

# “The cleantech industry in the European Green Deal: policy challenges and the finance landscape for SMEs (CLEU)”

Description of the project

## The CLEU project

- **Type of Grant:** EIB University Research Sponsorship Programme (EIBURS)
- **Duration:** From May 2022 to May 2025
- **Partners:** Politecnico di Torino (lead partner), Politecnico di Milano and University of Bologna

## Project goals

The goals of the project are to:

- analyze the actions that are undertaken by European cleantech firms to engage in transformative climate and innovation actions;
- examine the association between environmental indicators, firm-level innovation and venture capital investments in cleantech companies;
- analyze the enabling factors for the development of European cleantech firms;
- analyze the extent the interplay between policies and external equity financing.

## Main research lines

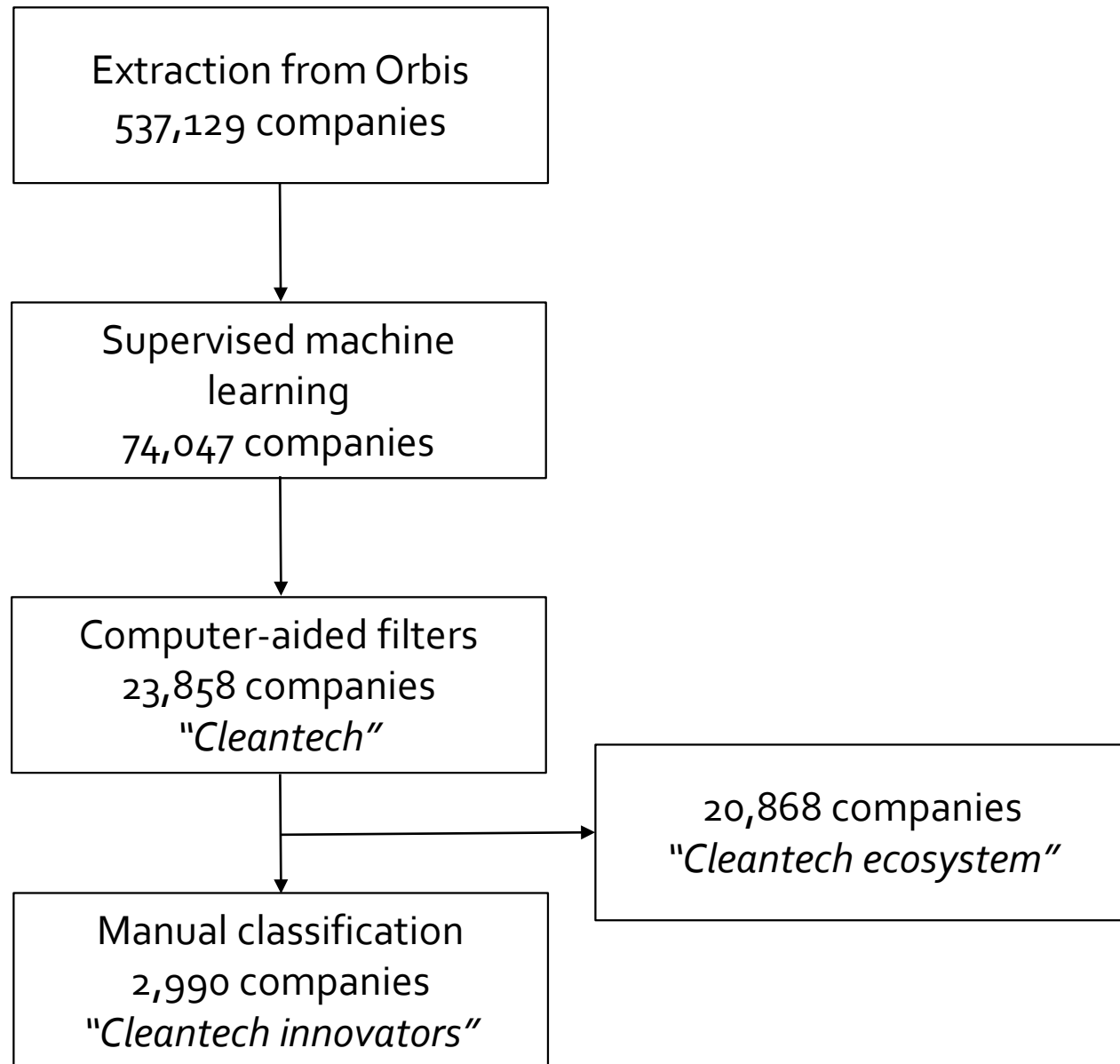
- **Wp1: The mapping of cleantech in Europe**
  - a dataset of cleantech companies with financial accounting information, patent data, and sources of financing
  - interactive data visualization tools and techniques to map the cleantech sector
- **WP2: The European Green Deal and the transformative climate and innovation actions of cleantech firms**
  - execution of a survey to a selected sample of European cleantech firms on the elements of the European Green Deal
- **Wp3: The enabling factors for the development of cleantech firms**
  - Impact of the implementation of targeted policies central to the European Green Deal and of the different sources of financing on the financial and innovative performance of cleantech firms
- **Wp4: Policies, equity offer and equity demand**
  - How policies and regulations affect both the propensity of cleantech firms to seek external equity financing and the offer of equity by VCs

# WP1

## The mapping of cleantech in Europe

- **Identification of cleantech companies**
  - usage of a methodology based upon a supervised machine learning (ML) algorithm applied to the extended business description of each company
  - cleantech companies (SMEs) identified from Orbis db.
  - categorization of cleantech companies to reflect the pillars of the EU Green Deal
- **Collection of patent data**
  - Collection of patents from Orbis Intellectual Property + additional patent information from PATSTAT
- **Collection of sources of financing data**
  - Identification of the sources of financing (VC financing)
- **Overview of the cleantech sector through visualization techniques**
  - Mapping of the geographical distribution, the evolution over time, the current size, the patenting activities, and the sources of financing of the cleantech sector

## Breakdown of classification steps



## The sub-classification

We then assigned each company one or more technological categories

1. Environmental management
  1. Air/water/soil pollution abatement/remediation
  2. Waste management
2. Resources preservation
  1. Water conservation/availability
  2. Sustainable agri-food technologies
  3. Sustainable raw materials
3. Industrial energy management
  1. Sustainable energy production
  2. Sustainable fuels
  3. Energy-efficient industrial technologies
4. Capture, storage, sequestration or disposal of GHG
5. Sustainable modes of transport
6. Sustainable buildings
7. Others categories

## The cleantech ecosystem

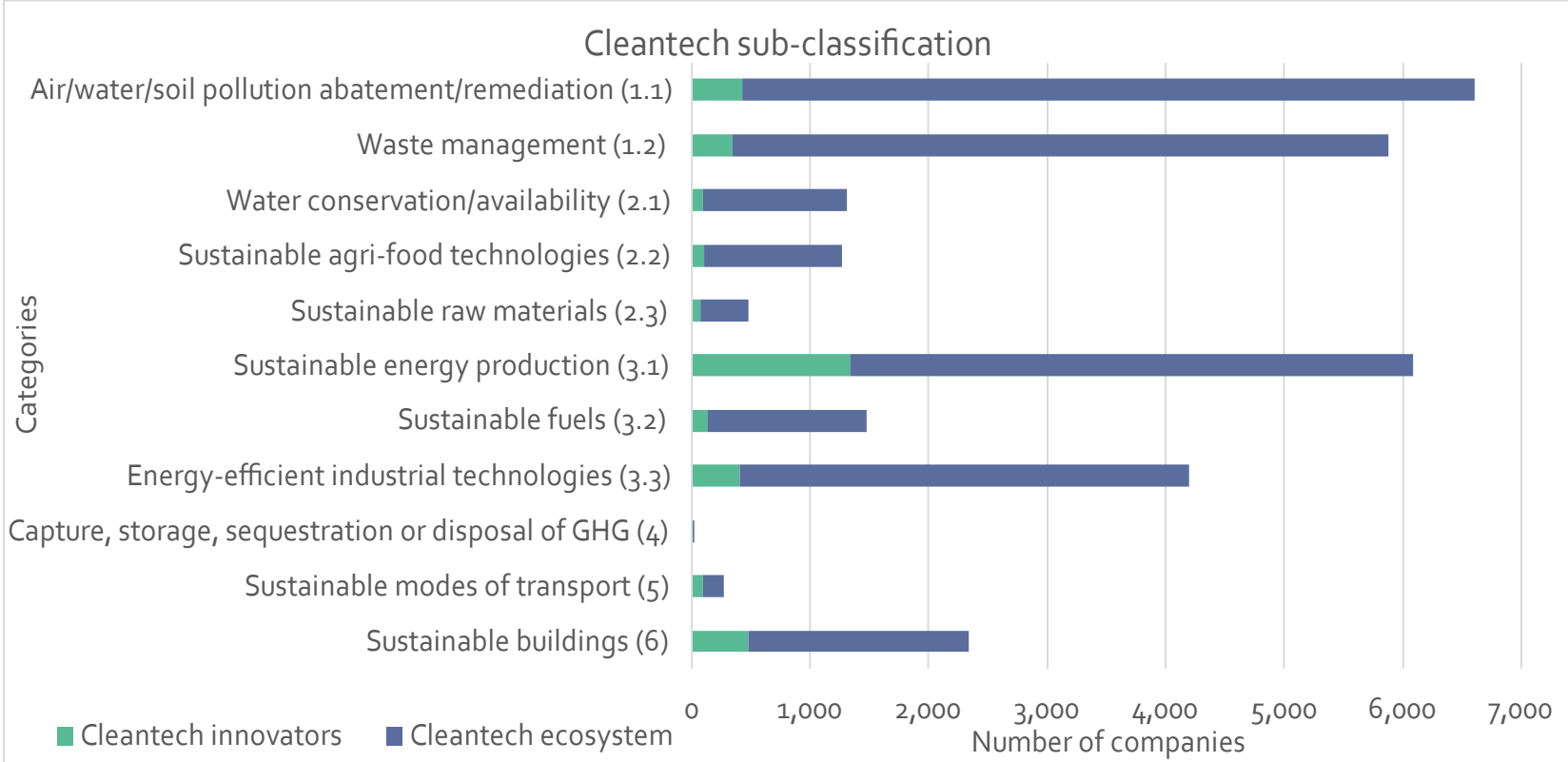
- **Cleantech innovators:** create (and eventually use) the clean technology as their core business
- **Cleantech ecosystem:** adopt clean technologies, sell services based on clean technologies, or provide inputs for the development of clean technologies
- We identified 5 different groups in the **cleantech ecosystem**:
  - **Distributors** – only distribute or are involved in the commercial provision of cleantech products or technologies.
  - **Integrators**– construction/installation services to support the cleantech sector
  - **Manufacturers** – manufacturers of cleantech supply chain products
  - **Operators**– operators of cleantech facilities
  - **Experimenters** – cleantech researchers (both private or public)



## The cleantech taxonomy

Category	n. companies	%
Cleantech innovators	2,990	12.5%
Cleantech ecosystem	20,868	87.5%
Experimenters	103	0.4%
Manufacturers	5,380	22.6%
Distributors	3,337	14.0%
Integrators	6,558	27.5%
Operators	5,490	23.0%
<i>Total</i>	<i>23,858</i>	<i>100.0%</i>

# Sub-classification distribution

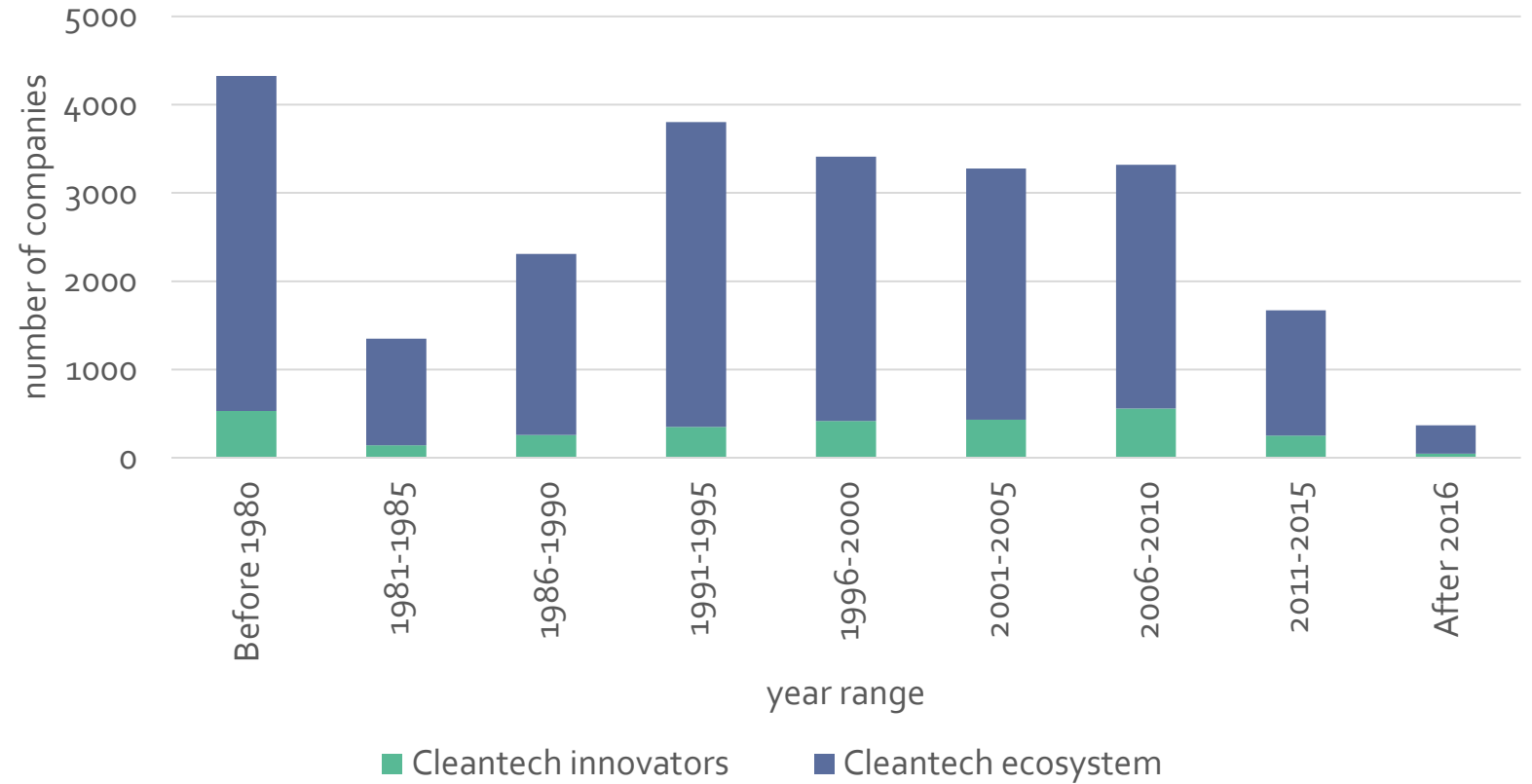


## Geographical distribution

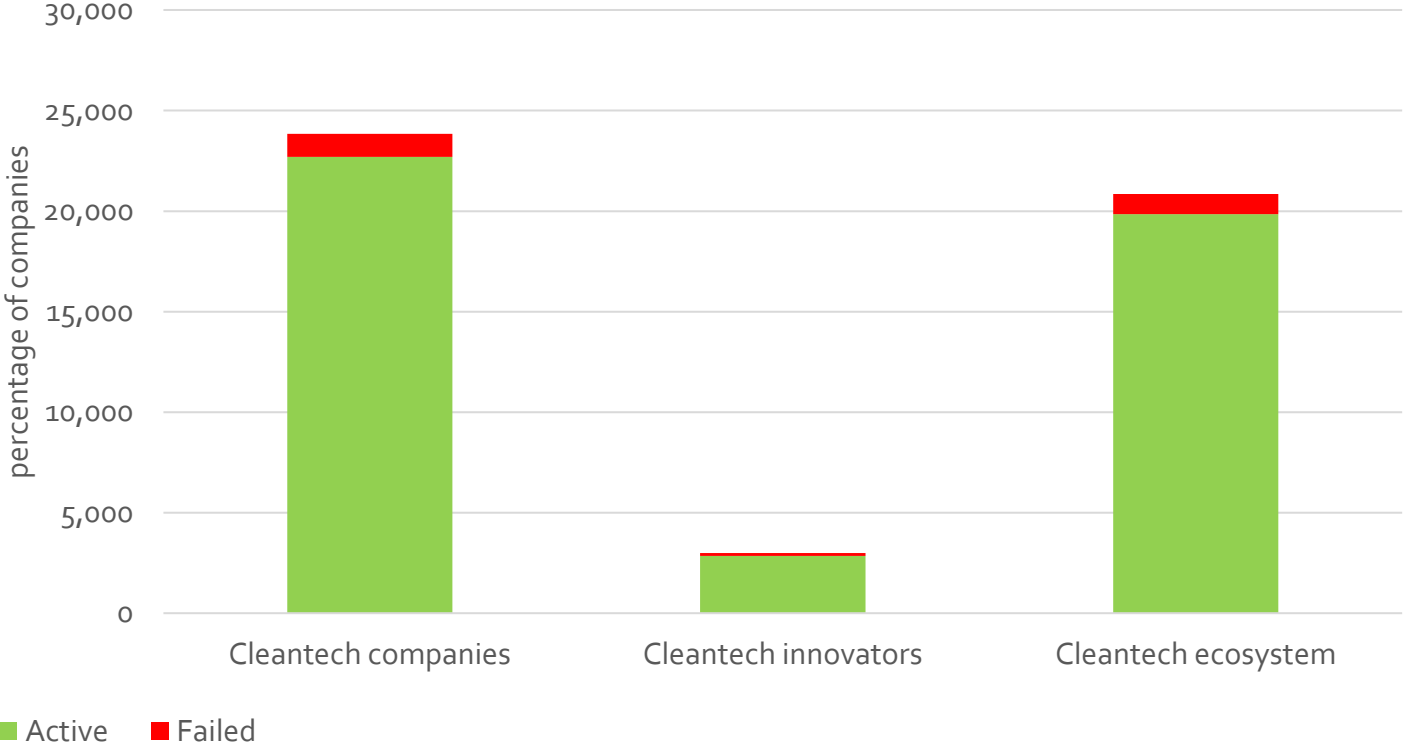
Country	Cleantech companies		Cleantech innovators		Cleantech ecosystem	
	n. comp	%	n. comp	%	n. comp	%
Germany	4,444	18.65%	515	17.25%	3,929	18.85%
Italy	4,254	17.85%	559	18.73%	3,695	17.73%
France	3,414	14.33%	371	12.43%	3,043	14.60%
Spain	2,072	8.70%	329	11.02%	1,743	8.36%
Poland	1,443	6.06%	152	5.09%	1,291	6.19%
Sweden	845	3.55%	141	4.72%	704	3.38%
Czech Republic	743	3.12%	99	3.32%	644	3.09%
Belgium	706	2.96%	101	3.38%	605	2.90%
Norway	677	2.84%	79	2.65%	598	2.87%
Austria	598	2.51%	85	2.85%	513	2.46%
Others	4,632	19.43%	554	18.56%	4,078	19.57%
<b>Total</b>	<b>23,828</b>	<b>100.00%</b>	<b>2,985</b>	<b>100.00%</b>	<b>20,843</b>	<b>100.00%</b>

**Note:** the residual category includes Romania, Finland, Portugal, Hungary, Netherlands, Denmark, Bulgaria, Slovakia, Serbia, Greece, Croatia, Lithuania, Slovenia, Latvia, Estonia, United Kingdom, Luxembourg, Switzerland, North Macedonia, Iceland, Turkey, Malta, Montenegro, Ireland, and Cyprus.

# Foundation year of sample companies



# Status of companies



## Patent data

- We retrieved EPO patent data for cleantech companies from Orbis IP
- We matched publication number of the patents collected from Orbis IP to those in the Worldwide Patent Statistical Database (PATSTAT) to retrieve additional data (e.g., application dates, technological codes, etc.)
- We identified those patents that report a Cooperative Patent Classification (CPC) code equal to Y02: it indicates the group of fields dealing with technologies or applications for mitigation or adaptation against climate change (CCMT)

Category	At least 1 EPO patent in any tech field		At least 1 EPO patent in a CCMT field (CPC: Y02)	
	n.comp.	%	n.comp.	%
All cleantech companies	2,705	11.3%	1,166	4.9%
<i>Cleantech innovators</i>	792	26.5%	490	16.4%
<i>Cleantech ecosystem</i>	1,913	9.2%	676	3.2%

## Patent data and cleantech taxonomy

### Firms with patents and with CCMT patents by cleantech taxonomy

Category	Cleantech companies		At least 1 EPO patent in any tech field		At least 1 EPO patent in a CCMT field (CPC: Y02)	
	n.comp.	%	n.comp.	%	n.comp.	%
Cleantech innovator	2,990	12.5%	792	26.5%	490	16.4%
Cleantech ecosystem						
<i>Integrator</i>	6,558	27.5%	307	4.7%	106	1.6%
<i>Operator</i>	5,490	23.0%	222	4.0%	107	1.9%
<i>Manufacturer</i>	5,380	22.6%	1,179	21.9%	396	7.4%
<i>Distributor</i>	3,337	14.0%	174	5.2%	56	1.7%
<i>Experimenters</i>	103	0.4%	31	30.1%	11	10.7%
<b>Total</b>	<b>23,858</b>	<b>100.0%</b>	<b>2,705</b>	<b>11.3%</b>	<b>1,166</b>	<b>4.9%</b>

## Patent data and sub-classification

### Firms with patents and with CCMT patents by cleantech sub-classification

Sub-classification	At least one EPO patent in any field		Of which with at least one EPO patent in a CCMT field	
	n. companies	%	n. companies	%
Air/water/soil pollution abatement/remediation (1.1)	591	9.57%	191	32.32%
Waste management (1.2)	369	6.67%	115	31.17%
Water conservation/availability (2.1)	164	13.50%	69	42.07%
Sustainable agri-food technologies (2.2)	68	5.85%	19	27.94%
Sustainable raw materials (2.3)	72	17.69%	24	33.33%
Sustainable energy production (3.1)	462	9.73%	206	44.59%
Sustainable fuels (3.2)	155	11.58%	71	45.81%
Energy-efficient industrial technologies (3.3)	327	8.63%	123	37.61%
Capture, storage, sequestration or disposal of GHG (4)	1	8.33%	1	100.00%
Sustainable modes of transport (5)	38	20.88%	19	50.00%
Sustainable buildings (6)	186	9.99%	67	36.02%
Others	59	8.59%	18	30.51%
<i>Total</i>	<i>1.913</i>	<i>9.17%</i>	<i>676</i>	<i>35.34%</i>



## Patent data and geographical distribution

### Firms with patents and with CCMT patents by country

Country	At least one EPO patent in any field		Of which with at least one EPO patent in a CCMT field	
	n. companies	%	n. companies	%
Germany	786	17.69%	379	48.22%
Italy	558	13.12%	186	33.33%
France	259	7.59%	95	36.68%
Spain	182	8.78%	88	48.35%
Poland	59	4.09%	17	28.81%
Sweden	164	19.41%	73	44.51%
Czech Republic	34	4.58%	15	44.12%
Belgium	88	12.46%	31	35.23%
Norway	70	10.34%	31	44.29%
Austria	133	22.24%	67	50.38%
Others	365	7.88%	181	49.59%
<b>Total</b>	<b>2,698</b>	<b>11.32%</b>	<b>1,163</b>	<b>43.11%</b>

**Note:** the residual category includes Romania, Finland, Portugal, Hungary, Netherlands, Denmark, Bulgaria, Slovakia, Serbia, Greece, Croatia, Lithuania, Slovenia, Latvia, Estonia, United Kingdom, Luxembourg, Switzerland, North Macedonia, Iceland, Turkey, Malta, Montenegro, Ireland, and Cyprus.

## Accounting data

- We retrieved accounting data for cleantech companies from Orbis

	Cleantech companies					
	N. obs	Mean	Median	St. dev.	Min	Max
Sales (000'€)	198,485	221,589	10,327	3,315,137	0	291,000,000
Total assets (000'€)	228,528	273,456	8,772	4,349,048	0	388,000,000
Net profit (000'€)	200,591	8,801	209	209,951	-19,000,000	27,000,000
EBITDA (000'€)	189,364	29,755	724	544,140	-12,700,000	79,900,000
N. employees	175,991	592	47	5,482	0	317,034

	Cleantech innovators	Cleantech ecosystem	Difference	sig.
Sales (000'€)	337,236	204,401	132,835	***
Total assets (000'€)	382,190	257,825	124,365	***
Net profit (000'€)	10,452	8,554	1,898	
EBITDA (000'€)	37,926	28,537	9,389	**
N. employees	1,112	515	597	***

## VC investments data and cleantech taxonomy

- We retrieved VC investment data for cleantech companies from VICO, Preqin and Crunchbase

Category	At least 1 deal	
	Count	%
All selected cleantech companies	219	0.92%
<i>Cleantech innovators</i>	77	2.58%
<i>Cleantech ecosystem</i>	142	0.68%
<i>Experimenters</i>	1	0.97%
<i>Manufacturers</i>	64	1.19%
<i>Distributors</i>	17	0.51%
<i>Integrators</i>	30	0.46%
<i>Operators</i>	30	0.55%

## VC investments and sub-classification

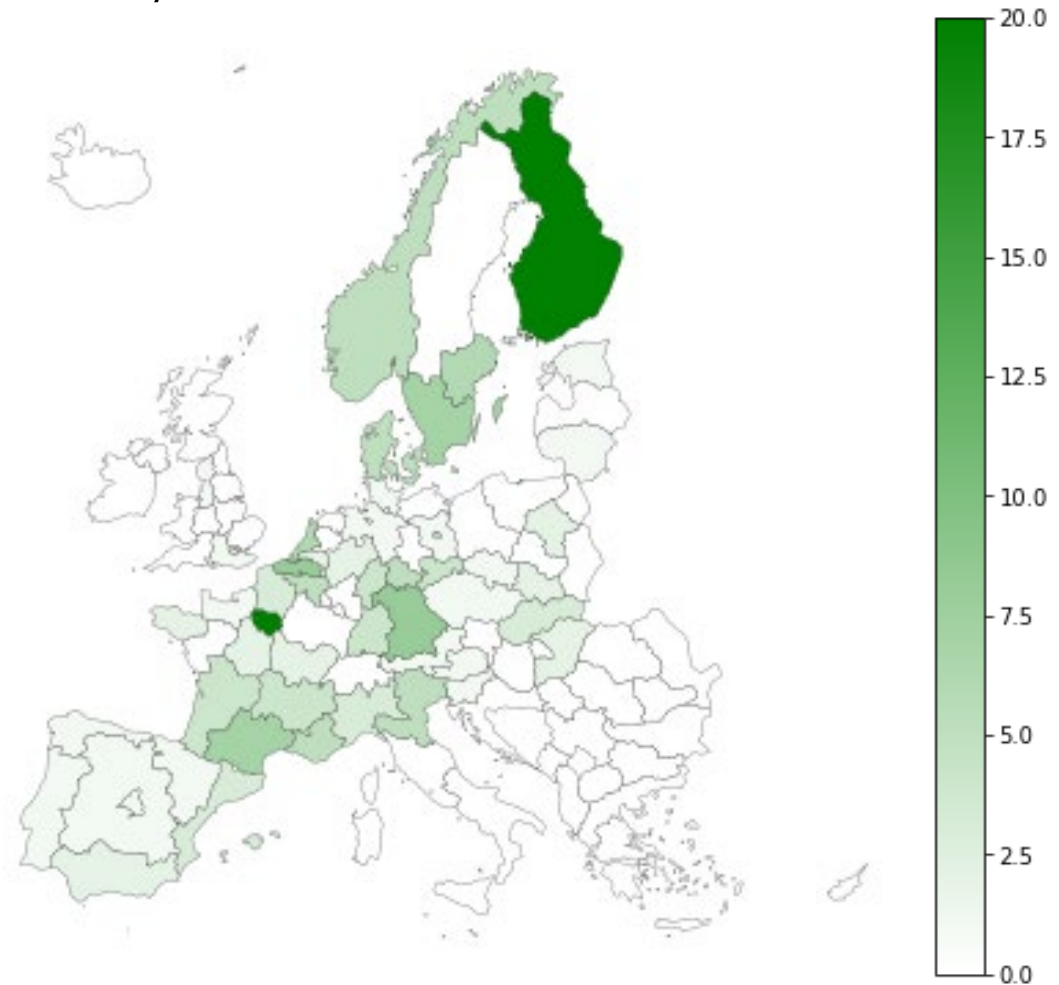
Sub-classification	VC-backed companies			
	cleantech innovators		cleantech ecosystem	
	n. comp.	%	n. comp.	%
Air/water/soil pollution abatement/remediation (1.1)	5	1.17%	27	0.44%
Waste management (1.2)	5	1.44%	23	0.42%
Water conservation/availability (2.1)	0	0.00%	4	0.33%
Sustainable agri-food technologies (2.2)	1	0.95%	4	0.34%
Sustainable raw materials (2.3)	4	5.26%	10	2.46%
Sustainable energy production (3.1)	43	3.21%	62	1.31%
Sustainable fuels (3.2)	6	4.48%	13	0.97%
Energy-efficient industrial technologies (3.3)	17	4.18%	27	0.71%
Capture, storage, sequestration or disposal of GHG (4)	0	0.00%	0	0.00%
Sustainable modes of transport (5)	1	1.11%	3	1.65%
Sustainable buildings (6)	6	1.27%	8	0.43%
Others	0	0.00%	5	0.73%
<b>Total</b>	<b>77</b>	<b>2.58%</b>	<b>142</b>	<b>0.68%</b>

## VC investments and patent data

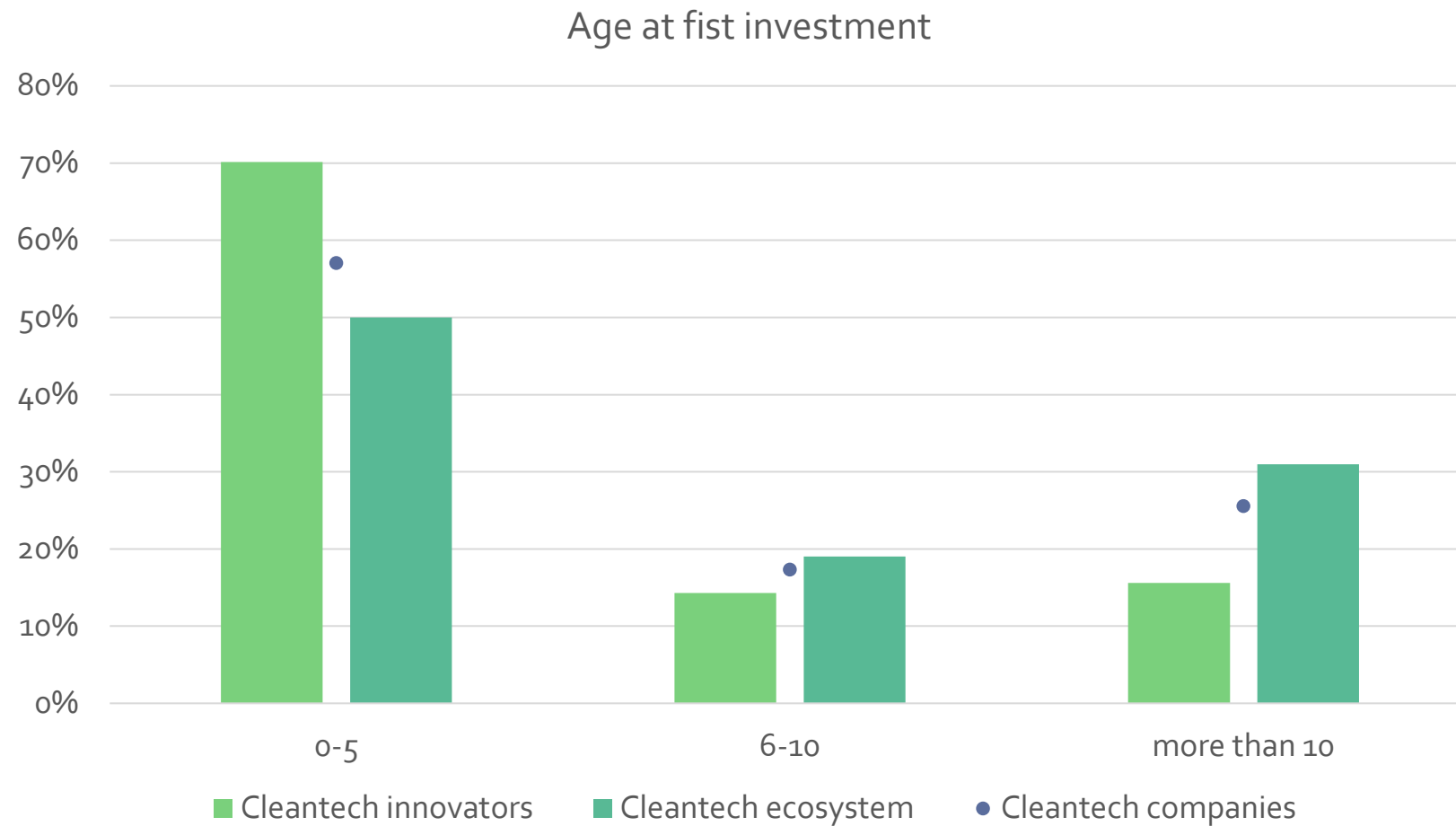
	At least one EPO patent in any field		Of which with at least one EPO patent in a CCMT field	
	n. comp.	%	n. comp.	%
VC-backed firms	113	51.60%	74	65.49%
Non-VC-backed firms	2,592	10.96%	1,092	42.24%
<i>Total</i>	<i>2,705</i>	<i>11.34%</i>	<i>1,166</i>	<i>43.22%</i>

# VC investments data and geographical distribution

Choropleth map on the geographic distribution of the number of VC-backed cleantech companies by NUTS1 area



# Age at first investment



## Cleantech type of investor

At least one type of investor	Cleantech innovators		Cleantech ecosystem	
	n. comp.	%	n. comp.	%
Business Angels	1	1.3%	4	2.8%
Independent VC	61	79.2%	106	74.6%
Captive VC	42	54.5%	54	38.0%
Bank-affiliated VC	13	16.9%	18	12.7%
Corporate VC	17	22.1%	15	10.6%
Governamental VC	25	32.5%	26	18.3%
University VC	2	2.6%	2	1.4%
<i>Total</i>	<i>77</i>	<i>2.6%</i>	<i>142</i>	<i>0.7%</i>



## Control sample

- We built a control sample of non-cleantech companies by resorting to a matching procedure
  - Initial sample: 6,508,939 non-cleantech companies retrieved from Orbis
  - Matching procedure (CEM+PSM):
    - For each cleantech company in our database we select up to 20 non-cleantech companies matching on Year of Foundation, Country (NUTSo) and Industry (NACE rev2)
  - Final sample: 124,732 non-cleantech companies
- We collected patent data, accounting data and VC investment data for matched control group companies

## Control group and patent data

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	At least one EPO patent in any field	
	n. comp.	%
Cleantech companies	2,705	11.34%
Control group companies	2,729	2.19%
<i>Total</i>	5,434	3.66%

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## Control group and type of investor

At least one type of investor	Cleantech companies		Control group companies	
	n. comp.	%	n. comp.	%
<b>Business Angels</b>	5	2.28%	15	4.34%
<b>Independent VC</b>	167	76.26%	251	72.54%
<b>Captive VC</b>	96	43.84%	149	43.06%
Bank-affiliated VC	31	14.16%	44	12.72%
Corporate VC	32	14.61%	53	15.32%
Governamental VC	51	23.29%	77	22.25%
University VC	4	1.83%	7	2.02%
<i>Total</i>	219	0.92%	346	0.28%

## WP2

# European Green Deal and the transformative climate and innovation actions of cleantech firms

- Survey addressed to our sample of European cleantech firms for which e-mail addresses are available: 13,059 firms
- Questions about:
  - how cleantech firms take actions to incorporate the elements that are central to the European Green Deal
  - the adoption of a clearly-defined path to increase climate related investments and R&D expenditures to meet the goals set by the European Green Deal
  - the engagement into structural changes to make the overall businesses 'future-proof' or into specific actions concerning just specific business units and operational sites
- First wave to be sent-out in June 2023, followed by two or three reminders

WP<sub>3</sub>  
Enabling factors  
for the  
development of  
cleantech firms

- **Collection of EU-level and country-level targeted policies and regulations**
  - Analysis of the the existing literature, news and newspapers to list the regulations that have been introduced at EU level
  - Interviews with experts in the cleantech industry
  - Categorization of policies
  - Search for measures of stringency of government environmental policies

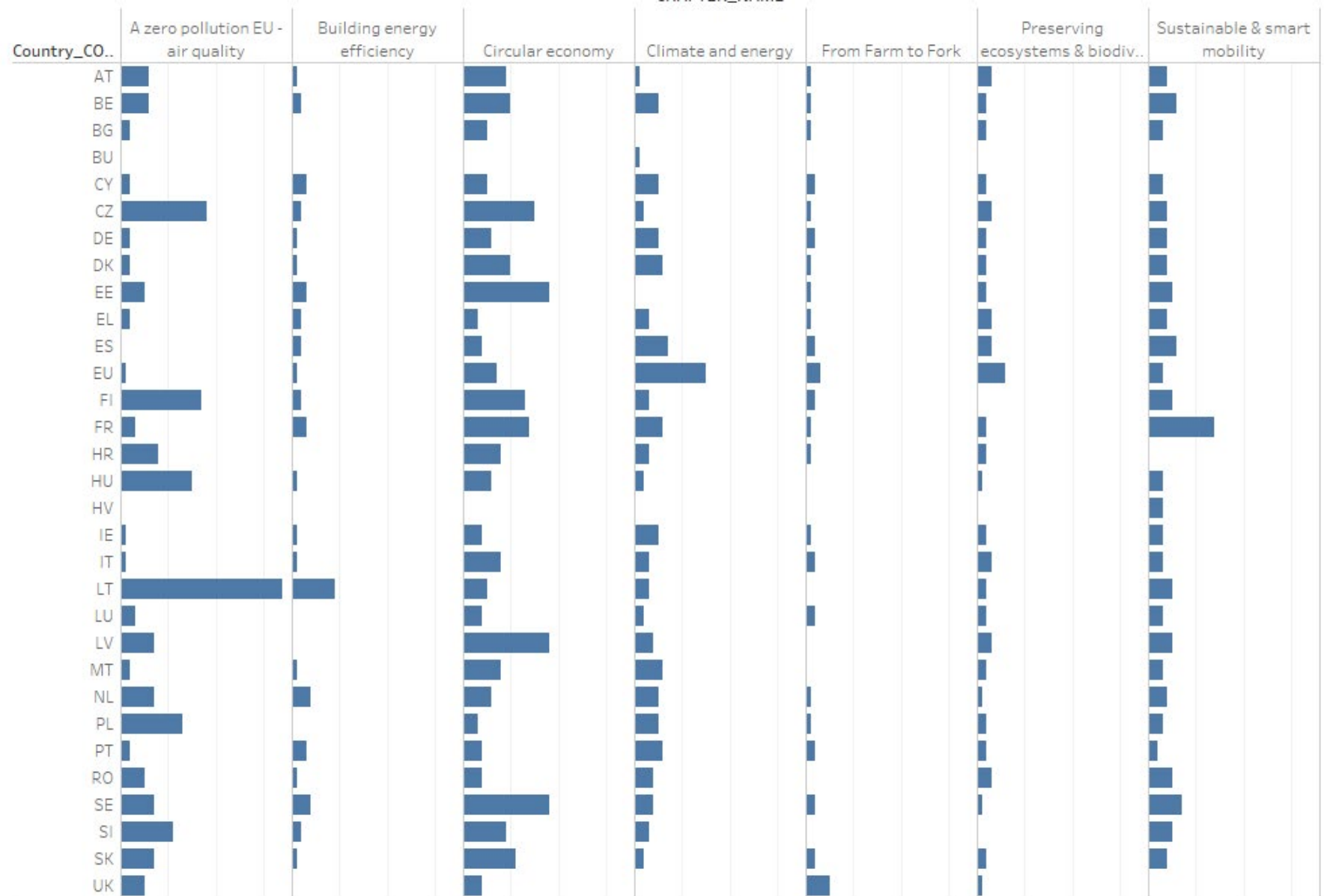
## WP3 Methodology

- **Top-down approach**
  - **European directives** according to the keywords identified
  - Transposition of EU directives into **national policies** in each member state
- **Independent analysis** of the different European countries for each chapter of the European Green Deal
- **Keywords identification** to identify key concepts for each chapter
- **Uniform classification** approach along the different chapters in order to create a coherent dataset of policies and regulatory initiatives at EU-level and country-level
- Analysis of the **overlaps** among chapters of the European Green Deal

## WP3 Classification approach

- **Administrative level:** European Union, national, and regional
- **Mechanism:**
  - *Non-market-based* tools use specific requirements or non-financial incentives to influence behavior (command and control regulations, technology support policies, voluntary approaches)
  - *Market-based* tools regulate economic/price incentives to drive changes in behavior (taxes, trading schemes, feed-in-tariffs, deposit refund schemes)
- **Indicator:** If it exists, we identify a performance indicator that forms the basis of the incentive system
- **Stringency:** we use the OECD PSI Index which provides a concise summary of the development of environmental policy frameworks in 40 countries in the period from 1990 to 2020

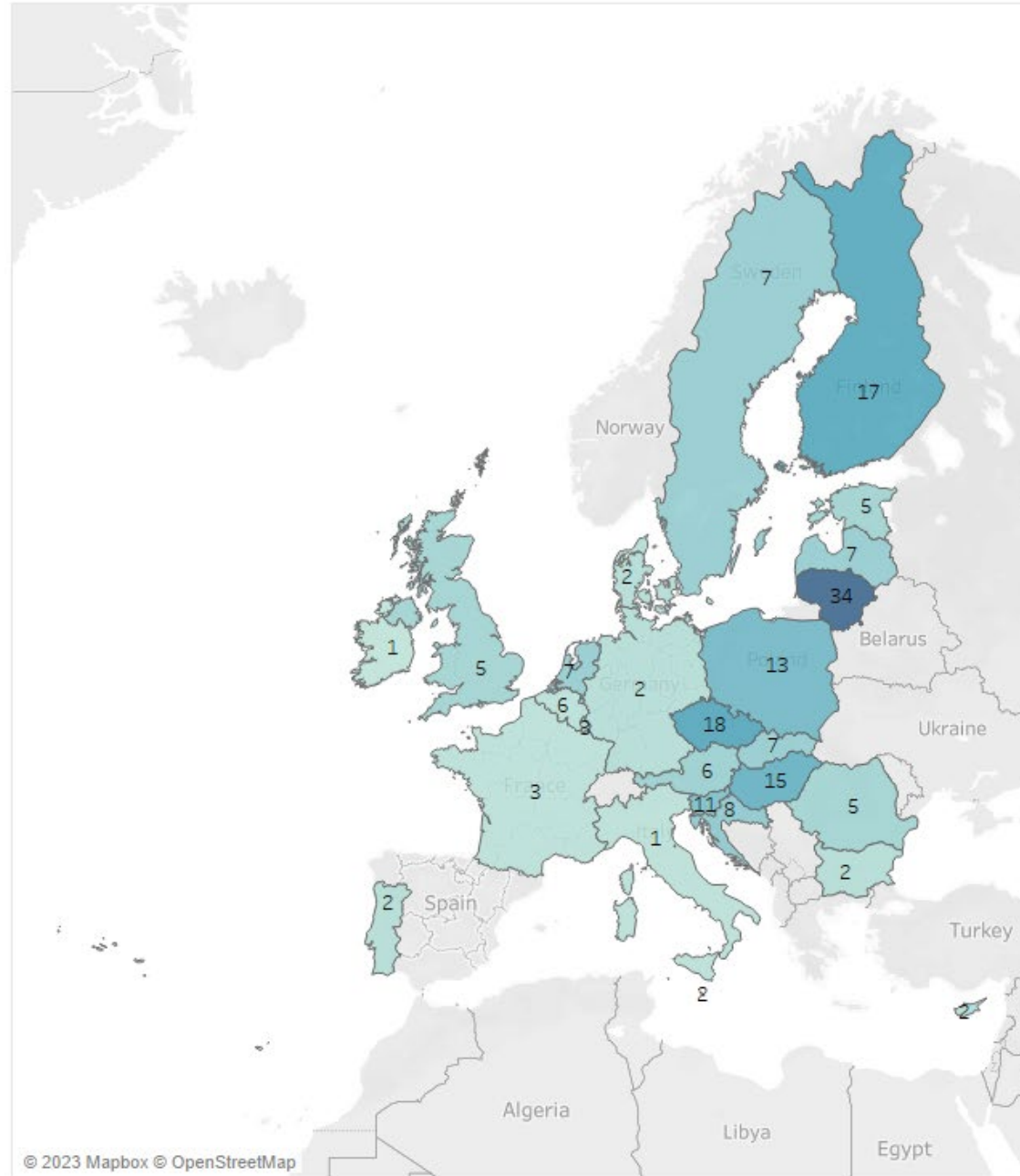
# WP3 Preliminary results



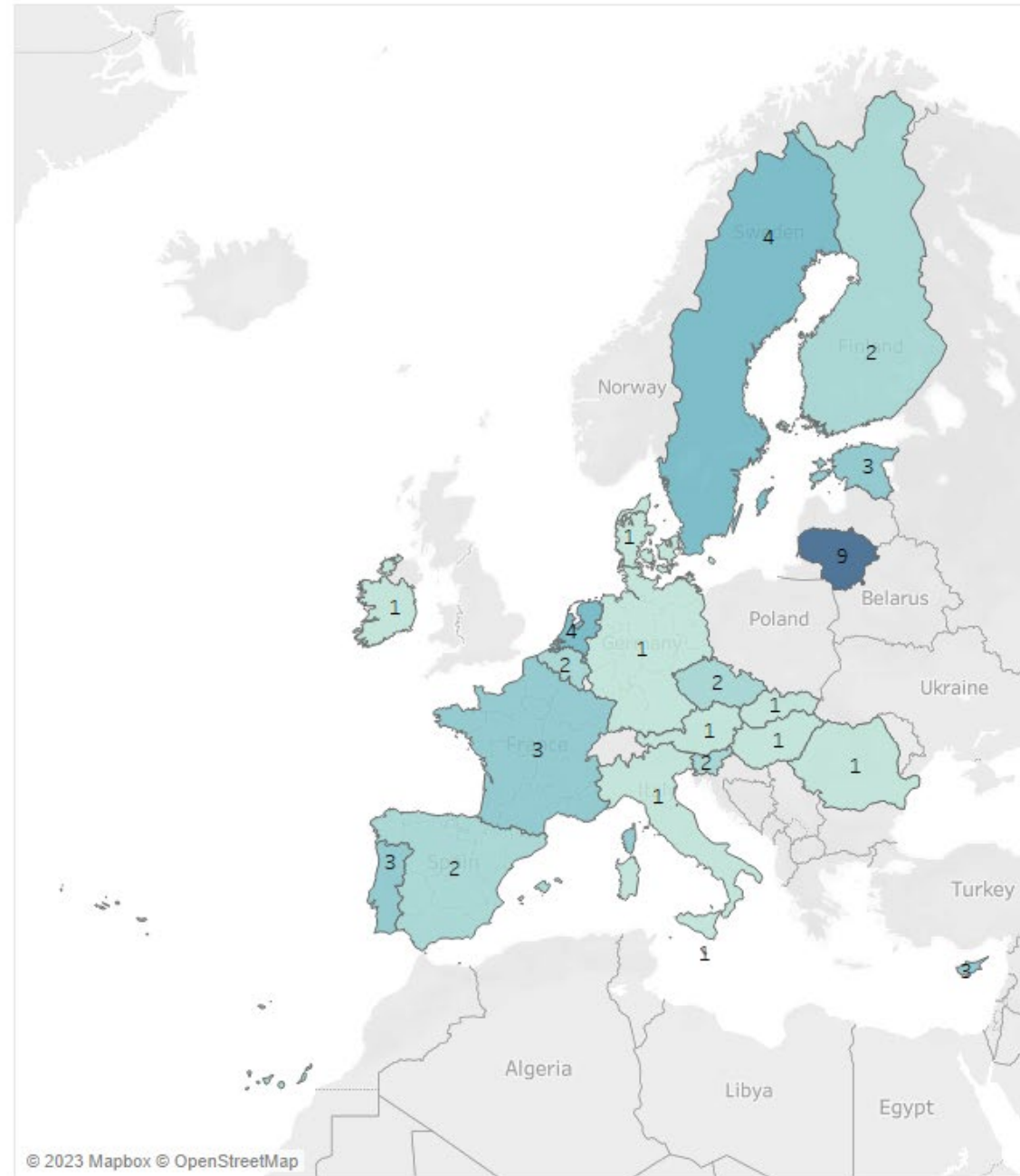
Count of policies developed



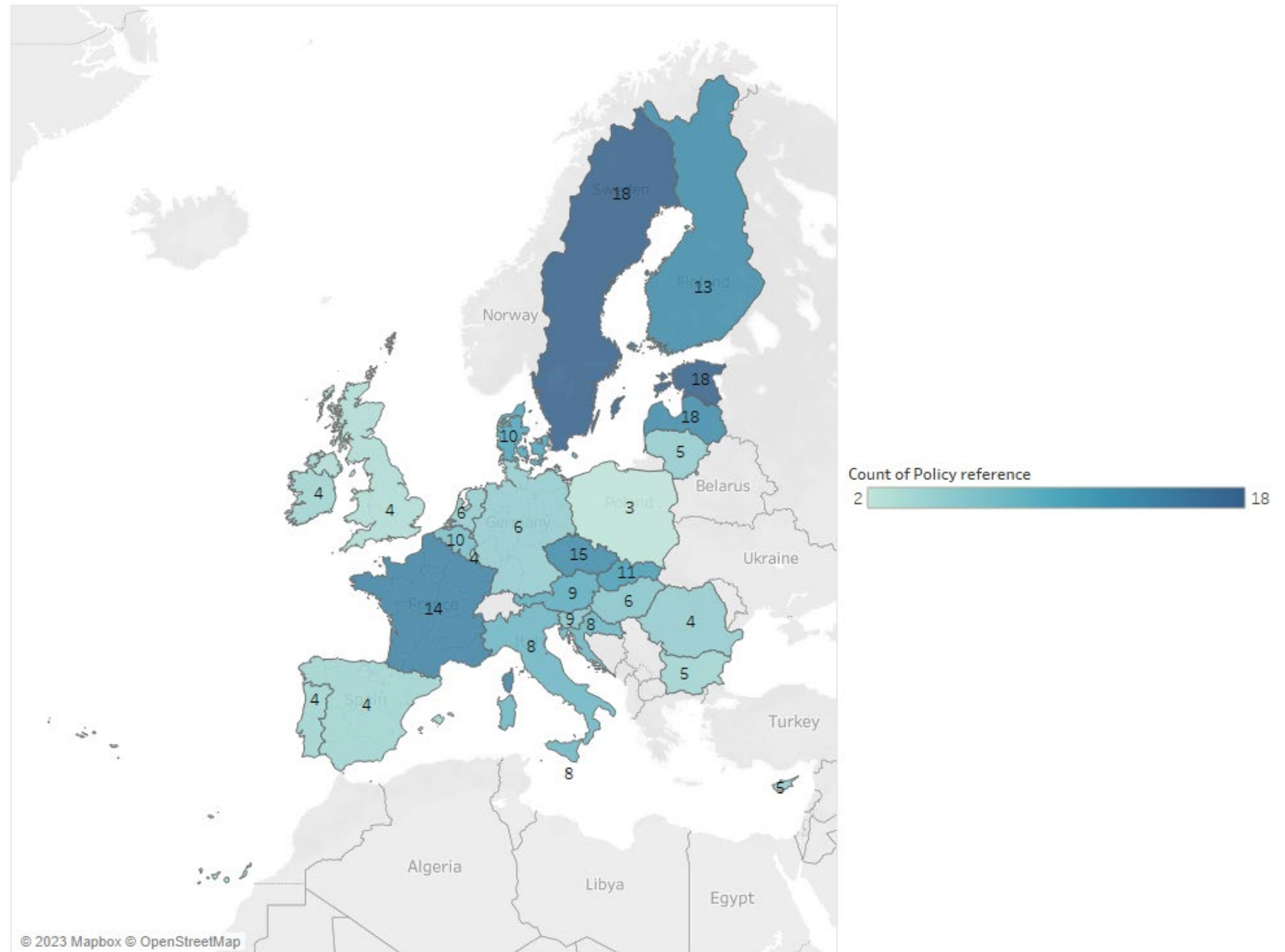
# WP3 A zero pollution EU – air quality



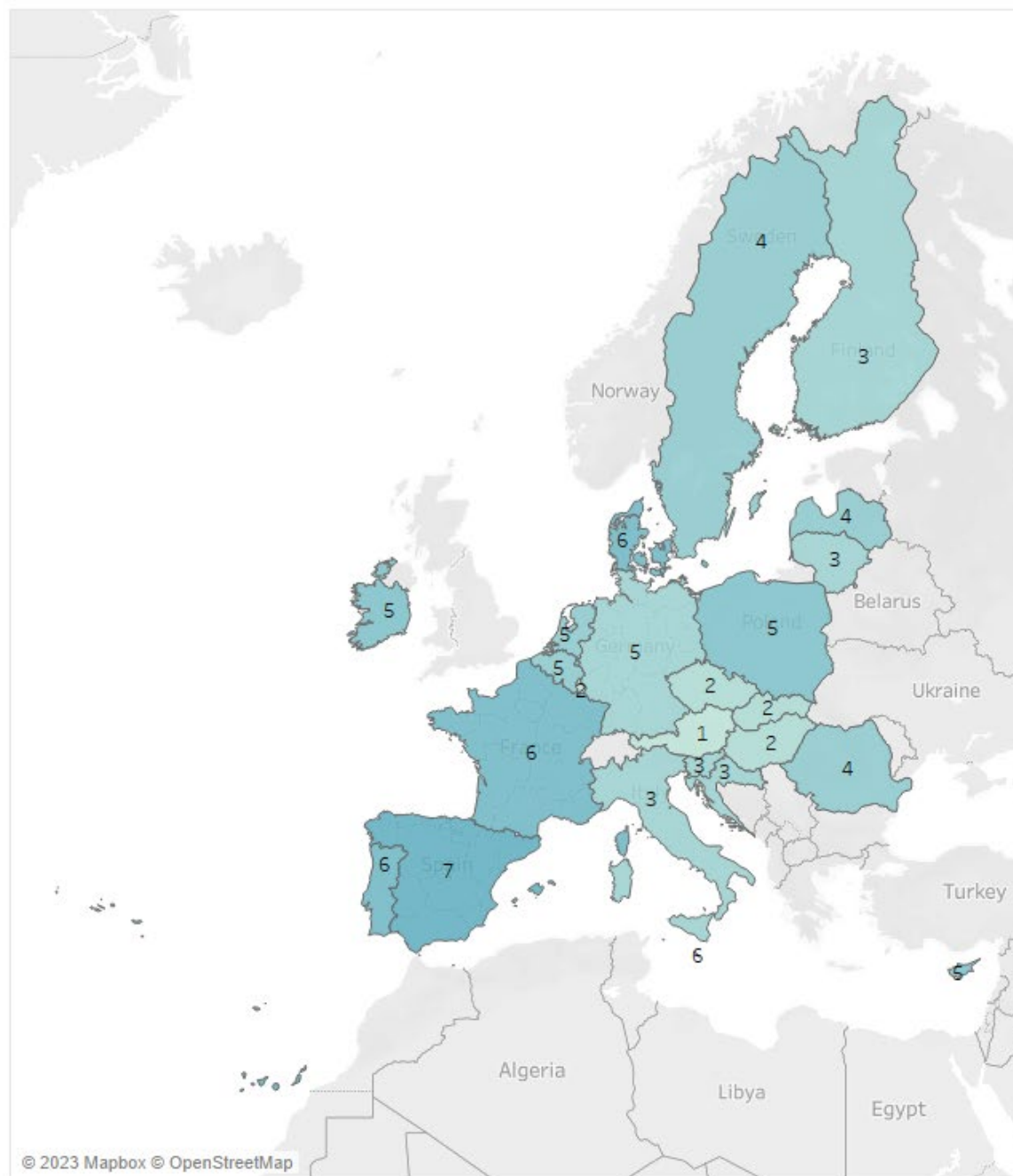
# WP3 Building energy efficiency



# WP3 Circular economy



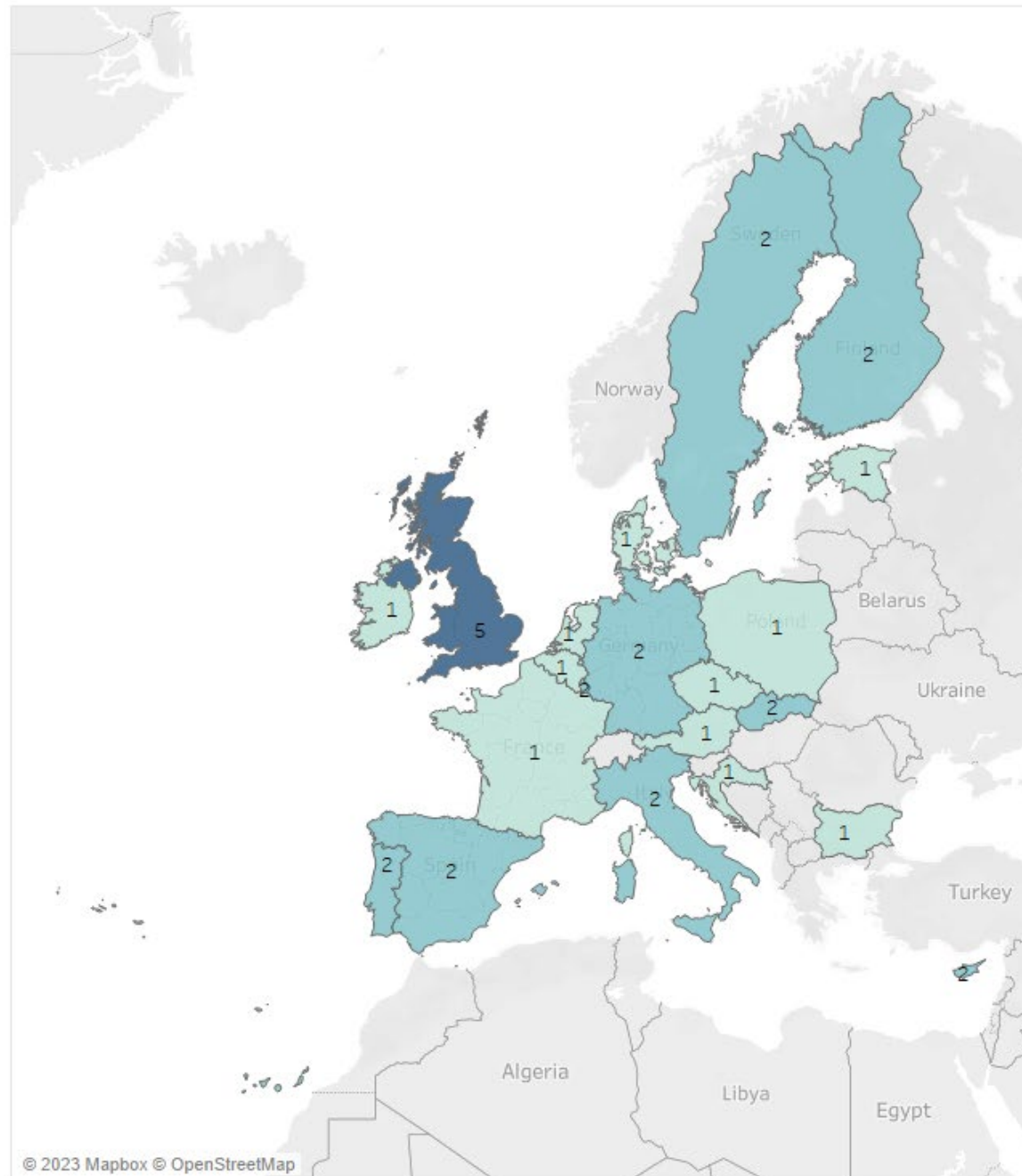
# WP3 Climate and energy



Count of Policy reference

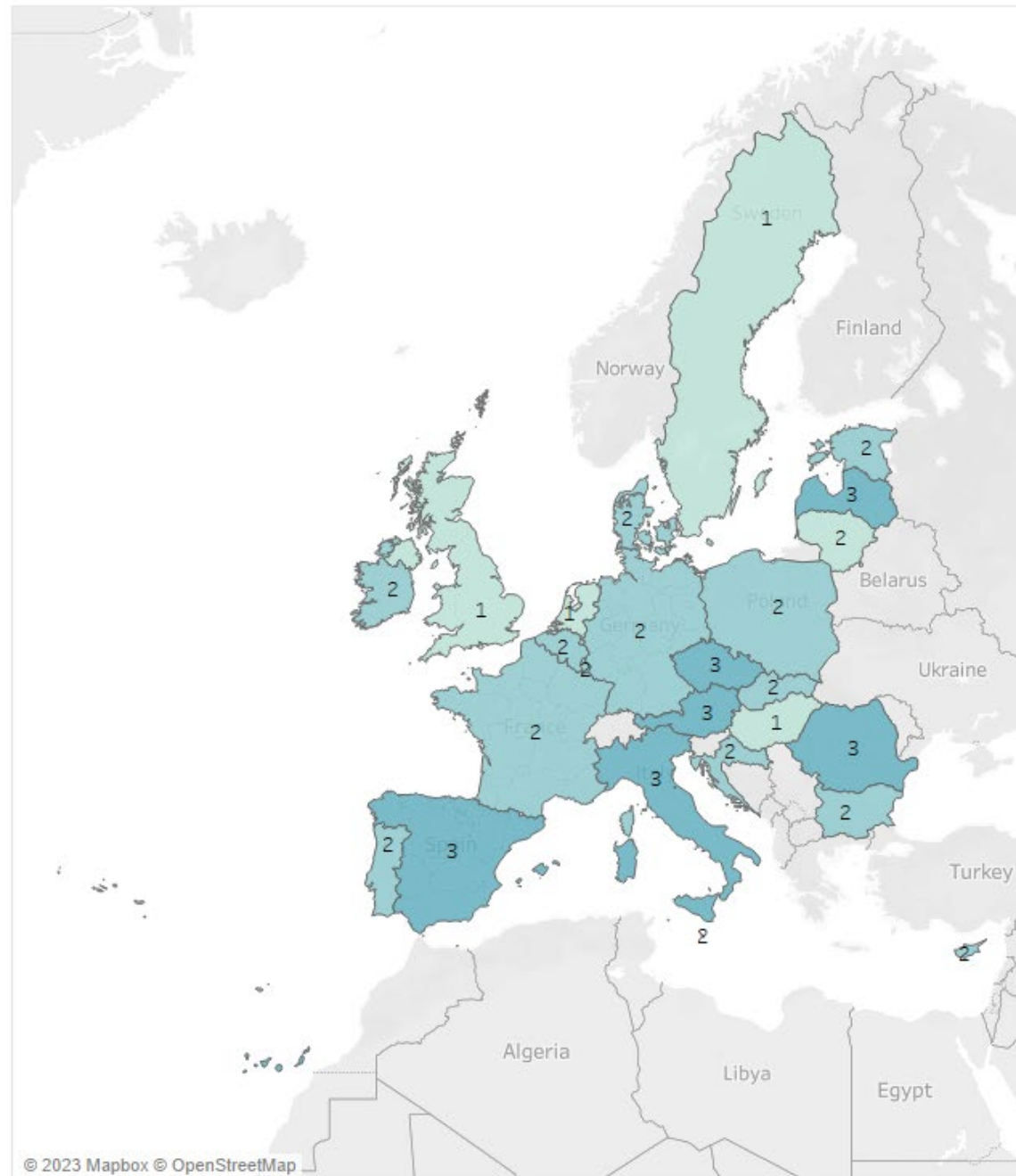


# WP3 From farm to fork





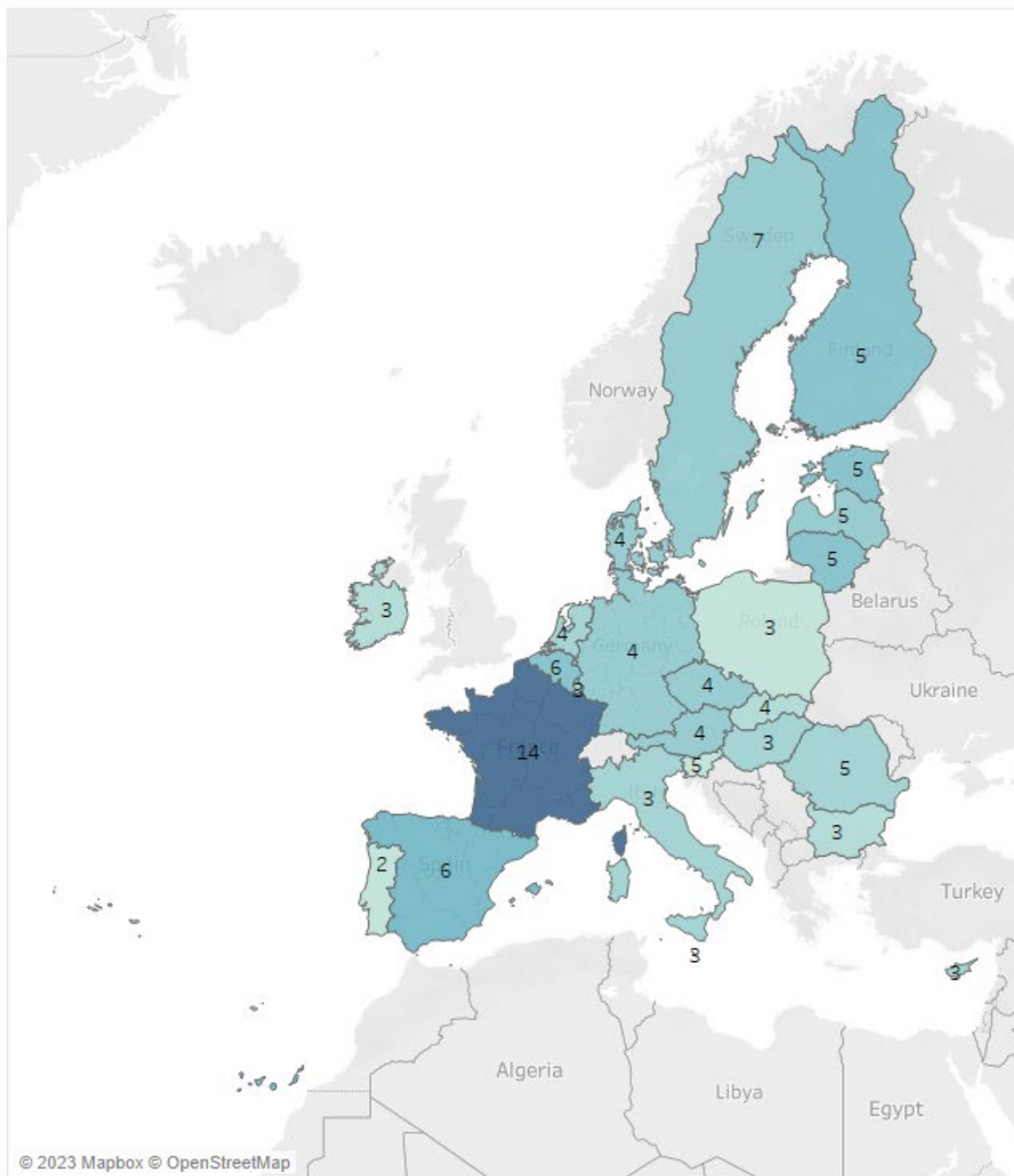
# WP3 Preserving ecosystems & buidiversity



Count of Policy reference



# WP3 Sustainable & smart mobility



## Next steps

- Finalization of the survey, e-mail invitations and analysis of responses
- Exploitation of gathered data for the production of academic papers
- Finalization of the dataset on policies and gathering of country-level indicators to identify correlations between policies in place and macro-economic or structural conditions