultural crisis is not considered because this productive sector is not part of the survey.

GRAPH 5. Distribution of companies according to the importance assigned to the different factors related to climate change (% of the total of companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies: 11,969. During 2019–2021, how important were the following climate change factors for your company?

In general, the are no differences between sectors of activity regarding the importance given to "Increased input costs or prices as a result of climate change" and "Government policies or measures related to climate change." Regarding policies, while planning instruments and public policy commitments on climate change are in place (some of which are international), there are no regulations forcing companies to take specific actions.

The most significant difference between sectors appears for the factors of "Negative impacts of extreme weather conditions" and "Increased customer demand for products, services and inputs that help mitigate or adapt to climate change", for which service companies seem to be more concerned than industrial companies. The services subsectors that account for this result are electricity, gas and water supply, and accommodation and food services.

4.2. Innovation with environmental benefits

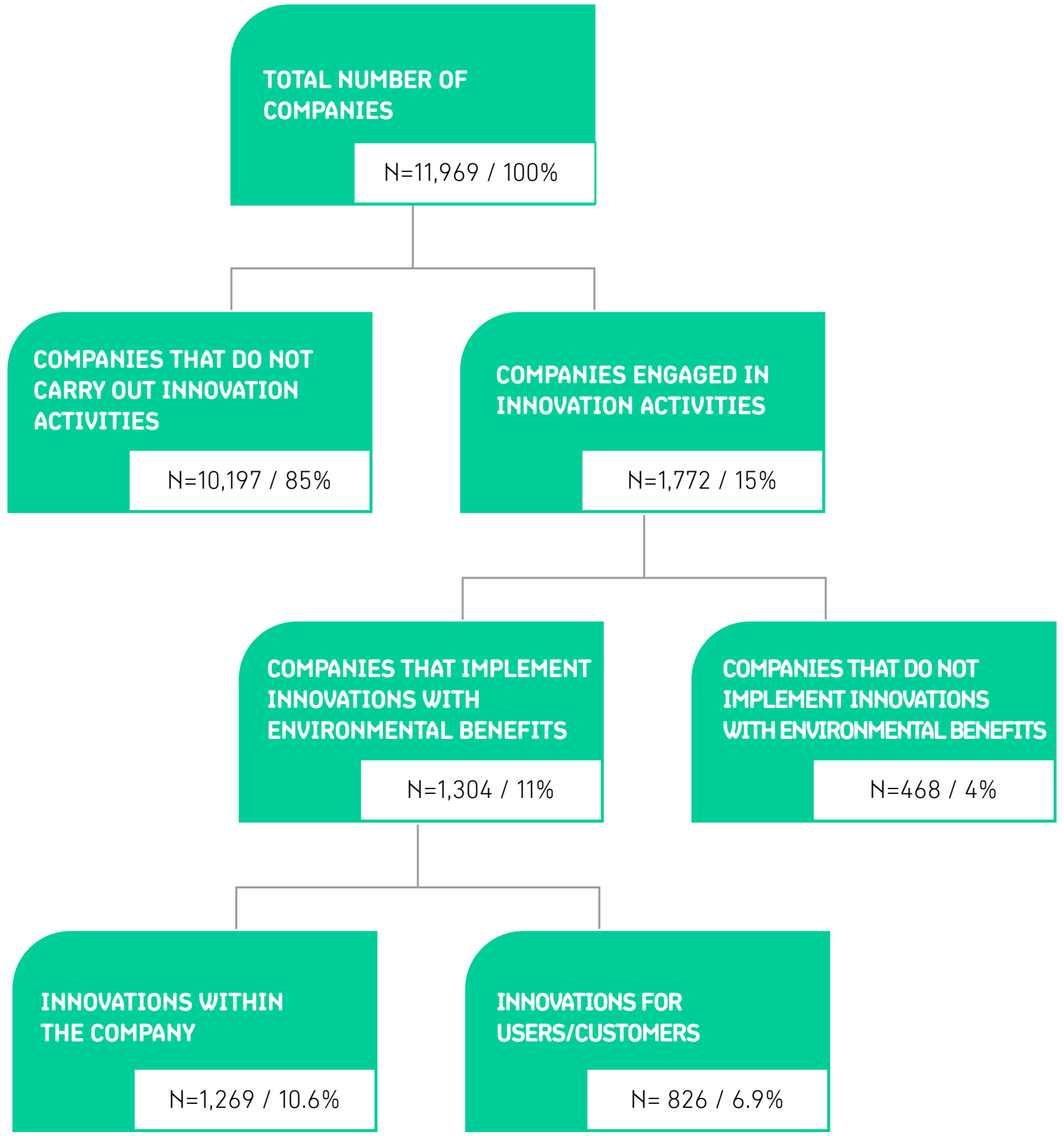
The results of the Innovation Activities Survey show that 85% of the companies reported that they do not implement innovation activities (IA)[10] , while the remaining 15% implement at least one IA.

This last group includes two types of companies: those that implement innovations with environmental benefits (11%), and those that carry out innovation activities but declare they do not implement innovations with environmental benefits (4%).

As mentioned in section 2, an innovation with environmental benefits is a new or improved product (good or service) or business process that creates positive environmental impacts or reduces negative impacts compared to the company's previous products or business processes, and which have been put into use by the company or made available to potential users.

In turn, innovations with environmental benefits can occur at two points in time: when a good or service is produced (within the company), and when it is consumed or used by the end user (user and customer). Almost all the companies that introduced innovations with environmental benefits (11 %) did so within the company (10.6 %). In turn, 6.9 % of the companies reported introducing innovations with environmental benefits for end users or customers.

FIGURE 2. Classification of companies according to innovation activities and innovation with environmental benefits.



Source: INE-ANII Innovation Activities Survey. Total number of companies: 11,969.
Note: the questions on innovation within the company or for users/customers are multiple-choice.

10 The Oslo Manual defines the following innovation activities: Intramural research and development, Extramural research and development, Acquisition of capital goods, Acquisition of software and database activities for innovation, Intellectual property activities, Engineering, design and other creative work; Training for innovation, Marketing and branding activities, and Management for innovation.

What are the characteristics of the companies that innovate through environmental benefits?

Thirty-eight percent of the innovative companies with environmental benefits are industrial companies, while services companies represent 62%. Nine percent of the companies incorporate foreign capital, and 15% of the companies are linked to economic groups. In addition, 37% of the companies are small, 40% are medium-sized, and 23% are large companies. Regarding age, 7% are young companies, 35% are middle-aged, and 58% are mature. Finally, 27% of these companies are involved in exports.

TABLE 1. Description of innovative companies that implement environmental benefits according to size, age, export activities, foreign capital, and economic group

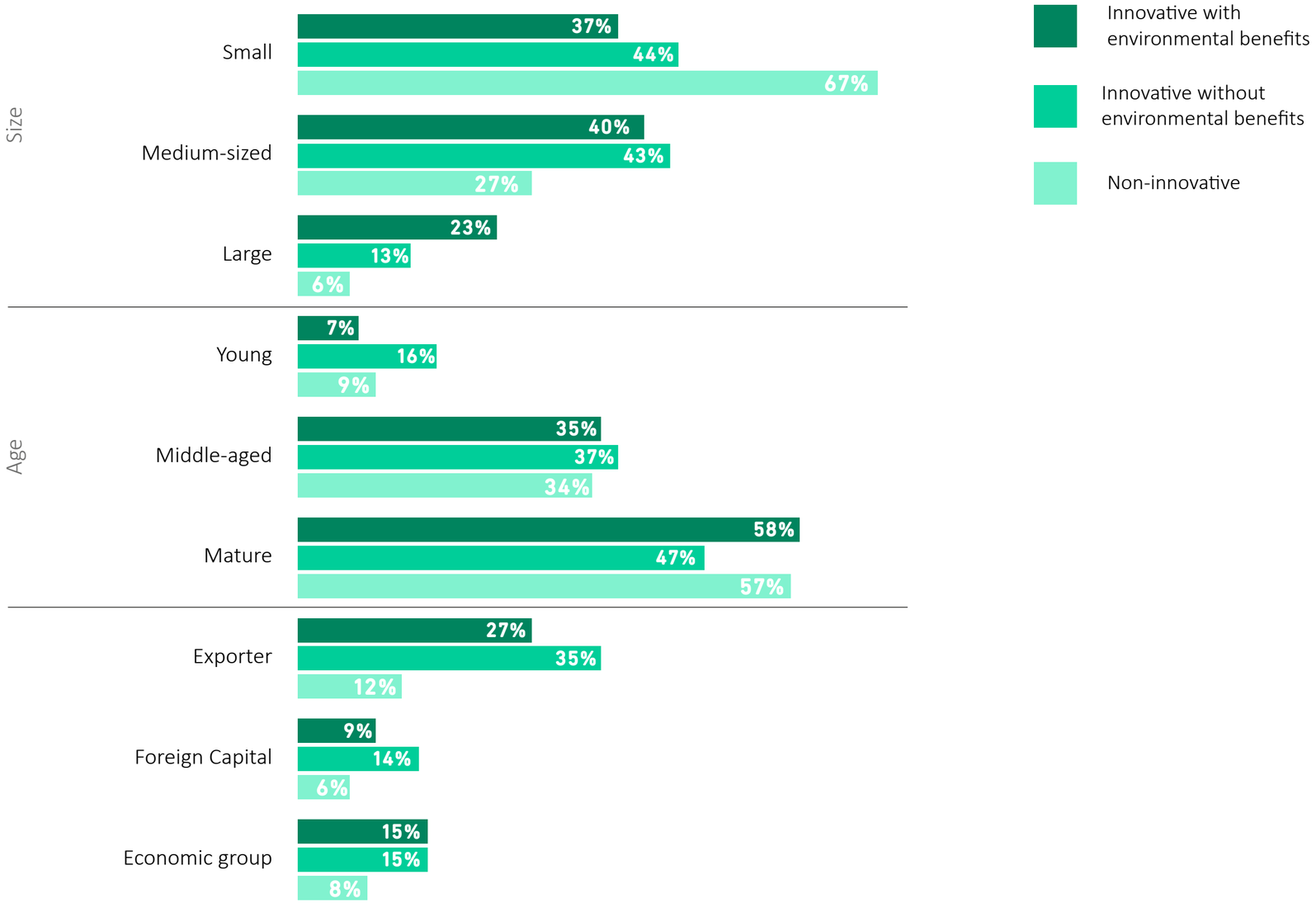
Sector of activity	Industry	38%	**Export activities**	Yes	27%
	Services	62%		No	73%
	Total	100%		Total	100%
Foreign capital	Yes	9%	**Economic group**	Yes	15%
	No	91%		No	85%
	Total	100%		Total	100%
Size	Small	37%	**Age**	Young	7%
	Medium-sized	40%		Middle-aged	35%
	Large	23%		Mature	58%
	Total	100%		Total	100%

Source: INE-ANII Innovation Activities Survey. Total number of innovative companies with environmental benefits: 1,304.

Companies that implement innovations with environmental benefits somewhat differ from those that do not report innovating with environmental benefits. The first group is characterized by larger and older (mature) companies in the market, with a lower ratio of companies with foreign capital and exporting companies.

Differences also appear between companies that implement innovations with environmental benefits and those that do not report any innovation activities (non-innovative). In this case, companies in the first group are larger, more export-oriented, and more likely to belong to an economic group.

GRAPH 6. Description of innovative companies that implement environmental benefits, innovative companies that do not implement environmental benefits and non-innovative companies, according to size, age, export activities, foreign capital, and economic group

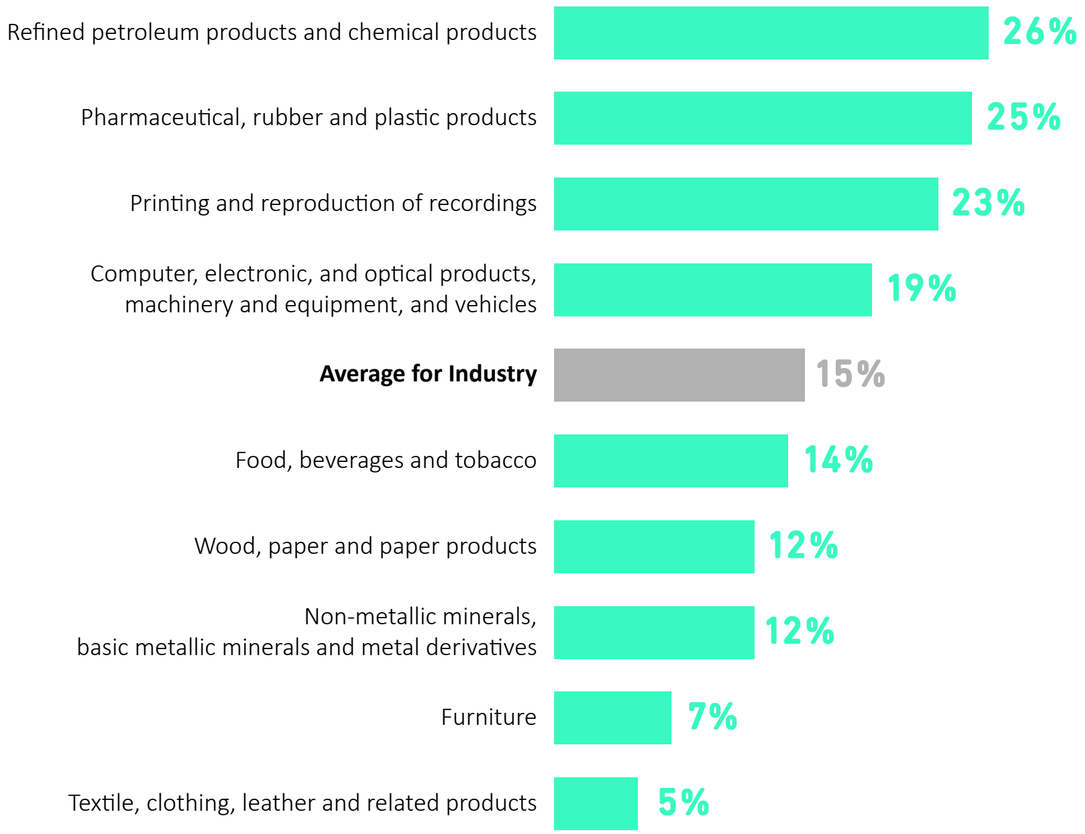


Source: INE-ANII Innovation Activities Survey. Total number of companies: 11,969. Total number of non-innovative companies: 10,197. Total number of innovations with environmental benefits: 1,304. Total number of innovative companies without environmental benefits: 10,665.

We analyzed environmentally innovative companies by subsector in the manufacturing industry, refining of petroleum products and chemicals, manufacture of pharmaceuticals, rubber and plastic products, and printing and reproduction of recordings. Almost one in four companies introduce innovations with environmental benefits: a much higher percentage than the sector's average (Graph 7).

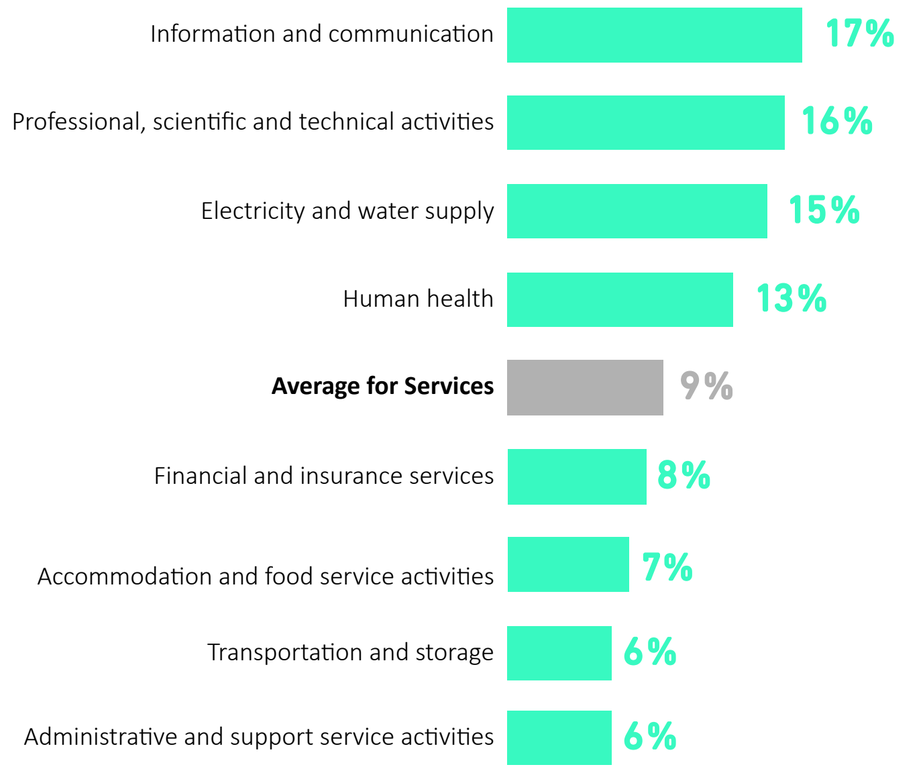
In the service sector, the subsectors of Services, information and communication, Scientific and technical professional activities, and Electricity and water supply show the highest percentage of companies implementing innovations with environmental benefits (Graph 8).

GRAPH 7. Innovative companies with environmental benefits in the manufacturing industry



Source: INE-ANII Innovation Activities Survey. Total number of innovative industrial companies implementing environmental benefits: 495.

GRAPH 8. Innovative companies with environmental benefits in the selected service industries



Source: INE-ANII Innovation Activities Survey. Total number of innovative companies that implement environmental benefits in services: 809.

Which innovations with environmental benefits are implemented within the company?

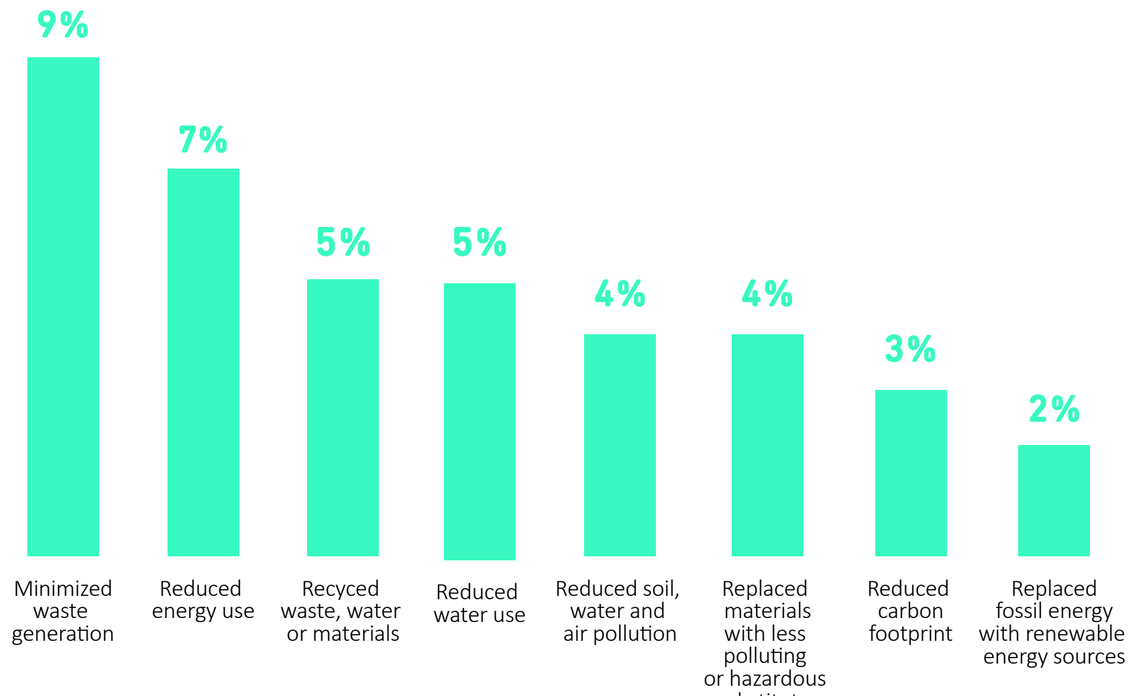
One of the stages where environmental innovations can occur is within the company, during the production process of a good or service, mainly to reduce costs, comply with regulations, and create business opportunities.

Nearly 9% of companies implement innovations that minimize waste production, and just over 7% of companies reduce energy use, both of which are widely used strategies. In particular, companies have minimized waste production, which might be a result of the 2013 regulatory framework for industrial waste and assimilated activities, which prioritizes minimizing waste production at the source over any other alternative (for example, Decree 182/013). This reduction might also be aligned with the Integrated Waste Management Law and the implementation of the National Waste Management Plan, whose implementation is coordinated by the ME in coordination with several other actors.

In contrast, less implemented activities, such as reducing the carbon footprint or replacing fossil energy with renewable sources, were carried out by only 2 and 3% of the companies, respectively. This could be explained by the lack of regulatory requirements, or by companies and the population being less knowledgeable about them (Ministry of the Environment, 2021). [11]

Industrial companies implement a higher rate of in-house innovation than service companies. These companies are in the following subsectors: Printing and reproduction of recordings; Refined petroleum products and chemicals; Pharmaceuticals, rubber and plastics; and Computer, electronic, optical, machinery and equipment, and vehicles.

GRAPH 9. Companies that implemented innovations and environmental benefits internally (% of the total of companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies: 11,969. During 2019-2021, did your company implement innovations with any of the following environmental benefits?

11 Climate Change Social Perception Survey, p.8.

These results can be put into perspective by comparing them to a country or group of countries that have implemented similar measurements and studies. In this regard, the European Statistical Office (better known as Eurostat) produces and publishes data from the European Community Innovation Survey (CIS), which includes similar questions to those in Uruguay's survey. Data for the Lain American region are not yet available. Uruguay's results are below the European countries results for almost every indicator considered, except in "Reduced materials or water use," "Reduced soil, water, and air pollution," and "Recycled waste, water, or materials," where it ranks only slightly higher than Bulgaria and Sweden.

TABLE 2. Companies that introduce environmental innovations in-house (% of the total of companies)

	Reduced material or water use	Reduced energy use or carbon footprint	Reduced soil, noise, water or air pollution	Replaced materials with less polluting or hazardous substitutes	Replaced fossil energy with renewable energy sources	Recycled waste, water or materials
Bulgaria	4.6	5.3	4.6	4.6	2.3	5.1
Czech Republic	10.4	17.6	10.9	6.1	2.7	9.7
Denmark	5.2	7.6	4.6	5.5	6.7	7.3
Germany	6.3	15	10	4.2	9	8.2
Estonia	18.2	20.4	16.7	13.9	12	15.5
Spain	6.3	9.2	6.7	8.6	4.7	11.2
France	8.9	14.7	8.9	8.8	5.5	15.1
Croatia	10.4	11.5	11.9	11	4.6	11.6
Italy	13.9	19.2	16.6	17.5	8.2	15.1
Cyprus	6.5	7	6.5	4.9	5.7	10
Latvia	19.6	27.2	19	23.6	10.3	15.2
Lithuania	8.3	17.3	10.8	10.4	6	7.7
Luxembourg	9.4	14.1	7.9	6.8	6.7	11.6
Hungary	5.2	10.5	6.1	7.2	6.6	6.1
Malta	9.4	13.6	6.1	7.5	7.3	11.9
Austria	10.9	22.4	11	11.9	15.3	11.1
Poland	6.6	7.5	6.6	7	4.7	7.3
Portugal	13.7	17	16.2	15	10.3	23.4
Romania	15.9	16.4	17.1	10.7	5.4	25.1
Slovenia	17.1	21.9	18.1	16.8	8.4	15.9
Slovakia	10.9	15.3	14.4	11.9	7.6	17.5
Finland	6.1	12.2	4.6	5.1	7.8	5.6
Sweden	4.1	10.8	3.8	4.7	7.3	5.2
Uruguay	**4.8**	**4.2**	**4.4**	**4**	**1.7**	**5,4**

Source: EUROSTAT[12] and INE-ANII Innovation Activities Survey.
Note: the cells marked in gray show values that are lower than or similar to those found in Uruguay.

12 https://ec.europa.eu/eurostat/databrowser/view/inn_cis12_bas/default/table?lang=en.

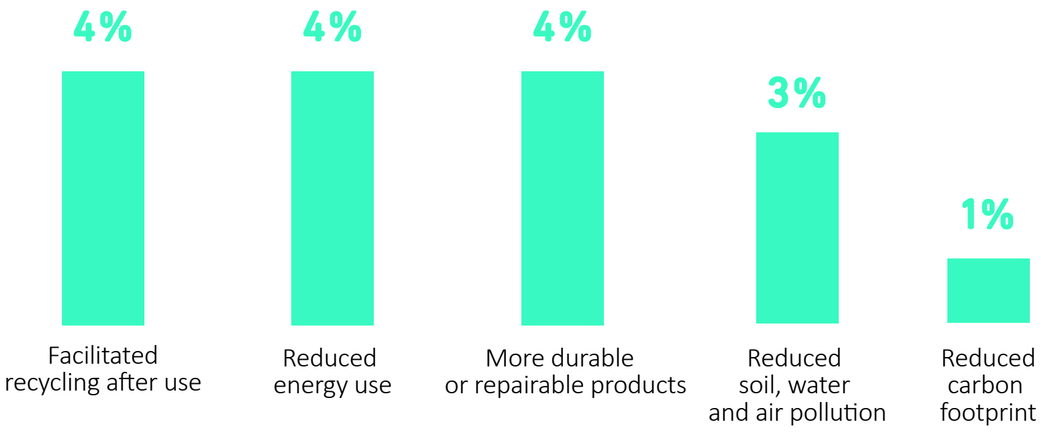
What innovations with environmental benefits are introduced for the user or customer?

Innovations with environmental benefits can also be addressed to end users or product users, for example by facilitating recycling, producing more durable goods and services, or reducing pollution. These innovations are not only beneficial to the environment, but also offer users options that in many cases save them money in the long run.

Between 3 % and 4 % of the companies introduced innovations with environmental benefits for the user or customer in at least one of the categories of the survey. The only exception is Carbon footprint reduction, which reaches a lower value close to 1%, similar to environmental innovations within the company outlined in the previous section.

The companies that reported implementing innovations for the user or customer are mainly in the following industrial subsectors: Printing and reproduction of recordings, Refined petroleum and chemical products, and Computer, electronic, optical, machinery and equipment, and vehicles. Regarding service companies, the Electricity and water supply subsector stands out, particularly in energy use reduction.

GRAPH 10. Companies that introduced innovations with environmental benefits for the user or customer (% of the total of companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies 11,969. During 2019-2021, did your company introduce innovations with any of the following environmental benefits?

Uruguay ranks below all European countries in the two categories most frequently reported by companies (promoting recycling and reducing energy use). However, when considering the “Reduced soil, noise, water or air pollution” and “More durable product” indicators, it ranks higher than Cyprus.

TABLE 3. Companies introducing environmental innovations for the user/customer (% of the total of companies)

	Reduced energy use or carbon footprint	Reduced soil, noise, water or air pollution	Facilitated recycling of product	Extended product life
Bulgaria	5.4	4.9	5.1	6.2
Czech Republic	12.9	8.6	7.1	6.9
Denmark	11.3	8.1	5.7	5.3
Germany	13.2	8.9	7.5	8.6
Estonia	21.6	15.6	15.4	19.4
Spain	7.2	6.3	14.1	7.6
France	14.1	8.7	14.3	11.2
Croatia	10.5	10.6	10.4	9.4
Italy	16.5	15	13.4	12.2
Cyprus	3.2	2.7	4.4	2.5
Latvia	23.6	20	13.9	17.7
Lithuania	16.3	10.8	8.3	11.6
Luxembourg	11.6	8.4	10.1	6.2
Hungary	8	4.8	5.9	6.7
Malta	11.5	5.8	10.2	8.6
Austria	19.2	10.2	12.2	13.3
Poland	8.4	7.8	5.3	7.3
Portugal	14.9	13.5	17.7	16.2
Romania	15	14	15.4	16.4
Slovenia	17.6	12.6	13.2	13.7
Slovakia	13.2	11.1	13.4	14.2
Finland	12.7	5.5	6	7.4
Sweden	11.7	4.2	5.1	6.6
Uruguay	**2.6**	**3.1**	**4.4**	**3.6**

Source: EUROSTAT[13] and INE-ANII Innovation Activities Survey.
Note: the cells marked in gray show values that are lower than or similar to those found in Uruguay.

13 https://ec.europa.eu/eurostat/databrowser/view/inn_cis12_bas/default/table?lang=en

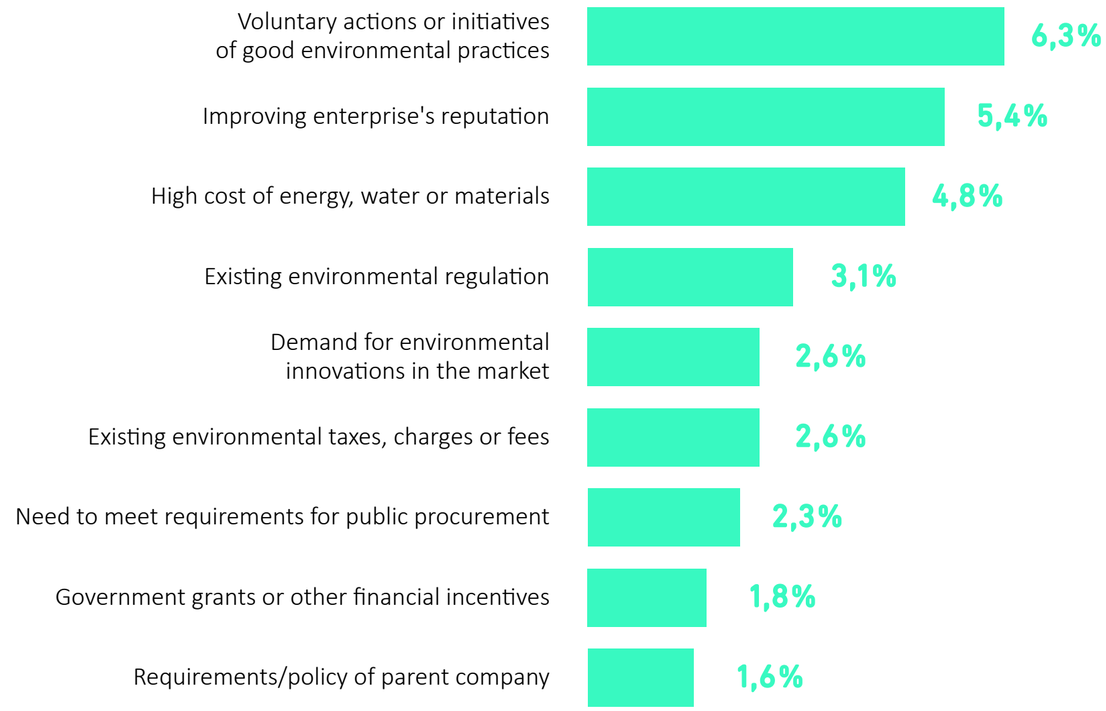
Why do companies introduce innovations with environmental benefits?

Just over 6 % of companies state that the reason for introducing innovations with environmental benefits is to carry out voluntary actions or initiatives of good environmental practices, while 5.4 % of companies carry out these innovations to improve their reputation. As well, almost 5% of companies state that it is very important to carry out environmental innovations to achieve greater production efficiency, due to the high costs of energy, raw materials, and water. These results confirm that the companies surveyed consider both internal factors (costs) and external factors (reputation or brand) in making decisions about environmental innovations.

The companies reporting that these are their reasons for making environmental innovations belong to the following subsectors: Food, beverages, and tobacco; Textiles, clothing, leather and related products; Pharmaceuticals, rubber and plastic products; and Electricity and water supply.

In contrast, regulatory aspects and economic instruments (such as taxes or subsidies) are less important as drivers of environmental innovations, which opens an opportunity for action.

GRAPH 11. Factors for the introduction of innovations with environmental benefits (% of the total of companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies 11,969. During 2019-2021, how important were the following factors for introducing innovations with environmental benefits in your company? Companies that ranked these factors as "highly important".

Uruguay ranks below all European countries in almost all categories under this question, except for "Voluntary actions or initiatives of good environmental practices" and "Existing taxes, charges or fees" where it outranks some countries.

TABLE 4. Reasons for companies to introduce environmental innovations (% of the total of companies)

	Existing regulations	Existing taxes, charges or fees	Regulations or taxes expected in the future	Government grants, subsidies, or other financial incentives	Current or expected market demand	Improving enterprises' reputation	Voluntary actions or initiatives within the sector	High cost of energy, water or materials	Need to meet requirement for public procurement
Bulgaria	4.1	2.3	2.9	2.5	4.2	8.2	5.4	7.1	2
Denmark	13.6	7.1	11.2	4.9	20	21.6	9.5	10.1	5.1
Germany	18.4	7.3	11.5	6	8	10.5	9	18.7	3.4
Estonia	8.1	6.9	9	4.8	7.6	17.9	5.4	15.6	5.7
Spain	9.8	6.5	6.6	3.9	7.8	12.9	11.1	10.1	5.3
France	6.9	2.6	4.9	5.5	6	11.8	12.2	5.8	3.3
Croatia	13	8.7	11	8.2	9.4	13.4	8.2	14.8	6.4
Cyprus	7.5	4.3	5.7	3.1	4.1	9.8	8.1	8	2.9
Latvia	10	6.9	8.9	8.9	8.5	18.9	6	10.9	5.3
Lithuania	11	9.6	10.2	9.5	8.1	16.8	7.9	12.8	6.2
Luxembourg	12.7	8.2	9.6	7.6	13.6	19.7	15.5	7.9	5.9
Hungary	10.4	6.3	7.4	6	10.2	14.2	7	15.4	5.8
Malta	8.8	5.8	6.9	6.9	8.6	17.7	10.9	13.4	4.4
Poland	8.7	7.8	6.1	3.1	6.1	7.6	7.1	10.8	3.4
Portugal	12.8	11.1	10.4	7.5	10.2	18.1	12.6	16.7	5.4
Romania	18.7	13.7	10.3	7.4	9.9	21.1	12.3	16.1	10
Slovenia	13.1	9.6	12.6	8.9	9	19.2	10.5	20	5.8
Slovakia	19.1	13.6	14.6	5.2	9.9	18.4	8.4	18.1	8.4
Sweden	11.1	7.2	8.1	3.9	12.3	19.7	9.9	8.4	9.7
Uruguay	**3.1**	**2.6**	**na**	**1.8**	**2.6**	**5.4**	**6.3**	**4.8**	**1.3**

Source: EUROSTAT[14] and INE-ANII Innovation Activities Survey.
Note: the cells marked in gray show values that are lower than or similar to those found in Uruguay.

14 https://ec.europa.eu/eurostat/databrowser/view/inn_cis12_bas/default/table?lang=en

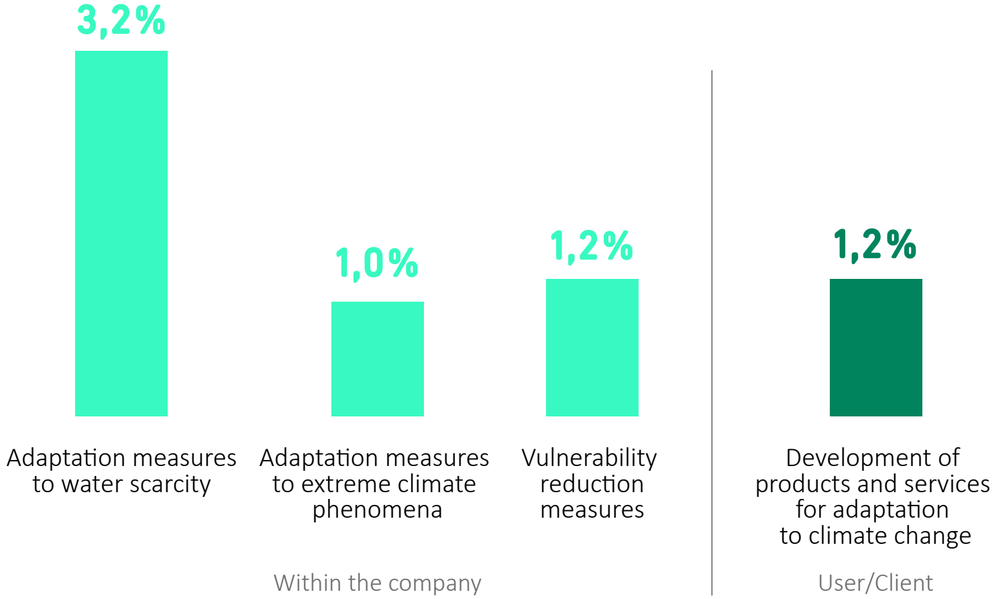
Did the company introduce innovations to adapt to current or future climate change-related conditions?

According to the framework, companies are exposed to multiple risks associated with climate change. Adaptation to climate change involves taking measures to mitigate risks, including measures to deal with water scarcity (1), extreme weather events (2), and reducing the company's vulnerability (3). Also, firms can take advantage of the opportunities that arise as a result of climate change by developing new products or services (4).

In terms of actions taken by companies to adapt to the real or expected effects of climate change, 3.2% take measures related to water scarcity, while the figures for other actions are close to 1%.

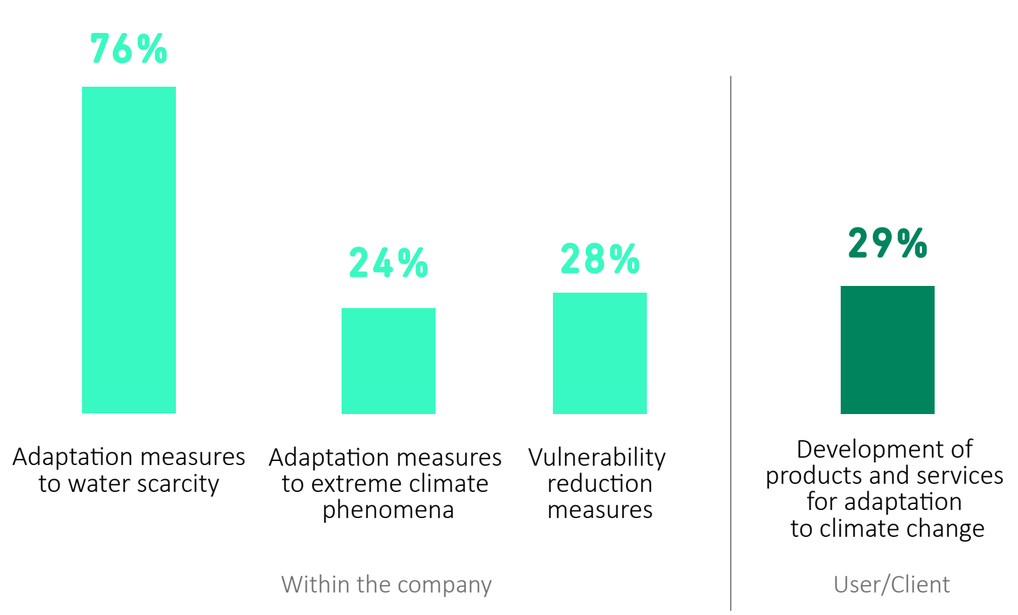
Close to 4.2% of all companies have put into practice at least one adaptation measure. Of these, 76% took measures against water scarcity. The companies that mentioned this adaptation measure belong to the following sectors: Food, beverages, and tobacco; Pharmaceuticals, rubber and plastic products; and Accommodation and food services.

GRAPH 12. Companies introducing environmental innovations to adapt to climate change (% of total companies)



Source: INE-ANII Innovation Activities Survey. Total number of companies 11,969. During 2019-2021, did your company introduce innovations to adapt to current and future Climate Change-related conditions?

GRAPH 13. Companies introducing environmental innovations to adapt to climate change (% of companies that carry out at least one adaptation activity)



Source: INE-ANII Innovation Activities Survey. Total number of companies with at least one adaptation activity: 507. During 2019-2021, did your company introduce innovations to adapt to current and future conditions caused by Climate Change?

What importance do innovative companies with environmental benefits give to factors linked to climate change?

Finally, regarding the significance attributed by innovative companies with environmental benefits to climate change-related factors, the percentage of companies that consider them irrelevant does not differ considerably from the total sample. However, the percentage of companies giving high importance almost doubles for all factors compared to the full sample.

TABLE 5. Companies introducing environmental innovations to adapt to climate change (% of total companies and % of innovative companies)

TYPE OF COMPANY	IMPORTANCE	Government policies or measures related to climate change	Increased customer demand for products, services and inputs that help mitigate or adapt to climate change	Increased input costs or prices as a result of climate change	Negative impacts of extreme weather conditions
All companies	High	2%	2%	5%	3%
	Average	10%	12%	16%	12%
	Low	26%	26%	23%	26%
	Irrelevant	62%	60%	56%	59%
	Total	100%	100%	100%	100%
Innovative with environmental benefits	High	6%	4%	9%	6%
	Average	11%	13%	22%	14%
	Low	29%	30%	23%	25%
	Irrelevant	54%	54%	46%	55%
	Total	100%	100%	100%	100%

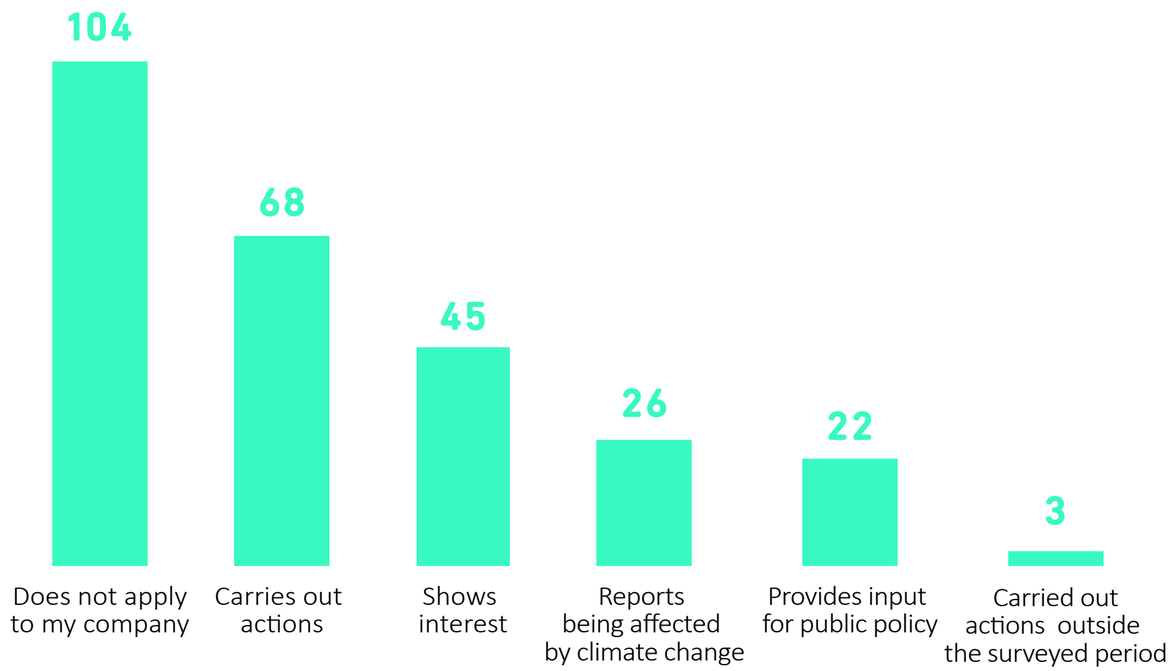
Source: INE-ANII Innovation Activities Survey. Total number of companies 11,969. Total number of innovations with environmental benefits: 1,304.

4.3. Analysis of open-ended questions

At the end of the survey, companies were given an open space to elaborate further on their responses to the Environment and Climate Change module. The 268 submitted responses were classified into six dimensions:

- Does not apply to my company
- Carries out actions
- Shows interest
- Reports being affected by climate change
- Provides input for public policy
- Carried out actions outside the surveyed period

GRAPH 14. Number of companies according to observed dimensions



Source: INE-ANII Innovation Activities Survey.

The category with the highest number of responses (104) includes companies that consider themselves to be distant from environmental issues, and therefore respond that these questions do not apply to them. Some examples are:

Our company is not affected by climate change due to the industry it belongs to.

Our activity does not significantly impact the environment or climate change.

It has no direct impact on our business.

In the second category with the highest number of responses (68), companies state that they carry out some actions on environmental issues. There is great heterogeneity in the activities reported under this dimension, ranging from companies that have environmental strategies and teams to manage them, to more basic actions related to the reduced use of resources and energy efficiency measures.

Basically, we reduced the use of power with LED lighting.

Our company develops software and its contribution to climate change is to reduce the use of electricity. The contribution to the environment is to reduce the use of paper.

Cigarette butt receptacles, associated with a company that uses cigarette butt waste holders ("No más colillas" - No more cigarette butts). Plastic cups were eliminated, and glass is used, single-use plastic is eliminated, recycling, composting, recyclable paper are used in printers, double-sided printing, sensor-operated light switches in offices.

Manages waste.

We began recycling cardboard and plastic by working with a local company.

There is an Environmental Management Department, and its activities extend across the rest of the organization since its processes contemplate the environmental perspective.

Generally, the company tries to use recyclable or environmentally friendly consumer products.

Has raised awareness of environmental issues among employees.

We try to use recycled or recyclable disposables.

Introduction of electric cars.

We introduced solar panels and other improvements for energy consumption.

The company manages a water treatment program.

In this group, it is mostly multinational companies which display a deep knowledge of the subject and implementation of actions:

Globally, the company has well-defined policies on sustainability, carbon footprint reduction, and the effects of climate change on health and safety.

In the third place are those companies that show interest and express a sense of obligation about the subject (45). These responses could be a result of social desirability bias (Chiesa et al, 2020)[15] , i.e., the respondent tends to answer what is socially expected of him/her:

> *We must all do our part to contribute to reducing climate change.*
>
> *Our company is like a family; we have always been interested in protecting the environment. I hope the world wakes up, because this is the only place we have to live, and our children will suffer the consequences if we do not do it.*
>
> *This (topic) is very important.*
>
> *We do everything in our power to take care of the environment.*
>
> *The preservation of the environment and reducing the effects of climate change is mainly a responsibility of those of us who carry out an industrial activity.*

In a fourth category are companies that report being affected by climate change and use this section to describe how they are affected by it:

> *Climate change has caused significant price fluctuations of the raw materials the company uses.*
>
> *Climate change affects the production and therefore the price of the main raw materials used in our industry, such as sugar, corn glucose and peanuts.*
>
> *Climate change interferes 100% with the durability of our inks.*
>
> *It has a direct impact on our company's line of business due to the resulting diseases.*
>
> *Our company's business develops in a seaside resort area, so climate plays a major role in our income. Without good weather, there is no tourism.*
>
> *Crops were affected by droughts and hail.*
>
> *Droughts in Europe reduced input supply and increased prices accordingly.*

15 This concept is similar to that found in the study "Percepción del sector empresarial de Uruguay sobre emisiones y su compensación" (Perception of Uruguay´s business sector about emissions and their compensation) by Proyecto REDD+ Uruguay.

Finally, there are companies that demand public policy actions in this area and provide inputs for this purpose:

0 [zero] import tax on electric units and waste management equipment.

It would be good if a comprehensive plan was created to effect a nationwide change in the gastronomy industry. The amount of waste, single-use inputs, etc. is very high, but there are not many ways to make changes without impacting business profitability.

There should be policies benefitting companies that try to do things right. In Uruguay, everything requires money. Doing things right is very expensive.

There should be public procurement policies to promote innovation in the Plastics Sector. This could mitigate the business risks of developing products with 100% recycled materials.

There should be more governmental measures, not because of the direct benefit it has on companies, but because it is extremely important for everyone.

5

Summary

The results of the Innovation Activities Survey offer valuable information on companies' strategies and attitudes towards environmental impact, climate change and innovation with environmental benefits in Uruguay.

Among the main findings are:

IMPLEMENTATION OF STRATEGIES RELATED TO ENVIRONMENTAL IMPACT

- **12 %** of companies implemented at least one **environmental impact strategy**.
- Most of the companies' **actions focused on the mitigation and prevention** of environmental impacts.
- **Manufacturing companies adopt more environmental strategies than services**.

ACTIVITIES TO ADDRESS ENVIRONMENTAL IMPACT

- **5% of companies measure their environmental performance**, with a higher percentage in industrial companies compared to services.
- Activities linked to the **circular economy and ISO 14001 certification are less common** among the companies surveyed.

IMPORTANCE OF FACTORS RELATED TO CLIMATE CHANGE

- **50%** qualified as **"irrelevant" the factors related to climate change** in their companies.
- The most important factors are: the increase in costs and the **negative impacts** derived from extreme weather conditions.

INNOVATION WITH ENVIRONMENTAL BENEFITS

- **11 % of the companies carry out innovations with environmental benefits.**
    - 10,6% within the company
    - 7% user/client
- Companies tend to introduce innovations to:
    - Develop good environmental practices.
    - Improve their reputation.
    - Increase production efficiency.
- **Regulatory aspects have less influence** on the decision to carry out environmental innovations.

ANALYSIS OF OPEN-ENDED QUESTIONS

- 104 firms declare that environmental innovations **do not apply to their activities**.
- 71 **express concerns** about the negative production consequences of climate change.
- 68 report **taking action** in environmental issues.
- 22 point to the need for **government policies** on environmental issues.

These results provide insights into how Uruguayan companies address issues related to environmental impact, climate change and innovation with environmental benefits. They also indicate opportunities for the development of public policies and the adoption of more sustainable practices in the business sector.

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