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# ALPINE GREEN ECONOMY: SCREENING OPPORTUNITIES AND CHALLENGES FOR THE ITALIAN ALPS

## REPORT 2

## THE GREEN ECONOMY IN THE ITALIAN ALPS: FRAMEWORK FOR REGIONAL EVALUATION AND IMPLEMENTATION

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Report developed within the framework of activities of the Memorandum of Understanding between the Italian Ministry for the Environment and the Permanent Secretariat of the Alpine Convention for the "Co-operation on the implementation of the Protocols to the Alpine Convention in the territory of the Republic of Italy"

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# 1. Introduction

The project "Alpine Green Economy: Screening Opportunities and Challenges for the Italian Alps" is developed within the framework of activities of the Memorandum of Understanding between the Italian Ministry for the Environment and the Permanent Secretariat of the Alpine Convention for the "Co-operation on the implementation of the Protocols to the Alpine Convention in the territory of the Republic of Italy". The Permanent Secretariat of the Alpine Convention was established by a decision taken at the 7th Alpine Conference in Merano in November 2002. The Permanent Secretariat supports the bodies established by the Alpine Convention. It offers a professional, logistic, administrative help and assists the countries in carrying out the actions, required by the Convention and its Protocols.

The project aims to identify concrete steps for implementing the "Green economy Action Programme" in the Italian Alpine region, coherently to the 6$^{th}$ Report on the State of the Alps "Greening the Economy in the Alps" and the latest advice of the Alpine Green Economy Board. The projects goals are: to identify specific solutions and a suitable procedure in order to deliver significant improvements in the green economic performance of some economic sectors in the Italian Alps; to identify suitable procedures that may ease and support processes of innovation and ensure sustainability in the economic context of the Italian Alps; to define a strategy for the replication of the approach developed in other Alpine contexts. The Table below summarizes the project Deliverables and the related Reports in which each Deliverable is included.

| **Alpine Green Economy: Screening Opportunities and Challenges for the Italian Alps** | |
|---|---|
| **Deliverables** | **Final Reports** |
| Deliverable 1.1: "Analysis of the policy frameworks for the Green Economy in mountain regions"<br>Deliverable 1.2: "Identification of the core green economy sectors for the Italian Alps" | Report 1 "The Green Economy in the Italian Alps: key economic sectors and their potential development" |
| Deliverable 2.1 "Identification of the criteria and indicators for best practices evaluation"<br>Deliverable 2.2 "Identification of suitable case study regions for data gathering and testing" | Report 2 "The Green Economy in the Italian Alps: framework for regional evaluation and implementation" |
| Deliverable 3.2 "Collection of best practices"<br>Deliverable 3.3 "Analysis of successful governance and business models" | Report 3 "The Green Economy in the Italian Alps: analysis of key case studies" |

# 2. Methodology

## 2.1. Scale and scope of the analysis

The present Report identifies and adopts a procedure for the evaluation of the performance of different Alpine areas with respect to the development of the Green Economy. The main goal is to identify the local performance across the different Green Economy dimensions and criteria identified in the Report 1. As these aspects may vary greatly depending of the characteristics of the Alpine local areas,
the evaluation is conducted through the creation of a novel dataset of indicators measured at the local level. More in detail, the Green Economy indicators are identified both a the provincial (NUTS 3) and at the municipal (NUTS 4) level. The selected geographical scales enable to characterize local Alpine specificities and, at the same time, to ensure data availability on the economic, social and environmental conditions of the areas under study.
The indicators are analyzed following two complementary approaches:

- through the development of aggregate indices measuring different criteria of the Green Economy and different Sustainable Development Goals, compared at the provincial level (paragraph 3);
- through a direct analysis of the values of the indicators, compared at the municipal level by identifying the heterogeneity in the performance across different urbanization and geographic groups (paragraph 4).

Through this combined analysis, the Report aims to identify both the green Economy criteria in which different local areas have reached a good degree of development and the areas where the performance is low and new actions should be taken to foster the Green Economy.
The classification and selection of the indicators for assessing the green economy in the Alpine regions was conducted with a direct reference to the three dimensions and criteria identified in the Deliverable 1.2 reported in Table 1.

Table 1

| Dimension | **Criteria** | **Alpine Convention** | **Agenda 2030** |
|---|---|---|---|
| **Economic** | Workforce and education | RSA6 ch. 2.4.1<br>GEAP Act. 5.2-5.3 | SDG 1, SDG 4<br>SDG 8 |
| | Value added | GEAP Act. 1.1-1.7<br>and 5.1-5.7 | SDG 8 |
| | Long term economic sustainability/stable contribution to economic development | GEAP Act. 1.1-1.7<br>and 5.1-5.7 | SDG 8, SDG 11 |
| | Competitiveness of local economic area | RSA6 ch. 2.2<br>GEAP Act. 5.4 | SDG 8, SDG 11 |
| **Social** | Contribute to local culture identity | RSA6 ch. 1.1.2<br>ACTS: Principle 1 | SDG 8, SDG 12 |
| | Social innovations | RSA6 ch. 2.5.1 | SDG 10 |
| | Contribution to human health and well-being | RSA6 ch. 2.5.3 | SDG 3 |
| **Environmental** | GHG mitigation<br>and reduction of air pollutants emissions | RSA6 ch. 2.1.1 | SDG 7, SDG 13 |
| | | RSA6 ch. 2.5.3 | SDG 7, SDG 13 |
| | Land and soil conservation | RSA6 ch. 2.2.2 | SDG 15 |
| | Resource efficiency use and circularity | RSA6 ch. 2.2 | SDG 12 |
| | Biodiversity conservation | RSA6 ch. 2.3.2<br>GEAP Act. 4.2 | SDG 15 |

The Alpine Provinces included in the Convention are reported in Table 2:

| Table 2 | | |
|---|---|---|
| **National area** | **Region** | **Province** |
| **North-west** | Piemonte | Torino, Vercelli, Novara, Cuneo, Verbano Cusio Ossola, Biella |
| | Valle d'Aosta | Valle d'Aosta |
| | Liguria | Imperia, Savona |
| **North** | Lombardia | Varese, Como, Sondrio, Bergamo, Brescia, Lecco |
| **North-east** | Trentino-Alto Adige/Südtirol | Bolzano, Trento |
| | Veneto | Belluno, Treviso, Verona, Vicenza |
| | Friuli-Venezia Giulia | Pordenone, Udine, Gorizia |

## 2.2. Selection of the indicators

For each criteria a set of indicators have been selected from a wide set of national and European sources, among which: the Benessere Equo e Sostenibile (BES) indicators from ISTAT (2018); the Altlante Statistico dei Comuni (ASC) indicators from ISTAT (2019); the Mapping and Assessment of Ecosystems and their Services (MAES) indicators; the European Environment Agency (EEA, 2019), the Urban Index (developed by the Department for Planning and Coordination of Economic Policy and Politecnico of Milan University), and other sources. The selection of the specific indicators has been conducted by taking into account the previous works of the Alpine Convention on the topic, and in particular the "Environmental objectives and indicators" document developed in 2004, reporting a set of indicators (111 indicators grouped in 23 categories and 3 macro-categories) for the monitoring of the sustainable development in the Alps. Some of the indicators are available at the provincial level directly, while some others report municipal (ASC indicators) or gird-level (EEA indicators) data. In the latter case, an aggregation of the indicator's results is conducted in order to provide a uniform provincial-level set of data. Table 3 reports the selection of the Green Economy indicators and their classification. A more detailed description of each indicator is reported in Table a.1 in Annex. For each of the three Green Economy Dimension, twelve indicators have been identified. Among the three groups, half of the indicators could be analyzed both at the provincial and at the municipal level.

| **Table 3** | | | |
|---|---|---|---|
| **INDICATOR** | **SOURCE** | **GREEN ECONOMY SUB-DIMENSION** | **LEVEL** |
| **Economic** | | | |
| Patents in the biotechnology sector | BES | Competitiveness of local economic area | Provincial |
| Bed capacity of farmhouses and alpine huts (number of beds over total capacity of hotels and other tourism establishments) | Bocconi based on ISTAT | Value added | Provincial |
| Average decadal net variation of residents (1991-2001-2011) | Urban Index | Long term sustainability and development | Provincial, Municipal |
| Digital divide | Urban Index | Competitiveness of local economic area | Provincial, Municipal |
| Income available per family | BES | Long term sustainability and development | Provincial |
| Percentage of young people who do not work and do not study | Urban Index | Workforce | Provincial, Municipal |

| | | | |
|---|---|---|---|
| Variation in the unemployment rate 2001-2011 | Urban Index | Workforce | Provincial, Municipal |
| Diffusion of farmhouse enterprises (number of farmhouse enterprises over total) | BES | Value added | Provincial |
| Diffusion of craft enterprises (number of enterprises over total enterprises) | Chambers of commerce | Value added | Provincial |
| Diffusion of silvicolture and forest management enterprises (number of enterprises over total enterprises) | Bocconi based on ISTAT | Value added | Provincial, Municipal |
| Diffusion of organic production enterprises (number of enterprises over total enterprises in the agricultural and farming sector) | Bocconi based on ISTAT | Value added | Provincial |
| Diffusion of highly innovative enterprises | Urban Index | Competitiveness of local economic area | Provincial, Municipal |
| **Environmental** | | | |
| High Nature Value farmland impacted by urban expansion (percentage of region's area) | EEA | Biodiversity conservation | Provincial |
| Diffusion of certified forests (PEFC or FSC certified forest area over total forest area) | Bocconi, based on RaFITALIA | Biodiversity conservation | Provincial |
| High and very high fragmentation (Percentage of region's area covered by pressure classes) | EEA | Land and soil conservation | Provincial |
| Population exposed to hydraulic risk | Urban Index | Land and soil conservation | Provincial, Municipal |
| Density of photovoltaic installations | Urban Index | Reduction of GHG and air pollutants emissions | Provincial, Municipal |
| Total density of green areas (protected natural areas and urban green areas) in the provincial capital municipalities | BES | Reduction of GHG and air pollutants emissions | Provincial |
| Density of cycle paths in the provincial capital municipalities | ISTAT | Reduction of GHG and air pollutants emissions | Provincial |
| Availability of local public transport | BES | Reduction of GHG and air pollutants emissions | Provincial |
| Production of urban waste per capita | Urban Index | Resource efficiency use and circularity | Provincial, Municipal |
| Water consumption per capita | Bocconi based on ISTAT | Resource efficiency use and circularity | Provincial, Municipal |
| Diffusion of slow mobility alternatives | Urban Index | Reduction of GHG and air pollutants emissions | Provincial, Municipal |
| Population exposed to landslide risk | ISPRA | Land and soil conservation | Provincial, Municipal |
| **Social** | | | |
| Number of public cultural sites | Urban Index | Contribute to local culture identity | Provincial, Municipal |
| Cohesion policy funding per capita (2007-2020) on the topics culture and tourism | Cohesion Policy data | Contribute to local culture identity | Provincial |
| GINI index | Urban Index | Social innovations | Provincial, Municipal |
| Children who have benefited from municipal childcare services | BES | Social innovations | Provincial |
| Irregularity of the electricity service | BES | Contribution to human health and well-being | Provincial |
| Diffusion of residential buildings in a very poor conservation status | Urban Index | Contribution to human health and well-being | Provincial, Municipal |
| Number of non-profit organizations | BES | Social innovations | Provincial, Municipal |
| Enterprises run by women over total enterprises | Chambers of commerce | Social innovations | Provincial |
| Ratio between male and female employment | Urban Index | Social innovations | Provincial, Municipal |

| | | | |
|---|---|---|---|
| Patient migration towards hospitals in other regions | BES | Contribution to human health and well-being | Provincial |
| Mortality rate due to PM2.5 | Dipartimento di Epidemiologia del Servizio Sanitario Regionale del Lazio | Contribution to human health and well-being | Provincial |
| Accessibility to train stations | Urban Index | Contribution to human health and well-being | Provincial, Municipal |

Each indicator may be related to one or more SGDs, as presented in the Table 4. In total, the SDGs are represented by the following number of indicators:

- SDG 3 “Good Health and Well-being”, by four indicators.
- SDG 4 “Quality Education”, by three indicators.
- SDG 5 “Gender Equality”, by two indicators.
- SDG 7 “Affordable and clean energy”, by five indicators.
- SDG 8 “Decent Work and Economic Growth”, by four indicators.
- SDG 9 “Industry, Innovation and Infrastructure”, by three indicators.
- SDG 10 “Reduced Inequality”, by five indicators.
- SDG 11 “Sustainable Cities and Communities”, by nine indicators.
- SDG 12 “Responsible Consumption and Production”, by seven indicators.
- SDG 13 “Climate action”, by six indicators.
- SDG 15 “Life on Land”. by five indicators.

The relative performance of the Provinces with respect to the contribution of the Green Economy to different SDGs can be identified by creating an index based on the group of indicators associated to each Goal (by following the classification reported in Table 3). The index is calculated following the methodology described in paragraph 2.3.

**Table 4**

| SDG | Indicators |
|---|---|
|   | Total density of green areas in the provincial capital municipalities; Children who have benefited from municipal childcare services; Patient migration towards hospitals in other regions; Mortality rate due to PM2.5 |
|   | Percentage of young people who do not work and do not study; Number of public cultural sites; Cohesion policy funding per capita on the topics culture and tourism |
|   | Enterprises run by women over total enterprises; Ratio between male and female employment |
|   | Density of photovoltaic installations; Density of cycle paths in the provincial capital municipalities; Availability of local public transport; Diffusion of slow mobility alternatives; Irregularity of the electricity service. |

| | |
|---|---|
|  | Average decadal net variation of residents; Income available per family; Variation in the unemployment rate; Cohesion policy funding per capita on the topics culture and tourism |
|  | Patents in the biotechnology sector; Digital divide; Diffusion of highly innovative enterprises; Accessibility to train stations |
|  | Digital divide; Percentage of young people who do not work and do not study; Variation in the unemployment rate; GINI index; Number of non-profit organizations |
|  | Average decadal net variation of residents; Population exposed to hydraulic risk; Total density of green areas in the provincial capital municipalities; Density of cycle paths in the provincial capital municipalities; Availability of local public transport; Population exposed to landslide risk; Irregularity of the electricity service; Diffusion of residential buildings in a very poor conservation status |
|  | Patents in the biotechnology sector; Diffusion of farmhouse enterprises; Diffusion of craft enterprises; Diffusion of silvicolture and forest management enterprises; Diffusion of certified forests; Production of urban waste per capita; Water consumption per capita |
|  | Density of photovoltaic installations; Population exposed to hydraulic risk; Population exposed to landslide risk; Density of cycle paths in the provincial capital municipalities; Availability of local public transport; Diffusion of slow mobility alternatives. |
|  | Diffusion of farmhouse enterprises; Diffusion of organic production enterprises; High Nature Value farmland impacted by urban expansion; Diffusion of certified forests; High and very high fragmentation |

## 2.3. Normalization and aggregation

The selected indicators are normalized in order to allow aggregation and comparison between different Green Economy criteria and dimensions. A min-max normalization is performed, based on the following formula:

$$z = \frac{x - \min(x)}{\max(x) - \min(x)}$$

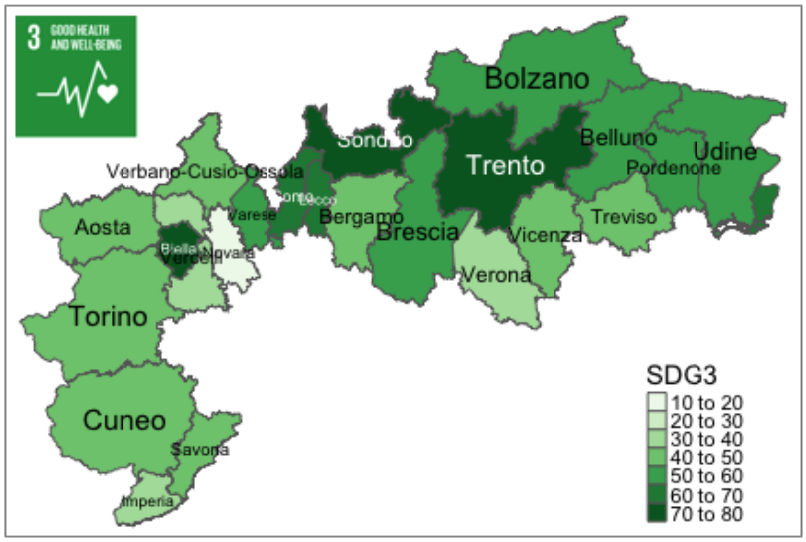
Each indicator has been assigned a negative or positive value depending on the effect played on the Green Economy development. In the figures presented in the next section, dark colors always represent the best performance: the highest score for the indicators with a positive effect and the lowest score for the indicators with a negative effect. Twelve indexes corresponding to the "Green Economy" criteria are calculated as the weighted average of the indicators assigned to each criterion. Subsequently, three Green Economy dimension indexes are calculated as the weighted average of the indicators assigned to each dimension. In both cases the weights are assigned to each indicator following a simple equal weighting approach.

# 3. The Alpine Green Economy across Provinces

## 3.1. Performance in the key Sustainable Development Goals

As for the SDG 3 "Good Health and Well-being", a relatively large number of Provinces obtain a medium-high score (from 60/100 to 80/100). The Provinces in the Central Alps obtain the highest scores (Trento, Sondrio and Biella), together with Como, Lecco and Gorizia. Novara is the Province with the lowest score.

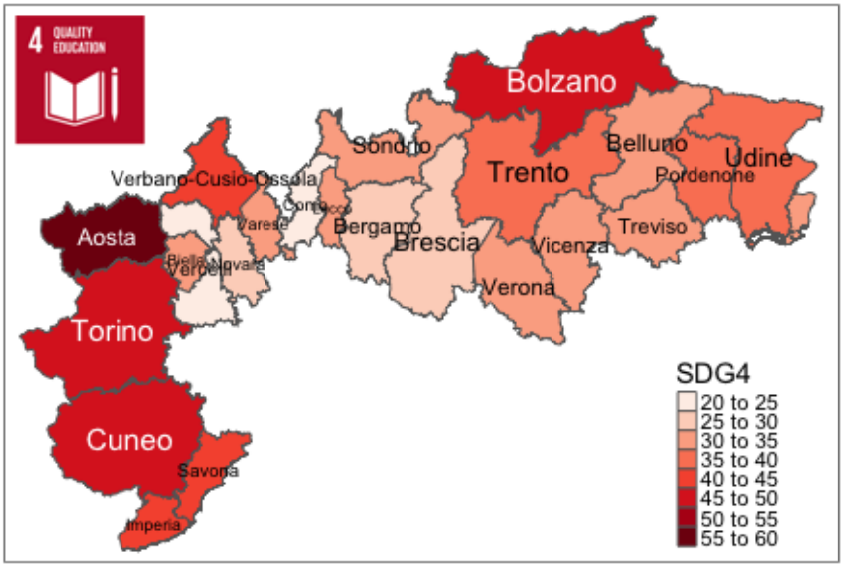
**Figure 1**




| SDG 3 Index | | |
|---|---|---|
| 1st | Sondrio | 78 |
| 2nd | Biella | 73 |
| 3rd | Trento | 73 |
| 22nd | Imperia | 39 |
| 23rd | Vercelli | 33 |
| 24th | Novara | 17 |

As for the SDG 4 "Quality Education", a relatively low number of Provinces obtain a medium score (from 50/100 to 60/100). The scores are relatively heterogeneous across regions, with the Western area being characterized by a group of Provinces with a higher than average scores. The only Province in the North East area with a medium score is Bolzano, while the remaining Provinces do not perform well. The Provinces in the Central Alps obtain relatively low scores, in particular Como and Vercelli.

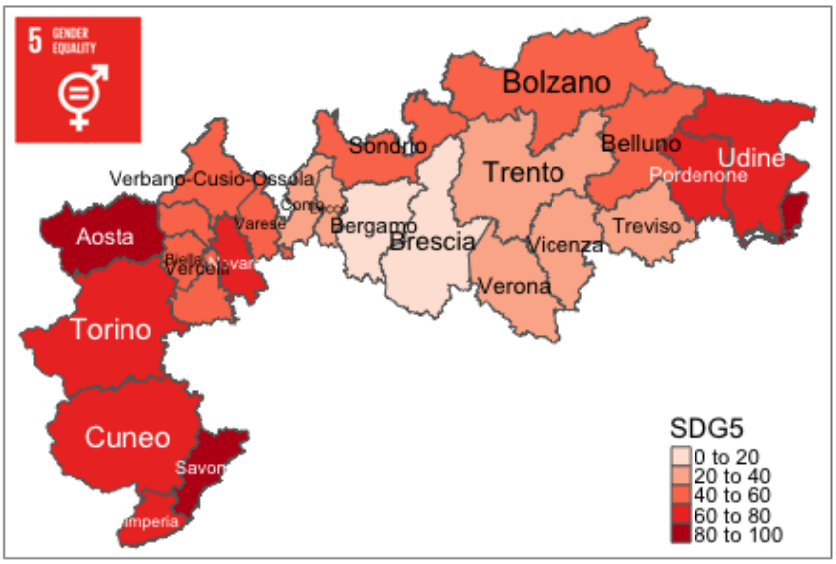
**Figure 2**




| SDG 4 Index | | |
|---|---|---|
| 1st | Aosta | 56 |
| 2nd | Bolzano | 50 |
| 3rd | Cuneo | 47 |
| 22nd | Bergamo | 26 |
| 23rd | Como | 25 |
| 24th | Vercelli | 23 |

As for the SDG 5 “Gender Equality”, the scores are relatively heterogeneous across regions, with the Western and Eastern areas being characterized by a group of Provinces with a higher than average scores. Savona, Aosta and Gorizia obtain the highest scores. The Provinces in the Central Alps, and in particular in the South-Central area (Bergamo and Brescia) obtain the lowest scores.

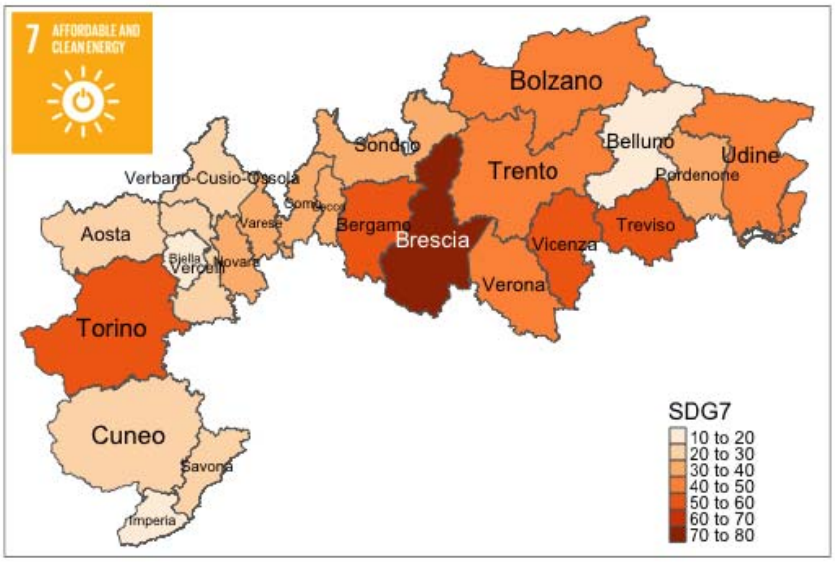
**Figure 3**




| SDG 5 Index | | |
|---|---|---|
| 1st | Aosta | 93 |
| 2nd | Gorizia | 80 |
| 3rd | Savona | 80 |
| 22nd | Lecco | 25 |
| 23rd | Brescia | 18 |
| 24th | Bergamo | 17 |

As for the SDG 7 “Affordable and clean energy”, the Provinces of the Cental Alps, especially Brescia, Bergamo, and Treviso obtain the highest scores. Many Provinces in the Western area obtain a low-medium score (from 20/100 to 40/100), together with Belluno, a Province with a very low score compared to its regional area.

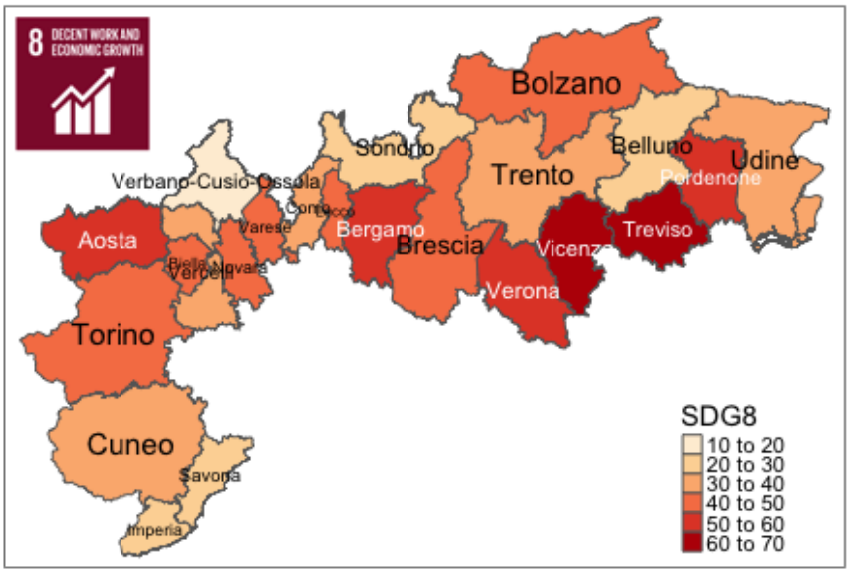
**Figure 4**




| SDG 7 Index | | |
|---|---|---|
| 1st | Brescia | 72 |
| 2nd | Bergamo | 60 |
| 3rd | Treviso | 57 |
| 22nd | Belluno | 19 |
| 23rd | Biella | 16 |
| 24th | Imperia | 13 |

As for the SDG 8 “Decent Work and Economic Growth”, the Provinces of the Southern Alps, especially Vicenza, Treviso, Bergamo, Verona and Pordenone obtain the highest scores. Interestingly, the Province of Aosta is characterized by the highest score within the Western Alps. Many Provinces in the South West and Central areas obtain a low-medium score (from 20/100 to 40/100).

**Figure 5**

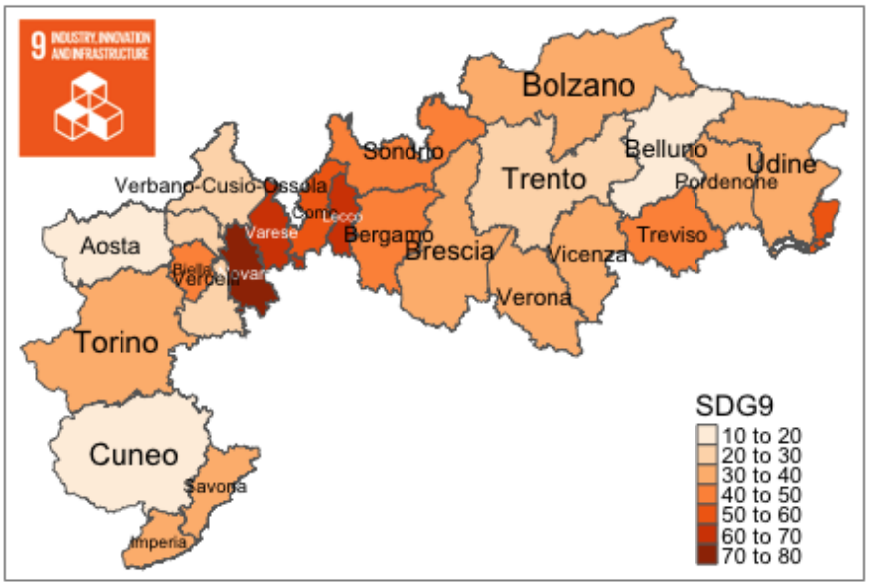



| SDG 8 Index | | |
|---|---|---|
| 1st | Treviso | 69 |
| 2nd | Vicenza | 61 |
| 3rd | Aosta | 56 |
| 22nd | Sondrio | 21 |
| 23rd | Imperia | 20 |
| 24th | Verbano-Cusio-Ossola | 16 |

As for the SDG 9 “Industry, Innovation and Infrastructure”, a strong heterogeneity emerges across the Provinces. The areas in the Central Alps (Novara, Varese, Como and Lecco) have very high scores (in the 60-80/100 range). A wide group of regions in the Central and both Western and Eastern areas obtain low-medium scores (30-40/100) and another group, composed by Aosta, Cuneo and Belluno, obtains the lowest scores (10-20/100).

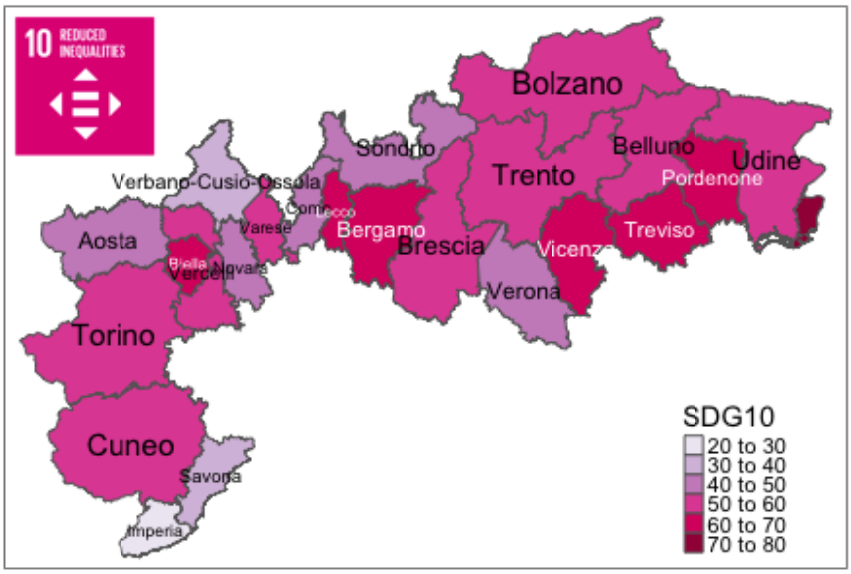
**Figure 6**

| SDG 9 Index | | |
|---|---|---|
| 1st | Novara | 80 |
| 2nd | Varese | 68 |
| 3rd | Lecco | 61 |
| 22nd | Aosta | 19 |
| 23rd | Cuneo | 13 |
| 24th | Belluno | 13 |




As for the SDG 10 "Reduced Inequality", the scores are characterized by a relative homogeneity. Gorizia obtains the highest score (71/100), while a large group of Provinces both in the Eastern, Central and Western area obtain medium-high scores (50-60/100). Imperia is the Province characterized by the lowest score (22/100).

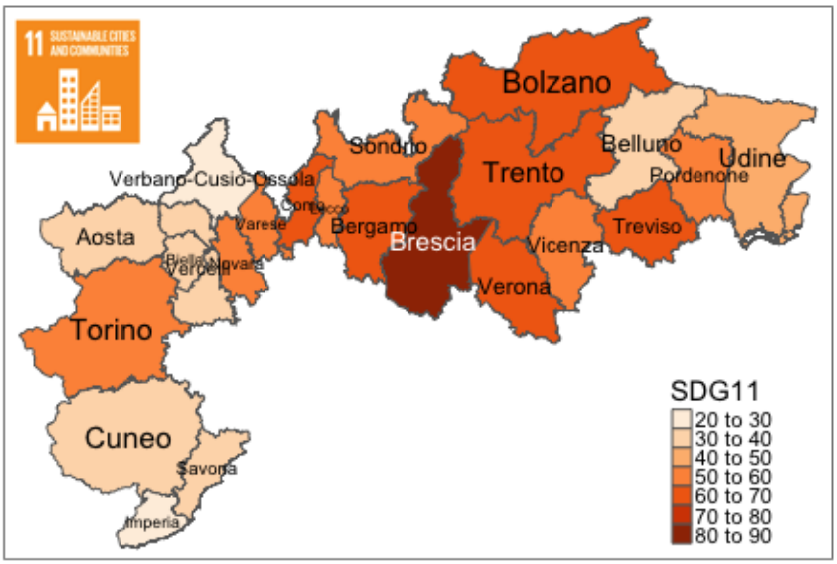
**Figure 7**




| SDG 10 Index | | |
|---|---|---|
| 1st | Gorizia | 71 |
| 2nd | Biella | 68 |
| 3rd | Pordenone | 63 |
| 22nd | Verbano-Cusio-Ossola | 37 |
| 23rd | Savona | 36 |
| 24th | Imperia | 23 |

As for the SDG 11 "Sustainable Cities and Communities", a general difference between the Central and North Eastern area and the Western area can be identified. Brescia obtains the highest scores, but all the remaining Central and North Eastern Provinces have high cores in the 60-80/100 range. All the Provinces in the Western area, with the exception of Torino, have the lowest scores cross the alpine Provinces (20-30/100). An outlier in the Central - Eastern area in Belluno, which has a low sore compared to its neighboring Provinces.

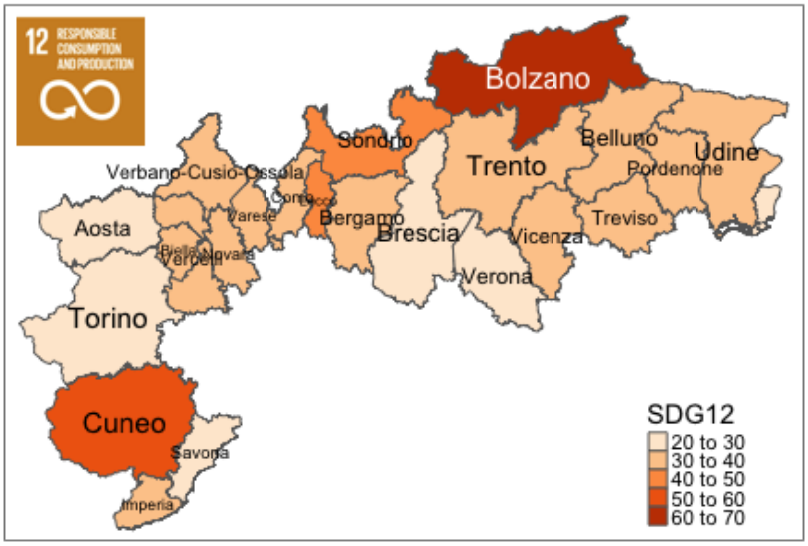
**Figure 8**




| SDG 11 Index | | |
|---|---|---|
| 1st | Brescia | 81 |
| 2nd | Bergamo | 67 |
| 3rd | Bolzano | 67 |
| 22nd | Cuneo | 31 |
| 23rd | Imperia | 23 |
| 24th | Verbano-Cusio-Ossola | 23 |

As for the SDG 12 “Responsible Consumption and Production”, the index is characterized by a strong heterogeneity between Eastern and Central Alps and the Southern and Western regions. The two Provinces with the highest scores are Bolzano and Cuneo. A large group of Provinces in the Central and Eastern areas is characterized by medium scores. Interestingly, the large Provinces of the Southern area, From Torino to Brescia and Verona, have particularly low scores.

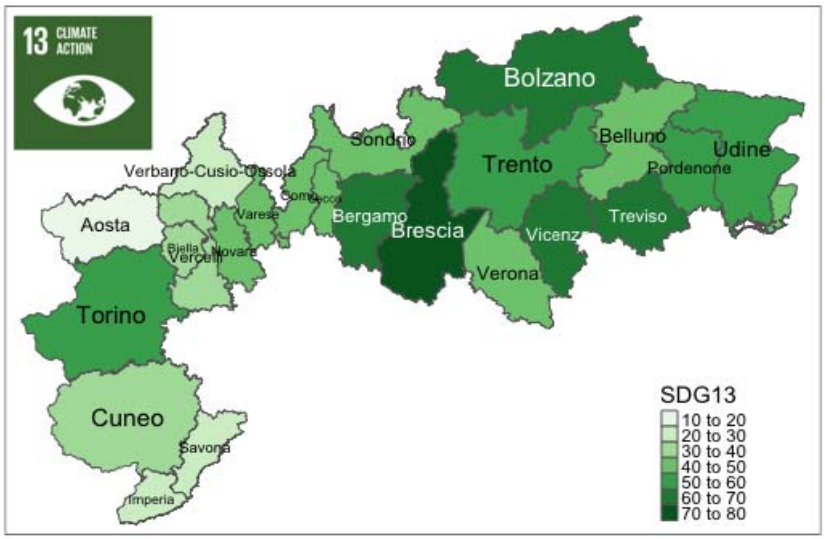
**Figure 9**




| SDG 12 Index | | |
|---|---|---|
| 1st | Bolzano | 64 |
| 2nd | Cuneo | 51 |
| 3rd | Sondrio | 42 |
| 22nd | Torino | 24 |
| 23rd | Gorizia | 22 |
| 24th | Verona | 20 |

As for the SDG 13 “Climate action”, the index is characterized by a relative heterogeneity between Eastern and Central Alps and the Western regions. The two Provinces with the highest scores are Brescia, Bolzano and Bergamo. A large group of Provinces in the Central and Eastern areas is characterized by medium scores. Interestingly, Torino has a particularly high score compared to the other Provinces is the Western alps.

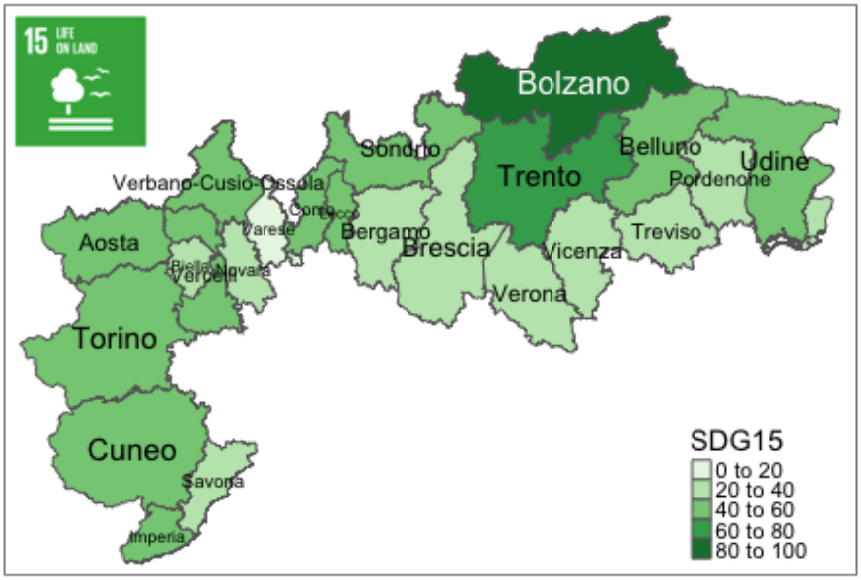
**Figure 10**




| SDG 13 Index | | |
|---|---|---|
| 1st | Brescia | 73 |
| 2nd | Bolzano | 67 |
| 3rd | Bergamo | 64 |
| 22nd | Verbano-Cusio-Ossola | 23 |
| 23rd | Imperia | 22 |
| 24th | Aosta | 16 |

As for the SDG 15 "Life on Land", the performance is relatively more homogeneous than in the other cases, partially reflecting the scores in the Environmental index. Trento and Bolzano obtain higher scores, while all Central - Southern Provinces (from Bergamo to Pordenone) have relatively low scores.

**Figure 11**



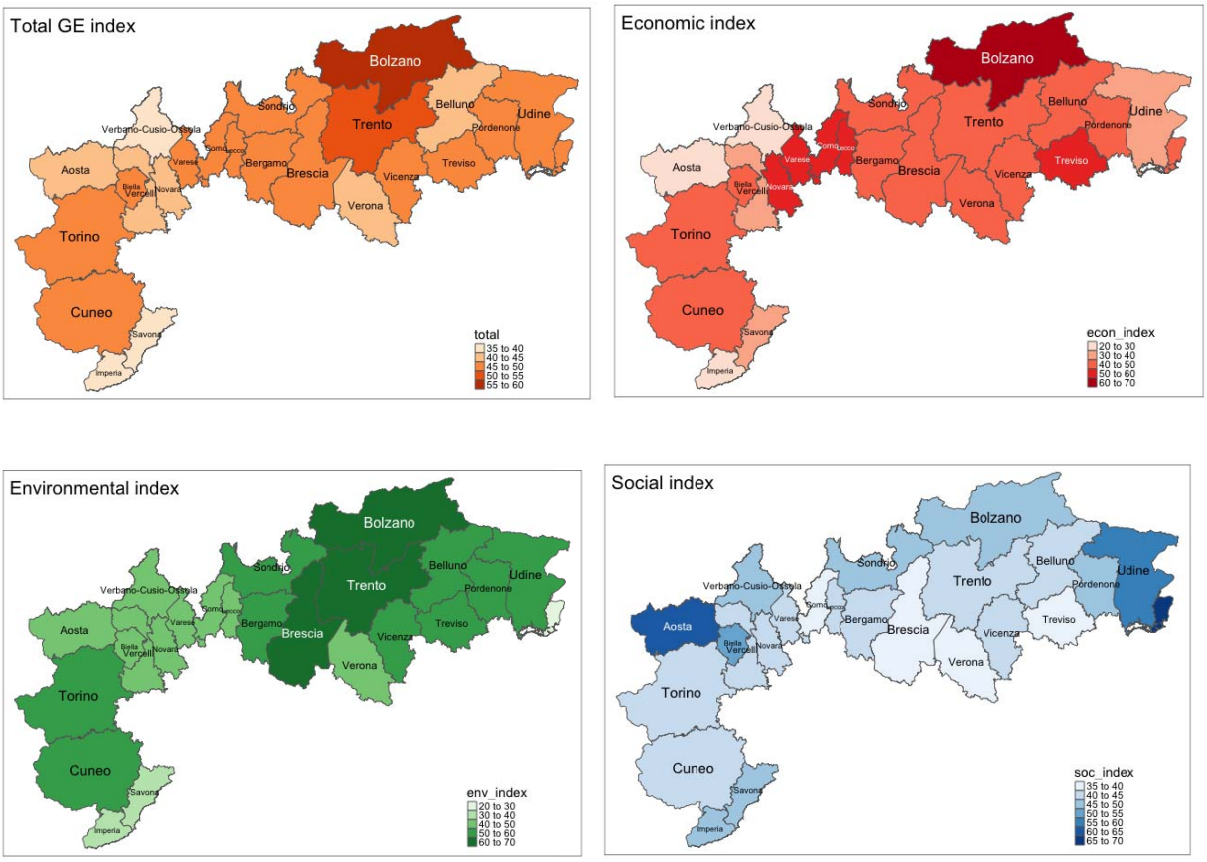

| SDG 15 Index | | |
|---|---|---|
| 1st | Bolzano | 93 |
| 2nd | Trento | 69 |
| 3rd | Cuneo | 55 |
| 22nd | Treviso | 27 |
| 23rd | Gorizia | 27 |
| 24th | Varese | 20 |

Overall, the analysis of the scores in the SDG indices show that each index tends to capture a specific set of characteristics of the Alpine areas, as the scores generally are not similar across most SDGs. Furthermore, in many cases (SDG 4, SDG 5, SDG 7, SDG 11, SDG 14) a relatively high heterogeneity across regional groups of Provinces and homogeneity within those groups, could be identified.

## 3.2. Green Economy indices scores

The overall performance with respect to the Green Economy in the Italian Alps is obtained by aggregating all the indicators selected into one unique index, following the methodology described in paragraph 2.2.

The maps below show the score of each Province in the Total GE index and in the Economic, Social and Environmental indices by which the former is composed.




**Figures 12-15** the figures report the value of the indices calculated based on the aggregation and weighting of the normalized indicators.

**Table 5**

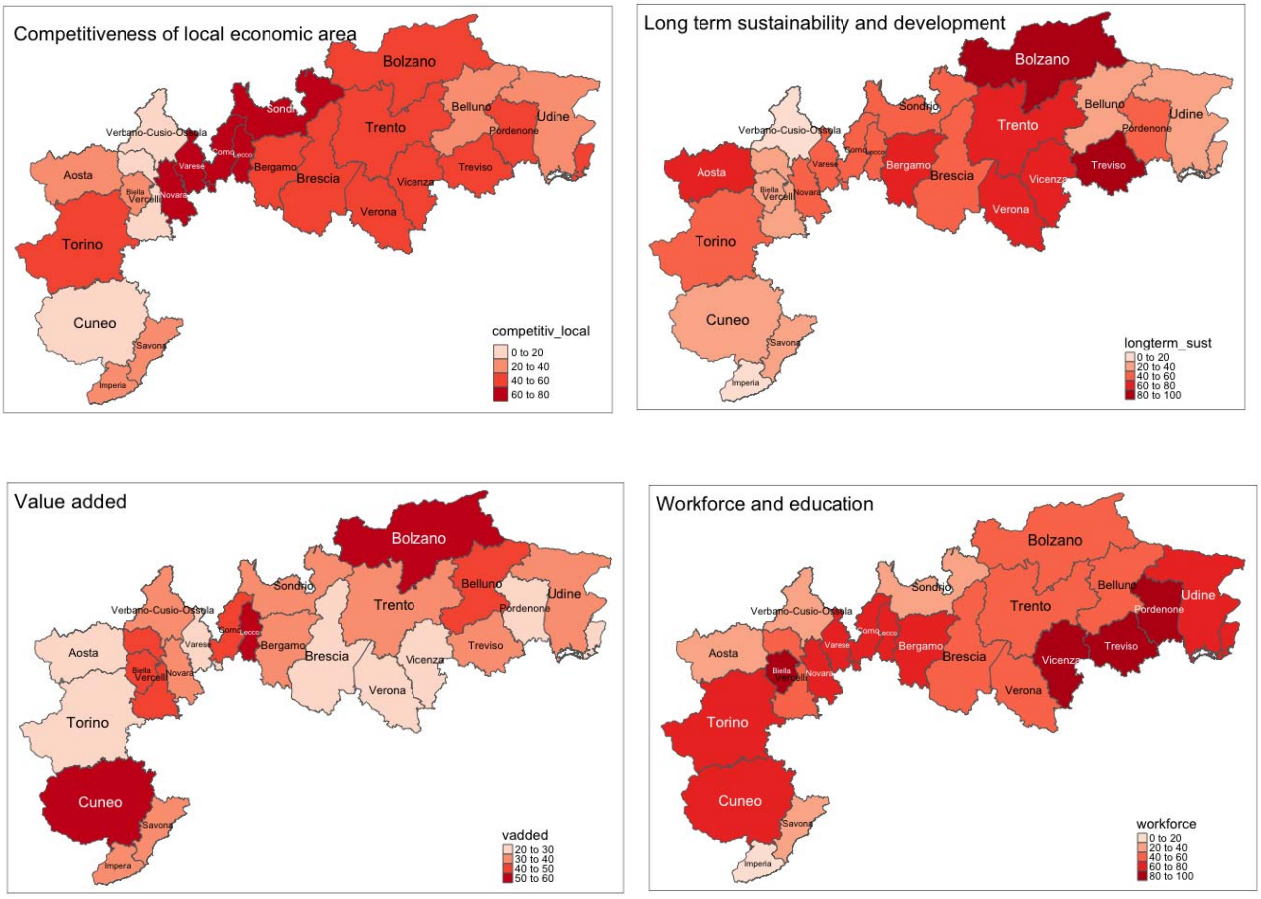
| Ranking and score | Total G.E. Index | | Economic Index | | Environmental Index | | Social Index | |
|---|---|---|---|---|---|---|---|---|
| 1st | Bolzano | 58 | Bolzano | 60 | Bolzano | 67 | Gorizia | 68 |
| 2nd | Trento | 50 | Lecco | 60 | Trento | 64 | Aosta | 62 |
| 3rd | Sondrio | 49 | Treviso | 54 | Brescia | 62 | Udine | 56 |
| 22nd | Savona | 39 | Aosta | 29 | Imperia | 35 | Verona | 39 |
| 23rd | Imperia | 36 | Imperia | 25 | Savona | 33 | Treviso | 39 |
| 24th | Verbano-Cusio-Ossola | 36 | Verbano-Cusio-Ossola | 22 | Gorizia | 29 | Brescia | 37 |

Table 5 presents the results of the three highest and lowest scoring Provinces in the different indices. The Provinces which have the highest score in the Total Green Economy index are Bolzano

and, with relatively similar scores, Trento. On the other hand, the Provinces with the lowest score are Savona, Imperia and Verbanio-Cusio-Ossola (35/100). The Central and Eastern Alpine regions are therefore characterized by the most performing Provinces, while the opposite can be observed as for the North Western region. The decomposition among key Green Economy dimensions shows that the driver of the high scores of the Province of Bolzano are both the Economic and Environmental dimensions. Trento, the second Province in the overall ranking, obtains high scores in the Environmental dimension and good scores in both the Economic and Social dimensions.
In the Economic index, besides Bolzano, other Provinces with high scores are Lecco, Treviso, followed by Como, Novara and Varese. On the other hand, the Provinces with the lowest score are Savona, Vercelli, Aosta, Imperia and Verbanio-Cusio-Ossola. In the Environmental dimension the Provinces' scores are relatively more homogeneous than in the other dimensions, with Sondrio, Brescia, Trento and Bolzano being the ones with the highest scores. A different picture emerges as for the Social dimension, where index scores are more heterogeneous. In this case, the Provinces with the highest index score are Gorizia, Aosta and Udine.

## 3.3. Economic dimension indices

The economic index is the weighted sum of twelve indicators grouped in four criteria: value added, long term sustainability and development, workforce and education, competitiveness of the local economic area. The overall index showed that the Central and North-Eastern Provinces of the Alps, and in particular Bolzano, have a higher score in the economic dimension. Novara, Varese, Como and Lecco are another core Alpine area obtaining higher than average scores.




**Figures 16-19:** the figures report the value of the indices calculated based on the aggregation and weighting of the normalized indicators.

The scores of Bolzano are consistent across the four Economic criteria and are particularly relevant with respect to the other Provinces as for the criteria "long term sustainability and development", which is composed by the indicators "income per family" and "Average decadal net variation of residents (1991-2001-2011)". In order to better capture the phenomena of decadal net variation of residents, section 5 presents the results where a distinction is made between municipalities with different urbanization levels and altimetric classes.

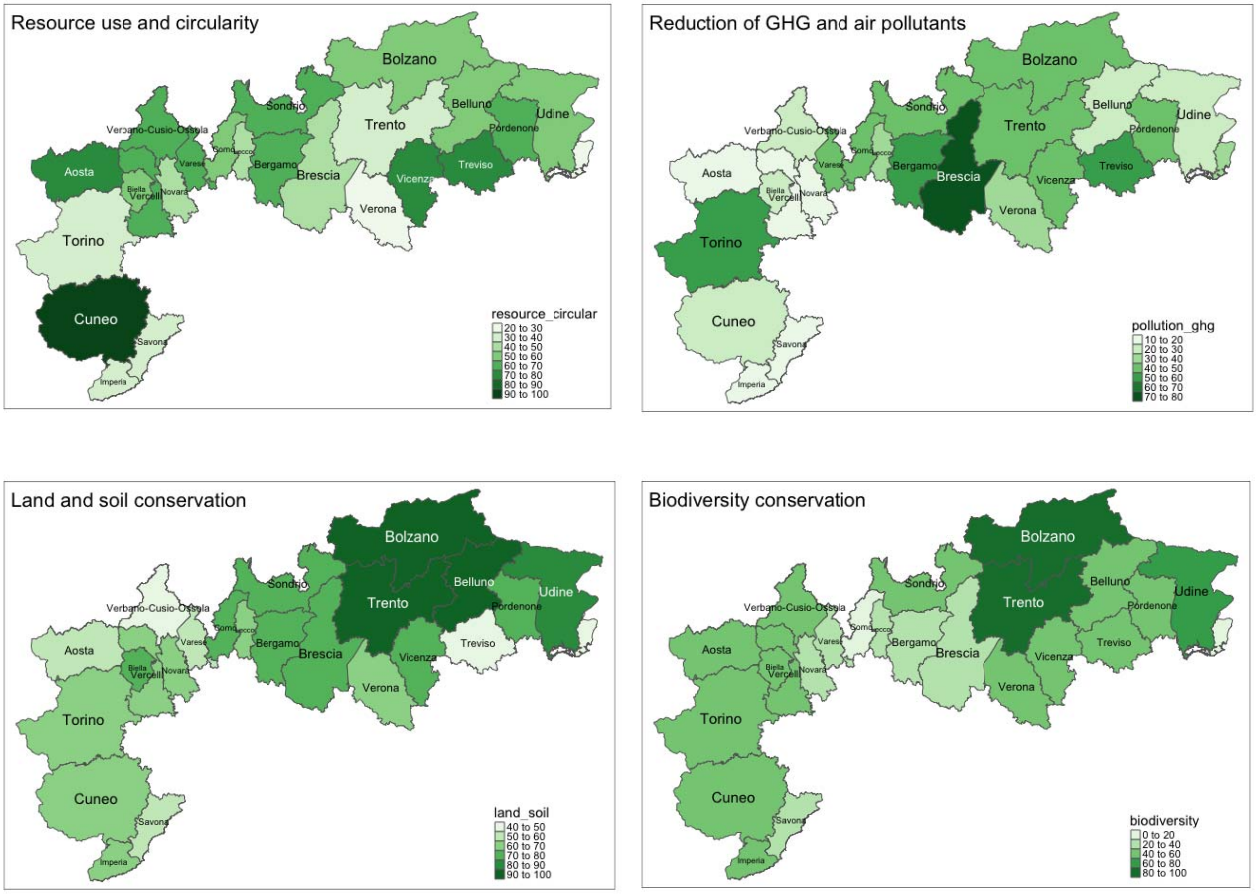
**Table 6**

| Ranking and score | Competitiveness | | Long term sustainability | | Value-added | | Workforce and educatin | |
|---|---|---|---|---|---|---|---|---|
| 1st | Varese | 75 | Bolzano | 91 | Bolzano | 57 | Treviso | 87 |
| 2nd | Novara | 72 | Treviso | 83 | Cuneo | 53 | Vicenza | 82 |
| 3rd | Sondrio | 69 | Verona | 79 | Lecco | 51 | Pordenone | 81 |
| 22nd | Cuneo | 16 | Belluno | 25 | Brescia | 24 | Savona | 28 |
| 23rd | Vercelli | 13 | Imperia | 18 | Torino | 22 | Aosta | 23 |
| 24th | Verbano-Cusio-Ossola | 3 | Verbano-Cusio-Ossola | 4 | Aosta | 22 | Imperia | 7 |

The index "value added" is composed by the indicators "diffusion of craft enterprises", "diffusion of organic production enterprises", "diffusion of farmhouse enterprises", "bed capacity of Alpine farmhouses and huts" and "diffusion of silviculture and forest management enterprises". Bolzano, Cuneo and Lecco have very high scores in this case. North-Eastern Provinces have very high scores in the farmhouse, silviculture and forest management sectors, while Central regions have the highest scores as for the diffusion of craft enterprises. The diffusion of organic products enterprises is instead relatively more homogeneous (see the indicators' results presented in the Annex).
The criteria "competitiveness of local economic area" is composed by the indicators "patents in biotechnology sector", "digital divide" and "diffusion of highly innovative enterprises". In this case all the Provinces in the Central Alps obtain very high scores, followed by a homogeneous group composed by Central Eastern Provinces. With the exception of Torino, all Provinces in the Western Area have lower scores.
The performance in the "workforce and education" index, which is composed by the indicators "variation in the unemployment rate 2001-2011" and "percentage of young people who do not work and do not study", is more homogeneous and characterized by high scores in the South Eastern Provinces (from Vicenza to Pordenone), in the Central Provinces (from Novara to Bergamo), and in some Western Provinces (Torino and Cuneo).

### 3.4. Environmental dimension indices

The environmental index is the weighted sum of twelve indicators grouped in four criteria: reduction of GHG and air pollutants, land and soil conservation, resource use and circularity and biodiversity conservation. The overall index showed that the Central-Eastern Provinces of the Alps (Bolzano, Trento and Brescia) have the highest scores in the environmental dimension. The Provinces characterized by the lowest scores are instead in different coastal areas of the Alps (Imperia, Savona and Gorizia).




**Figures 20-23:** the figures report the value of the indices calculated based on the aggregation and weighting of the normalized indicators.

**Table 7**

| Ranking and score | Biodiversity | | Land and soil conservation | | Pollution and GHG | | Resource use and circularity | |
|---|---|---|---|---|---|---|---|---|
| 1st | Bolzano | 100 | Belluno | 96 | Brescia | 75 | Cuneo | 93 |
| 2nd | Trento | 90 | Bolzano | 91 | Torino | 57 | Treviso | 79 |
| 3rd | Udine | 62 | Trento | 91 | Bergamo | 54 | Aosta | 74 |
| 22nd | Lecco | 24 | Treviso | 45 | Vercelli | 17 | Imperia | 33 |
| 23rd | Como | 18 | Gorizia | 42 | Aosta | 16 | Verona | 25 |
| 24th | Gorizia | 0 | Verbano-Cusio-Ossola | 40 | Imperia | 14 | Gorizia | 24 |

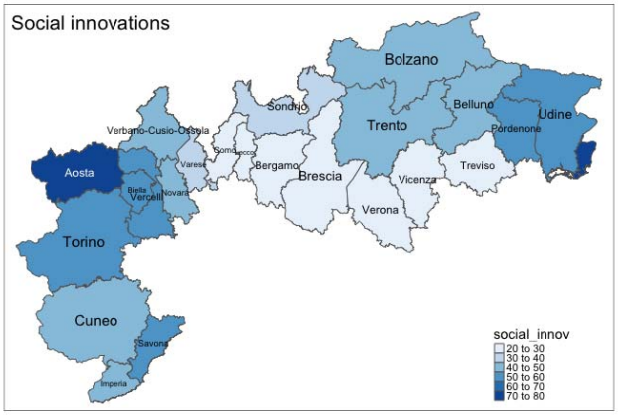
The criteria "reduction of GHG and air pollution" is composed by the indicators "density of photovoltaic installations", "total density of green areas (protected natural areas and urban green areas) in the provincial capital municipalities", "density of cycle paths in the provincial capital municipalities", "availability of local public transport", "diffusion of slow mobility alternatives".
In the indicators related to transport emissions, the most virtuous Provinces are Torino and Brescia as for "density of cycle paths" and "availability of local public transport", while Bolzano as for the "diffusion of slow mobility alternatives". In except from Torino and Brescia, the scores of the indicator on the density of cycle paths are relatively heterogeneous. A similar homogeneous geographical distribution of scores is found as for the availability of public transport. The

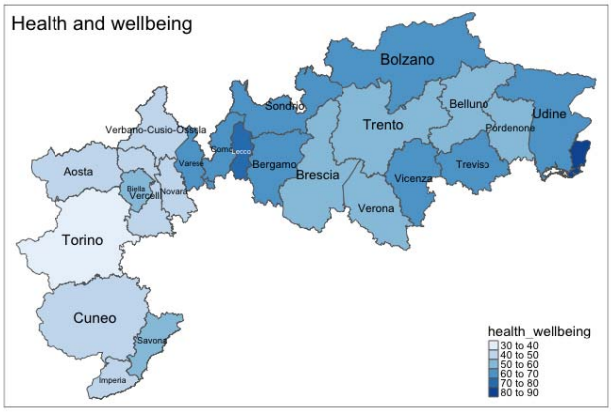
municipalities with the highest scores as for the diffusion of photovoltaic installations are instead Treviso and Gorizia, while this indicator is lower than average in the Western and Northern areas.

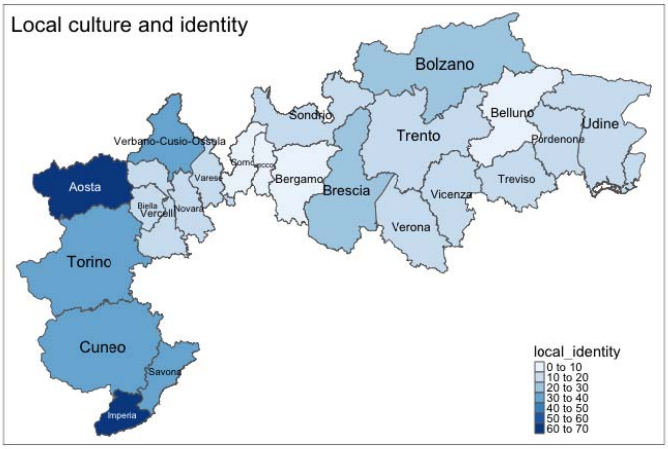
The criteria “resource use and circularity” is composed by the indicators “production of urban waste per capita” and “water consumption per capita”. In this case, the scores are rather heterogeneous, as Cuneo obtains a very high score, as opposed to neighboring Provinces of Torino, Savona and Imperia. Other Provinces with lower than average scores are Trento and Verona (the Province of Torino is affected by the a very low score in the water consumption). In general, Northern Provinces obtain higher scores than Southern Provinces in the overall index, Western Provinces obtain higher than average scores in the waste generation indicator and lower than average scores in the water consumption indicator.
The criteria “land and soil conservation” is composed by the indicators “population exposed to landslide risk”, “high and very high fragmentation (Percentage of region's area covered by pressure classes)” and “population exposed to hydraulic risk”. The scores in this case are very heterogeneous and clustered in regional areas. Bolzano, Trento and Belluno obtain the highest scores, while Treviso the lowest. All Provinces score relatively well in the indicator of urban impact on HNV farmland, with the exception of Como, Lecco, Varese and Brescia. Sondrio and Aosta are the Provinces with the highest risk of soil erosion by water, while Verbano-Cusio-Ossola is the Province with the highest risk of landslide.
The criteria “biodiversity conservation” is composed by the indicators “diffusion of certified forests (PEFC or FSC certified forest area over total forest area)” and “High Nature Value farmland impacted by urban expansion”. As for the overall index, Bolzano and Trento have the highest scores, while other Provinces have rather homogeneous results, with the exception of Como. The indicator “certified forest area” drives the results as it is relatively unbalanced: the only Provinces that have a high share of certified forest areas are Bolzano, Trento and Udine (but other eight Provinces have lower shares).

## 3.5. Social dimension indices

The social index is the weighted sum of twelve indicators grouped in three criteria: social innovations, health and well-being, local culture identity. The overall index showed that the North-Eastern Provinces of the Alps, and in particular Udine and Gorizia, have a higher score in the social dimension, together with Aosta.




**Figures 24-27:** the figures report the value of the indices calculated based on the aggregation and weighting of the normalized indicators.

| **Table 8** | | | | | | |
|---|---|---|---|---|---|---|
| Ranking and score | Local identity | | Health and wellbeing | | Social innovation | |
| 1st | Imperia | 65 | Gorizia | 81 | Aosta | 77 |
| 2nd | Aosta | 62 | Lecco | 76 | Gorizia | 76 |
| 3rd | Savona | 40 | Udine | 69 | Udine | 57 |
| 22nd | Bergamo | 7 | Novara | 46 | Como | 27 |
| 23rd | Lecco | 6 | Cuneo | 43 | Treviso | 24 |
| 24th | Como | 4 | Torino | 35 | Brescia | 23 |

The criteria “social innovation”, in which the Provinces of Aosta and Gorizia obtain the highest scores, is composed by the indicators “number of non-profit organizations”, “number of enterprises run by woman”, “GINI index”, “ratio between male and female employment” and “children who benefited from municipal childcare services”. The Central and Western Provinces of the Alps have overall higher scores as for the number of non-profit organizations, while Eastern Provinces have higher scores as for the number of enterprises run by women.
The GINI index, measuring income inequality, is particularly relevant and is characterized by a relative homogeneity across the Alpine Provinces, with the exception of Bolzano, Varese and Como which have the lowest scores (see the indicators’ results presented in the Annex).
The criteria “health and wellbeing”, in which all Central and Eastern Provinces obtain higher scores than Western Provinces, is composed by the indicators “inequality of the electricity service”,

“mortality rate due to pm 2.5”, “patient migration towards hospitals in other regions”, “accessibility to train stations” and “diffusion of residential buildings in a very poor conservation status”. An important indicators for the criteria is the “mortality rate due to pm 2.5”, which shows a large heterogeneity between the Central-Southern Provinces (Torino, Novara, Bergamo, Brescia, Verona), with lower than average scores, and Northern (Bolzano, Trento, Belluno, Sondrio) and Western (Cuneo, Savona, Imperia, Aosta, Biella, Verbano-Cusio-Ossola) Provinces, with higher than average scores (see the indicators’ results presented in the Annex).
The criteria “local culture identity”, in which the Provinces of Aosta and Imperia obtain the highest scores, followed by Torino Cuneo and Savona, is composed by the indicators “cohesion policy funding per capita on tourism and culture”, and “number of public cultural sites”.

The analysis of the scores in the Green Economy indices confirms the results of the SDGs indices, as the scores generally are not similar across most indices and that each index tends to capture a specific set of characteristics of the Alpine areas. Nevertheless, is some cases the result point to the correlation of some indices. Sometimes the correlation is driven by the similarity of the phenomena captured by the indices, as in the case of the indices of the Environmental criteria “Land and soil conservation” and “Biodiversity”. In other cases, the correlation is less obvious, as for the Social indices “Local culture and identity” and “Social innovation”.
The Green Economy indices furthermore show with even more clarity than the SDG indices the heterogeneity across regional groups of Provinces and the homogeneity within regional groups. This result suggests the possible relevance of regional institutional frameworks and regulations in driving part of the variation in the performance across areas.

# 4. The Alpine Green Economy across municipalities

In this section the indicators which could be collected at the municipal level (18 out of 36), are further analyzed in order to provide a more detailed characterization of the results obtained from the scores of the indices at the provincial level. Each one of the three Green Economy dimensions is measured by 6 indicators, leading as in the case of the provincial analysis to a balanced set of indicators for the different areas of interest. In total, 2848 municipalities are part of the alpine Provinces (see table 1 in section 2.1). Table 4 reports the selection of the Green Economy indicators and the availability of data across the municipalities.

**Table 9**

| INDICATOR | SOURCE | GREEN ECONOMY SUB-DIMENSION | AVAILABILITY (number of municipalities) |
|---|---|---|---|
| **Economic** | | | |
| Average decadal net variation of residents (1991-2001-2011) | Urban Index | Long term sustainability and development | 2738 |
| Digital divide | Urban Index | Competitiveness of local economic area | 2738 |
| Percentage of young people who do not work and do not study | Urban Index | Workforce | 2738 |
| Variation in the unemployment rate 2001-2011 | Urban Index | Workforce | 2738 |
| Diffusion of silvicolture and forest management enterprises (number of enterprises over total enterprises) | Bocconi based on ISTAT | Value added | 2190 |
| Diffusion of highly innovative enterprises | Urban Index | Competitiveness of local economic area | 2738 |
| **Environmental** | | | |
| Population exposed to hydraulic risk | Urban Index | Land and soil conservation | 2738 |
| Density of photovoltaic installations | Urban Index | Reduction of GHG and air pollutants emissions | 2738 |
| Production of urban waste per capita | Urban Index | Resource efficiency use and circularity | 2738 |
| Water consumption per capita | Bocconi based on ISTAT | Resource efficiency use and circularity | 2738 |
| Diffusion of slow mobility alternatives | Urban Index | Reduction of GHG and air pollutants emissions | 2738 |
| Population exposed to landslide risk | ISPRA | Land and soil conservation | 2738 |
| **Social** | | | |
| Number of public cultural sites | Urban Index | Contribute to local culture identity | 2738 |
| GINI index | Urban Index | Social innovations | 2738 |
| Diffusion of residential buildings in a very poor conservation status | Urban Index | Contribution to human health and well-being | 2738 |
| Number of non-profit organizations | BES | Social innovations | 2754 |
| Ratio between male and female employment | Urban Index | Social innovations | 2738 |
| Accessibility to train stations | Urban Index | Contribution to human health and well-being | 2738 |

In order to determine the possible socio-economic and demographic drivers of the difference in the indicators' value across the alpine municipalities, the results are compared between municipalities with a specific urbanization level and typology of altimetric zone, using the classification classes

provided by EUROSTAT (2019). The degree of urbanisation classifies local administrative units (LAUs) as cities ("high density"), towns and suburbs ("intermediate density") or rural areas "low density") based on a combination of geographical contiguity and population density, measured by minimum population thresholds applied to 1 km² population grid cells; each LAU belongs exclusively to one of these three classes. Only part of the Alpine provincial capitals are classified as "high density" cities. The provincial capitals that fall in this classification are: Torino, Novara, Imperia, Savona, Varese, Como, Bergamo, Brescia, Bolzano, Trento, Verona, Vicenza, Treviso, Udine, Pordenone, Biella and Lecco. The provincial capitals which falls in the category of "intermediate density" towns and suburbs are instead: Aosta, Vercelli, Cuneo, Verbano Cusio Ossola, Gorizia, Belluno and Sondrio.

The distribution of the national territory in homogeneous altimetric zones is conducted by ISTAT deriving from the aggregation of contiguous municipalities on the basis of altimetric threshold values. Mountain, hill and plain altimetric areas are distinguished. The altimetric zones of mountain and hill have been divided, to take into account the moderating action of the sea on the climate, respectively, in altimetric areas of internal mountain and internal hill and of coastal mountain and coastal hill. The altimetric zone classification is therefore composed by five categories: "inner mountain" (1280 municipalities); "coastal mountain" (1 municipality); "inner hill" (733 municipalities); "coastal hill" (49 municipalities); "flat land" (675 municipalities). The only municipality in a "coastal mountain" areas is Varazze, in the Province of Savona. The figures 28 and 29 show the different distribution of the urbanization level and typology of altimetric zone across the alpine municipalities.

**Figure 28: Map of the urbanization classes in the Alpine municipalities**

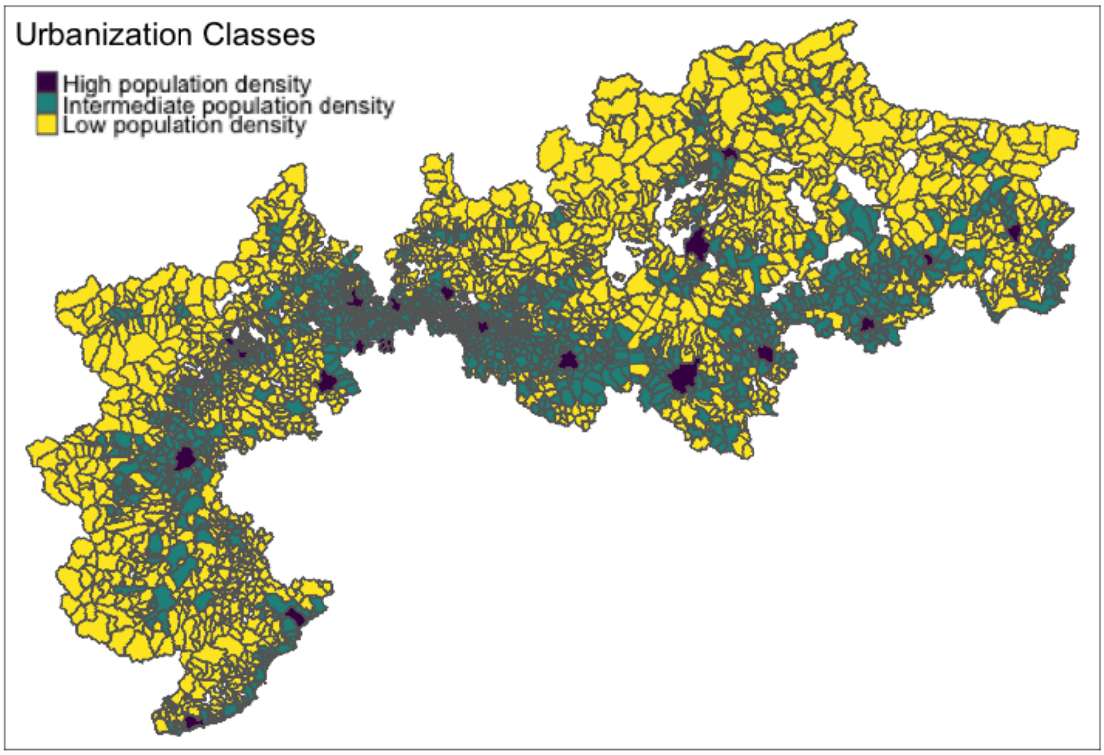
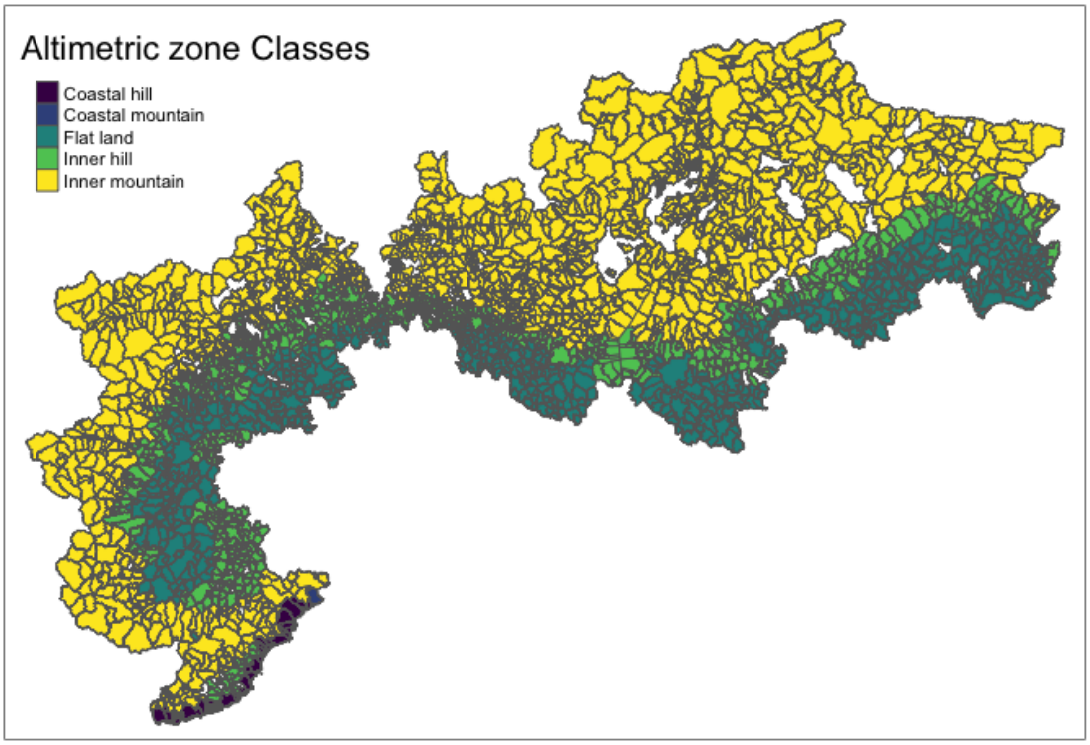



**Figure 29: Map of the altimetric zones in the Alpine municipalities**




## 4.1. Economic dimension indicators

The table 10 shows the summary statistic of the normalized indicators of the Green Economy Economic Dimension (minimum, mean and standard deviation, maximum). Each column corresponds to a specific urbanization or altimetric class. For the indicators showing the highest degree of heterogeneity across classes, a figure showing the probability density function (PDF) of the indicator's score is presented. The PDF is a function that provides the relative likelihood (on the y axis) that any given point in the set of possible values (on the x axis) takes a value equal to that point.

**Table 10: Selected G.E. Economic Criteria Indicators**

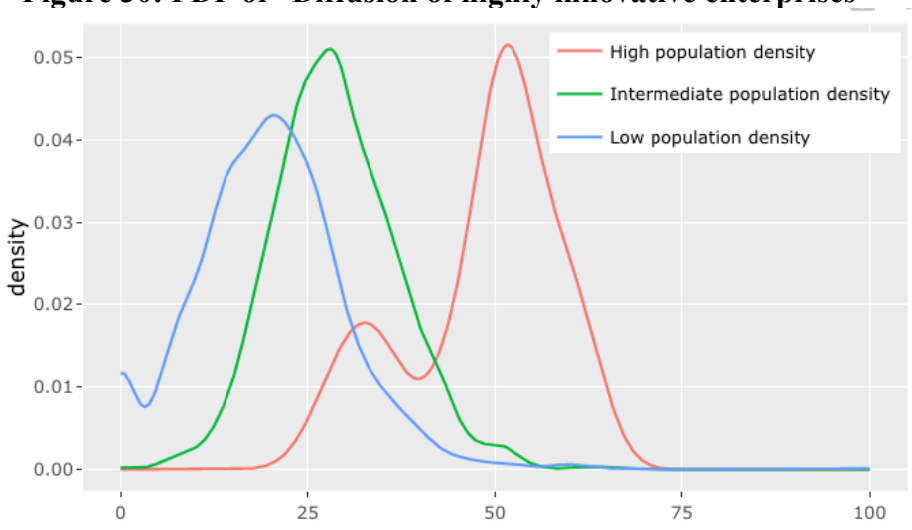
| | Altimetric zone classes | | | | | Urbanization classes | | |
|---|---|---|---|---|---|---|---|---|
| | Inner hill (N = 733) | Coastal hill (N = 49) | Inner mountain (N = 1,280) | Coastal mountain (N = 1) | Flat land (N = 675) | High density (N = 23) | Intermediate density (N = 1,068) | Low density (N = 1,647) |
| **Percentage of young people who do not work and do not study** | | | | | | | | |
| Minimum | 74.40 | 80.50 | 0.00 | 92.30 | 64.80 | 88.60 | 80.20 | 0.00 |
| Mean and sd | 92.62 +/- 2.75 | 89.70 +/- 3.44 | 92.30 +/- 4.86 | 92.30 | 91.78 +/- 2.80 | 92.18 +/- 1.52 | 92.13 +/- 2.36 | 92.26 +/- 4.69 |
| Maximum | 100.00 | 100.00 | 100.00 | 92.30 | 100.00 | 94.90 | 100.00 | 100.00 |
| **Diffusion of highly innovative enterprises** | | | | | | | | |
| Minimum | 0.00 | 6.90 | 0.00 | 24.48 | 0.00 | 27.41 | 0.00 | 0.00 |
| Mean and sd | 27.47 +/- 10.71 | 22.34 +/- 7.94 | 20.14 +/- 10.86 | 24.48 | 25.73 +/- 8.36 | 48.41 +/- 10.01 | 28.77 +/- 8.35 | 19.77 +/- 10.19 |
| Maximum | 100.00 | 42.89 | 67.15 | 24.48 | 61.30 | 62.13 | 67.15 | 100.00 |
| **Variation in the unemployment rate 2001-2011** | | | | | | | | |
| Minimum | 3.75 | 34.83 | 0.00 | 57.30 | 22.47 | 32.58 | 21.72 | 0.00 |
| Mean and sd | 42.40 +/- 7.03 | 54.88 +/- 7.05 | 46.45 +/- 10.00 | 57.30 | 41.26 +/- 5.70 | 41.65 +/- 4.68 | 42.34 +/- 6.11 | 45.51 +/- 9.92 |
| Maximum | 78.65 | 71.54 | 100.00 | 57.30 | 68.16 | 52.81 | 71.54 | 100.00 |
| **Digital divide** | | | | | | | | |
| Minimum | 0.00 | 9.30 | 0.00 | 79.20 | 0.20 | 98.00 | 0.10 | 0.00 |
| Mean and sd | 81.22 +/- 30.25 | 90.74 +/- 22.58 | 68.83 +/- 37.82 | 79.20 | 87.02 +/- 25.07 | 99.51 +/- 0.76 | 94.27 +/- 16.34 | 65.53 +/- 37.31 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Maximum | 100.00 | 100.00 | 100.00 | 79.20 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Diffusion of silviculture and forest management enterprises** | | | | | | | | |
| Minimum | 0.00 | 0.00 | 0.00 | 0.88 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mean and sd | 0.80 +/- 3.07 | 0.21 +/- 0.62 | 3.90 +/- 11.22 | 0.88 | 0.34 +/- 2.19 | 1.72 +/- 2.43 | 1.34 +/- 5.22 | 2.65 +/- 9.50 |
| Maximum | 57.14 | 3.23 | 100.00 | 0.88 | 50.00 | 10.53 | 57.14 | 100.00 |
| **Average decadal net variation of residents (1991-2001-2011)** | | | | | | | | |
| Minimum | 8.87 | 19.92 | 0.00 | 33.93 | 13.24 | 31.23 | 19.92 | 0.00 |
| Mean and sd | 46.94 +/- 10.68 | 42.27 +/- 11.43 | 39.64 +/- 12.07 | 33.93 | 48.63 +/- 10.92 | 39.85 +/- 8.08 | 49.04 +/- 10.38 | 40.55 +/- 12.03 |
| Maximum | 86.50 | 66.45 | 83.93 | 33.93 | 100.00 | 62.34 | 100.00 | 91.00 |

***Percentage of young people who do not work and do not study:*** for this indicator, the results show a general homogeneity across both altimetric and urbanization classes. Municipalities in the "flat land" and "coastal hill" have slightly lower values, while the municipalities in the "inner mountain" class and in the "rural" class show a higher (almost double) standard deviation relative to the values of the other classes.

***Diffusion of highly innovative enterprises:*** for this indicator, the results show a considerable heterogeneity across groups. The municipalities in the "densely populated" class have much higher mean value (48/100) compared to the one in the "intermediate density" class (28/100) and "rural" class (19/100). The difference is less sharp when looking at the altimetric zone: the municipalities are characterized by a score between 20-30/100 across all classes, with the higher scores in the classes "flat land" and "inner hill". The figure 30 presents the density function of the indicator's score across the three different urbanization classes.

**Figure 30: PDF of "Diffusion of highly innovative enterprises"**

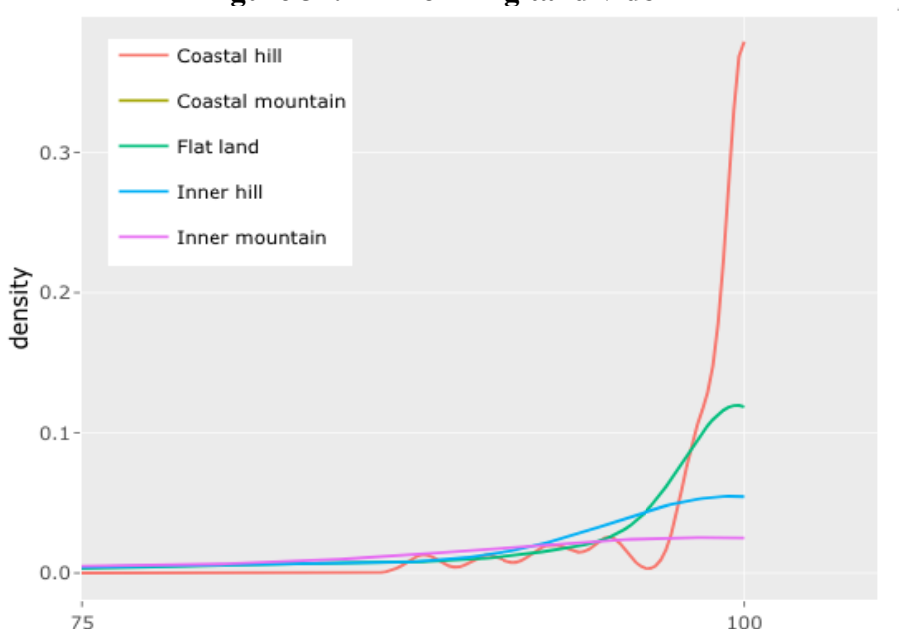



***Variation in the unemployment rate 2001-2011:*** for this indicator, the results show a general homogeneity across urbanization groups. The municipalities in the "densely populated" class have lower mean value (41/100) compared to the one in the "intermediate density" class (42/100) and "rural" class (45/100). This suggests that rural areas have experienced more sharp declines in unemployment and/or less sharp increases in the unemployment rate from 2011 to 2001. More heterogeneity is found across altimetric zones, in which the municipalities in the "coastal mountain" (as well as the only municipality classified as "coastal hill"), show higher mean values (in the 55-57/100 range) compared to the higher classes.

***Digital divide:*** for this indicator, similarly to the "Diffusion of highly innovative enterprises**",** the results show a considerable heterogeneity across groups. The municipalities in the "densely populated" and "intermediate density" class have a much higher mean value (in the 99-95/100 range), than the municipalities in the "rural" class (in which the mean value is 65/100). The most relevant difference when looking at the altimetric zone is found between the "inner mountain" class (having a mean score of 68/100), and the other classes. The "flat land" and "coastal hill" classes

have the highest mean values (87/100 and 90/100 respectively). The figure 31 presents the density function of the indicator's score across the three different altimetric zone classes. Coastal hills have a distribution of scores around much higher levels than flat lands and inner hills, while in turn inner mountain municipalities have a distribution of scores more homogeneous but around considerably lower levels.

**Figure 31: PDF of "Digital divide"**




All in all, the economic indicators are characterized by different distributions of scores in the areas related to innovation and technology, while show greater homogeneity in the areas related to socio-economic conditions of the residents. As for the former group of indicators, the municipalities in the "inner hills" and "rural" classes emerges as the least developed. In turn, these areas are characterized by a relative specialization in the silviculture and forest management sector. At the same time, the group with the highest score in these dimensions is the "high density" class, which is mainly composed by provincial capitals. Therefore, the Alpine capital cities tend to be the centers of localization of services and innovative economic activities.

## 4.2. Environmental dimension indicators

Table 11 shows the summary statistic of the normalized indicators of the Green Economy Environmental Dimension (minimum, mean and standard deviation, maximum). Each column corresponds to a specific urbanization or altimetric class.

**Table 11: Selected G.E. Environmental Dimension Indicators**

| | Altimetric zone classes | | | | | Urbanization classes | | |
|---|---|---|---|---|---|---|---|---|
| | Inner hill (N = 733) | Coastal hill (N = 49) | Inner mountain (N = 1,280) | Coastal mountain (N = 1) | Flat land (N = 675) | High density (N = 23) | Intermediate density (N = 1,068) | Low density (N = 1,647) |
| Population exposed to hydraulic risk | | | | | | | | |
| Minimum | 45.47 | 30.68 | 8.60 | 86.74 | 0.00 | 81.57 | 5.46 | 0.00 |
| Mean and sd | 98.11 +/- 4.78 | 91.63 +/- 11.42 | 96.41 +/- 8.14 | 86.74 | 96.76 +/- 10.72 | 97.29 +/- 4.81 | 97.07 +/- 8.06 | 96.72 +/- 8.48 |
| Maximum | 100.00 | 100.00 | 100.00 | 86.74 | 100.00 | 100.00 | 100.00 | 100.00 |

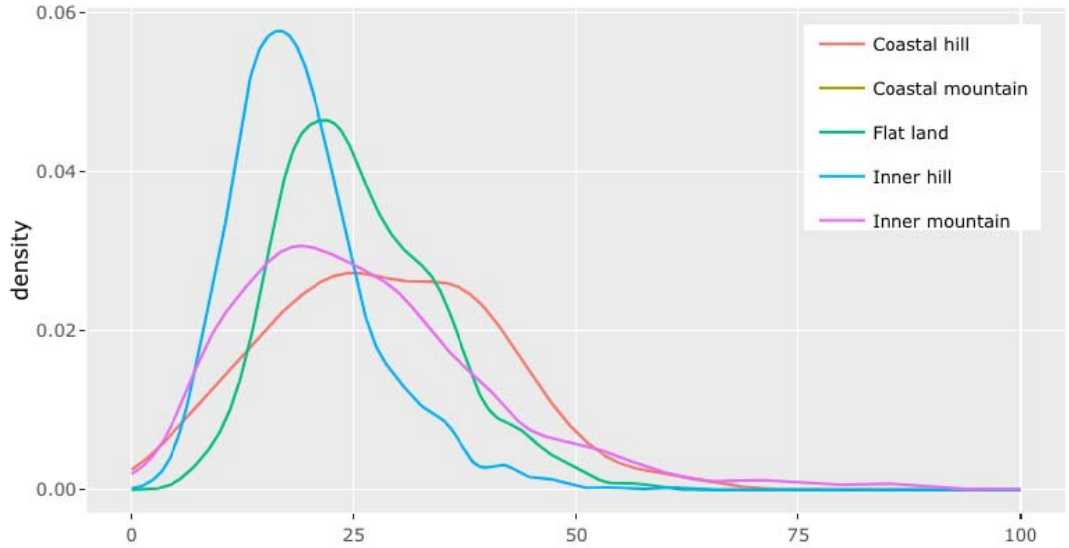
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Population exposed to landslide risk | | | | | | | | |
| Minimum | 19.12 | 70.99 | 0.00 | 79.43 | 85.16 | 96.84 | 17.35 | 0.00 |
| Mean and sd | 97.61 +/- 7.10 | 95.50 +/- 5.44 | 93.40 +/- 12.45 | 79.43 | 99.92 +/- 0.79 | 99.59 +/- 0.81 | 98.47 +/- 5.80 | 94.63 +/- 11.36 |
| Maximum | 100.00 | 99.97 | 100.00 | 79.43 | 100.00 | 100.00 | 100.00 | 100.00 |
| Diffusion of slow mobility alternatives | | | | | | | | |
| Minimum | 2.76 | 5.67 | 0.00 | 31.29 | 6.90 | 16.72 | 3.22 | 0.00 |
| Mean and sd | 19.28 +/- 7.96 | 28.32 +/- 12.30 | 26.28 +/- 14.70 | 31.29 | 25.72 +/- 8.89 | 36.23 +/- 12.30 | 23.46 +/- 10.06 | 24.69 +/- 13.35 |
| Maximum | 60.58 | 60.12 | 100.00 | 31.29 | 57.36 | 77.45 | 83.90 | 100.00 |
| Density of photovoltaic installations | | | | | | | | |
| Minimum | 0.00 | 0.29 | 0.00 | 2.05 | 0.29 | 5.26 | 0.00 | 0.00 |
| Mean and sd | 15.30 +/- 12.57 | 8.52 +/- 6.13 | 4.71 +/- 7.15 | 2.05 | 17.71 +/- 13.84 | 25.27 +/- 14.68 | 19.53 +/- 13.71 | 4.96 +/- 5.99 |
| Maximum | 87.13 | 27.78 | 74.27 | 2.05 | 100.00 | 54.39 | 100.00 | 45.32 |
| Water consumption per capita | | | | | | | | |
| Minimum | 88.66 | 87.21 | 0.00 | 95.79 | 85.87 | 94.91 | 85.87 | 0.00 |
| Mean and sd | 97.13 +/- 1.00 | 94.81 +/- 2.44 | 95.43 +/- 5.09 | 95.79 | 97.36 +/- 1.12 | 96.44 +/- 0.68 | 96.96 +/- 1.29 | 95.96 +/- 4.61 |
| Maximum | 99.23 | 98.19 | 99.34 | 95.79 | 100.00 | 97.40 | 100.00 | 100.00 |
| Production of urban waste per capita | | | | | | | | |
| Minimum | 36.99 | 49.85 | 0.71 | 68.02 | 0.00 | 70.43 | 0.00 | 0.71 |
| Mean and sd | 84.58 +/- 6.55 | 71.42 +/- 10.62 | 82.81 +/- 8.92 | 68.02 | 84.55 +/- 5.78 | 78.93 +/- 4.01 | 82.36 +/- 6.79 | 84.31 +/- 8.48 |
| Maximum | 100.00 | 91.23 | 96.47 | 68.02 | 94.79 | 90.81 | 100.00 | 96.47 |

***Percentage of population under hydraulic risk:*** for this indicator, the results show a general homogeneity across both altimetric and urbanization classes. Municipalities in the “coastal” areas have lower values than the other classes, underscoring that such areas are characterized by a higher hydraulic risk. No remarkable variation is found across urbanization classes.

***Percentage of population under landslide risk:*** for this indicator, the results show a general homogeneity across both altimetric and urbanization classes. Nevertheless, municipalities in the “inner mountain” and “coastal” areas have lower values than the other classes, underscoring that such areas are characterized by a higher landslide risk. Furthermore, “rural” municipalities have a relatively higher risk, as the mean value for this class is relatively lower than the one in the other urbanization classes (94/100 versus 98-99/100).

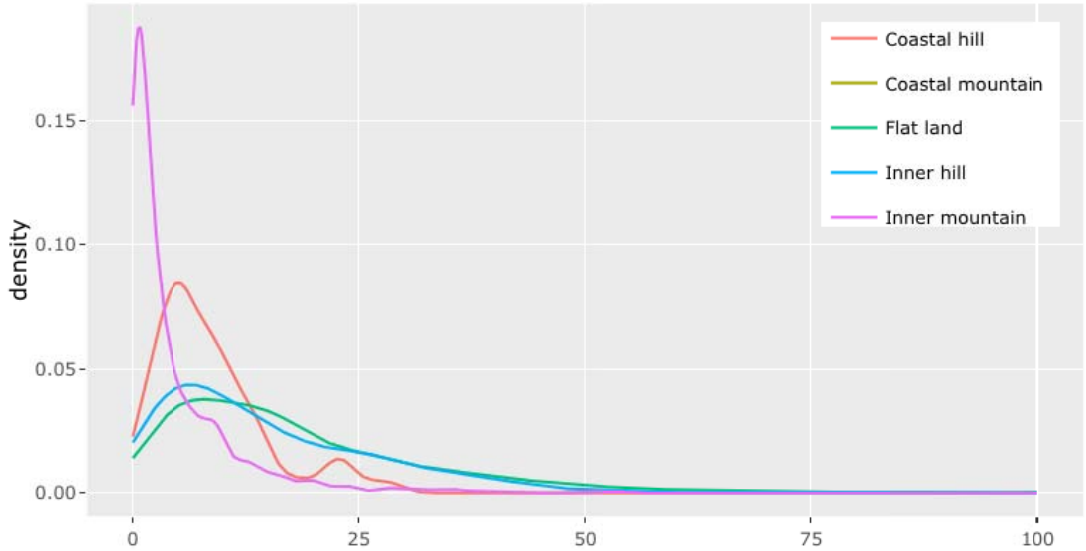
***Diffusion of slow mobility alternatives:*** for this indicator, the results show a relative heterogeneity across both altimetric and urbanization classes. The “densely populated” municipalities have a considerably higher mean value (36/100) compared to both “intermediate density” and “rural” classes (23-24/100). The figure 32 shows that municipalities in the “coastal hill” areas have the highest mean score (28/100) and a more homogeneous distribution compared to the other altimetric classes, particularly than the ones in the “inner hill” and “flat land” areas, which have a lower mean score and higher heterogeneity within the classes. Interestingly, municipalities in the "inner mountain" group have a distribution of the scores more similar to the “coastal hill” group.

**Figure 32: PDF of “Diffusion of slow mobility alternatives”**




***Density of photovoltaic installations:*** for this indicator, the results show a remarkable heterogeneity across both altimetric and urbanization classes. The "densely populated" municipalities have a considerably higher mean value (25/100) compared to the "intermediate density" class (19/100) and, especially, the "rural" class (5/100). As shown in the figure 33, municipalities in the "inner hill" and "flat land" areas have the highest mean score (15-17/100) and more homogeneity whitin the same group, compared to the other altimetric classes, particularly than the ones in the "inner mountain" and "coastal mountain" areas, which have the lowest mean score (2-4.7/100).

**Figure 33: PDF of "Density of photovoltaic installations"**




***Water consumption per capita:*** for this indicator, the results show a relative homogeneity across both altimetric and urbanization classes. Nevertheless, "rural" municipalities are characterized by a slightly lower score and higher standard deviation than the other urbanization classes. Municipalities in "coastal hill" areas have slightly lower values than the other classes.

***Production of urban waste per capita:*** for this indicator, the results show a relative heterogeneity across both altimetric and urbanization classes. The municipalities in the "highly density" class are characterized by a lower score than the lower urbanization classes (79/100). On the other hand, "rural" municipalities emerge as the one with the highest mean score (84/100) but also highest standard deviation. Municipalities in "coastal" areas have the lowest values compared to the other altimetric zone classes (68-71/100 versus a mean range of 82-84/100 of the other classes).

All in all, the environmental indicators are characterized by a relatively homogeneouts distributions of scores in most of the areas identified. Nevertheless, the indicators related to environmental risks show the high vulnerability of the Alpine municipalities in the “coatal hill” and, to a lower extent, in the “inner mountain" areas. Interestingly, two groups are identified as for the indicators related to the transport and renewable energy indicators. Municipalities in the “inner mountain” and “coastal hill” areas are more virtuous in the former ("Diffusion of slow mobility alternatives”), while “flat land” and “inner hill” areas, as well as “high density” areas, are more virtuous in the latter ("Density of photovoltaic installations”). Highly urbanized areas are furthermore less virtuous than the other urbanization groups as for waste generation, while no difference is found as for water consumption.

## 4.3. Social dimension indicators

Table 12 shows the summary statistic of the normalized indicators of the Green Economy Social Criteria (minimum, mean and standard deviation, maximum). Each column corresponds to a specific urbanization or altimetric class.

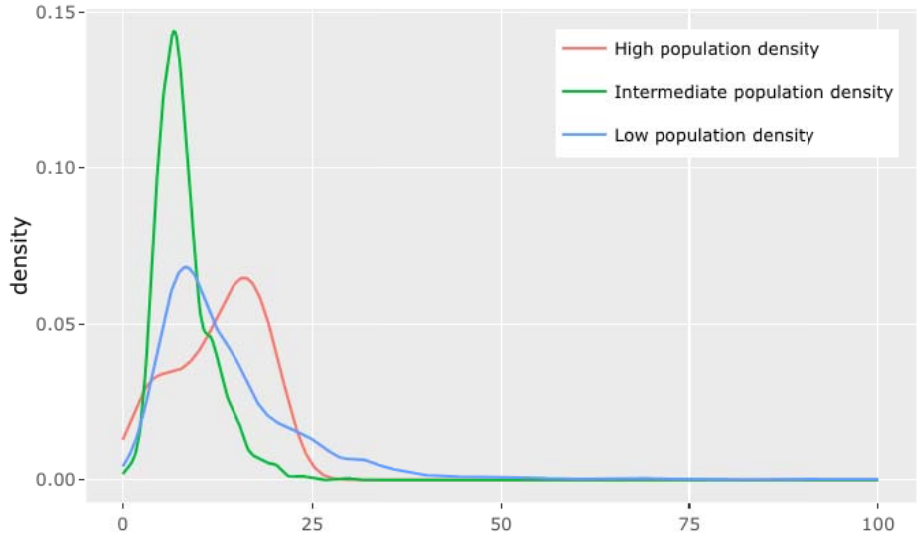
**Table 12: Selected G.E. Social Criteria Indicators**

| | Altimetric zone classes | | | | | Urbanization classes | | |
|---|---|---|---|---|---|---|---|---|
| | Inner hill (N = 733) | Coastal hill (N = 49) | Inner mountain (N = 1,280) | Coastal mountain (N = 1) | Flat land (N = 675) | Densely populated (N = 23) | Intermediate density (N = 1,068) | Rural (N = 1,647) |
| Number of non-profit organizations | | | | | | | | |
| Minimum | 0.48 | 0.00 | 0.44 | 10.74 | 0.79 | 3.00 | 0.00 | 0.32 |
| Mean and sd | 8.69 +/- 4.83 | 8.72 +/- 4.65 | 15.64 +/- 11.62 | 10.74 | 7.94 +/- 3.84 | 12.60 +/- 5.76 | 8.09 +/- 3.71 | 14.13 +/- 10.98 |
| Maximum | 54.33 | 27.05 | 100.00 | 10.74 | 33.82 | 20.61 | 29.54 | 100.00 |
| Diffusion of residential buildings in a very poor conservation status | | | | | | | | |
| Minimum | 39.21 | 46.70 | 0.00 | 92.95 | 32.16 | 77.53 | 44.05 | 0.00 |
| Mean and sd | 94.24 +/- 7.33 | 93.28 +/- 8.81 | 92.45 +/- 10.17 | 92.95 | 94.55 +/- 6.26 | 95.36 +/- 5.06 | 95.00 +/- 5.64 | 92.43 +/- 10.03 |
| Maximum | 100.00 | 100.00 | 100.00 | 92.95 | 100.00 | 99.12 | 100.00 | 100.00 |
| GINI index | | | | | | | | |
| Minimum | 12.48 | 31.25 | 0.00 | 47.39 | 32.99 | 30.05 | 3.54 | 0.00 |
| Mean and sd | 62.44 +/- 12.79 | 53.27 +/- 11.11 | 64.83 +/- 15.40 | 47.39 | 67.67 +/- 9.22 | 49.73 +/- 12.23 | 62.26 +/- 11.99 | 66.45 +/- 14.15 |
| Maximum | 98.50 | 77.38 | 100.00 | 47.39 | 99.04 | 76.06 | 94.12 | 100.00 |
| Ratio between male and female employment | | | | | | | | |
| Minimum | 56.94 | 58.80 | 0.00 | 77.31 | 34.26 | 75.93 | 34.26 | 0.00 |
| Mean and sd | 77.30 +/- 5.40 | 76.80 +/- 3.87 | 74.41 +/- 10.13 | 77.31 | 74.13 +/- 7.04 | 79.07 +/- 2.30 | 75.61 +/- 6.19 | 74.81 +/- 9.54 |
| Maximum | 97.69 | 83.80 | 100.00 | 77.31 | 89.81 | 84.72 | 89.81 | 100.00 |
| Accessibility to train stations | | | | | | | | |
| Minimum | 0.00 | 50.00 | 0.00 | 75.00 | 0.00 | 75.00 | 0.00 | 0.00 |
| Mean and sd | 66.95 +/- 21.31 | 87.24 +/- 14.54 | 43.11 +/- 31.15 | 75.00 | 74.22 +/- 19.07 | 94.57 +/- 10.54 | 73.17 +/- 22.32 | 47.59 +/- 29.19 |
| Maximum | 100.00 | 100.00 | 100.00 | 75.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Number of public cultural sites | | | | | | | | |
| Minimum | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mean and sd | 0.46 +/- 2.26 | 1.22 +/- 2.63 | 1.99 +/- 7.43 | 0.30 | 0.25 +/- 1.31 | 0.30 +/- 0.21 | 0.27 +/- 0.74 | 1.72 +/- 6.78 |
| Maximum | 50.00 | 12.69 | 100.00 | 0.30 | 24.55 | 0.68 | 10.14 | 100.00 |

***Number of non-profit organizations:*** for this indicator, the results show a remarkable heterogeneity across both altimetric and urbanization classes. As shown in figure 34, the

municipalities in the "densely populated" and "rural" classes both have higher mean scores than the intermediate urbanization class (12-14/100 the former two respectively and 8/100 the latter). These differences emerge more clearly when looking at the altimetric classes, in which "inner mountain" areas are characterized by almost a double score than the other classes. This underscores that more remote mountain areas have, together with provincial capital municipalities, a higher number of NGOs per capita.

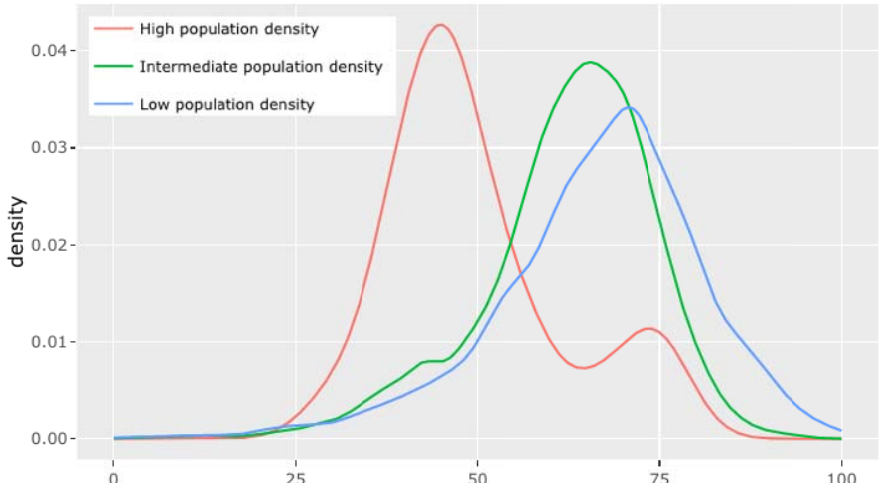
**Figure 34: PDF of "Number of non-profit organizations"**




***Diffusion of residential buildings in a very poor conservation status:*** for this indicator, the results show a general homogeneity across both altimetric and urbanization classes. Municipalities in the "coastal" and "rural" areas have lower values than the other classes, underscoring that such areas are characterized by a lower conservation status of the residential built environment.

***GINI index:*** for this indicator, the results show a relative heterogeneity across urbanization classes and, to a lower extent altimetric classes. The group of "rural" municipalities is characterized by a higher score (66/100) than the other urbanization classes (that is, a lower Gini index and hence a lower inequality across income classes), and in particular of the "densely populated" class, whose score is roughly 25% lower than the former group (49/100). More urbanized centers emerge therefore as more unequal as for the income distribution. Municipalities in "coastal" areas have the lowest values across the altimetric classes (47-53/100, versus a range of 62-67/100 in the other classes).

**Figure 35: PDF of "GINI index"**



***Ratio between male and female employment:*** for this indicator, the results show a relative homogeneity across urbanization and altimetric classes. The group of "rural" and "intermediate density" municipalities is characterized by a relatively lower score (74-75/100) than the group of "densely populated" municipalities (79/100). Municipalities in "inner mountain" and "flat land" areas have a slightly lower values across the altimetric classes (74/100, versus a range of 77-79/100 in the other classes).
***Number of public cultural sites:*** for this indicator, the results show a very remarkable heterogeneity across urbanization classes. The group of "rural" municipalities is characterized by a higher score and standard deviation (1.7/100) than the group of "densely populated" and "intermediate density" municipalities (0.2-0.3/100). Sharp relative variations emerge also across altimetric zone classes, "coastal hill" and "inner mountain" municipalities have a higher value than the remaining altimetric classes (1.2-2/100, versus a range of 0.2-0.4/100 in the other classes).

***Accessibility to train stations***: for this indicator, the results show remarkable differences among the different urbanization classes. The densely populated areas have a mean value almost double than the rural areas. The latter are therefore characterized, unsurprisingly, by a very low performance in this measure of accessibility from the rail network. Similarly, the "inner mountain" class has the lowest mean value across the altimetric classes. Interestingly "coastal hill" municipalities perform even better than the "flat lands" municipalities.

All in all, the social indicators are characterized by a relatively heterogeneity in more than half of the areas identified. More urbanized centers emerge as more virtuous as for social indicators related to infrastructural development ("Accessibility to train stations"), similarly to the results found as for the Economic dimension. The indicator measuring the Alpine cultural dimension on the other hand highlights the strong performance of rural and inner mountain areas. Furthermore, the group of "rural" municipalities is characterized by lower income inequality than the other urbanization classes (that is, a higher score in the indicator based on the Gini index), and in particular of the "densely populated" class, whose score is roughly 25% lower than the former group. More urbanized centers emerge therefore as more unequal as for the income distribution. Municipalities in "coastal" areas are more unequal compared to the other altimetric classes.

# 5. Conclusions

The Report has analyzed the performance of the alpine Provinces and of classes of alpine municipalities across a set of thirty-six indices measuring different aspects of the Green Economy.

The analysis of the SDGs indices confirmed the role of specific Provinces as key case study regions in many dimensions, in particular as for **SDG 3 "Good Health and Well-being"**, the most developed Provinces are Trento, Sondrio and Biella; as for **SDG 4 "Quality Education"**, the most developed Province is Aosta, as for **SDG 5 "Gender Equality"** the most developed Provinces are Aosta, Savona and Gorizia; as for SDG 7 "Clean and affordable energy", the most developed Provinces are Brescia and Bergamo; as for **SDG 8 "Decent Work and Economic Growth"** the most developed Provinces are Vicenza and Treviso, as for the **SDG 9 "Industry, Innovation and Infrastructure"** the most developed Province is Novara, as for **SDG 10 "Reduced Inequality"** the most developed Province is Gorizia, as for **SDG 11 "Sustainable Cities and Communities"** the most developed Province is Brescia, as for **SDG 12 "Responsible Consumption and Production"** the most developed Provinces are Cuneo and Bolzano; as for the SDG 13 "Climate Action", the most developed Provinces are Brescia and Bolzano; as for **SDG 15 "Life on Land"** the most developed Province is Bolzano.

The results of the provincial level analysis point to the substantial **heterogeneity in the performances** of Provinces depending on the dimension analyzed. When looking at the aggregated Green Economy index, some regional groups composed by different provincial units with similar scores emerge: the Central and Eastern Alpine regions are characterized by the most performing Provinces, while the opposite can be observed as for the North Western region. More in detail, **Bolzano emerges as the most developed Province in terms of the aggregate Green Economy index**, while the Western coastal Provinces of Imperia and Savona as well as the North-Western Province of Verbano-Cusio-Ossola as the most underdeveloped.
In the **Economic index**, besides Bolzano, other Provinces with **high scores are all located in the Central areas of the Alps** (Lecco, Treviso, Como, Novara and Varese). On the other hand, the Provinces with the lowest score are in the Central Western and South Western areas (Savona, Vercelli, Aosta, Imperia and Verbanio-Cusio-Ossola). In the **Environmental index** the Provinces' scores are relatively **more homogeneous** than in the other dimensions, despite **few Provinces of the Central Alps have scores relatively higher than the average** (Sondrio, Brescia, Trento and Bolzano). A different picture emerges as for the **Social index**, in which the scores are **more heterogeneous** across the provincial units. In this case, the **Provinces with the highest index score are located in the most Eastern and Western sides of the Alps** (Gorizia, Aosta and Udine).
The scores in the Green Economy indices confirm the results of the SDGs indices, as both generally are not similar across most indices. This suggests that the indices tend to capture a specific set of characteristics of the Alpine areas. Nevertheless, in some cases the result point to the correlation of some indices: this correlation is only occasionally driven by the similarity of the phenomena captured by the indices, as in the case of the indices of the Environmental criteria "Land and soil conservation" and "Biodiversity". More often, the correlation characterizes complementary aspects, as in the case of the Social indices "Local culture and identity" and "Social innovation".
The Green Economy indices furthermore show with even more clarity than the SDG indices the heterogeneity across regional groups of Provinces and the homogeneity within regional groups. This result suggests the possible relevance of regional institutional frameworks and regulations in driving part of the variation in the performance across areas.

In order to determine the possible socio-economic and demographic drivers of the difference in the indicators' value across the alpine municipalities, the results have been compared between

municipalities with a **specific urbanization level** (high density", "intermediate density", "low density") and **typology of altimetric zone** (inner mountain", "coastal mountain", "inner hill", "coastal hill", "flat land").
As for the Economic indicators, high density provincial capitals, often located in flat lands, tend to have higher scores than low density and inner mountain areas as for the **indicators related to innovation** ("diffusion of highly innovative enterprises", "digital divide"), while no substantial difference is found as for the main socio-economic indicators ("variation in the unemployment rate 2001-2011" and "percentage of young people who do not work and do not study") and, finally, lower density areas and inner mountain areas are characterized by higher scores in the indicators related to specific green economy activities ("diffusion of silviculture and forest management enterprises"). The Alpine capital cities tend to be the centers of localization of services and innovative economic activities, while inner mountainous areas are specialized in some key Green Economy sectors.

As for the **Environmental indicators**, high density provincial capitals tend to have higher scores than low density and inner mountain areas as for the indicators related to **green technologies' diffusion** ("density of photovoltaic installations"). Less differences are found as for the **consumption related indicators**, despite as for the waste generation low density municipalities emerge as more virtuous than more dense areas. Coastal hills and mountain areas emerge as the **most vulnerable to hydraulic risk and landslide risk**, as well as lower density areas compared to higher density ones. The provincial capitals and coastal hills areas are more virtuous as for the "diffusion of slow mobility alternatives", but at the same time low density rural areas are more virtuous than intermediate density areas.
As for the Social indicators, the heterogeneity across different municipalities emerges more clearly than in the Environmental and Economic dimension. High density areas in flat lands tend to have higher scores than low density and inner mountain areas as for the indicators related to **infrastructure** ("Accessibility to train stations", "Diffusion of residential buildings in a very poor conservation status"). Interestingly, a very relevant difference across the social indicators is found as for income inequality, measured by the normalization of the **Gini index**. The group of "rural" municipalities is characterized by lower income inequality than the other urbanization classes, and in particular of the "densely populated" class, whose score is roughly 25% lower than the former group. More urbanized centers emerge therefore as more unequal as for the income distribution. Furthermore, inner mountains and rural areas have much higher scores than other classes as for the **public cultural promotion** ("number of public cultural sites per capita"). Finally, no substantial differences are found as for the **gender equality** indicator ("ratio between male and female employment"), despite provincial capital areas have slightly higher scores than lower density areas.

# 6. Annex

Table a.1 DESCRIPTION OF INDICATORS

| SELECTED INDICATOR | SOURCE | LEVEL | UNIT | YEAR | CODE |
|---|---|---|---|---|---|
| **Patents in the biotechnology sector** | BES | Provincial | Percentage | 2011-2012 | IE_8 |
| **Bed capacity of farmhouses and alpine huts** | Bocconi based on ISTAT | Provincial | Percentage (number of beds over total capacity of hotels and other tourism establishments) | 2015 | IE_1 |
| **Average decadal net variation of residents (1991-2001-2011)** | Urban Index | Provincial, Municipal | Average of the percentage difference between 1991-2001-2011 | 2011 | IE_5 |
| **Digital divide** | Urban Index | Provincial, Municipal | Percentage of population excluded from broadband from fixed and mobile networks | 2013 | IE_11 |
| **Income available per family** | BES | Provincial | Euro | 2016 | IE_4 |
| **Percentage of young people who do not work and do not study** | Urban Index | Provincial, Municipal | Percentage ratio of residents aged 15-29 in non-professional condition other than a student on residents | 2011 | IE_9 |
| **Variation in the unemployment rate 2001-2011** | Urban Index | Provincial, Municipal | Percentage ratio | 2011 | IE_3 |
| **Diffusion of farmhouse enterprises** | BES | Provincial | Percentage (Number over total number of enterprises) | 2016 | IE_2 |
| **Diffusion of craft enterprises (number of enterprises over total enterprises)** | Chambers of commerce | Provincial | Percentage (Number over total number of enterprises) | 2017 | IE_6 |
| **Diffusion of silvicolture and forest management enterprises** | Bocconi based on ISTAT | Provincial, Municipal | Percentage (Number over total number of enterprises) | 2010 | IE_10 |
| **Diffusion of organic production enterprises** | Bocconi based on ISTAT | Provincial | Percentage (number of enterprises over total enterprises in the agricultural and farming sector) | 2010 | IE_7 |
| **Diffusion of highly innovative enterprises** | Urban Index | Provincial, Municipal | Percentage of APS and KIBS companies | 2011 | IE_12 |
| **High Nature Value farmland impacted by urban expansion (percentage of region's area)** | EEA | Provincial | Percentage | 2017 | ENV_6 |
| **Diffusion of certified forests (PEFC or FSC** | Bocconi, based on | Provincial | Percentage | 2018 | ENV_2 |

| | | | | | |
|---|---|---|---|---|---|
| **certified forest area over total forest area)** | RaFITALIA | | | | |
| **High and very high fragmentation** | EEA | Provincial | Percentage (of region's area covered by pressure classes) | 2015 | ENV_7 |
| **Population exposed to hydraulic risk** | Urban Index | Provincial, Municipal | Percentage | 2015 | ENV_5 |
| **Density of photovoltaic installations** | Urban Index | Provincial, Municipal | num/kmq | 2013 | ENV_4 |
| **Total density of green areas (protected natural areas and urban green areas) in the provincial capital municipalities** | BES | Provincial | mq per inhabitant | 2016 | ENV_8 |
| **Density of cycle paths in the provincial capital municipalities** | ISTAT | Provincial | | | ENV_3 |
| **Availability of local public transport** | BES | Provincial | seats-km per inhabitant | 2015 | ENV_1 |
| **Production of urban waste per capita** | Urban Index | Provincial, Municipal | kg/ab | 2013 | ENV_9 |
| **Water consumption per capita** | Bocconi based on ISTAT | Provincial, Municipal | l/ab | 2016 | ENV_10 |
| **Diffusion of slow mobility alternatives** | Urban Index | Provincial, Municipal | Infrastructure and mobility | 2011 | ENV_12 |
| **Population exposed to landslide risk** | ISPRA | Provincial, Municipal | Percentage | 2015 | ENV_11 |
| **Number of public cultural sites** | Urban Index | Provincial, Municipal | Total number of the following state cultural sites: fortified architecture, archaeological areas, historical monuments, monuments of industrial archeology, funerary monuments, archives and libraries, churches and places of worship, villas and palaces, archaeological parks, museums and galleries. | 2013 | IS_3 |
| **Cohesion policy funding per capita (2007-2020) on the topics culture and tourism** | Cohesion Policy data | Provincial | Euro per capita | 2018 | IS_2 |
| **GINI index** | Urban Index | Provincial, Municipal | Index based on population divided into subgroups and having only the average income for each subgroup | 2012 | IS_11 |
| **Children who have benefited from municipal childcare services** | BES | Provincial | Number per 10.000 inhabitants | 2015 | IS_1 |
| **Irregularity of the electricity service** | BES | Provincial | Number per user | 2015 | IS_4 |
| **Diffusion of** | Urban Index | Provincial, | Percentage ratio between the | 2011 | IS_12 |

| | | | | | |
|---|---|---|---|---|---|
| **residential buildings in a very poor conservation status** | | Municipal | residential buildings used in a very bad state and the total residential buildings used | | |
| **Number of non-profit organizations** | BES | Provincial, Municipal | Number per 10.000 inhabitants | 2011 | IS_6 |
| **Enterprises run by women** | Chambers of commerce | Provincial | Percentage (over total enterprises) | 2017 | IS_7 |
| **Ratio between male and female employment** | Urban Index | Provincial, Municipal | Percentage ratio between the male employment rate (males employed compared to the male resident population aged 15 and over) and the female one. | 2011 | IS_10 |
| **Patient migration towards hospitals in other regions** | BES | Provincial | Number per 10.000 inhabitants | 2015 | IS_9 |
| **Mortality rate due to PM2.5** | Dipartimento di Epidemiologia del Servizio Sanitario Regionale del Lazio | Provincial | Deaths per hundred tohousand inhabitants | 2010 | IS_5 |
| **Accessibility to train stations** | Urban Index | Provincial, Municipal | Ranking (0-4);<br>It is calculated using a sampling function of the isochrones in which the centroid of the municipality falls. Among all the isochrones, the one corresponding to the shortest travel time is selected: 0 = average travel time greater than 60 minutes<br>1 = average travel time between 45 and 60 minutes<br>2 = average travel time between 30 and 45 minutes<br>3 = average travel time between 15 and 30 minutes<br>4 = average travel time less than 15 minutes | 2013 | IS_8 |

Table a.2 RESULTS FOR EACH INDICATOR

| Province | EN1_n | EN2_n | EN3_n | EN4_n | EN5_n | EN6_n | EN7_n | EN8_n | EN9_n | EN10_n | EN11_n | EN12_n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aosta** | 4 | 0 | 21 | 4 | 24 | 100 | 100 | 4 | 100 | 49 | 40 | 45 |
| **Belluno** | 33 | 0 | 4 | 3 | 100 | 86 | 100 | 59 | 31 | 84 | 88 | 32 |
| **Bergamo** | 35 | 0 | 78 | 74 | 64 | 76 | 75 | 35 | 30 | 98 | 87 | 45 |
| **Biella** | 1 | 0 | 5 | 24 | 69 | 95 | 50 | 99 | 39 | 73 | 99 | 0 |
| **Bolzano** | 42 | 100 | 67 | 14 | 79 | 100 | 100 | 9 | 26 | 75 | 94 | 100 |
| **Brescia** | 100 | 0 | 92 | 55 | 55 | 57 | 75 | 83 | 11 | 83 | 84 | 46 |
| **Como** | 39 | 3 | 13 | 55 | 70 | 33 | 75 | 98 | 25 | 86 | 88 | 13 |
| **Cuneo** | 34 | 0 | 20 | 12 | 33 | 90 | 75 | 11 | 89 | 96 | 88 | 54 |
| **Gorizia** | 10 | 0 | 12 | 100 | 0 | 0 | 25 | 28 | 25 | 23 | 100 | 25 |
| **Imperia** | 8 | 0 | 0 | 10 | 16 | 100 | 100 | 1 | 1 | 66 | 65 | 49 |
| **Lecco** | 22 | 0 | 8 | 49 | 53 | 48 | 75 | 60 | 12 | 87 | 80 | 27 |
| **Novara** | 29 | 0 | 13 | 24 | 89 | 76 | 25 | 0 | 47 | 50 | 95 | 32 |
| **Pordenone** | 17 | 0 | 76 | 40 | 64 | 90 | 75 | 51 | 35 | 95 | 98 | 22 |
| **Savona** | 34 | 4 | 3 | 7 | 24 | 62 | 75 | 23 | 0 | 68 | 60 | 31 |
| **Sondrio** | 0 | 10 | 54 | 24 | 61 | 100 | 100 | 98 | 36 | 94 | 75 | 52 |
| **Torino** | 82 | 9 | 100 | 28 | 36 | 90 | 75 | 49 | 69 | 0 | 72 | 26 |
| **Trento** | 51 | 84 | 23 | 26 | 97 | 95 | 100 | 100 | 11 | 62 | 75 | 49 |
| **Treviso** | 40 | 0 | 74 | 89 | 35 | 95 | 0 | 29 | 57 | 100 | 100 | 24 |
| **Udine** | 40 | 43 | 46 | 40 | 87 | 81 | 75 | 6 | 38 | 78 | 94 | 18 |
| **Varese** | 29 | 0 | 11 | 69 | 77 | 52 | 0 | 88 | 31 | 100 | 95 | 8 |
| **Verbano-Cusio-Ossola** | 14 | 0 | 44 | 0 | 20 | 100 | 100 | 48 | 76 | 56 | 0 | 27 |
| **Vercelli** | 1 | 1 | 30 | 3 | 56 | 95 | 50 | 8 | 71 | 63 | 93 | 44 |
| **Verona** | 41 | 0 | 28 | 35 | 62 | 90 | 25 | 22 | 20 | 30 | 97 | 35 |
| **Vicenza** | 50 | 7 | 48 | 73 | 86 | 90 | 50 | 9 | 48 | 97 | 97 | 26 |

| Province | IS1_n | IS2_n | IS3_n | IS4_n | IS5_n | IS6_n | IS7_n | IS8_n | IS9_n | IS10_n | IS11_n | IS12_n |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aosta** | 61 | 100 | 24 | 58 | 100 | 77 | 85 | 28 | 14 | 100 | 62 | 39 |
| **Belluno** | 1 | 9 | 10 | 25 | 100 | 44 | 39 | 7 | 72 | 69 | 65 | 54 |
| **Bergamo** | 31 | 2 | 11 | 67 | 25 | 5 | 27 | 65 | 99 | 6 | 72 | 71 |
| **Biella** | 34 | 12 | 21 | 50 | 92 | 36 | 42 | 84 | 68 | 74 | 95 | 0 |
| **Bolzano** | 25 | 0 | 49 | 25 | 97 | 100 | 0 | 0 | 82 | 95 | 0 | 100 |
| **Brescia** | 15 | 3 | 42 | 67 | 38 | 3 | 35 | 28 | 91 | 0 | 62 | 64 |
| **Como** | 28 | 7 | 0 | 75 | 41 | 1 | 16 | 49 | 99 | 52 | 37 | 75 |
| **Cuneo** | 2 | 21 | 42 | 0 | 84 | 45 | 68 | 17 | 89 | 63 | 59 | 23 |
| **Gorizia** | 100 | 9 | 16 | 92 | 51 | 45 | 81 | 100 | 80 | 79 | 76 | 85 |
| **Imperia** | 13 | 31 | 100 | 0 | 99 | 9 | 85 | 72 | 44 | 50 | 47 | 30 |
| **Lecco** | 30 | 1 | 11 | 83 | 52 | 9 | 19 | 75 | 99 | 32 | 53 | 71 |
| **Novara** | 39 | 10 | 17 | 67 | 28 | 5 | 65 | 65 | 0 | 65 | 62 | 70 |
| **Pordenone** | 40 | 3 | 37 | 42 | 75 | 34 | 61 | 51 | 47 | 60 | 63 | 58 |
| **Savona** | 29 | 17 | 63 | 33 | 87 | 10 | 100 | 52 | 46 | 60 | 51 | 50 |
| **Sondrio** | 14 | 3 | 23 | 58 | 100 | 9 | 82 | 23 | 100 | 12 | 59 | 61 |
| **Torino** | 25 | 22 | 56 | 17 | 0 | 22 | 62 | 21 | 89 | 74 | 72 | 49 |
| **Trento** | 60 | 4 | 26 | 67 | 98 | 56 | 3 | 11 | 33 | 49 | 45 | 65 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treviso** | 0 | 12 | 9 | 58 | 61 | 4 | 26 | 58 | 86 | 42 | 47 | 66 |
| **Udine** | 45 | 3 | 37 | 100 | 76 | 43 | 77 | 32 | 80 | 52 | 67 | 56 |
| **Varese** | 19 | 1 | 34 | 50 | 26 | 0 | 32 | 80 | 94 | 69 | 40 | 69 |
| **Verbano-Cusio-Ossola** | 20 | 35 | 35 | 25 | 93 | 53 | 70 | 66 | 17 | 37 | 56 | 37 |
| **Vercelli** | 18 | 10 | 21 | 33 | 55 | 38 | 72 | 44 | 53 | 47 | 100 | 47 |
| **Verona** | 18 | 5 | 32 | 67 | 38 | 6 | 34 | 48 | 81 | 40 | 42 | 63 |
| **Vicenza** | 14 | 5 | 15 | 75 | 52 | 4 | 24 | 45 | 93 | 40 | 61 | 58 |

| **Province** | **IE1_n** | **IE2_n** | **IE3_n** | **IE4_n** | **IE5_n** | **IE6_n** | **IE7_n** | **IE8_n** | **IE9_n** | **IE10_n** | **IE11_n** | **IE12_n** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aosta** | 36 | 1 | 0 | 54 | 70 | 66 | 0 | 0 | 45 | 6 | 34 | 30 |
| **Belluno** | 17 | 6 | 36 | 50 | 0 | 76 | 33 | 0 | 83 | 100 | 59 | 31 |
| **Bergamo** | 20 | 11 | 81 | 29 | 94 | 89 | 27 | 10 | 66 | 5 | 86 | 50 |
| **Biella** | 59 | 12 | 93 | 57 | 17 | 66 | 40 | 0 | 69 | 26 | 47 | 49 |
| **Bolzano** | 69 | 100 | 7 | 100 | 82 | 0 | 64 | 91 | 100 | 51 | 62 | 0 |
| **Brescia** | 16 | 14 | 63 | 20 | 97 | 58 | 26 | 15 | 41 | 4 | 85 | 71 |
| **Como** | 15 | 25 | 55 | 11 | 71 | 92 | 64 | 30 | 67 | 11 | 71 | 95 |
| **Cuneo** | 100 | 11 | 48 | 54 | 24 | 24 | 100 | 6 | 77 | 29 | 25 | 17 |
| **Gorizia** | 9 | 57 | 62 | 29 | 42 | 29 | 52 | 0 | 80 | 0 | 93 | 57 |
| **Imperia** | 37 | 39 | 14 | 7 | 29 | 59 | 21 | 33 | 0 | 17 | 44 | 1 |
| **Lecco** | 39 | 20 | 71 | 25 | 82 | 100 | 90 | 11 | 84 | 6 | 92 | 96 |
| **Novara** | 3 | 9 | 69 | 30 | 74 | 76 | 51 | 100 | 58 | 16 | 42 | 75 |
| **Pordenone** | 45 | 3 | 91 | 59 | 46 | 50 | 19 | 14 | 70 | 15 | 59 | 52 |
| **Savona** | 9 | 22 | 7 | 18 | 48 | 69 | 28 | 19 | 49 | 50 | 63 | 21 |
| **Sondrio** | 58 | 6 | 0 | 56 | 26 | 52 | 21 | 70 | 69 | 31 | 86 | 50 |
| **Torino** | 23 | 5 | 64 | 51 | 55 | 49 | 25 | 30 | 58 | 8 | 52 | 66 |
| **Trento** | 23 | 13 | 23 | 53 | 72 | 13 | 50 | 24 | 81 | 50 | 62 | 44 |
| **Treviso** | 77 | 27 | 100 | 65 | 100 | 32 | 14 | 0 | 75 | 2 | 75 | 78 |
| **Udine** | 15 | 17 | 57 | 49 | 12 | 58 | 25 | 11 | 77 | 39 | 35 | 47 |
| **Varese** | 0 | 12 | 69 | 23 | 82 | 79 | 34 | 26 | 63 | 15 | 100 | 100 |
| **Verbano-Cusio-Ossola** | 16 | 1 | 22 | 0 | 8 | 93 | 29 | 0 | 56 | 30 | 0 | 8 |
| **Vercelli** | 64 | 0 | 64 | 40 | 12 | 58 | 64 | 0 | 37 | 22 | 11 | 28 |
| **Verona** | 15 | 28 | 55 | 64 | 94 | 35 | 42 | 12 | 58 | 1 | 78 | 58 |
| **Vicenza** | 26 | 17 | 83 | 73 | 81 | 62 | 19 | 1 | 80 | 10 | 78 | 58 |

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