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Green Skills:

What they are, who holds them, and why they matter*

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Creating Opportunities

Motivation

- A necessary condition for moving towards a low-carbon economy is to have a labor supply that has the necessary skills[1] to carry it out (Bowen *et al.*, 2018; European Committee, 2019).
  - According to Cedefop (2012), green skills are "the knowledge, skills, values and attitudes necessary to live, work and act in economies and societies that seek to reduce the impact of human activity on the environment".
  - All green skills are essential to ensure environmental sustainability, but not to decarbonize the economy. For example, caring for livestock favors the conservation of terrestrial ecosystems, but it may increase net greenhouse gas (GHG) emissions.
- The demand for green talent is growing at a faster rate than the supply (Linkedin, 2022, 2023, 2024; Kaura, 2024):
  - Globally, the demand for labor with green skills has increased by 6% per year between 2021 and 2024, while the supply has increased by 3%.
  - The offer is advancing in a heterogeneous way, which can exacerbate inequalities between population groups (women *vs.* men, the older population *vs.* the younger, population with higher education *vs.* the rest).
  - In Spain, the SEPE Training Needs Prospecting and Detection Report (2024) has identified a lack of green management knowledge (e.g., environmental regulations) and technical knowledge (e.g., waste management, energy efficiency, etc.).
- Knowing the characteristics of the population that holds green skills and identifying what skills they have acquired allows us to:
  - Adapt *upskilling/reskilling* educational and training programs in order to close the gap between supply and demand (Granata and Posadas, 2024, WEF, 2023).
  - Analyze vulnerable groups (Cedefop, 2015; ILO, 2023; Vandeplas *et al.*, 2022).
  - Devise effective policies that promote ecological transition (Durán y Pagés, 2024; EEA, 2019).

(1) In this work the terms competencies, skills and knowledge are used as synonyms.

Objectives

1

Quantify the relevance of the green skills of the working population in Spain and their evolution over time in comparison with Europe.

2

Identifying who possesses which skills. What are the socio-demographic and labor characteristics of the working people who have acquired (or lack) green skills? Does the profile differ between skill groups?

3

Analyze the implications of defining green skills and assess their suitability laying the foundation for the decarbonization process.

Key points (1)

- In Spain, the weight of green skills in the employed population (i.e., the green intensity) reaches 4%, in line with the EU-27 average.
- The green intensity is moderate because:
  - Occupations in the primary sector exhibit the highest concentration of green skills.
  - The number of general skills is higher in more qualified occupations, which magnifies the importance of certain occupations in the calculation of the indicator (e.g., waste workers or foresters) and minimizes that of others (e.g., engineers or biologists).
- Who has a greater prevalence of green skills? Individuals with the highest concentration of green skills in the workforce are predominantly male, aged 40–54, with primary-level education or lower, residing in the autonomous communities of La Rioja, Castilla y León, or Aragón. They are typically self-employed full-time in sectors such as primary industries (e.g., agriculture), water and waste management, energy supply, or administrative roles.
- Green talent is ubiquitous. 72% of green skills are used in all sectors of activity (20), although the vast majority of skills are concentrated in occupations that are not representative of each sector. When only the occupations with the highest share in employment in each sector are considered, the ubiquity drops to 20%.

Key points (2)

- The typology of the population with green skills differs depending on the skill group:
  - Natural language processing, machine learning and expert criteria techniques have been combined in order to identify five groups of green skills: Renewable energy and energy efficiency, biodiversity and agriculture, environmental policies and studies, recycling and others.
  - Spain stands out in Europe in skills related to biodiversity and agriculture, but there is room for improvement in those associated with renewables and energy efficiency, which are necessary to meet the growing demand for professionals and promote the decarbonization of the economy.
  - The skills in agriculture and recycling explain why the weight of green intensity is greater among the older population, with a low level of education and employed in agriculture, water supply or waste management sectors.
  - Furthermore, those with skills in renewable energy or environmental policies are young(er), have a university education and work in the activities of energy supply, construction or water supply and waste management.
- To achieve climate carbon neutrality, it will be necessary to increase the population's knowledge of renewables and energy efficiency and the design of environmental policies, which requires promoting higher education and designing training programs to instruct the adult population.
- The aim is to meet the growing demand for professionals who will help the Spanish economy take advantage of its renewables potential and meet the PNIEC objective of increasing the installed capacity of solar and wind energy by 124% between 2025 and 2030.

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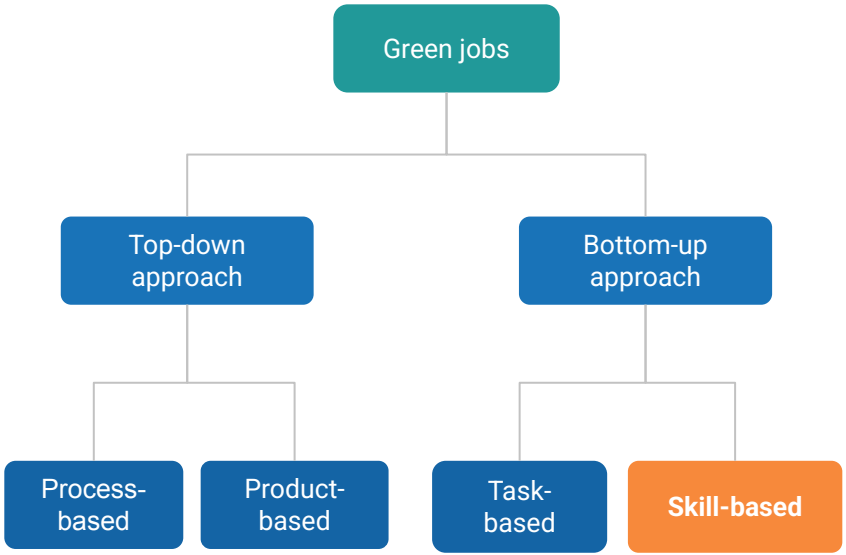
01

Green Skills:

Definition, taxonomy and application to the Spanish economy

Green jobs: A competency-based approach

ALTERNATIVE DEFINITIONS OF GREEN JOBS



- The definition of a green job depends on the benchmark: Top-down vs. Bottom-up.
- The top-down approach classifies jobs according to the sector in which they are created. Whether a sector can be characterized as green depends on the product (good or service with reduced GHG emissions) or the production process (use of practices or technologies considered green).
- The bottom-up approach starts from the individual's occupation, regardless of the sector in which he or she works. It is based on the tasks (e.g. O*NET) or green skills (e.g. ESCO) needed to perform that occupation.

Source: BBVA Research based on OECD (2023) data.

Green jobs: A competency-based approach

Pros and cons of the bottom-up approach

- In this work, a bottom-up skills-based approach has been chosen, which uses the European Skills, Competences, Qualifications and Occupations (ESCO), which combines statistical criteria with expert assessment(1).
- Advantages of the Skills-Based Bottom-Up Approach:
  - The bottom-up approach considers the green skills of the population employed in polluting sectors, so it is more flexible than the top-down approach.
  - The Green Skills taxonomy included in ESCO is adapted to the European labor market and is more recent than O*NET (2024 vs 2019).
- The bottom-up, skills-based approach is not without its critics:
  - The commonly accepted definition of green skills, proposed by Cedefop (2012), is too generic. Green skills are "*the knowledge, skills, values and attitudes necessary to live, work and act in economies and societies that seek to reduce the impact of human activity on environment*".
  - By attaching greater importance to the literal meaning of the skill or task than to the functions performed in the job, it is possible to label skills that are not green as green (and vice versa) (Fernández *et al.*, 2025). The expert criteria used by ESCO helps to mitigate this problem.
  - In ESCO, the concentration of green skills in primary sector occupations is high, which could influence the results of the analysis given the composition of the population employed in the sector and its change over time (Maldonado *et al.*, 2024).

(1) See the Appendix for more details.

The European Classification of Skills, Competences and Occupations (ESCO)

- ESCO is an initiative of the Europe 2020 strategy launched in 2017 that "works as a dictionary, describing, identifying and classifying professional occupations and skills relevant for the EU labour market and education and training".
  - In 2024, it associates 14,575 competencies with 3,039 occupations that follow the structure of the International Standard Classification of Occupations (ISCO-08).
- In January 2022, in line with the EU's 2050 climate neutrality target, the labeling of green skills (v1.1.0) was added, following Cedefop's definition.
- The green skills taxonomy was updated in May 2024 (v1.2.0): 591 green skills in 2024 (570 in 2022) compared to a total of 14,575 (14,530 in 2022).
- Following the recommendation of ESCO, in this work taxonomy v1.1.0 is used until 2022 and v1.2.0 for the biennium 2023 - 2024.

(1) See the Appendix for more details on the green taxonomy in ESCO.

The European Classification of Skills, Competences and Occupations (ESCO)

ESCO: GREEN SKILLS (IN GREEN) **AND NON-GREEN SKILLS** (IN BLACK)

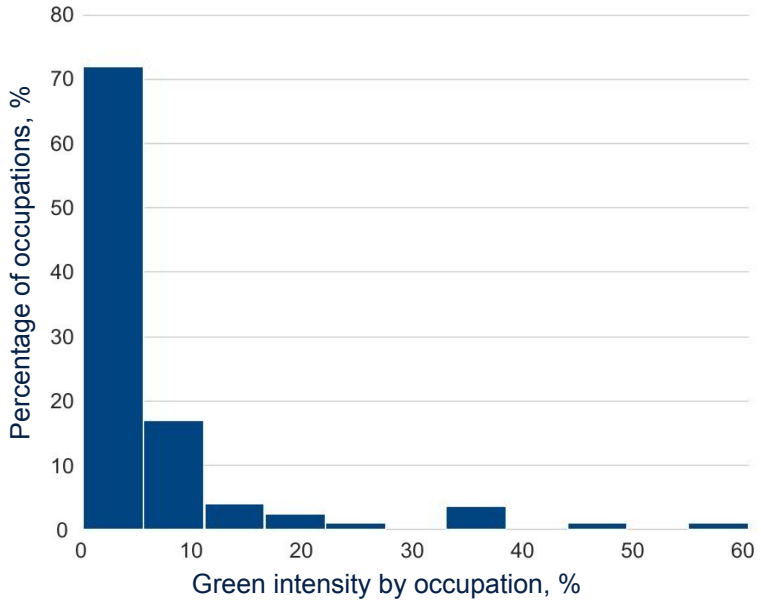
(ESCO V1.2.0. THE SIZE OF THE TEXT IS PROPORTIONAL TO THE NUMBER OF OCCUPATIONS IN WHICH EACH SKILL APPEARS)

Source: BBVA Research based on ESCO v 1.2.0.

Green intensity is lower than 2.8% in half of the 130 occupations

ESCO: DISTRIBUTION OF OCCUPATIONS BY GREEN INTENSITY

(ESCO V1.2.0, 2024. %)

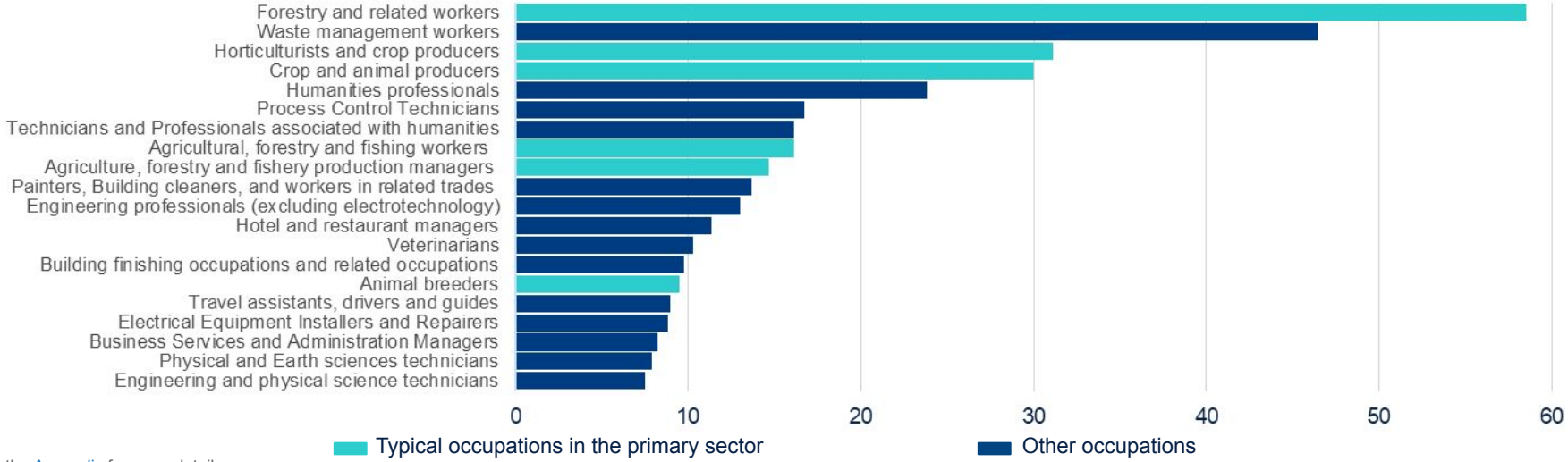


Source: BBVA Research based on ESCO v1.2.0.

- Using ESCO, the green intensity per occupation (i.e., the percentage of green skills over the total skills of each occupation) is calculated to three digits of the International Standard Classification of Occupations (ISCO-08).
- In v1.2.0 of 2024, the weight of green skills (5.1% on average) varies between 58.5% for forestry and related workers and 0% in 20 of the 130 occupations, including doctors, journalists or street vendors.
- However, the distribution of green skills is skewed to the left: 71.5% of occupations have a green intensity lower than 5% and only fifteen have a green intensity higher than 10%.

The occupations with the highest green intensity are mostly concentrated in the primary sector

THE 20 OCCUPATIONS WITH THE HIGHEST GREEN INTENSITY* (ESCO V1.2.0, 2024. %)



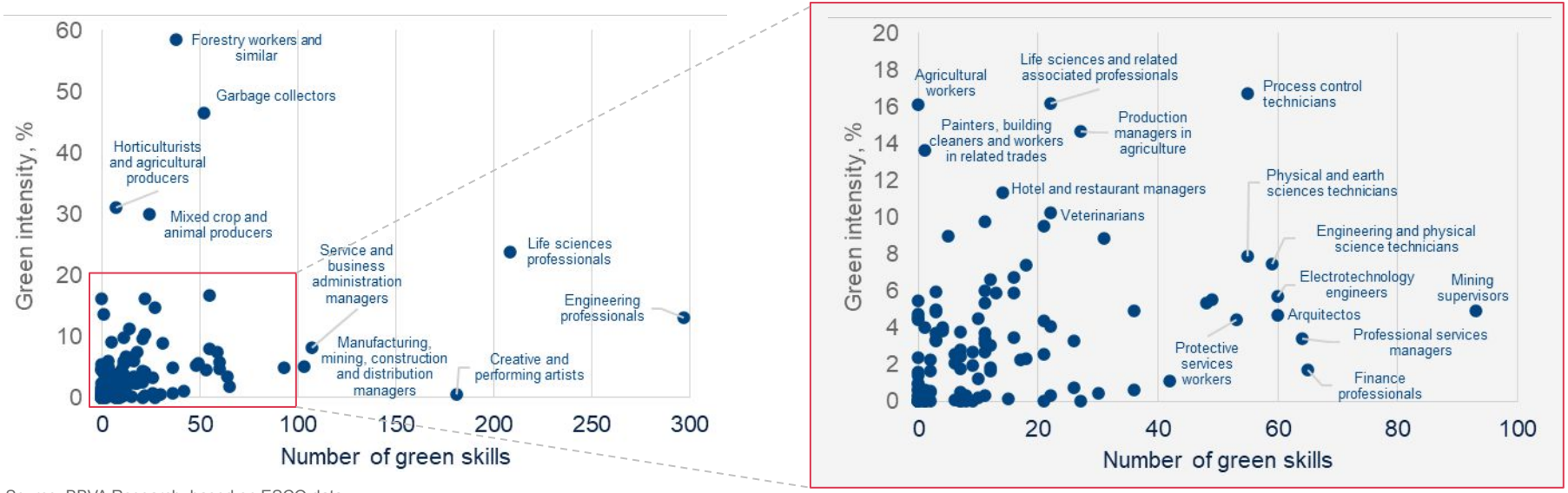
*See the Appendix for more details.
Source: BBVA Research based on ESCO v1.2.0.

Given the definition of green skills used by ESCO, the green intensity of primary sector occupations is relatively high.

The bias towards the primary sector may be magnified by the differences between occupations in the total number of skills

GREEN INTENSITY *VS* NUMBER OF GREEN SKILLS BY OCCUPATION

(ESCO v1.2.0, 2024. %)



Source: BBVA Research, based on ESCO data.

The total number of skills (*i.e.*, the denominator of the intensity of green skills) tends to be higher for the most skilled occupations and lower for the least skilled. Therefore, using an aggregate indicator of green intensity can magnify the importance of certain occupations (e.g., waste managers or forestry conservationists) and minimize that of others (e.g., engineers or biologists).

Green skills are classified into five groups

to differentiate traditional abilities (conservation of natural resources) from emerging abilities (environmental studies and renewable energies)

- The concentration of green abilities in jobs in the primary sector and the differences in the number of general competencies needed to perform a job (higher in the most qualified ones) condition the results of the analysis.
- To overcome these shortcomings and determine if there are differences among the skills, green skills have been classified into five subgroups. This classification was carried out using natural language processing techniques and expert criterion(1):
  - Phase 1: *Initial clustering* .
    - Natural Language Processing : The TF-IDF (Buckley & Salton, 1988) and Word2Vec (Chen *et al.*, 2013) models were used to measure the semantic similarity between skills and create 10 groups with each technique (according to the elbow method, Thorndike, 1953).
    - Hierarchical clustering (Dubes & Jain, 1988; Drake *et al.*, 2002): The correlation between skills was measured based on their distribution in different occupations, and then the skills were grouped into 50 and 10 clusters.
  - Phase 2: Integration of clusters.
    - Based on the four segments of skills obtained (10, 10, 50 and 10 groups), the *k-means* clustering method was applied (MacQueen, 1967; Arthur & Vassilvitskii, 2007) and 9 groups obtained.
  - Phase 3: Expert refining.
    - By means of a manual review, the 9 groups were consolidated into the final 5, guaranteeing conceptual coherence.
- The main skills of each group can be consulted in the Appendix.

(1) An approach similar to that carried out by ESCO to label green skills. See the Appendix for more details.
We use *machine learning techniques* together with expert criteria to group skills, based not only on the language used (Janser & Markus, 2018; Durán & Pagés, 2024), but also on the correlation derived from their distribution in occupations.

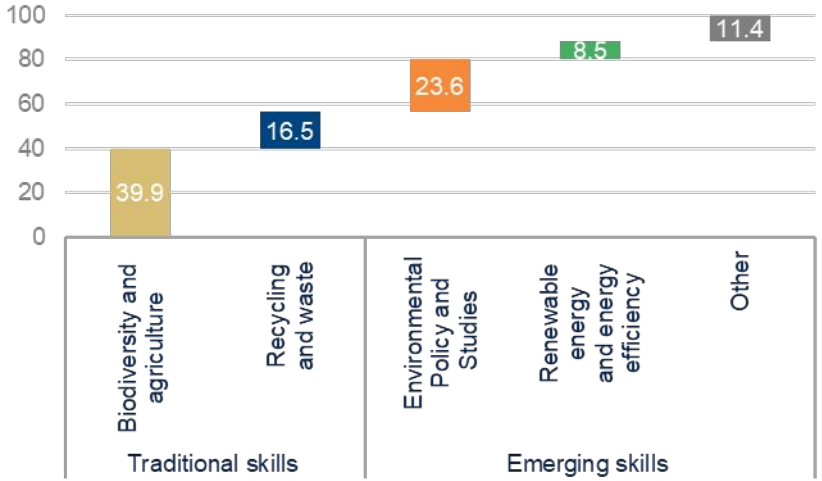
Green skills are classified into five groups

to differentiate traditional abilities (conservation of natural resources) from emerging abilities (environmental studies and renewable energies) ...

GREEN SKILLS GROUPS*

(ESCO V1.2.0, 2024)

PARTICIPATION OF EACH GROUP OF GREEN SKILLS IN THE TOTAL GREEN INTENSITY (%). ESCO V1.2.0, 2024)



Renewables and energy efficiency | Biodiversity and agriculture | Environmental policies and studies | Recycling and waste | Other

*The size of the text is proportional to the number of occupations in which each skill appears. Each color represents a group.
Source: BBVA Research, based on ESCO data.

...which correspond to some of the Sustainable Development Goals

OVERVIEW OF CORRESPONDING SDGs - GREEN SKILLS CLUSTERS

Green skills group	Main SDGs
Renewable energy and energy efficiency	7, 9, 11
Environmental policy and studies	12, 13, 16
Biodiversity and agriculture	2, 6, 14, 15
Recycling and waste	3, 11, 12
Other	4, 8 ,9

Source: UN and BBVA Research, based on ESCO data.

- Each group of green skills relates to specific Sustainable Development Goals (SDGs) related to climate action, responsible production and environmental governance.
- The skills classified as green by ESCO range from drafting environmental policies (SDGs 13, 16) and the promotion of clean and efficient energy (SDGs 7, 9, 11), to the conservation of ecosystems (SDGs 14, 15) and the circular economy through the responsible management of waste and chemicals (SDGs 3, 11, 12). In addition, they combine technical skills with legal, social and educational aspects (SDGs 2, 4, 6, 8).

ESCO and EPA are merged to know who holds green skills in Spain

- To analyze the weight of green skills in Spain and their performance over time, ESCO's taxonomy of skills and occupations is combined with the information provided by the quarterly microdata datasets of the Labor Force Survey (LFS) between 2015 and 2024.
  - 2.3 million employed people across 170 occupations classified at the three-digit level of the CNO-2011, with an average of 57,300 per quarter.
- Each worker is assigned the green skills of their occupation according to ESCO:
  - ISCO-08 occupations are matched with CNO-2011 occupations based on the equivalence established by the INE(1).
- Three groups of socio-occupational variables are considered:
  - Job characteristics: occupation, working hours, professional situation (type of contract), seniority in the company, hours worked, holding multiple jobs, etc.
  - Company characteristics: Institutional sector (public, private), sector of activity.
  - Personal/family characteristics: gender, age, nationality, level of education, household size and composition, province/autonomous community of residence, etc.

(1) If there is a one-to-one equivalence between the occupation in ISCO-08 and CNO-2011, the same green intensity is assigned. If one occupation in ISCO-08 corresponds to several in CNO-2011, all occupations in CNO-2011 will have the same green intensity. If several occupations in ISCO-08 correspond to one in CNO-2011, the green intensity of the occupation in CNO-2011 will be the average of the green intensities of the occupations in ISCO-08.

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02

Results: descriptive analysis

The importance of green skills in the economic literature

- The specialized literature indicates that the distribution of occupations with green skills is heterogeneous. The traditional occupations are dominated by men, who are older and have a lower level of education (Maldonado *et al.*, 2024). However, emerging occupations demand more qualified profiles and are located in urban areas with high technological density (Bluedorn et *al.*, 2023; Consoli *et al.*, 2019; Durán & Pagés, 2024).

- The share of jobs with green skills in the total has barely changed in advanced economies since 2010 (Deschenes, 2013; Maldonado *et al.*, 2024). Although estimates vary, between 7.1% and 7.5% of employed people in the UE-27 in 2022 were classified as green using the bottom-up approach (O*NET or ESCO).

- These figures are conditioned by the definition of 'employment with green skills'. Traditionally, an arbitrary threshold (e.g., a green intensity greater than 10%) has been used to classify a job as green, which ignores the intensity gradients (e.g., Fernández *et al.*, (2025); Consoli *et al.*, (2019); Maczulskij, (2024)).

- The literature tends to consider green skills as a whole. Few studies explore skills subgroups, and those that do (e.g. Janser, 2018; Durán & Pagés, 2024; Fernández & Larrea, 2023), use only lexicographic criteria to make the groupings.

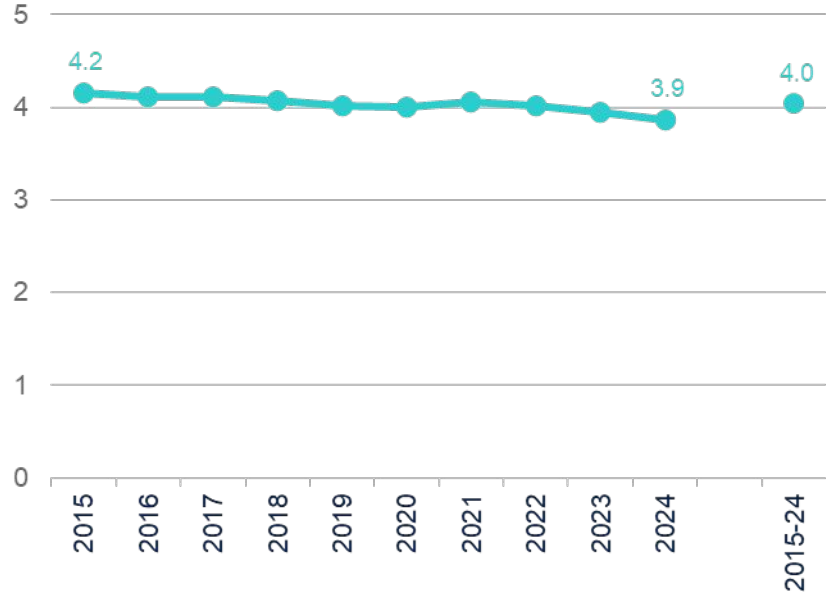
- References are scarce in the case of Spain (e.g., SEPE, 2024; Durán & Pagés, 2024; Fernández and Larrea, 2023, Forum Ambiental, 2010). Green employment estimates range from 2.6% (top-down approach) to 7% (bottom-up approach with thresholds) for the period 2021-2024, slightly below the European average (BBVA Research, 2024). However, research on the socio-occupational characteristics of the population with green skills is limited, which makes it difficult to design policies that try to reduce the impact of human activity on the environment.

The weight of green skills in employment is moderate (4%)...

Its trend has decreased slightly since 2015, in line with the EU average

SPAIN: GREEN INTENSITY*

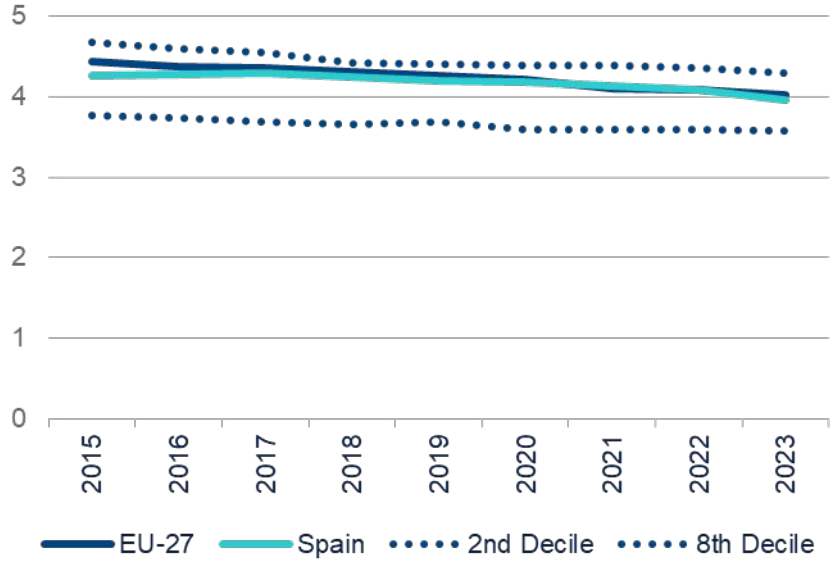
(%, 2015 - 2024)



*See the Appendix for more details on green intensity by occupation.
Source: BBVA Research based on EC (ESCO) and INE (EPA).

EU-27: GREEN INTENSITY*

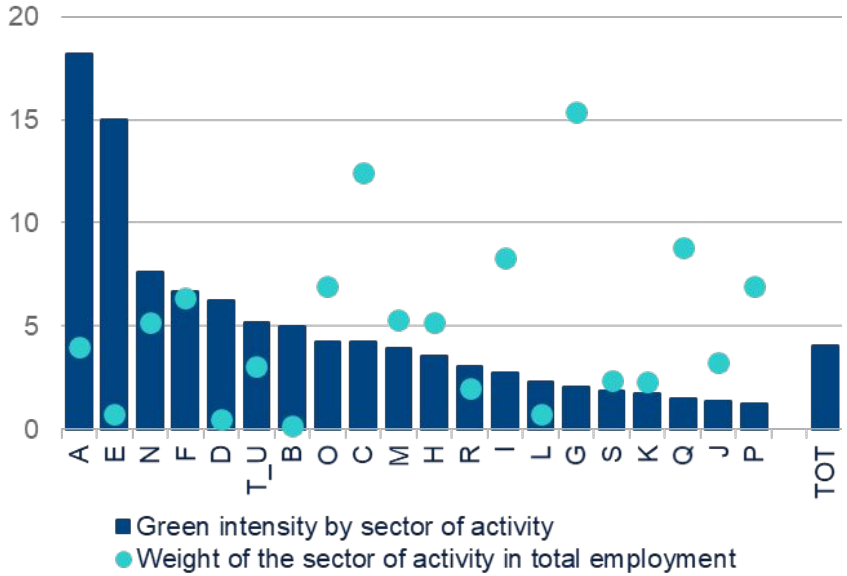
(%, 2015 - 2023)



*When comparing Spain with other European countries, the ISCO-08 two-digit green index has been calculated.
Source: BBVA Research based on CE (ESCO) and Eurostat.

… due to the concentration of occupations with green skills in the primary sector, which barely represents 4% of total jobs

GREEN INTENSITY BY SECTOR OF ACTIVITY* AND WEIGHT OF THE SECTOR OF ACTIVITY IN TOTAL EMPLOYMENT
(%, AVERAGE 2015-2024)



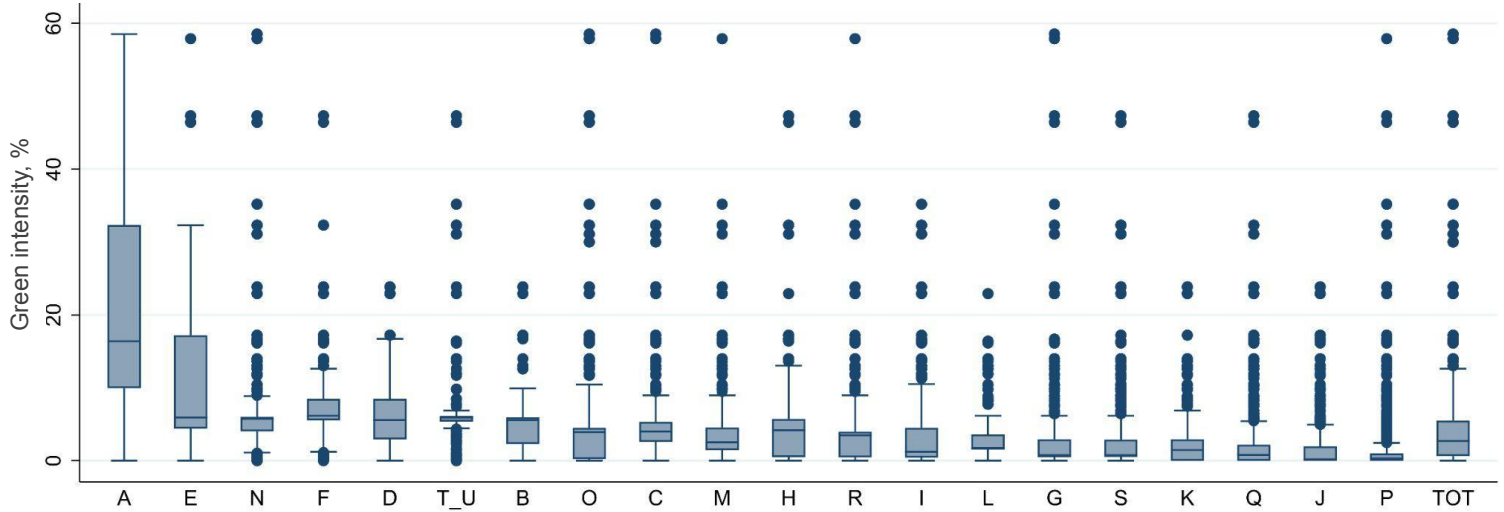
*The 20 sections of CNAE-09 can be consulted in the Appendix.
Source: BBVA Research based on CE (ESCO) and INE (EPA).

- Agriculture (A: 18%) and water supply and waste management (E: 15%) are the only two sectors in which green intensity exceeded 10% in the period of 2015-2024.
- Above-average green intensities are seen in Administrative activities (N), construction (F), energy supply (D), extractive industries (B) and manufacturing (C), among others, which highlights the scarcity of green skills in the services sector.

Although there are green skills common to all sectors, they are not considered essential in most of them

DISTRIBUTION OF THE GREEN INTENSITY IN EMPLOYMENT BY SECTOR*

(%, 2015 - 2024. MEDIAN, 25TH AND 75TH PERCENTILES, ADJACENT AND ATYPICAL)



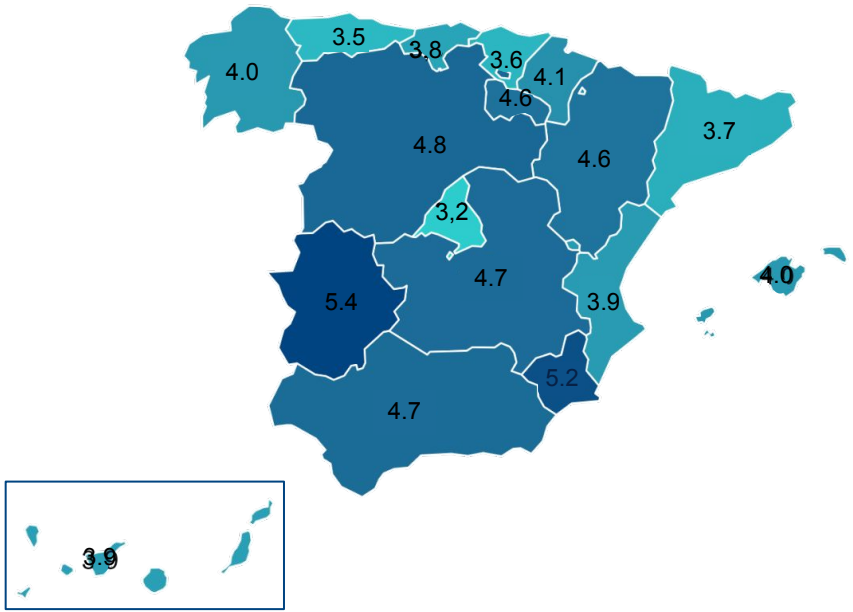
*The 20 sections of CNAE-09 can be consulted in the Appendix.
Source: BBVA Research based on EC (ESCO) and INE (EPA).

When analyzing the distribution of green skills by sector, it is found that 72% are used in all sectors (20), although the vast majority are concentrated in occupations that are not representative of each sector. When considering only the occupations with the highest share in employment in each sector, the ubiquity of green skills drops to 20% (see the Appendix for details).

The sectoral concentration of green skills conditions regional distribution

GREEN INTENSITY BY AUTONOMOUS COMMUNITY.

(%, AVERAGE 2015 - 2024)



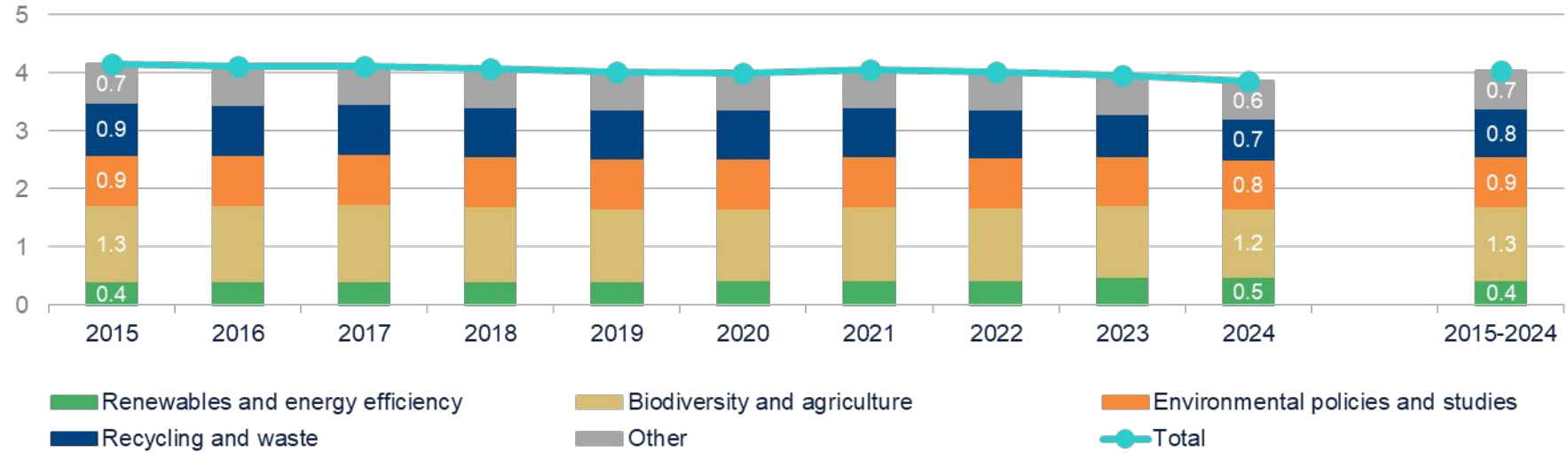
The green intensity is higher in the Autonomous Communities, with a greater share of the primary sector in employment: Extremadura, Murcia, Castilla-La Mancha, Andalusia, and Castile and Leon.

Source: BBVA Research based on EC (ESCO) and INE (EPA).

The contribution of each skill group to green intensity has barely changed since 2015

GREEN INTENSITY AND THE CONTRIBUTION OF DIFFERENT GROUPS

(%, 2015 - 2024)



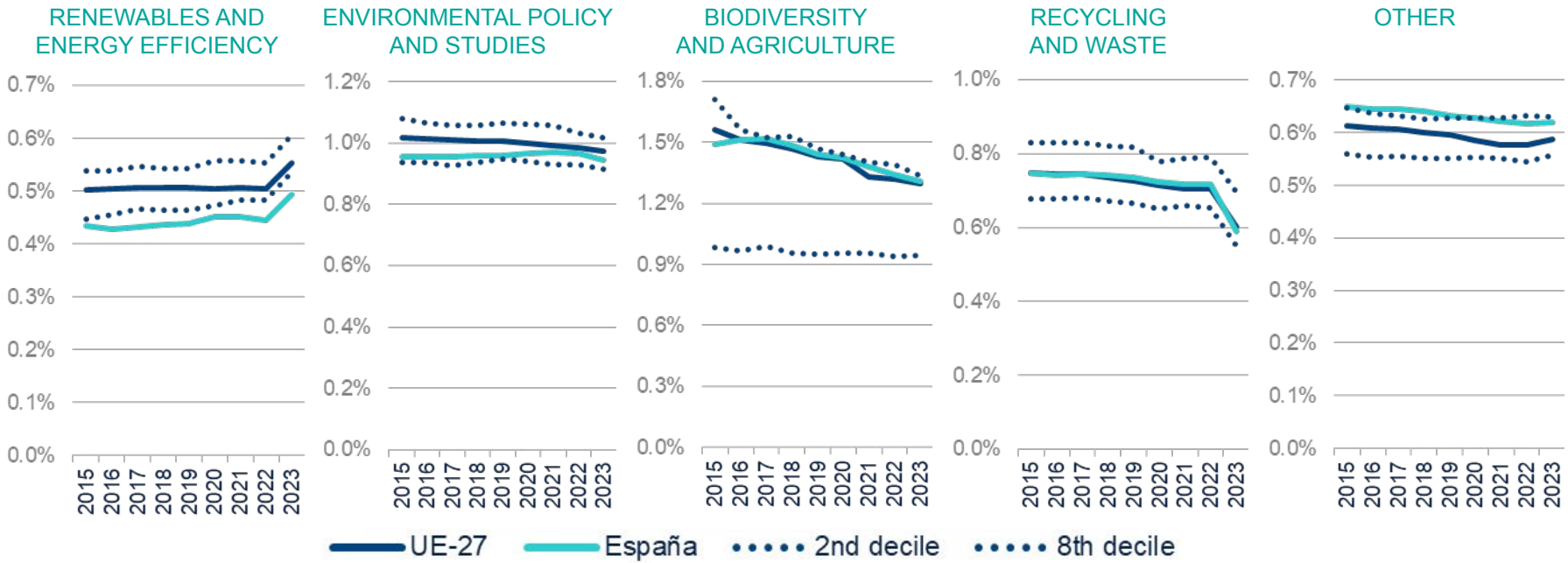
Source: BBVA Research based on EC (ESCO) and INE (EPA).

Biodiversity and agriculture account for 31% of the green intensity. Environmental policies and studies represent 21%; recycling and waste, 21%; renewables and energy efficiency, 11% and the rest, 16%.

Spain stands out in green skills related to biodiversity and agriculture. There is room for improvement in renewables and energy efficiency

GREEN INTENSITY BY SKILL GROUP*

(%, 2015 - 2023)



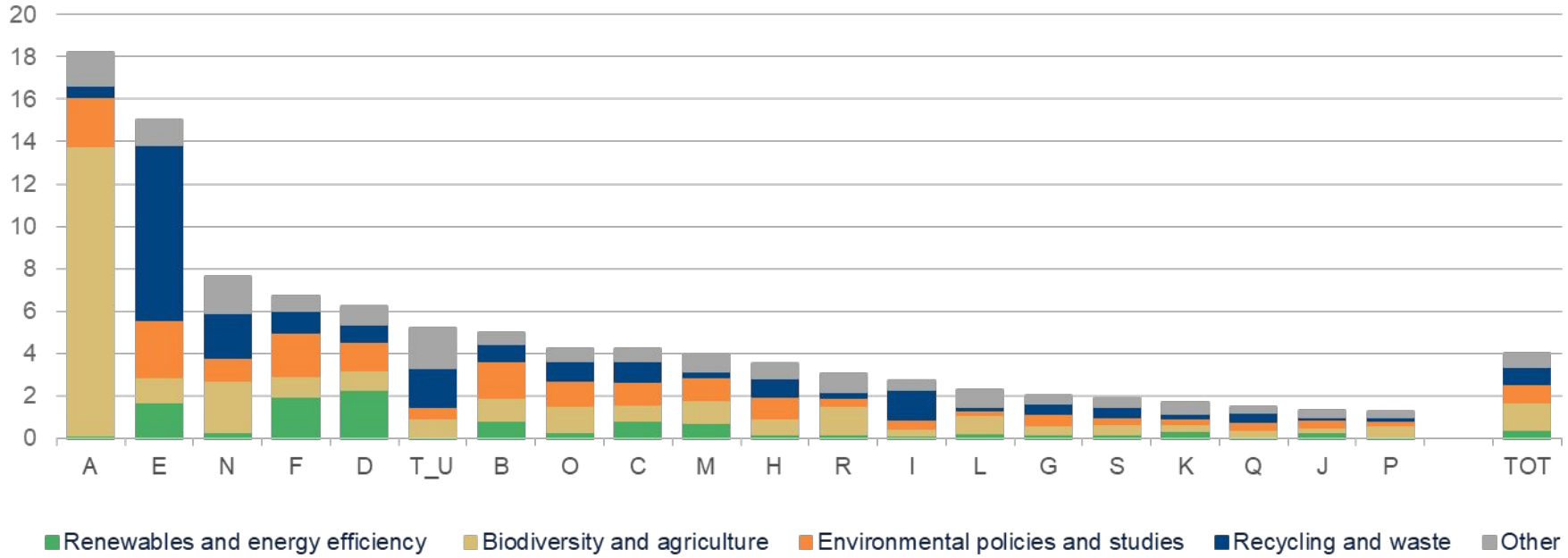
* For the comparison of Spain with other European countries, the green intensity has been calculated at the double digit level of ISCO-08.

Source: BBVA Research based on Eurostat and ESCO.

All sectors demand competencies from the 5 groups of green skills, although the importance of each group varies by sector

GREEN INTENSITY BY SECTOR, 2015-2024

(%, AVERAGE 2015 - 2024)



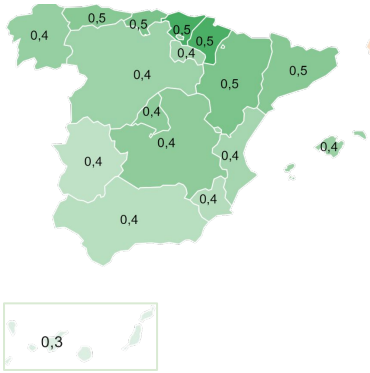
Source: BBVA Research based on EC (ESCO) and INE (EPA).

The regional distribution of green skills differs depending on the group considered

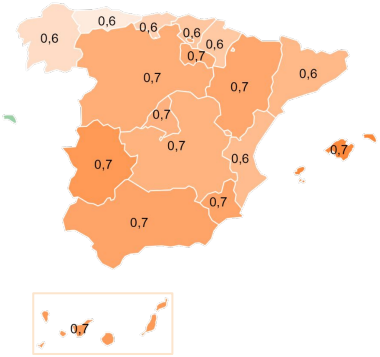
GREEN INTENSITY BY AUTONOMOUS COMMUNITY

(%, AVERAGE 2015 - 2024)

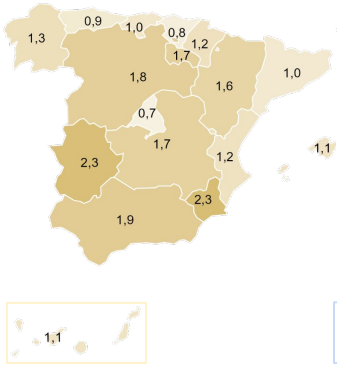
RENEWABLES AND ENERGY EFFICIENCY



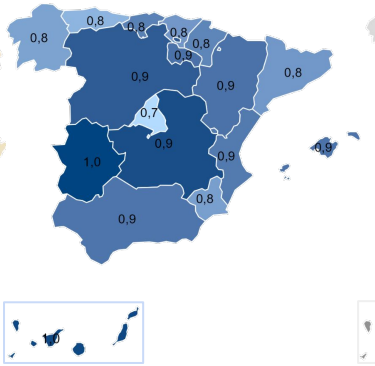
ENVIRONMENTAL POLICY AND STUDIES



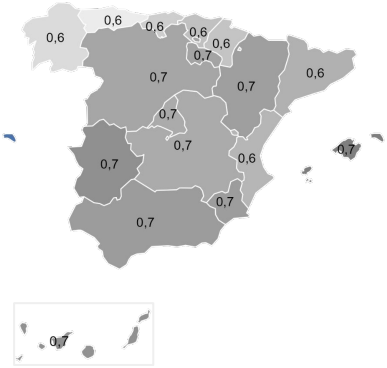
BIODIVERSITY AND AGRICULTURE



RECYCLING AND WASTE



OTHER



Source: BBVA Research based on EC (ESCO) and INE (EPA).

The weight of green skills in occupations related to renewables and energy efficiency is greater in the Basque Country, Navarre and Cantabria. Extremadura, Castile and Leon and Murcia stand out in the field of environmental policy and studies, whereas in the field of biodiversity and agriculture, Murcia, Extremadura and Andalusia stand out. Extremadura, the Canary Islands and Castilla-La Mancha lead in recycling and waste management.

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03

Results: Conditional analysis

Profile of the employed population with a higher green intensity

- Descriptive analysis is insufficient to perform a profiling of the population with green skills. For example, the descriptive analysis indicates that the prevalence of green skills is higher among the working individuals aged 60 or over with primary education or lower. Given that workers aged 60 and over represent 38% of the employed population with primary education or lower, what role do age and educational level play in possessing green skills?

- The dependent variable ($y \equiv$ weight of green skills) takes values between 0 and < 1. Therefore, we cannot assume a linear relationship between the weight of green skills and their determinants ($E(y|x) = x\beta$) because:
  - The effect of an explanatory variable x_i is not constant in the range of definition of y.
  - It does not guarantee that the predicted values of y fall within the interval [0, 1).

- It is also not appropriate to perform a transformation of y (e.g., logistics) because the function is not defined at the extremes of the interval (in particular, at $y = 0$).

- Solution: Fractional regression model (Papke & Wooldridge, 1996; Murteira *et al.*, 2011).
  - $E(y|x) = G(x\beta)$; $0 \leq G(.) < 1$
  - Although the distribution of y is skewed toward the left tail, the specification tests of the functional form indicate that we cannot reject that the logistic function is the best specification of G(.). We estimate $G(x\beta)$ by (quasi)maximum likelihood(1).

(1) An example of this estimation method can be found in Doménech *et al.* (2018).

Profile of the employed population with a higher green intensity

Total *vs* skill groups

	TOTAL*	RENEWABLES AND ENERGY EFFICIENCY	ENVIRONMENTAL POLICY AND STUDIES	BIODIVERSITY AND AGRICULTURE	RECYCLING AND WASTE	OTHER
	**Male**; 40-54 years old; elementary level education **or lower**; resident in La Rioja, Castile and León or Aragon.	**Male**; 35-44 years; **university level of education (undergraduate/postgraduate)**; resident in the Basque Country, Madrid, Navarre or Aragon.	**Male**; Spanish nationality; 35 years or older; **postgraduate studies**; resident in Navarre, Castile and León or Aragon.	**Male**; < 50 years old; **elementary education or less**; resident in La Rioja or Valencia.	**Male**, foreign nationality, 45-59 years old, **elementary education or lower**, resident in Castile and León, Extremadura; Navarre, Aragon, La Rioja, Castile-La Mancha, or the Basque Country	**Female**, 40 years of age or older, **secondary education or lower**, resident in the Balearic Islands, Canary Islands, La Rioja, Aragon, Extremadura or Catalonia.
	Full-time; **self-employed or permanent discontinuous contract**.	Full-time; **self-employed or permanent contract**.	Full-time; **intermittent fixed-term contract or temporary contract**.	Full-time; **self-employed**; 20 or more hours usually worked.	Part-time; **intermittent fixed-term contract**; less than 20 hours usually worked.	Part-time; **permanent or permanent discontinuous contract**; less than 40 hours usually worked.
	**Primary sector; water or energy supply; administrative activities; local corporation.**	**Power supply, construction, or water supply; local corporation.**	**Construction; water supply; primary sector; local corporation.**	**Primary sector; administrative activities; public administration; local corporation.**	**Water supply; administrative activities or household activities; local government.**	**Household activities; administrative activities; primary sector; private sector or local corporation.**

*The variables for which the differences in green intensity are greater are highlighted in bold. See Appendix for more details.
*The differences in green intensity by nationality, household size and composition, length of service in the company and multiple jobholding are negligible (<0.1pp).
Source: BBVA Research.

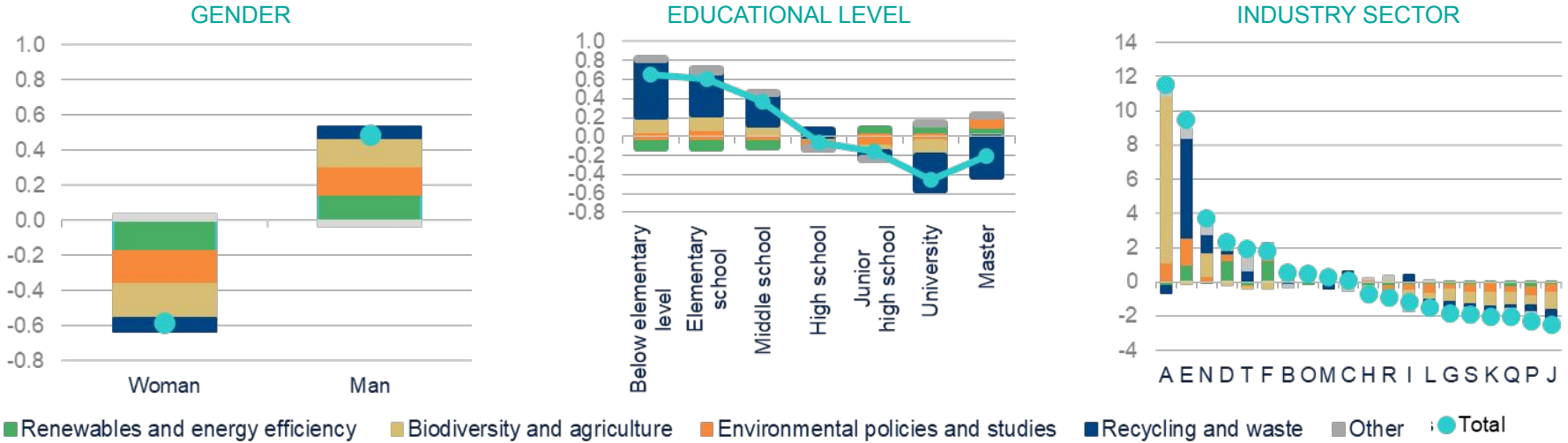
Profile of the employed population with a higher green intensity

- The typology of workers with the most green intensity changes by skill group:
  - If we consider the whole range of green skills, the profile would be that of a man, between 40 and 54 years old, with elementary education or lower, who is self-employed full-time in the primary sectors, water supply, energy supply or administrative activities.
  - Skills in agriculture and waste management explain why the green intensity is greater among the older population, with a lower level of education and working in agriculture or in the water supply and waste management sector.
  - Whereas, those with green skills in energy efficiency or environmental policies are younger, with a university degree (undergraduate or postgraduate) and work in energy supply, construction or water supply and waste management activities.
- To achieve the decarbonization of the Spanish economy, it will be necessary to increase the skills of the population in renewables and energy efficiency and the design of environmental policies. However, Spain is currently below the EU average in these areas, which makes it essential to promote higher education and the design of training programs to equip the adult population.
- The aim is to meet the growing demand for professionals so that the Spanish economy can take advantage of its renewable potential and meet the objective of increasing the current installed capacity of solar and wind energy by 124% between 2025 and 2030 (see the Appendix for details).

Profile of the employed population with a higher green intensity

DIFFERENCE BETWEEN THE GREEN INTENSITY OF EACH CHARACTERISTIC AND THE AVERAGE WORKER WITH ALL OTHER CHARACTERISTIC BEING EQUAL

(CONTRIBUTION OF THE FIVE SKILL GROUPS, PP, 1Q2015 - 4Q2024)



Source: BBVA Research based on EC (ESCO) and INE (EPA).

The employed population with skills in renewable energies and environmental studies has a higher educational level and works in sectors that are strategic for the ecological transition.

Key points (1)

- In Spain, the weight of green skills in the employed population (i.e., the green intensity) reaches 4%, in line with the EU-27 average.
- The green intensity is moderate because:
  - Occupations in the primary sector exhibit the highest concentration of green skills.
  - The number of general skills is higher in more qualified occupations, which magnifies the importance of certain occupations in the calculation of the indicator (e.g., waste workers or foresters) and minimizes that of others (e.g., engineers or biologists).
- Who has a greater prevalence of green skills? Individuals with the highest concentration of green skills in the workforce are predominantly male, aged 40–54, with primary-level education or lower, residing in the autonomous communities of La Rioja, Castilla y León, or Aragón. They are typically self-employed full-time in sectors such as primary industries (e.g., agriculture), water and waste management, energy supply, or administrative roles.
- Green talent is ubiquitous. 72% of green skills are used in all sectors of activity (20), although the vast majority of skills are concentrated in occupations that are not representative of each sector. When only the occupations with the highest share in employment in each sector are considered, the ubiquity drops to 20%.

Key points (2)

- The typology of the population with green skills differs depending on the skill group:
  - Natural language processing, machine learning and expert criteria techniques have been combined in order to identify five groups of green skills: Renewable energy and energy efficiency, biodiversity and agriculture, environmental policies and studies, recycling and others.
  - Spain stands out in Europe in skills related to biodiversity and agriculture, but there is room for improvement in those associated with renewables and energy efficiency, which are necessary to meet the growing demand for professionals and promote the decarbonization of the economy.
  - The skills in agriculture and recycling explain why the weight of green intensity is greater among the older population, with a low level of education and employed in agriculture, water supply or waste management sectors.
  - Furthermore, those with skills in renewable energy or environmental policies are young(er), have a university education and work in the activities of energy supply, construction or water supply and waste management.
- To achieve climate carbon neutrality, it will be necessary to increase the population's knowledge of renewables and energy efficiency and the design of environmental policies, which requires promoting higher education and designing training programs to instruct the adult population.
- The aim is to meet the growing demand for professionals who will help the Spanish economy take advantage of its renewables potential and meet the PNIEC objective of increasing the installed capacity of solar and wind energy by 124% between 2025 and 2030.

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Green Skills:

What they are, who holds them, and why they matter*

J.M. Barrutiabengoa, J. Cubero, J.R. García, R. Ortiz and S. Vázquez

March 26, 2025

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Appendix

The European Classification of Skills, Competencies and Occupations (ESCO)

The labeling of green skills in ESCO follows a 3-step process:

- **Step 1:** Manual labeling based on the definition of Cedefop (2012): Green skills are *"the knowledge, abilities, values and attitudes needed to live, work and act in economies and societies seeking to reduce the impact of human activity on the environment".*
- **Step 2:** Creation of a machine learning classifier to identify green skills within the ESCO skill set. Subsequently, the classifier is used to label all the skills as "brown" (increases the environmental impact), "white" (neutral) or "green" (reduces the impact).
  - To construct the ML classifier, the Commission used a training dataset composed of green and non-green activity texts, mainly sentences and short definitions, collected from European and international sources.
- **Step 3:** Comparison and validation. The skills are re-labeled as “green” and “not green” for both methodologies, with the final labeling being applied using the following criteria:
  - If both methods classify the skill as "green", its classification as "green" is automatically accepted.
  - If both methods classify the skill as "not green", its classification as "not green" is automatically accepted.
  - If the skill is classified as green by only one of the methods, the final classification will depend on a new manual labeling process based on expert criteria.

Main competencies by group of green skills

RENEWABLES AND ENERGY EFFICIENCY

- energy conservation
- energy performance of buildings
- use resource-efficient technologies in hospitality
- energy efficiency knowledge
- renewable energy knowledge
- knowledge of electricity consumption
- knowledge of wind energy
- knowledge of solar energy
- promote sustainable energy
- analyse energy consumption
- knowledge of smart grid systems
- advise on heating systems energy efficiency

ENVIRONMENTAL POLICY AND STUDIES

- ensure compliance with environmental legislation
- knowledge of health and safety regulations
- pollution prevention
- environmental legislation
- report pollution incidents
- knowledge of environmental policy
- follow procedures to control substances hazardous to health
- follow health and safety procedures in construction
- pollution legislation
- ensure correct goods labelling
- analyse environmental data
- manage environmental impact of operations

BIODIVERSITY AND AGRICULTURE

- knowledge of biology
- knowledge of types of good
- knowledge of geology
- knowledge of animal welfare
- knowledge of ecology
- water policies
- knowledge of botany
- engage local communities in the management of natural protected areas
- knowledge of agronomy
- monitor the welfare of animals
- pest control in plants

RECYCLING AND WASTE

- dispose of hazardous waste
- knowledge of waste management
- dispose of non-hazardous waste
- food waste monitoring systems
- manage waste
- hazardous waste storage
- mitigate waste of resources
- develop food waste reduction strategies
- advise on waste management procedures
- replace defect components

OTHER

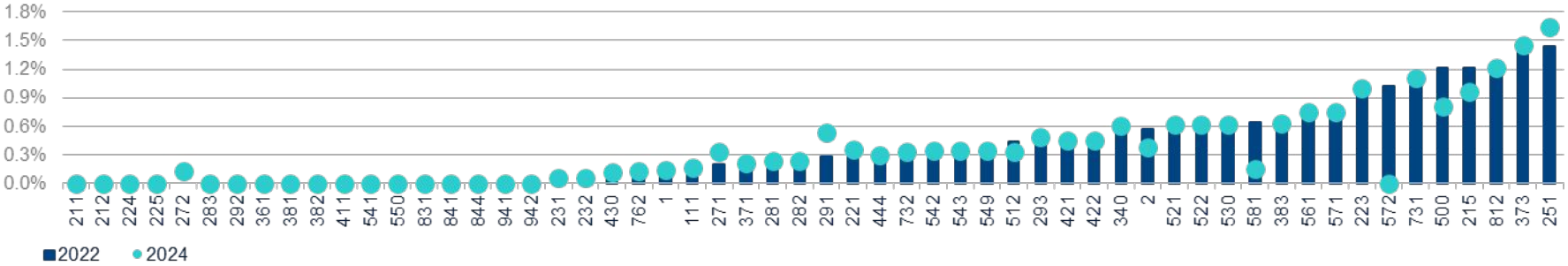
- promote environmental awareness
- corporate social responsibility
- radiation protection
- monitor manufacturing impact
- reduce environmental impact of footwear manufacturing
- advise on pollution prevention
- knowledge of corporate sustainability
- challenging issues in the textile industry
- avoid contamination
- knowledge of ecotourism
- support local tourism

Source: BBVA Research based on EC (ESCO) data.

Green intensity by occupation (1)

SPAIN: OCCUPATIONS WITH A LOW WEIGHT OF GREEN SKILLS*

(% OF GREEN SKILLS)



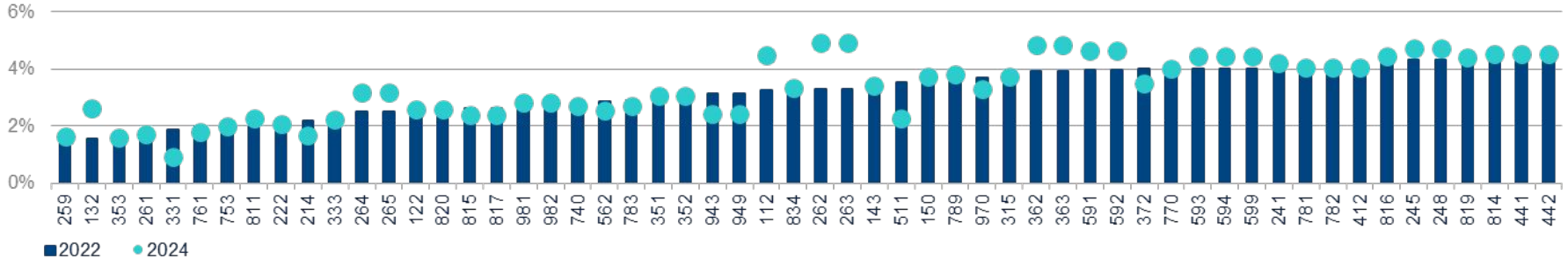
211 Doctors
212 Nursing and midwifery professionals
224 Elementary school teachers
225 Early childhood teachers and educators
272 Database and computer network specialists
283 Priests of the different religions
292 Writers, journalists and linguists
361 Clerical staff and specialized assistants
381 Information and support operations/transactions technicians
382 Computer programmers
411 Accounting and financial employees
541 Vendors at kiosks or flea markets
550 Cashiers and ticket sellers (except banks)
831 Locomotive engineers and similar occupations
841 Car, taxi, and van drivers
844 Motorcycle and moped drivers
941 Street vendors
942 Advertising distributors, shoe shiners and others
231 Special education teachers and technicians
232 Other teachers and teaching professionals
430 Other administrative employees without public-facing duties
762 Graphic arts professionals and operators
001 Officers and non-commissioned officers of the armed forces
111 Members of the executive branch; public administration managers
271 Software and multimedia analysts and designers
371 Legal and social services support professionals
281 Economists
282 Sociologists, historians, psychologists and others
291 Archivists, librarians, conservators and similar
221 Teachers in universities and other higher education (except vocational training)
444 Counter and related employees (except ticket clerks)
732 Blacksmiths and toolmakers and related workers
542 Telemarketing operators
543 Gas station attendants
549 Other vendors
512 Waitstaff
293 Creative and performing artists
421 Library and archive staff
422 Postal service employees, encoders, proofreaders
340 Finance and math support professionals
002 Troops and navy personnel of the armed forces
521 Section Heads of stores and warehouses
522 Salespeople in stores and warehouses
530 Shop owners
581 Hairdressers and specialists in aesthetic, wellness and related treatments
383 Audiovisual recording, broadcasting and telecommunications technicians
561 Nursing assistants
571 Home personal care workers
223 Middle school teachers
572 Childcare workers
731 Moulders, welders, sheet metal workers, assemblers
500 Owner waiters and cooks
215 Other health professionals
812 Operators in metal treatment facilities
373 Technicians and professionals supporting cultural and artistic activities
251 Judges, magistrates, lawyers and prosecutors

Source: BBVA Research based on EC (ESCO) and INE (EPA).

Green intensity by occupation (2)

SPAIN: OCCUPATIONS WITH A MODERATE WEIGHT OF GREEN SKILLS*

(% OF GREEN SKILLS)



259 Other legal professionals
132 Managers of information and communications technology (ICT) services and
353 Real estate agents and other agents
261 Finance specialists
331 Healthcare laboratory, diagnostic testing and prosthetics technicians
761 Precision metalworkers, ceramists, glaziers and craftsmen
753 Electronic and telecommunications equipment installers and fitters
811 Mineral extraction and processing facility operators
222 Vocational training teachers (specific subjects)
214 Pharmacists
333 Alternative therapy practitioners
264 Technical and medical sales professionals (except ICT)
265 Other sales, marketing and advertising professionals
122 Commercial, advertising, public relations and R&D managers
820 Factory assemblers
815 Machine operators for manufacturing textile products
817 Laundry and dry-cleaning machine operators
981 Transport workers, loaders and similar workers
982 Stockers

740 Machinery mechanics and fitters
562 Auxiliary pharmacy and emergency health technicians and other care workers for
783 Textile, garment, leather, and footwear workers
351 Agents and commercial representatives
352 Other commercial agents
943 Porters, bellboys, delivery boys and similar
949 Other elementary occupations
112 General managers and chief executive officers
834 Deck sailors, engine room sailors and similar
262 Specialists in organization and administration
263 Tourism company and activity technicians
143 Wholesale and retail trade company directors and managers
511 Salaried chefs
150 Service company directors and managers
789 Gluers, divers, product testers and other operators
970 Workers in the manufacturing industries
315 Maritime and aeronautical navigation professionals
362 Customs, tax and related officers
363 Law enforcement personnel

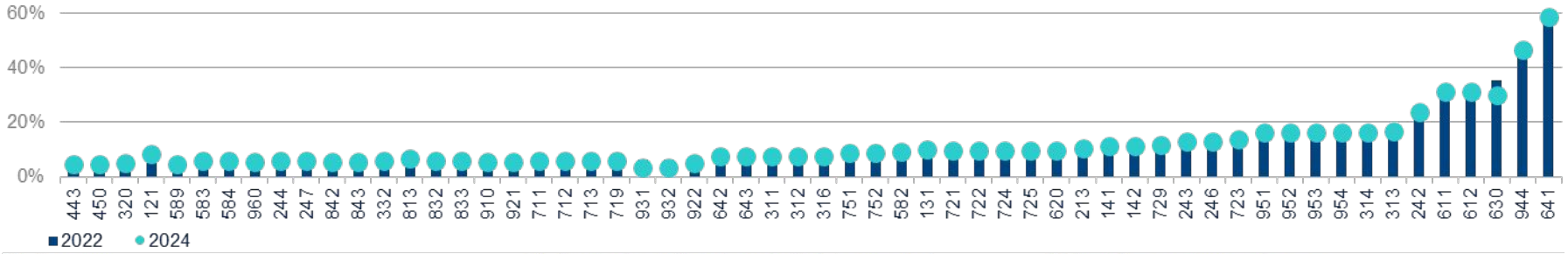
591 Civil guards
592 Police officers
372 Athletes, coaches, sports activity instructors
770 Workers in the food & beverage, and tobacco industry
593 Firefighters
594 Private security personnel
599 Other security and protection service workers
241 Physicists, chemists, mathematicians and similar
781 Wood workers and similar
782 Cabinetmakers and similar
412 Employees in charge of material registration and production support services
816 Operators of machines for the production of food & beverages and tobacco products
245 Architects, urban planners and geographical engineers
248 Technical architects, surveyors and designers
819 Other operators of fixed installations and machinery
814 Operators at facilities plants for the treatment and processing of wood
441 Information staff and receptionists (except for hotels)
442 Travel agency employees, hotel receptionists, and telephone operators

Source: BBVA Research based on EC (ESCO) and INE (EPA).

Green intensity by occupation (3)

SPAIN: OCCUPATIONS WITH A HIGH WEIGHT OF GREEN SKILLS*

(% OF GREEN SKILLS)



443 Survey agents
450 Administrative employees with public-facing duties
320 Mining engineering and manufacturing industry supervisors
121 Clerical staff department managers
589 Other personal services workers
583 Building maintenance and housekeeping supervisors, janitors, and butlers
584 Workers who own small accommodations
960 Construction and mining laborers
244 Electrical, electronics, and telecommunications engineers
247 Electrical, electronics and telecommunications technical engineers
842 Bus and tram drivers
843 Truck drivers
332 Other healthcare technicians
813 Chemical and pharmaceutical facilities and machine operators
832 Mobile agricultural and forestry machinery operators
833 Other mobile machine operators
910 Domestic employees
921 Office, hotel and other similar establishment cleaning staff
711 Concrete workers, formworkers, steel fixers and similar
712 Masons, stonemasons, stone cutters and engravers
713 Carpenters (except cabinetmakers and metal structure assemblers)
719 Other structural construction workers
931 Kitchen helpers
932 Fast food preparers
922 Vehicle cleaners, window cleaners and hand cleaning personnel
642 Skilled workers in fisheries and aquaculture
643 Skilled workers in hunting activities
311 Drafters and technical illustrators
312 Physical, chemical, environmental and engineering sciences technicians
316 Physical sciences, chemistry and engineering quality control technicians
751 Construction electricians and similar
752 Other electrical equipment installers and repairers
582 Workers who provide services to travelers, tour guides, and similar
131 Agricultural and forestry exploitation production managers, and similar.
721 Plasterers and applicators of paste and mortar coatings
722 Plumbers and pipefitters
724 Floorers, parquet installers and similar
725 Refrigeration and air conditioning installers-mechanics
620 Skilled workers in livestock activities
213 Veterinarians
141 Hospitality company directors and managers
142 Catering company directors and managers
729 Other finishing workers in construction, installations and similar
243 Engineers (except agronomist, forestry, electrical, electronic and ICT engineers)
246 Technical engineers (except agricultural, forestry, electrical, electronic engineers)
723 Painters, wallpaperers and similar
951 Farm laborers
952 Livestock laborers
953 Agricultural laborers
954 Fishing, aquaculture, forestry and hunting laborers
314 Natural science technicians and similar auxiliary professionals
313 Process Control Technicians
242 Professionals in natural sciences
611 Skilled workers in agricultural activities
612 Skilled workers in orchards, greenhouses, nurseries, and gardens
630 Skilled workers in mixed agricultural and livestock activities
944 Waste collectors and related occupations
641 Skilled workers in forestry and natural environment activities

Source: BBVA Research based on EC (ESCO) and INE (EPA).

National Classification of Economic Activities

DESCRIPTION OF THE ACTIVITY SECTIONS OF THE CNAE-2009

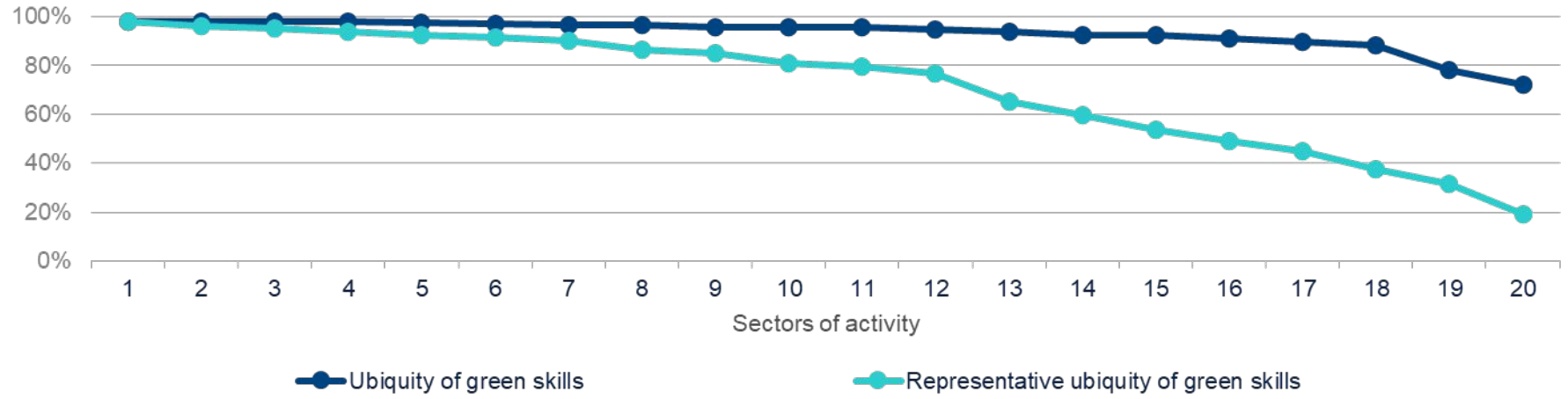
Letter	Description
A	Agriculture, livestock, forestry and fisheries
B	Extractive industries
C	Manufacturing industry
D	Supply of electricity, gas, steam and air conditioning
E	Water supply, sanitation, waste management and decontamination
F	Construction
G	Wholesale and retail trade
H	Transport and storage
I	Hospitality
J	Publishing, broadcasting, and production and distribution activities
K	Telecommunications, IT programming, consulting, IT infrastructure and other information services
L	Financial and insurance activities
M	Real estate activities
N	Professional, scientific and technical activities
O	Administrative activities and ancillary services
P	Public administration and defense; compulsory social security
Q	Education
R	Health and social services activities
S	Artistic, sporting and entertainment activities
T	Other services
U	Activities of households as employers of domestic staff and as producers of goods and services for their own use

Source: BBVA Research, based on INE data.

Although there are green skills common to all sectors, they are not considered essential in most of them

UBIQUITY OF GREEN SKILLS IN THE SECTORS OF ACTIVITY IN SPAIN

(%, 2015 - 2024)



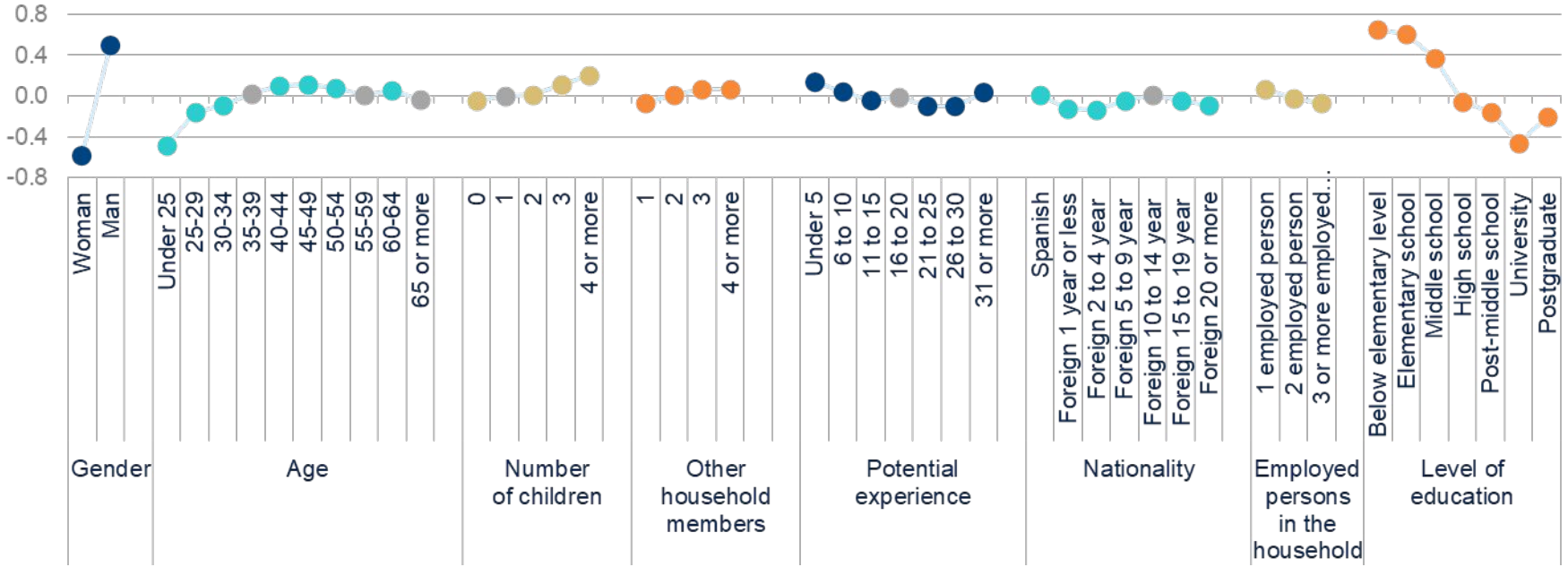
Source: BBVA Research based on EC (ESCO) and INE (EPA).
General ubiquity: Percentage of green skills required in occupations that are used in at least x sectors of activity.
Representative ubiquity: This refers to green skills needed in occupations whose significance within a sector exceeds the 75th percentile (i.e. the 42 most important occupations by sector).

When analyzing the distribution of green skills by sector, it is found that 72% are used in all sectors (20), although the vast majority are concentrated in occupations that are not representative of each sector. When considering only the occupations with the highest share in employment in each sector, the ubiquity of green skills drops to 20%.

Profile of the employed population with a higher green intensity (1)

DETERMINANTS OF THE IMPORTANCE OF GREEN SKILLS. PERSONAL/FAMILY CHARACTERISTICS

(DIFFERENCES COMPARED TO THE AVERAGE EMPLOYED PERSON, %, Q1 2015 - Q4 2024)



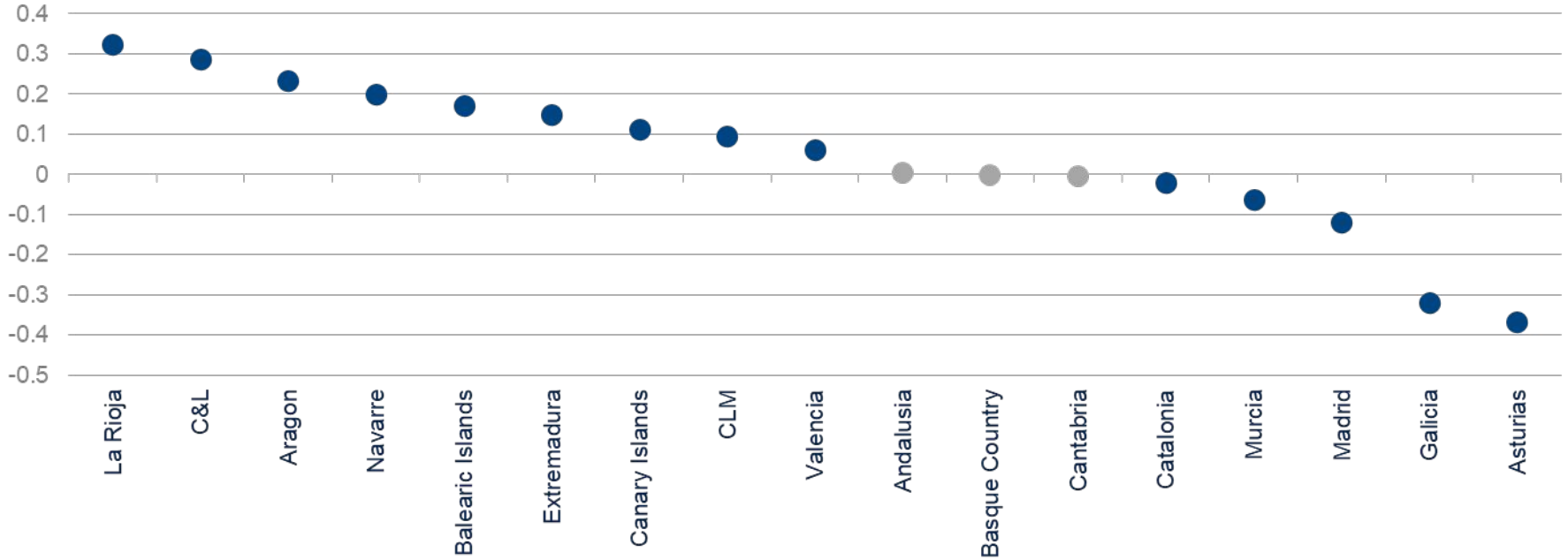
*In grey, category not significant at 10%. The estimate includes quarter indicator variables.

Source: BBVA Research.

Profile of the employed population with a higher green intensity (2)

DETERMINANTS OF THE IMPORTANCE OF GREEN SKILLS. PERSONAL/FAMILY CHARACTERISTICS

(DIFFERENCES COMPARED TO THE AVERAGE EMPLOYED PERSON, %, Q1 2015 - Q4 2024)

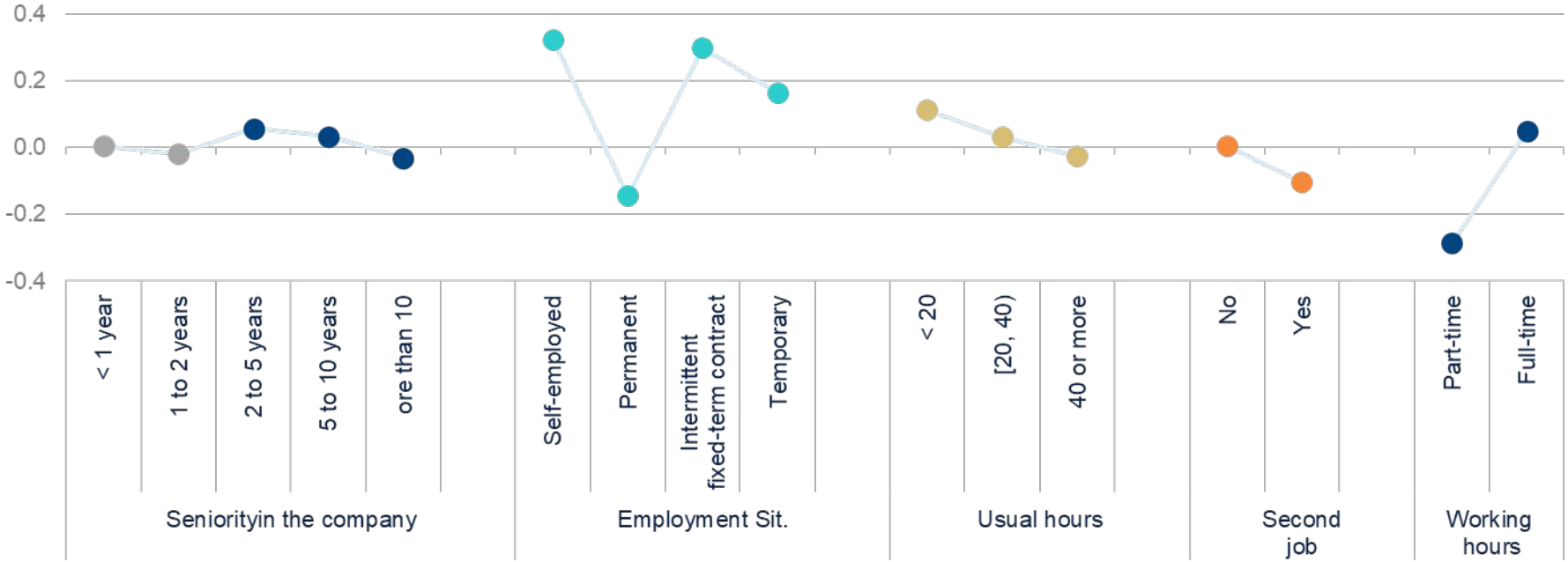


*In grey, category not significant at 10%.
Source: BBVA Research.

Profile of the employed population with a higher green intensity (3)

DETERMINANTS OF THE IMPORTANCE OF GREEN SKILLS. LABOR CHARACTERISTICS

(DIFFERENCES COMPARED TO THE AVERAGE EMPLOYED PERSON, %, Q1 2015 - Q4 2024)



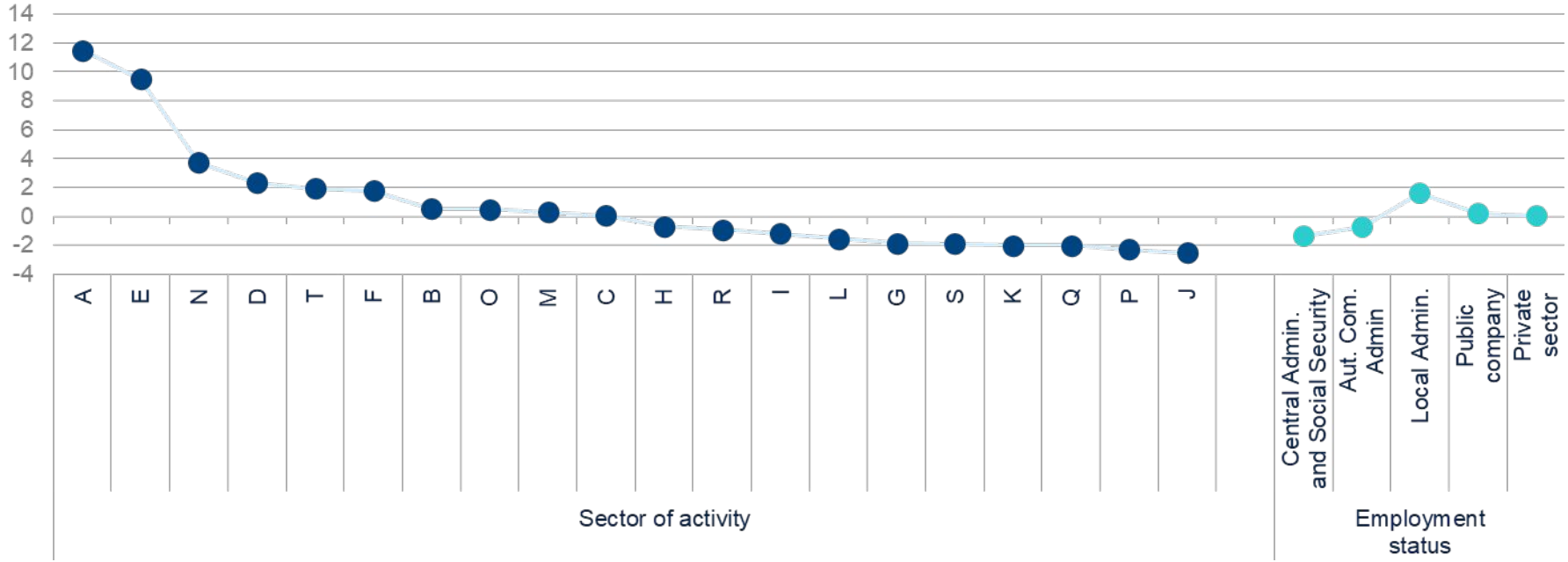
*In grey, category not significant at 10%.

Source: BBVA Research.

Profile of the employed population with a higher green intensity (4)

DETERMINANTS OF THE IMPORTANCE OF GREEN SKILLS. COMPANY CHARACTERISTICS

(DIFFERENCES COMPARED TO THE AVERAGE EMPLOYED PERSON, %, Q1 2015 - Q4 2024)

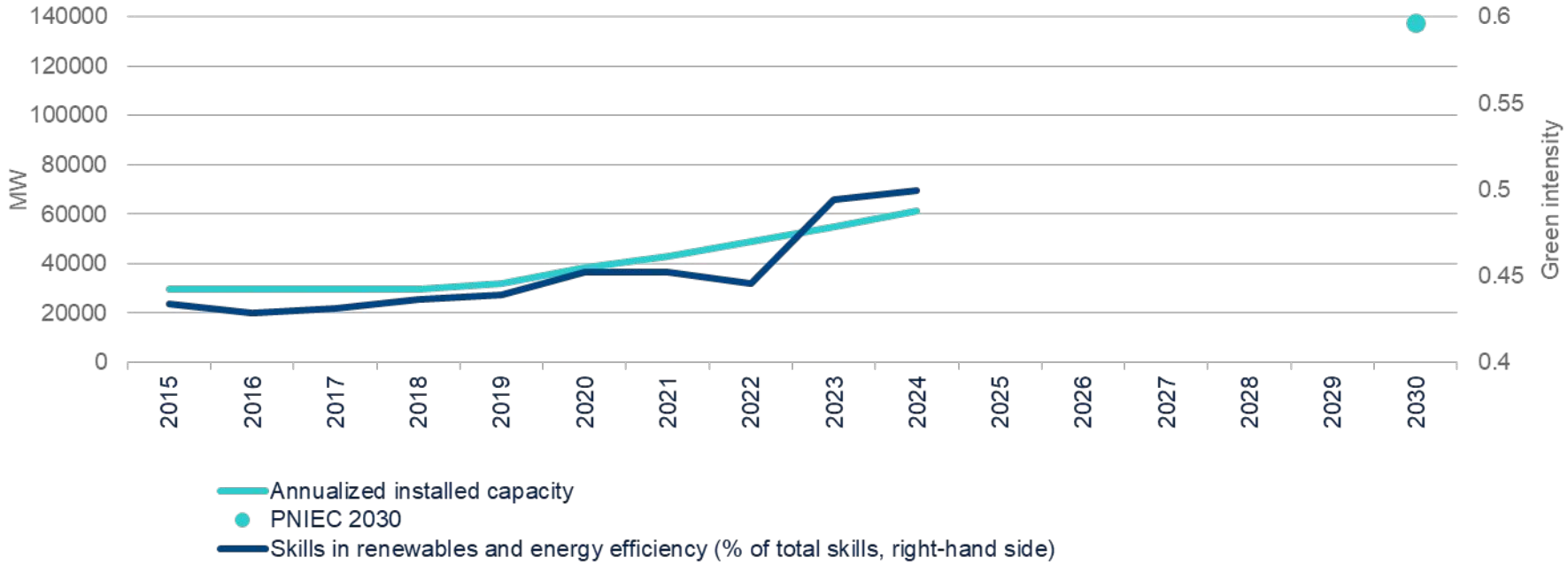


*In grey, category not significant at 10%.

Source: BBVA Research.

Installed capacity and skills related with renewable energy technologies

INSTALLED SOLAR AND WIND CAPACITY IN THE IBERIAN PENINSULA *vs* THE RATIO OF RENEWABLE AND ENERGY EFFICIENCY SKILLS (MW AND %. 2015 - 2024)



Source: BBVA Research based on EC (ESCO), INE (EPA and REE).

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