
Climate-KIC
Funded by the European Union
PLANETech
Climate Change Technologies
Greece's State of Climate Tech 2022
Innovation towards a better planet

An initiative of EIT Climate-KIC and PLANETech
https://www.climate-kic.org/
https://www.planetech.org/

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The activities leading to this report were carried out as part of a collection of projects and actions that received funding from the EIT Climate-KIC Regional Innovation Scheme Programme.

https://eit.europa.eu/our-activities/eit-regional-innovation-scheme)

Foreword

Professsor Phoebe Koundouri, School of Economics and ReSEES Laboratory, Athens University of Economics and Business; Department of Technology, Management and Economics, Technical University of Denmark; Sustainable Development Unit, ATHENA RC; Sustainable Development Solutions Network-Europe; Academia Europaea.

Nowadays, we witness a serious degradation of natural resources and the environment. Climate change is a reality and constitutes a global challenge that does not respect national borders. Addressing risks stemming from climate change was the overarching goal of both the Paris Agreement and the UN SDGs framework. Countries agreed to adopt the Paris Agreement at the COP21 in Paris in 2015, with which, they set a common goal of limiting global temperature rise to well below 2 degrees Celsius and strive for a reduction even below 1.5 degrees. In the same direction the 2030 Agenda for Sustainable Development, adopted by the Unite Nations in 2015, placing as its core the 17 Sustainable Development Goals, acts as an urgent call and a comprehensive plan to have a prosperous and peaceful planet by leaving no one behind.

Climate change is now affecting everyone, every country and every region by disrupting national economies and affecting people's lives with significant social, environmental and economic costs. People are continuously confronting with changing weather patterns, rising sea levels, and more extreme weather events, while industries are threatened with economic losses and supply chain disruptions due to these adverse events.

In order to deal with the increasing threats and challenges and enable stakeholders to live and operate in cleaner and more resilient societies and economies, affordable and scalable solutions are highly needed. Innovation acceleration, and more precisely, innovation acceleration towards climate tech solutions, is a prerequisite to cope with all these barriers.

Greece has taken big steps in research & development and innovation acceleration the last years. As European Commission Innovation Scoreboard (EIS) data reveal, in 2021 Greece achieved a 84.52 score compared to a 64.54 score in 2016. What is more is that Greece, with a continuous trend since 2014 is among the five countries with the greatest improvement in performance according to EIS (2021). Impressive work is also being done in environment and energy industries with the number of registered start-ups growing and being 57 as of today, according to data from Elevate Greece.

In the Sustainable Development Unit (SDU) of the ATHENA RC, which I lead and direct, we engage in cutting-edge research to enable the transition to resilience and sustainability, through the implementation of UN Agenda 2030 (17 SDGs), the Paris Agreement and the European Green Deal. Our Unit focuses on interdisciplinary systems research and the delivery of innovative solutions for the transition to a green, digital, job-based and fair future. SDU is part of larger network, the Alliance of Excellence for Research and Innovation on Aephoria (AE4RIA), an initiative for collaboration between research institutions, innovation accelerators and science-technology-policy interface networks, focused on sustainable development, where one of our core working and expertise pillars, among many other things, is the facilitation of innovation acceleration towards the transition to a zero carbon economy. In this effort, we also have the support and contribution of EIT Climate-KIC, EIT Climate-KIC Hub Greece, and BRIGAID Connect Association.

Contributors

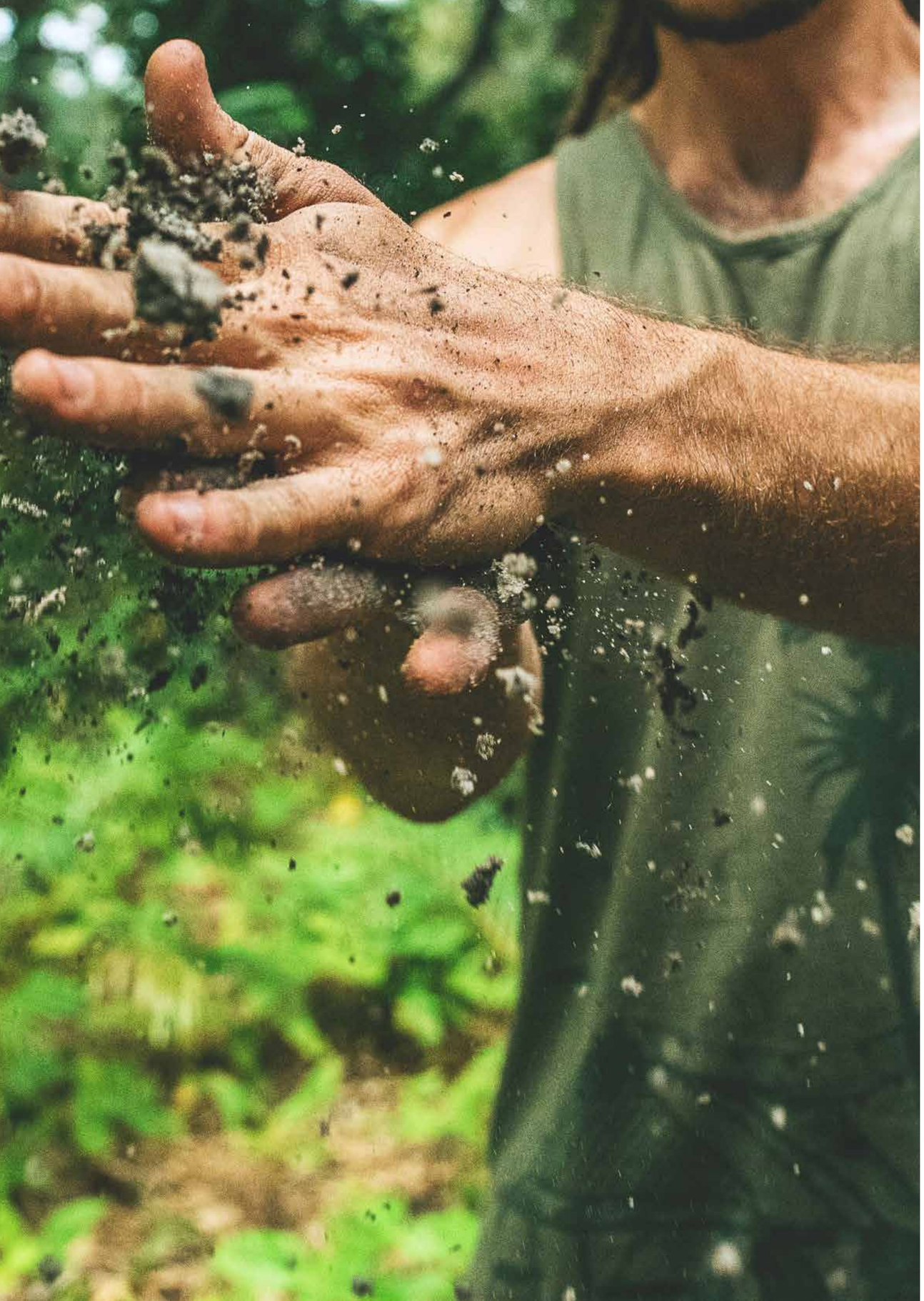
PLANETech is a nonprofit climate tech innovation community - a joint venture of the Israel Innovation Institute and Consensus Business Group. PLANETech aims to lead the Israeli and global climate tech ecosystem in tackling climate change via a combination of approaches. This is done by modifying business focus and technologies towards climate change challenges, supporting the deployment and implementation of innovative climate technologies, and by building a global network for climate tech innovators while promoting Israel as a world center for climate change technologies.

ATHENA Research Centre is based in Athens and it was founded in 2003 under the auspices of the General Secretariat for Research and Technology (Ministry of Development). The Sustainable Development Unit (SDU) operates under the Athena Research Center. SDU is Scientifically directed by Prof. Phoebe Koundouri. SDU engages in cutting-edge research to enable the transition to resilience and sustainability, through the implementation of UN Agenda 2030 (17 SDGs), the Paris Agreement and the European Green Deal. The Unit focuses on interdisciplinary systems research and the delivery of innovative solutions for the transition to a green, digital, job-based and fair future.

The Foundation for Economic & Industrial Research (IOBE) is a private, non-profit, public-benefit research organisation. It was established in 1975 with the dual purpose of promoting research on current problems and prospects of the Greek economy and its sectors and of generating reliable information, analysis and proposals for action that are non-produced elsewhere and can thus be of high value to policymakers in the context of economic policymaking. In that sense, IOBE holds a unique position in Greek society: it is the only politically independent, non-partisan body dealing with major issues of the economy, and it aspires to be pro-active, that is, it seeks to identify, at an early stage, economic issues that can become crucial in the future and propose timely solutions for these.

EIT Climate-KIC is the EU's climate innovation initiative, working to accelerate the transition to a zero-carbon and resilient world by enabling systems transformation. EIT Climate-KIC was established in 2010 and is predominately funded by the European Institute of Innovation and Technology (EIT), a body of the European Union. The Regional Innovation Scheme (RIS) is the EIT Climate-KIC flagship initiative active across Southern and Central Eastern Europe countries. The EIT RIS is designed as a long-term initiative to strengthen the national and regional innovation ecosystems of countries that are moderate and emerging innovators, based on the EU Innovation Scoreboard. EIT Climate-KIC RIS programme offers a concrete way to design, build and deliver mission-oriented portfolios of interconnected programmes on skills development and learning, entrepreneurship, and innovation to catalyse fast decarbonisation, deliver future-proof jobs, generate new markets aligned to 1.5° and drive forward adaptation and resilience.

EIT Climate-KIC Greece Hub aims to become an inclusive and innovative hub driving the transition to circularity and decarbonisation across the country. It is comprised of three partners, ATHENA RC (leading partner, Academy of Athens (AA) -Research Centre for Atmospheric Physics and Climatology and the Foundation for Economic & Industrial Research (IOBE). EIT Climate-KIC Greece Hub is a connector between policymakers, innovators and the society, seeking the transformation of the society.



Executive Summary

Greece lags behind other European countries in terms of innovation and is ranked 20th in the EU27 Innovation Scoreboard. However, looking at the country's participation in the EU research funding program Horizon 2020, its performance in terms of number of organizations involved in the selected projects is much stronger, placing it in the 8th place.
Elevate Greece, an initiative launched by the Greek Government, constitutes the first attempt to record all innovative start-ups and support their growth. Based on this database, this report has identified 83 climate tech start-ups using the classification of the 22 PLANETech Climate Challenges. The most prevalent climate challenges addressed are Circularity, Sustainable Mobility & Transport, Clean Energy Systems and Climate Smart Agriculture.

The identified climate tech start-ups vary in terms of their year of establishment, with the oldest being registered in 2014. They are relatively small with 5.4 employees on average. The majority rely on self-funding and public grants, while only 15% of them have received funding from investors. Apart from Venture Capital which can provide significant amounts of funding for start-ups, the Greek government has collaborated with the European Investment Fund and in 2016 established EquiFund, a €300 million fund for early-stage businesses. Today, Greek start-ups have access to additional funding opportunities through the Hellenic Development Bank of Investments (HDBI) and the Q-Equity program.

Looking ahead, the Greek government, has announced a series of initiatives/measures to facilitate start-ups and speed up their development (e.g. expansion of the Elevate Greece platform and the new NSRF aid program providing €60 million in grants to SMEs). However, there are also many areas that constitute a weakness for the Greek innovation ecosystem, such as bureaucracy, the lack of financing tools and brain drain, all of which need to be improved. At the same time, whilst climate tech start-ups are subject to global threats such as the energy crisis and the pandemic that have severe impact on the economic environment, they also present the opportunity to play a pivotal role in the net-zero transition. In order to upscale climate tech innovation in Greece and enable it to leverage present opportunities in a world with net zero ambitions, a system with strong foundations for funding and technical support is required. The business utilization of innovation related to environmental and climate protection needs to be based not only on public, but also on private financing. The development of the capital markets with the incorporation of sustainability aspects and the enhancement of the link with the academia are prerequisites for bridging the financing gap and ensuring that innovative ideas of higher technology readiness level will reach the market up-scale phase, improving climate resilience of the Greek economy, generating jobs and growth and contributing to climate tech innovations that are deployable around the globe.

12 competence centres worth over 22 million Euros are established to support innovation, initiated by Next Generation EU and National Recovery and Resilience Plan "Greece 2.0" aiming to support innovation and technology transfer in 5 fields, 3 of which are related to climate technologies (Energy, Agriculture, Materials and Construction).

Introduction

European Institute of Innovation and Technology

The European Institute of Innovation and Technology (EIT) was created in 2008 and contributes to achieving the four key strategic orientations of the Horizon Europe Strategic Plan:

- strengthening sustainable innovation ecosystems across Europe
- fostering the development of entrepreneurial and innovation skills in a lifelong learning perspective and supporting the entrepreneurial transformation of EU universities
- bringing new solutions to global societal challenges to the market
- creating synergies and added value within Horizon Europe.

Since its establishment, the EIT has gradually established itself as a unique instrument addressing societal challenges through the integration of the Knowledge Triangle (KT). The EIT operates mainly through Knowledge and Innovation Communities (KICs). There are currently nine KICs that operate in the areas of climate change, digital transformation, energy, food, health, raw materials, urban mobility, added-value manufacturing, and cultural & creative industries.

The EIT Regional Innovation Scheme (RIS)

Against the backdrop of persisting regional disparities in European innovation performance, the EIT launched a Regional Innovation Scheme (RIS) in 2014 to widen its outreach to emerging and moderate innovator countries, according to the European Innovation Scoreboard (EIS). The EIT RIS is steered by the EIT and implemented by its KICs. The overarching objective of the EIT RIS is to contribute to the advancement of the innovation performance of these countries and their regions by strengthening the capacity of their innovation enablers and actors and linkages among them (such as business accelerators, incubators, startups, businesses, educational and research institutions, etc.) through the dissemination of the KT approach.

The establishment of the so-called RIS Hubs is a central element of the EIT RIS' place-based approach. Article 2 (4) of the EIT Regulation provides that RIS Hubs are "physical hub, established by a KIC and forming part of its structure, in a Member State or in an associated country targeted by the RIS and that serves as focal point for the KIC's activities and for the mobilisation and involvement of local knowledge triangle actors in the activities of the KIC". KICs engage local organisations to serve as EIT RIS Hubs.

Besides the primary functions mandated by the EIT and a common strategic approach, each KIC has designed its Hubs structure and goals according to its own mission and strategy. EIT Climate KIC, one of the nine existing EIT KICs, adopted the EIT RIS as a strategic instrument to target climate resilience needs and foster regional development. Over eight years of implementation, we have worked across 20 countries in Southern, Eastern, and Central Europe and the Western Balkans region, with 13 active Hubs, involving 83 place-based organisations and investing over EUR 26 million, leveraging more than EUR 6.3 million of co-funding.

The Collaboration with PLANETech

Together with EIT Climate KIC, the RIS Hubs gather assertive regional outreach and experience in co-designing capacity-building programmes, supporting entrepreneurs, liaising with local, regional and national authorities and connecting to wider society. Within their mission of being innovation community catalysts, a pioneer collaboration with Israeli organisation PLANETech was planned in 2022.

Some Hub members learning how to use the PLANETech Climate Challenge Map during the EIT Climate-KIC RIS Hubs days (June 2022)

The Israel's State of Climate Tech 2021 report, written by PLANETech and the Israel Innovation Authority and published a few weeks before COP26, was the first report to portray the climate tech ecosystem of any country. As detailed in the Methodology section, this report provided the PLANETech Climate Challenge Map, an original classification tool that presents the main challenges to successful climate change mitigation and adaptation, across all activities of our daily life and natural ecosystems. Based on the findings of this report, the Israeli government approved a ILS 3 billion program to promote technological innovation in the field of climate change. This report has been a fundamental step towards building a solid climate tech ecosystem in Israel, a country with the largest number of startups per capita (about one per 1,400 inhabitants).

PLANETech's team, Dr. Tamar Moise (Head of Climate Programs) and Deborah Kreis (Global Partnerships Manager) during the EIT Climate-KIC RIS Hubs days (June 2022)

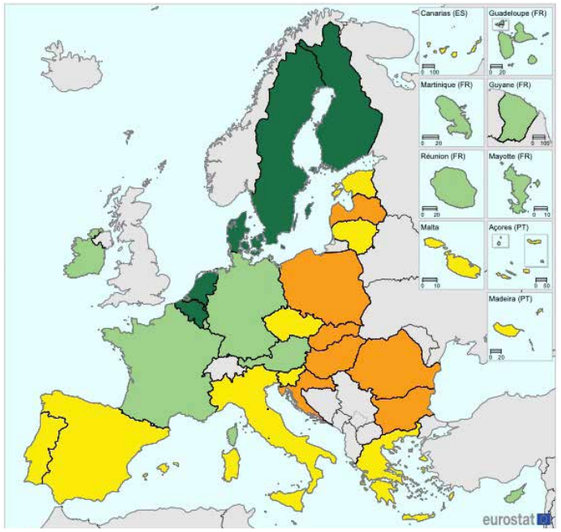
Considering this successful practice and the urgent need of national stakeholders (policymakers, investors, businesses, researchers…) to know the size, components and challenges of their climate tech ecosystems, some RIS Hubs decided to be part of a pilot intended to replicate this Israeli report in Southern Europe. The pilot has provided capacity-building sessions by PLANETech for the RIS Hubs, sharing their methodology on data compilation and report writing. It has included online (June 6th) and in-person sessions during the EIT Climate-KIC RIS Hubs days (June 21st-24th; Valencia).

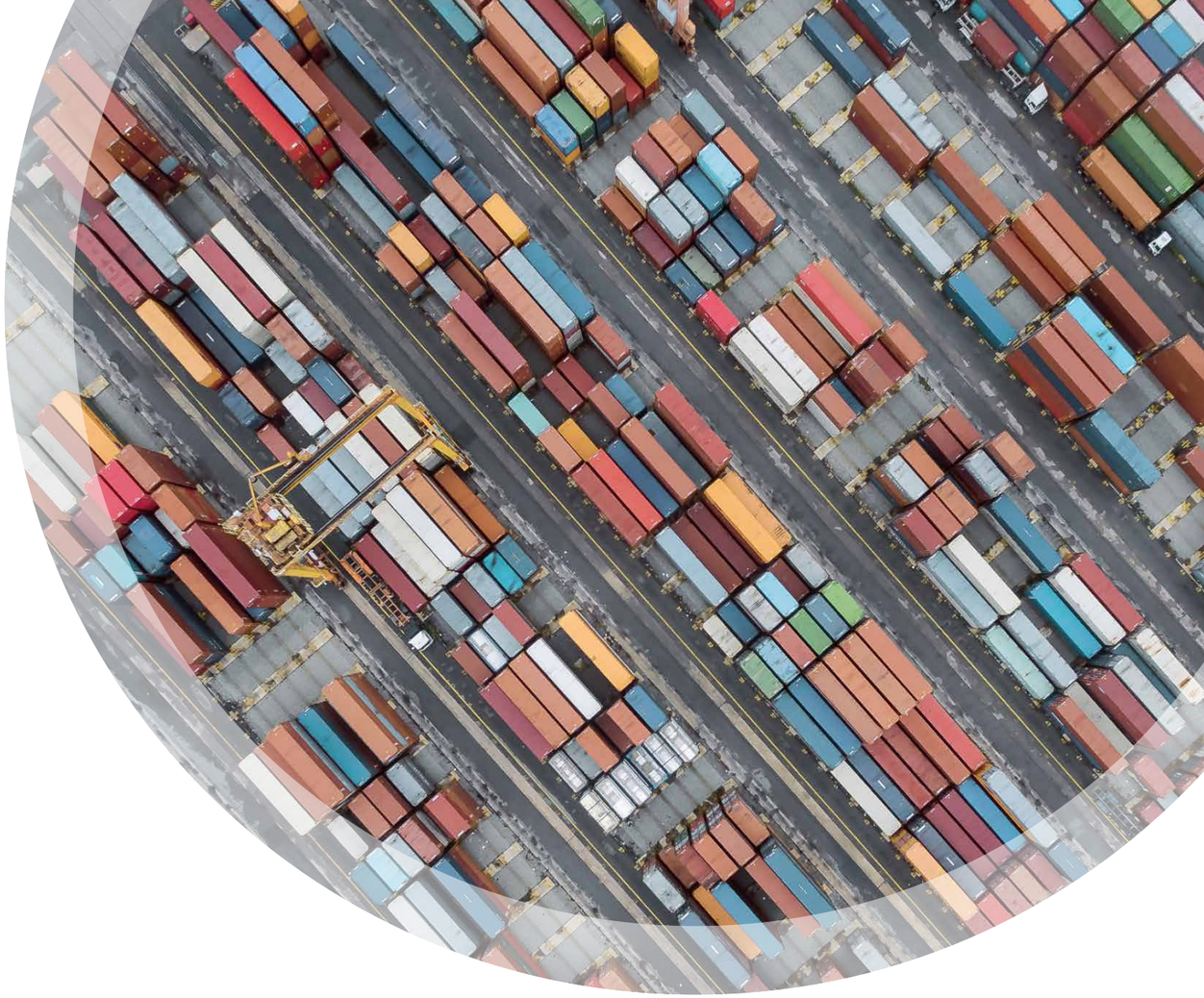
Our goal was to provide a unique asset that provides a deep dive into the local climate tech ecosystems in different Southern European countries and also serves as an engaging tool for all the innovation ecosystem players of the KT by providing valuable insights.

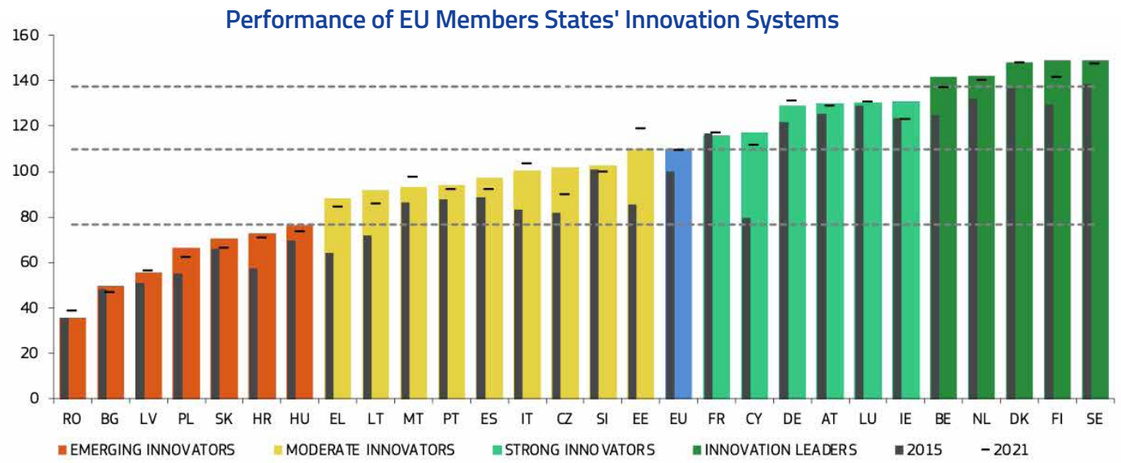
Innovation EcoSystem in Greece

Climate tech innovation will best flourish when the innovation ecosystem in which it is developing provides a fertile breeding ground. This section describes the general Greek innovation ecosystem.

Greece ranks at the 20th place among the 27 European countries in terms of innovation, with a score index of 88.18 in 2022 (Sweden, ranked at first place, has a score index of 149.10). It is worth noting though that even among similar economies such as Cyprus (117.42), Italy (100.68), Spain (97.54), or Portugal (94.31) Greece lags behind and it is classified as a moderate innovator.
(Figure 1)







Coloured columns show countries' performance in 2022, using the most recent data for 32 indicators, relative to that of the EU in 2015. The horizontal hyphens show performance in 2021, using the next most recent data, relative to that of the EU in 2015. Grey columns show countries' performance in 2015 relative to that of the EU 2015. The dashed lines show the threshold values between the performance groups, where the threshold values of 70%, 100%, and 125% have been adjusted upward to reflect the performance increase of the EU between 2015 and 2022.

Figure 1 - European Innovation Scoreboard 2022, Source: European Commission, https://ec.europa.eu/

A closer look at the Regional Innovation Scoreboard shows that, whilst overall, Greece is a moderate innovator, there are still regions in Greece that are characterized as emerging innovators (Peloponissos, Sterea Ellada, Western Macedonia, Eastern Macedonia and Thrace, among others).
(Figure 2)

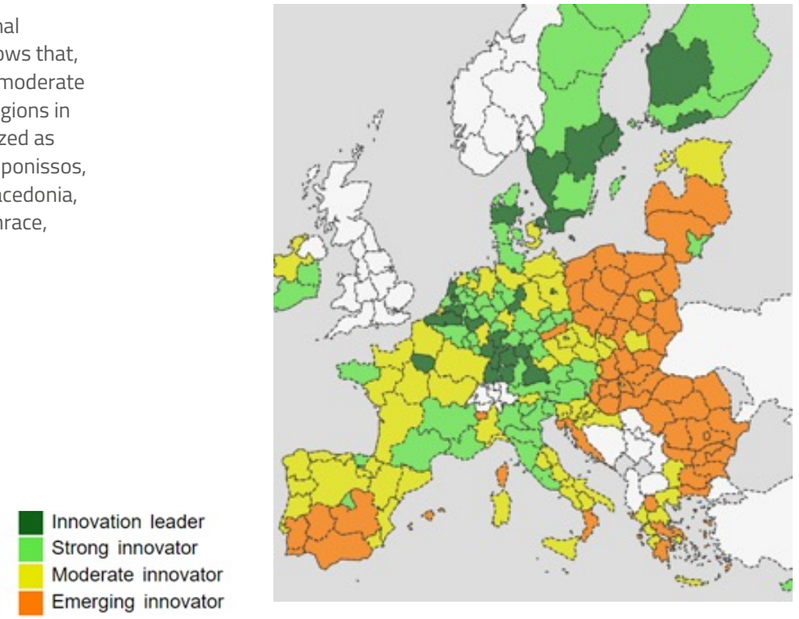


Figure 2 - Regional Innovation Scoreboard 2021, Source: European Commission, https://ec.europa.eu/

R&D expenditure (% of GPDP), Greece, 2012 – 2020

Greece's R&D intensity has increased over the years with a growth of 111.2% over a period of nine years, between 2012 to 2020.
(Figure 3).

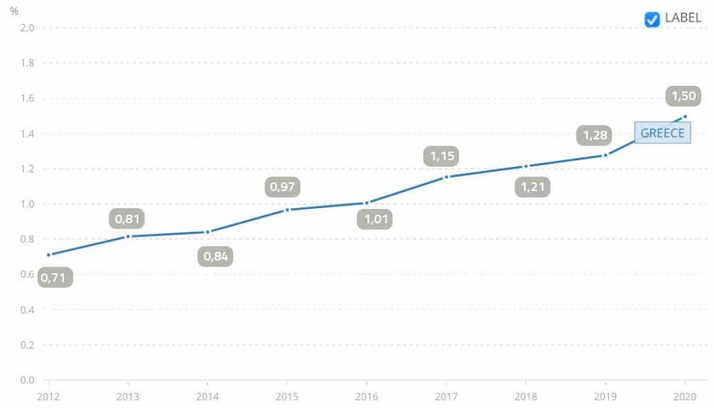


Figure 3 - R&D expenditure in Greece, Source: World Bank WDI .

R&D expenditure by sector of performance, Greece, 2011 – 2019

The largest amounts of R&D expenditure are realized on the business sector, then on Higher Education Institutes (HEIs), followed by Research Centers and NGO's as shown in *Figure 4.*

Figure 4 - R&D expenditure by sector of performance in Greece, Source: Elevate Greece

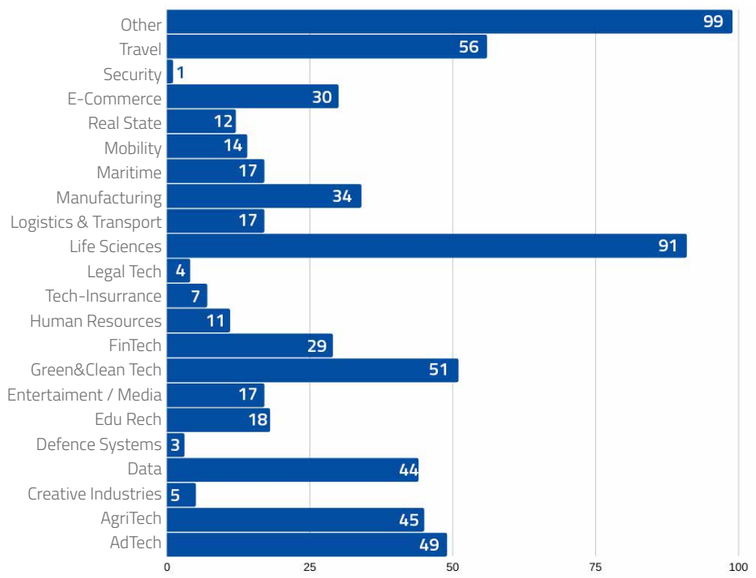


Figure 5 - Number of start-ups in Greece by industry, Source: Elevate Greece, https://elevategreece.gov.gr/el/

Number of Start-ups in Greece, by industry

In Greece, a first attempt to record all innovative start-ups, made by Elevate Greece, an initiative launched by the Greek Government, intended to identify all promising start-ups and support their growth. From these registered start-ups, 13.91% specialize in Life Sciences, 8.56% in Travel/Hospitality/Leisure and 7.8% in Green & Clean Tech and 7.49% in Advertising & Marketing.
(Figure 5)

654 start-ups are registered in the Elevate Greece portal to date

Green and Clean Tech specialized start-ups are ranked third in the overall allocation of start-ups in Greece.

Approximately 68% of start-ups are located in the region of Attica, while 14% of them are located in Central Macedonia. The rest are dispersed all over Greece with 6.3% of them being in Crete region.
(Figure 6 & 7)

Number of start-ups in Greece (Greographic allocation)

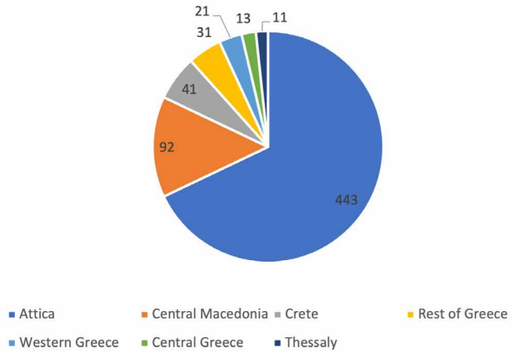


Figure 6 - Geographic allocation of start-ups in Greece, Source: Elevate Greece, https://elevate-greece.gov.gr/el/
Note: The rest of Greece includes the following regions: Eastern Macedonia and Thrace (6), Epirus (6), South Aegean (5), North Aegean (4), Western Macedonia (4), Ionian Islands (3) and Peloponnese (3).

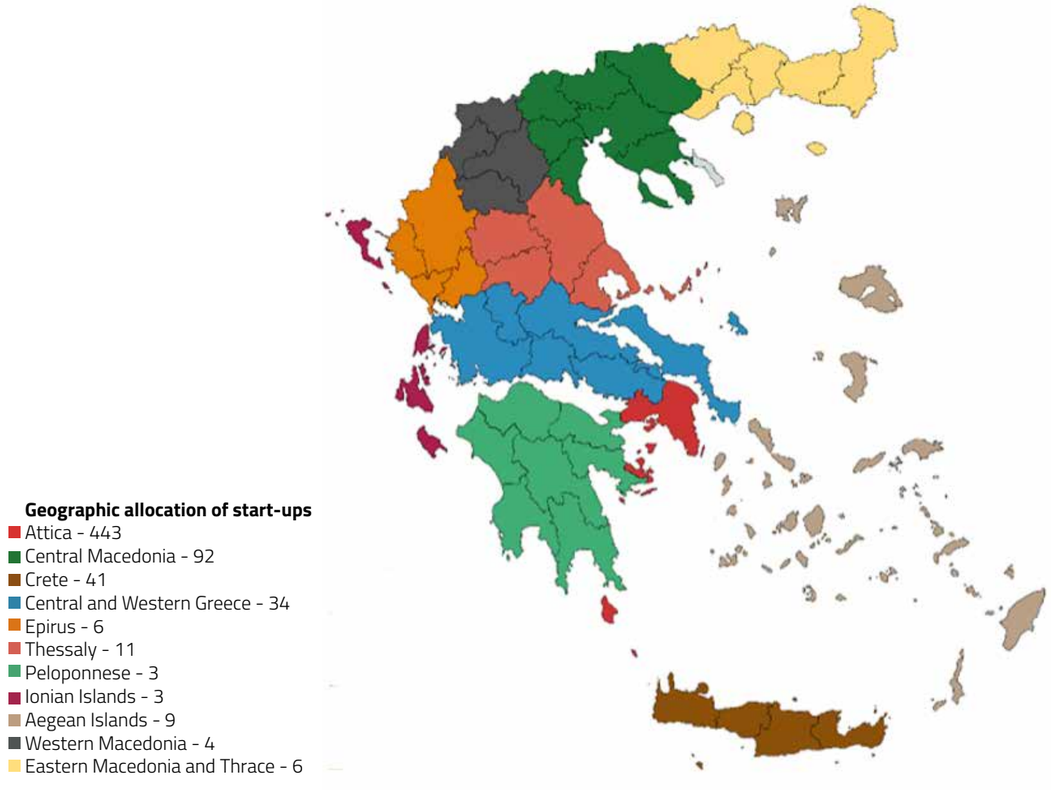


Figure 7 - Geographic allocation of start-ups in Greece

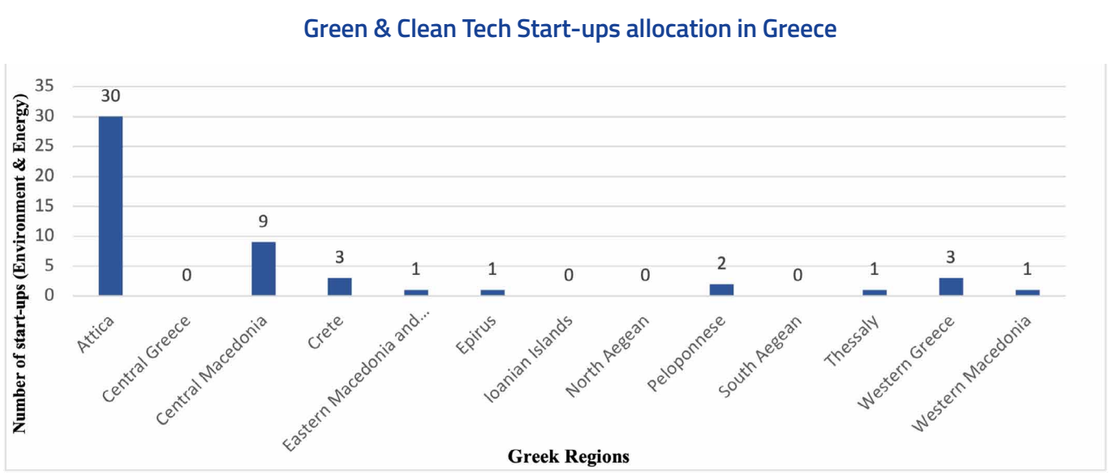


Figure 8 - Environment & Energy start-ups geographic allocation, Source: Elevate Greece, https://elevategreece.gov.gr/el/

Of the Start-ups specializing in the Green and Clean Tech Industry, 30 of 51 are located in Attica, and 9 of 51 are in Central Macedonia. Compared to the total number of start-ups in Attica and Central Macedonia, Green & Clean Tech specialized start-ups constitute 6,77% and 9,78% respectively.

Concerning start-ups specialized in Green and Clean Tech, 30 of 51 are located in Attica, whereas 9 of 51 are in Central Macedonia.

Essential innovation ecosystem actors in Greece contain science parks and technology transfer, innovation clusters, VCs, incubators, accelerators, coworking spaces and federations.

Ecosystem Actors

Science Parks and Technology Transfer

Technology Parks are open spaces that serve as business incubators for startups affiliated with a university. The Parks contribute to the economic growth of a territory by increasing the level of economic activity and the productivity of companies moving there.

Incubators

Innovation clusters are groupings of independent undertakings — innovative startups, small, medium and large undertakings, as well as research organizations — operating in a particular sector and region and designed to stimulate innovative activity! This is achieved through common use of premises, joint promotion, exchange of knowledge and expertise, by creating networks, disseminating information and creating synergies between the undertakings and other cluster stakeholders.

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Accelerators

Business Accelerators in Greece offer startups intensive, educational programmes, assisting them in the preparation and early growth stage so that they may progress to the establishment and maturation phases. Accelerators share some features with incubators, in the sense of offering consultation and guidance to startups, but they do not provide accommodation. Their basic role is to help enterprises along their course from an idea to a product by offering guidance and/or funding at the early stages. The incubation period is short, as the aim is to transform business ideas into services and products, either as prototypes or ready for marketing.

Venture Capital Funds

IVenture capital funds undertake the investment risk of startups with high growth potential. This type of funding is vital, particularly at the early stages of an enterprise. Such funding plays a vital role in developing the ecosystem. EquiFund is an initiative of the Hellenic Republic in cooperation with the European Investment Fund (EIF) to boost the venture capital market in Greece.EquiFund aims to bolster the venture capital market in Greece with an investment strategy spanning three windows: (i) the Innovation window, (ii) the Early Stage window, (iii) the Growth Stage window.

Federations

Business Federations/Associations play an integral role in Greek Entrepreneurship. They offer their members a wide range of vital business services, including advice, financial expertise and support, as well as a powerful voice in the government/powerful lobbying with the government. The mission of a Federation/an Association is to help its members achieve their ambitions.

Coworking spaces

Coworking spaces are essentially common workspaces. They offer affordable office space for those looking to escape the isolation of a home office or the use of a coffee shop. These shared workspaces offer a suite of office-like amenities, such as hot-desks, private meeting rooms, kitchens, coffee and more.

Figure 9 - Ecosystem Actors, Source: Elevate Greece, https://elevategreece.gov.gr/el/

The Public sector

The public sector in Greece is a catalyst in innovation acceleration and includes the above institutions under the auspices of the Ministry of Development and Investments.

Figure 10 - Public Sector, Source: Elevate Greece, https://elevategreece.gov.gr/el/

Greece, the home base of renowned global firms and multinationals

Figure 11 - Multinational firms in Greece, Source: Elevate Greece, https://elevategreece.gov.gr/el/

Methodology

This report evaluates Greece innovation's potential to be a key player in meeting the challenge of combating climate change, both now and in the future. It reveals the current strengths of Greece's climate technology breakthroughs by conducting a mapping of Greek startups creating technologies for climate change mitigation and adaptation.

Mapping the Greek Climate Innovation Arena

Companies that specialize in climate technology are mapped based on the pertinent climate challenges that their innovations solve. The report's methodology section provides an overview of the PLANETech Climate Challenge Map, the methodology used to gather information on the climate startups, and the mapping process.

PLANETech Climate Challenge Map

The report's methodology section provides an overview of the PLANETech Climate Challenge Map. This map was used in the first "Israel's State of Climate Tech 2021" report, and was updated in the 2022 edition. The PLANETech Climate Challenge Map presents the main challenges to successful climate change mitigation and adaptation, across all activities of our daily life and natural ecosystems. The climate challenges are associated with five main areas: The Built Environment (5 challenges), Materials & Manufacturing (5 challenges), Land Use (5 challenges), Nature (5 challenges), and Digital (2 challenges). In total, there are 22 challenges (Figure 12). This entails a broad and all-encompassing approach rather than focusing on specific economic sectors and services. When focusing on challenges, solutions can be facilitated by innovations from varied technologies that target the areas listed below each challenge. The challenges target the reduction of emission sources, enhancement of carbon sinks, as well as community, nature, and infrastructure resilience.

Climate-KIC

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PLANETech Climate Change Technologies

Built Environment Where we live

- Clean Energy Systems
- Sustainable Mobility & Transport
- Low Carbon Buildings
- Green Construction
- Eco-Efficient Water Infrastructure

Materials & Manufacturing Things we make

- Novel Materials
- Clean Manufacturing
- Circularity
- Transparent & Agile Supply Chains
- Carbon Capture & Utilization

Land Use How we impact our land

- Climate Smart Agriculture
- Soil Health
- Alternative Proteins
- Food Loss & Waste
- Metal & Mineral Mining

Nature What we need to revive

- Forest & Land Ecosystems
- Oceans & Water Ecosystems
- Extreme Weather Events
- Biodiversity
- Earth Observations

Digital The digital space

- Sustainable Digital Infrastructure
- Carbon Management Risk & Finance

Figure 12 - PLANETech Climate Challenge Map (source: Israel's State of Climate Tech 2022).

Climate Tech Startups

A list of Greek startups identified as active in the climate arena was compiled from the following databases: Elevate Greece and Climate-KIC Greece Hub. These startups either have direct climatic impact or are developing and implementing technologies that can positively contribute to tackling climate challenges. The assembled database includes information on the company's inception year and personnel count.

Each startup that was identified as a climate tech startup underwent a careful review and classification process based on the match of its technology to one or more of the 22 PLANETech climate challenges. This was evaluated based on the innovation's sector attribution, the technology it is based on, the functionality of the innovation, how and where it is applied, and how (in the case of material products) it is produced. Innovation by a firm, whether it be a new product, service, or platform, can provide a solution to a number of challenges. Startups were allocated between 1 to 4 challenges.

Greek Climate Ecosystem

Based on the methodology described in Chapter 2, our research identified 83 Greek start-up companies, providing solutions to at least one of the 22 climate challenges, defined by PLANETech. Since the climate challenges are broad in scope, the aforementioned list of start-ups includes companies that are classified in various industries in Elevate Greece (i.e. Environment and Energy, AgriTech/FoodTech, Maritime, and Mobility). The startups were assigned up to four climate challenges which their activities target, evaluated based on information found in their websites.

We presume that several younger start-ups exist in the Greek ecosystem that we did not identify, as these are at a very pre-mature stage and are not registered in any database.

As shown in Figure 13, the four climate challenges in which the highest number of start-ups are active are Circularity, Sustainable Mobility & Transport, Clean Energy Systems and Climate Smart Agriculture. This figure takes into consideration all the relevant challenges for each start-up, and hence some start-ups are included in more than one category.

Circularity is an important challenge for the Greek economy as the country is ranked 18th in EU-27 with regard to circular material use rate, at just 5.4% compared to the EU-27 average of 12.8%. Additionally, Greece lags behind the European average in terms of municipal waste management, since 77.6% of the waste is landfilled, placing it at the 24th position within the EU-27. This not only hinders the transition towards a circular economy but also has a negative environmental footprint (IOBE, 2022). The start-ups that have been identified as relevant to Circularity offer a spectrum of different solutions including, but not limited to, the circular usage of water and wastewater, the upcycling of different types of materials or waste (e.g. marine waste, coffee waste, seagrass) and the use of residual biomass for energy production.

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PLANETech Climate Change Technologies

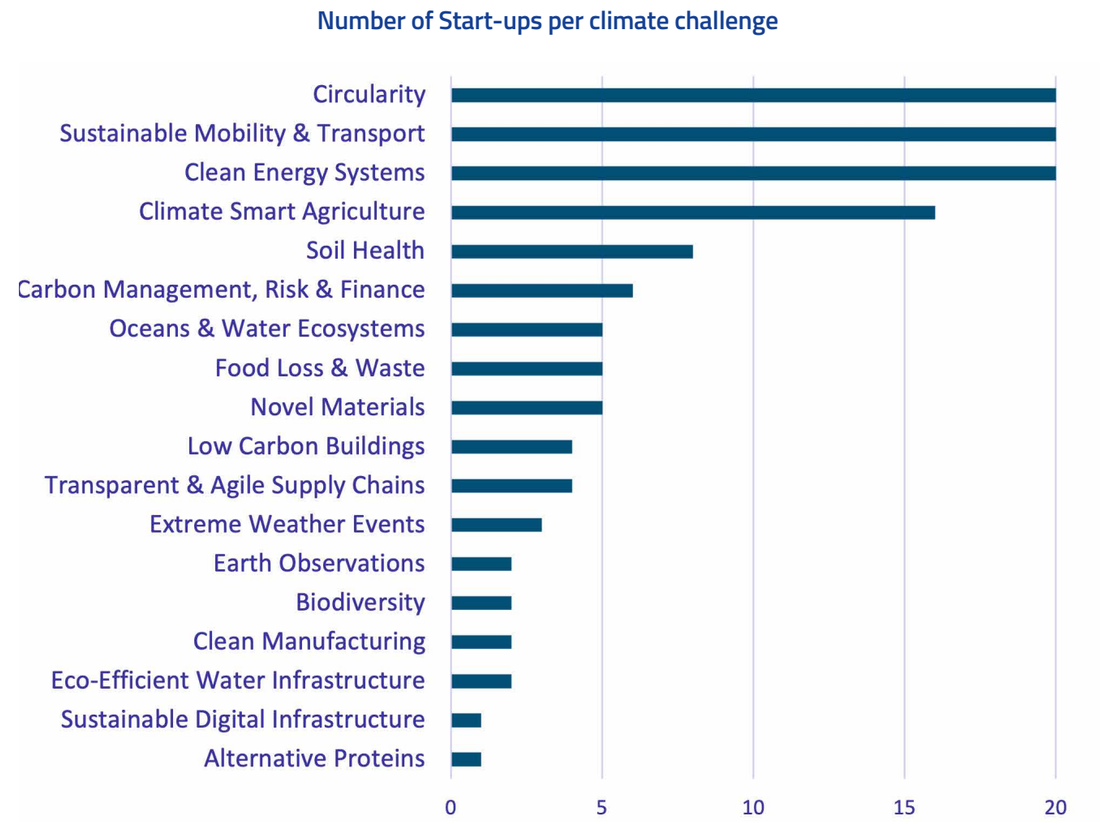


Figure 13 - Number of start-ups per climate challenge

Another challenge for improving sustainability and climate positive outcomes especially in urban environments is transport. Transport is the sector with the second highest emissions in the country (27% in 2019). Sea transport, mostly from the Greek coastal shipping, accounts for more than half of the GHG emissions of the sector, thus it is encouraging that 20% of the start-ups tackling the Sustainable Mobility & Transport challenge, are offering solutions related to the maritime sector. Moreover, the country has set ambitious targets with regards to electromobility and aims to achieve, by 2030, a 30% share of electric passenger vehicles amongst all newly registered vehicles (Hellenic Republic Ministry of the Environment and Energy, 2019). In 2021, the share for both EV battery cars and plug-in hybrid cars was 7% (EEA, 2022).

Year of establishment of the climate tech start-ups

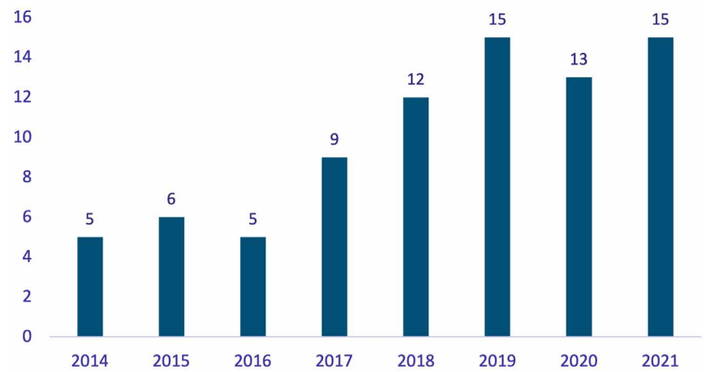


Figure 14 - Year of establishment of the climate tech startups

Share of climate tech start-ups per region

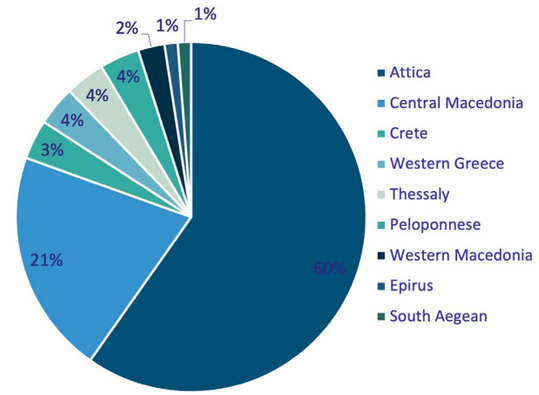


Figure 15 - Number of climate tech start-ups per region

The interest in electric mobility is also reflected in the domestic climate entrepreneurship, since half of the start-ups in this challenge are providing products or services related to electric vehicles (e.g., software or hardware for electric vehicles charging).

Related to the third most prominent challenge addressed by the climate tech start-ups, is the fact that Greece has been shifting towards cleaner energy. This has been one of the drivers for the Greenhouse gas (GHG) emissions reduction over the past decade. However, the country's GHG intensity has only slightly improved and the country, up until 2020, was among OECD's ten most carbon intensive economies, indicating that further actions need to be taken (OECD, 2020). At the same time, it is rich in renewable energy resources (RES - wind, solar, geothermal and biomass) so there is further potential that can be tapped. For example, the startups included under this challenge in this report are offering various services regarding RES, from development and production (e.g., small wind turbine technology, power generation from low-temperature heat sources) to energy storage and management. It should also be noted that the changes in the EU energy strategy (RepowerEU) might lead to a temporary increase in the use of lignite for electricity production in the next period, however, further research in increasing the country's dependence in RES is already taking place.

Lastly, Climate Smart Agriculture, is an important challenge since in Greece agriculture is the sector that is expected to be most severely impacted by climate change (Bank of Greece, 2011). Therefore, it is imperative to identify and adopt targeted adaptation measures in order to minimise its negative effects. In the National Adaptation Strategy, where specific measures for different sectors are presented, one of the measures for agriculture is related to the sustainable use of resources, and in particular water, soil and biodiversity. Hence, the development of innovative solutions for climate data monitoring, soil and crop mapping, and water management, which are some of the services provided by the start-ups under Climate Smart Agriculture, can contribute towards strengthening the resilience of the agricultural sector.

The Greek ecosystem of climate tech start-ups contains a mix of different start-ups in terms of year of establishment. In 2014 and for a number of years following, the number of climate tech start-ups registered annually was around five. From 2017 onwards, an increase is noted in the number of start-ups established, but still, the number of companies remains very small. In the last years (2019-2021), 13-15 climate start-ups were established annually, exhibiting a good potential

Number of employees (excluding founders) in Greek climate tech start-ups

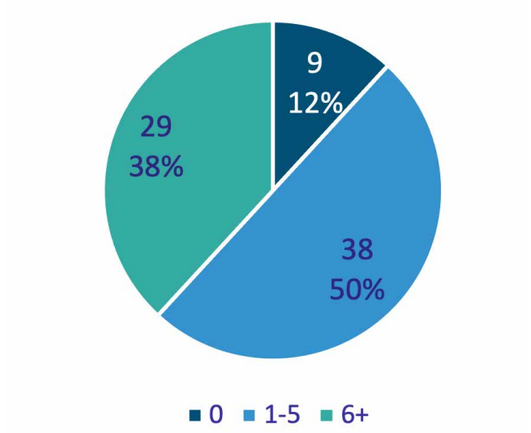


Figure 16 - Number of climate tech startups per employee bracket size (not including founders)

for increased growth in years to come too. Despite the significant increase in the number of newly established startups in the last 5 years, further actions are required to ensure the sustainability of these start-ups and to support them in their growth and their prospects of providing mature and business relevant solutions (Figure 14).

Regarding geographical concentration, which is defined based on the location the company is registered, 80% of the start-ups are located in Attica and Central Macedonia, the two more densely populated regions in the country (Figure 15). This is similar to the geographical concentration of the start-ups classified in Elevate Greece under the Green&Clean Tech industry, as described in a

Number of employees in early-stage entrepreneurship (ttl Greece)

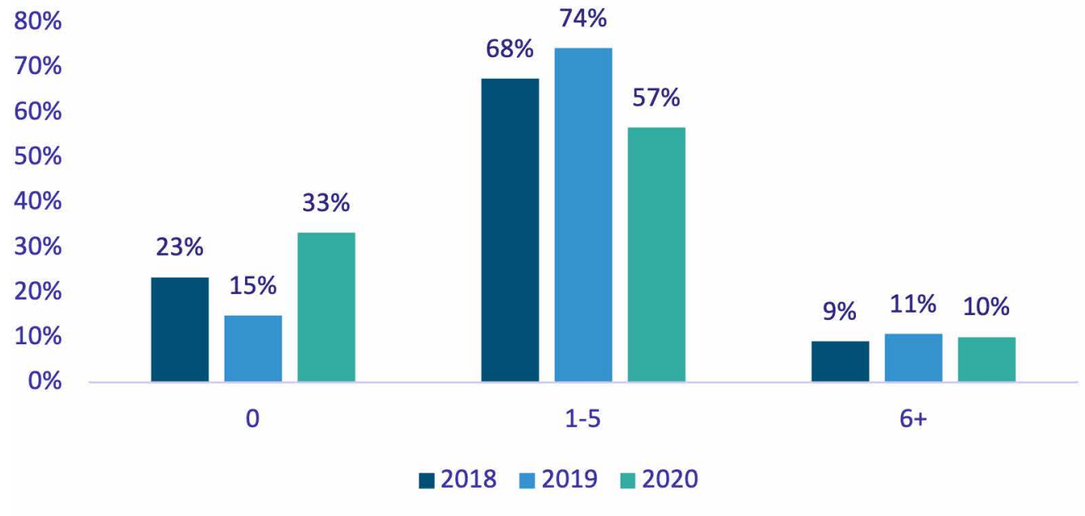


Figure 17 - Number of employees in early-stage entrepreneurship (Source: IOBE, GEM Entrepreneurship Monitor 2020-2021, Greece)

previous section. However, it should be highlighted that this concentration is even stronger than the general economic strength of the regions, as indicated by their GDP contribution (61.4% being the summed GDP of both regions in 2019) (ELSTAT, 2022).

Greek climate tech start-ups seem to be small, with 12% having no other employees than the founders, and half of them employing 1 to 5 people (Figure 16). At the same time the average number of employees (not including founders) is 5.4, which is considerably smaller compared to the average number of employees in the wider Greek start-up ecosytem (660 start-ups, 9.7 average employees as per ELEVATE Greece). However, if we focus our attention on newly established climate tech start-ups, registered since 2020 (Figure 18), and compare them to all early-stage startups in the country (Figure 17), we see that a higher proportion of climate tech startups has 6 employees or more. Of course, the small sample size of newly registered climate start-ups should be taken in consideration, but nevertheless it is an indication of higher complexity compared to the average early-stage startup in the country.

Finally, another characteristic of the climate tech start-ups identified is that 12% of them are spin-offs of public universities or research institutions. This demonstrates the contribution the public sector can have in climate

Number of employees (excluding founders) in Greek climate tech start-ups since 2020

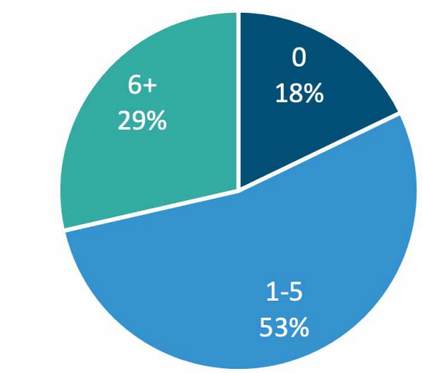
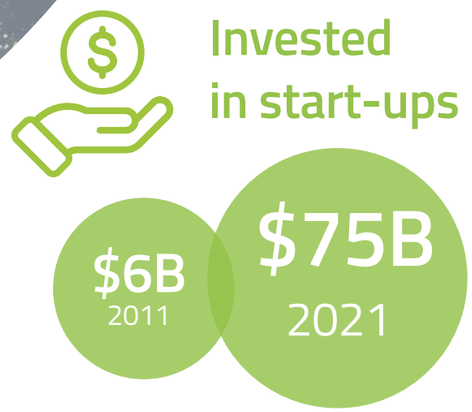


Figure 18 – Number of employees, excluding founders, in Greek climate tech start-ups established since 2020

tech entrepreneurship. This is sustained through the participation of the universities and academia in relevant EU funded projects (i.e., Horizon Europe, LIFE, INTERREG etc). However, the increased competition for receiving relevant funding hinders the approval of proposals and affects the birth rate of start-ups.



Capital Investments

With regards to capital investments in the climate start-ups and based on information available in ELEVATE Greece and Crunchbase, only 13 out of the 83 companies have received funding from an investor, and in fact only for 12 of them the amount invested has been disclosed. For 75% of these companies the investment has been under a million euros and only 3 of them have received over a million euros, with the largest amount invested in one company being €9.7 million. At the same time, many climate start-ups have received national or European grants that have supported their operations.

The funding of early stage innovation activities in the country depends heavily on EU funds. The amount of €28.8 million was allocated to Greece for the promotion of innovative technologies for environmental protection and resource efficiency in the areas of waste management, water management, soil contamination and air pollution

Number of climate tech startups per funding bracket (in euros)

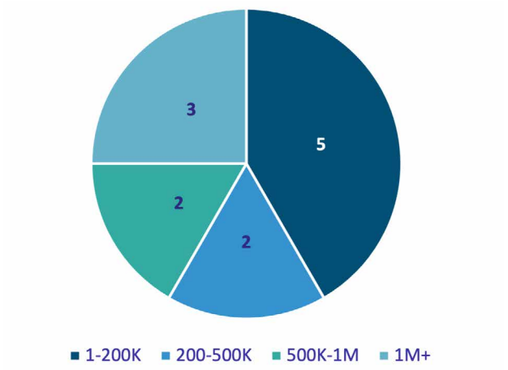


Figure 19 - Number of climate tech startups per funding bracket

Climate-KIC

Funded by the European Union

PLANETech Climate Change Technologies

VC investments in start-ups and other early stage, Greece, 2011-2021

Figure 20 - VC investment in start-up and other early-stage business (in USD current prices and as a percentage of GDP), Source: OECD

through the Operational Programme on Competitiveness, Entrepreneurship and Innovation (EPAnEK) under the new National Strategic Reference Framework (NSRF, 2004-2020) (European Commission). In the same direction, the new NSFR (2021-2027) has expanded towards promoting innovative entrepreneurship, upgrading and developing transport infrastructure, mitigating the effects of climate change, rational water management, biodiversity protection, and clean energy among other things.

Start-ups can undertake a pivotal role in the Greek innovation ecosystem by accelerating innovation and fostering growth. Venture Capital (VC) is an effective financing approach that can provide significant amounts of funding for start-ups. Indeed, in 2019, 84.3% of capital investments to start-ups came from VCs . Figure 20 shows VC investment in start-up and other early stage in Greece between 2011 and 2021 both in USD prices and as a percentage of GDP. It is obvious that between these years, VC investment in Greece has skyrocketed from $6 billion in 2011 to $75 billion in 2021.

In 2016, the Greek government collaborated with the European Investment Fund to establish EquiFund[8], a €300 million fund for early-stage businesses. Today, Greek start-ups have discovered additional funding through the Hellenic Development Bank of Investments (HDBI) and the Q-Equity program[9],which allocates nearly 400 million euros through the Recovery Fund to new funds in private equity/venture capital companies that will invest in Greek innovative enterprises.

However, as it can be seen in the below graph (Figure 21), although gross fixed capital formation in Greece was on average 11% of GDP between 2014 and 2019, investments in environmental protection were, on average, only 0.25% of GDP during the same period.

Investments in Greece

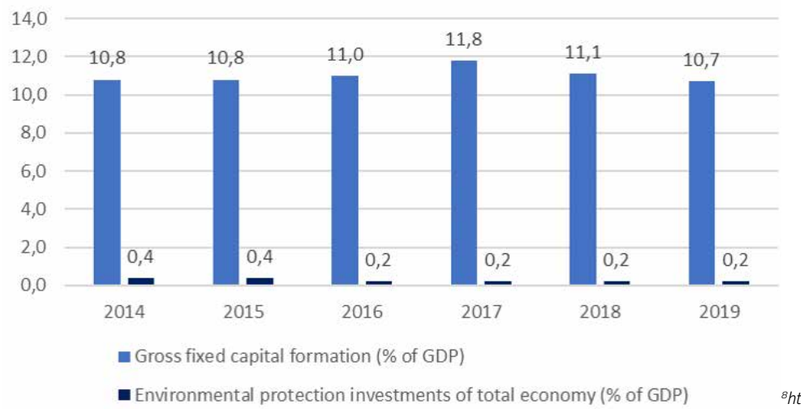


Figure 21: Gross fixed capital formation and environmental protection investments in Greece, 2014-2019, Source: Eurostat

[8] *https://equifund.gr/*
[9] *https://hdbi.gr/en/expression-of-interest/q-equity-en*

Greece as a Regional Climate Tech Player

To evaluate Greece's role as a regional climate tech player, a couple of indices were examined.

Firstly, according to the latest Global Cleantech Innovation Index (2017) which based on 15 indicators explores where entrepreneurial clean technology companies are most likely to emerge, Greece ranks 34th out of the 40 countries included (Cleantech Group, 2022). Although this is a weak performance, it should be noted that in the previous ranking Greece was ranked second-to-last, so during the period 2014-2017 the position of the country has slightly improved.

Another metric that is indicative of the country's activity in research and innovation relative to other countries, is its ranking in terms of Horizon projects participation. According to data for the Horizon 2020 programme, Greece performs strongly, being in the 8th place out of the 28 countries in terms of number of participations, which is the number of organizations involved in the selected projects (Figure 22). More specifically, Greece had a total of 5,488 participations, with 1,006 unique participants in 2,900 signed grants out of the 32,539 grants in total.

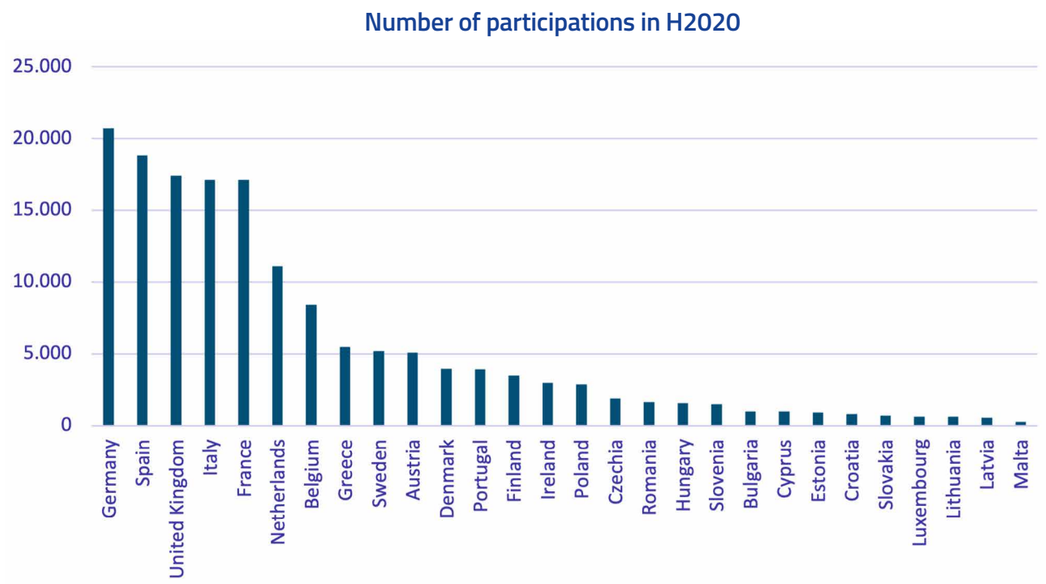


Figure 22 - Number of participations in H2020 (Source: https://webgate.ec.europa.eu/dashboard/sense/app/98dcd94d-ca66-4ce0-865b-48ffe7f19f35/overview)

Climate-KIC
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Opportunities and Barriers to Climate Tech in Greece

Table 1 presents a Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis of the Innovation Ecosystem in Greece through literature review. A SWOT analysis gathers data from internal sources (the country's strengths and weaknesses) as well as from outside factors that could have an uncontrollable impact on decisions (opportunities and threats).

4.1. Strengths and Weaknesses of Greece

As Pepelasi et al. (2022) and others describe, Greece lacks, and thus, needs to make improvement in the following areas:

- The stabilization of the economy and modernization of the public administration and the competent authorities. Bureaucracy and instability in the institutional and regulatory frameworks as well as in the tax system create an unfriendly ecosystem for new businesses and investors to operate in Greece.

- The adoption of a unified policy and strategy to support entrepreneurship, which will include public programs, special initiatives for young entrepreneurs, women and the unemployed at national and regional level, providing support in protecting the intellectual rights of patents and in creating a spin-off.

- The disposal of modern tools to provide financial support.

- The need for strengthening and restructuring of technology transfer offices.

- Reduction of the brain drain and attraction of skilled professionals.

However, the Greek government, in the context of the development of the Greek ecosystem, has announced a series of initiatives/measures to facilitate start-ups and speed up their development. These initiatives include a systematic registration process of the Greek innovation ecosystem, which will be performed via a digital platform on the Greek Start-up Ecosystem, known as "Elevate Greece" (https://elevategreece.gov.gr/). In addition to Elevate Greece, several other initiatives are implemented aiming at enhancing the Greek innovation ecosystem. More specifically:

- The expansion of Elevate Greece into an ecosystem collaboration platform that will include events calendars, chat rooms, thematic support groups for various topics, networking opportunities and presentations.

- Simplification of tax and insurance frameworks. The tax rate of the first step of the tax scale has been reduced by 50%, for the first three years of activity, as long as the annual gross income from business activity does not exceed €10,000.

- New NSRF aid program, amounting to €60 million for financing, in the form of a non-refundable grant for very small, small, and medium-size companies. 60 start-ups registered at Elevate Greece were successfully accepted by the program - the grant ranges between €5,000 and €100,000.

- Structural partnerships between universities (and other public bodies) and industry: 12 competence centres worth over 22 million Euros are established to support innovation, initiated by Next Generation EU and National Recovery and Resilience Plan "Greece 2.0" (https://greece20.gov.gr/en/). The centres will support innovation and technology transfer in 5 fields, 3 of which are related to climate technologies (Energy, Agriculture, Materials and Construction). The cooperation of the universities and research centres with the business sector will enhance the research results, and increase the extroversion of Greek universities and the employability prospects of their graduates. 12% of climate tech companies are currently spin-offs – there could be an expectation that these competence centres with climate-focused fields can lead to even more.

- There are several accelerators and incubators in Greece giving the opportunity to Climate tech start-ups to get access to funding, mentoring and networking opportunities with possible clients and investors. Indicatively, the thematic "MENA Maritime Accelerator" (http://maritime-accelerator.org) focused on the maritime sector; Enso XL (https://www.optima-x.org/enso-xl-accelerator) is a Greek Maritime Tech accelerator; the ClimAccelrerator (https://climaccelerator.climate-kic.org/partners/impact-hub-athens/); the NBG Business Seeds (https://www.nbg.gr/el/epaggelmaties/nbg-business-seeds) targeting innovative and technological solutions as a whole; Corallia (https://corallia.org), the Hellenic Technology Cluster Initiative; IQbility (https://www.iqbility.com) is a corporate business incubator that provides high-potential entrepreneurs with high-quality mentorship, angel capital, and business networks; i4G (https://i4g.gr) is Greece's first private business incubator and a hotbed for young entrepreneurs and start-ups; Metavallon (https://metavallon.vc) is a model social enterprise that empowers and accelerates early-stage start-ups.

Strenghts

1. Elevate Greece, a digital platform on the Greek Start-up Ecosystem
2. Support of new and low-income businesses New NSRF aid program providing €60 million grant to SMEs.
3. Structural partnerships between universities (and other public bodies) and the industry
4. Existence of several accelerators and incubators in Greece

Threats

1. Global crisis (COVID-19 pandemic, Energy crisis, war in Europe, climate change)
2. Inflation and other macroeconomic factors.
3. Lack of enough financing or innovation
4. Rapid decarbonisation challengee

Weakness

1. Complex tax and legislative framework
2. Bureaucracy .
3. Lack of a unified policy and strategy to support entrepreneurship
4. Brain-Drain

Need for restructuring of the technology transfer offices

Opportunities

1. Affordable and accessible technology and infrastructure
2. Higher investor demand .
3. Favourable global policy framework for decarbonization
4. Skilled employees working in the climate tech sector
5. Ambitious companies to become net zero
6. Consumers demand for low carbon products and services
7. Motivated founders to mitigate climate change start-ups

Table 1 - SWOT Analysis of the Greek Innovation Ecosystem

4.2. Opportunities and Threats to the global climate tech ecosystem

Climate Tech start-ups are subject to global threats that have a direct effect on their operations and sometimes on their business model.

- The COVID-19 pandemic. (UNDP, 2022) states that the COVID-19 epidemic affects communities and economies on a fundamental level; it is not just a health crisis. Although the epidemic may have different effects in different nations, it will almost certainly worsen poverty and inequality globally, making the SDGs' fulfilment even more critical.

- The war in Ukraine. The war is still having a significant impact on the world markets and food supply. The inability of Ukraine to export food for the first five months of the fighting increased the world's hunger crisis, which had disastrous effects elsewhere.

- The Global Energy Crisis. Numerous causes, particularly the incredibly quick economic recovery following the epidemic, caused the energy markets to tighten up in 2021. However, once Russia invaded Ukraine in February 2022, the situation quickly worsened and turned into a full-fledged global energy crisis. Natural gas prices hit record highs, which had an impact on electricity prices in several markets. The price of oil reached its highest point since 2008 (IEA, 2022).

- Inflation. The two main drivers of inflation are the increase in food and energy prices eroding global living standards (IMF, 2022).

- Lack of enough financing or innovation in climate technology to propel the pace and scale necessary for a net zero change.

- Economies and societies need to react fast to address the rapid decarbonisation challenge.

Climate technology is anticipated to become more and more important to provide the transformation needed to achieve net zero since the quickly expanding market has already shown an exceptional capacity for scalability. It makes sense to consider what the primary drivers of this excellent growth to date have been and how those can be strengthened if climate tech is to play a more prominent part in the net zero transformation. Seven significant factors contributing to the emergence and expansion of the climate technology ecosystem over the past few years that we related to for the SWOT analysis for the Greek climate tech ecosystem in this study (PwC, 2020).

- Technology and infrastructure: Low-carbon technology, particularly in regard to the production of batteries and renewable electricity, has become significantly more affordable and accessible.

- Finance and investor demand: Institutional VC funds and other alternative sources, such as those mentioned above, are making substantially more investment capital available.

- Policy and process: the policy and regulatory environment is becoming more favourable as a result of 120 national governments commitments to decarbonize their economies, which have been accompanied by corresponding spending and policy actions in both the areas of regulatory standards, such as bans and phase-outs to market-based measures, such as carbon pricing.

- People: Across a variety of industries and regions, top entrepreneurs and talent have been pulled to various aspects of this significant and pressing challenge.

- Corporate demand: As more businesses adopt broader and more specific Environmental, Social, and Governance (ESG) objectives, corporate ambition and, in turn, action, are increasing. Nearly 300 global businesses have announced net zero commitments.
- Consumer demand: A variety of high-profile "winners," such as Beyond Meat, Tesla, and Nest, have been made possible by high-quality low-carbon products and services.

- Motivated founders: As more and more firms find success; more and more entrepreneurs are becoming inspired to take on the climate challenge.

Looking ahead

The upscaling of climate related innovation in Greece requires a system with strong foundations that will be able to support all phases of innovation creation and upscale. A short presentation of the different phases and need for funding and technical support is provided in the section below.

In literature, three phases are identified from the identification of the innovative idea until the business exploitation. At the validation phase, the innovative idea is tested in theory and in practice (i.e. through small scale implementation). In Greece, this phase is usually funded by different types of subsidies and public resources (i.e. national, European etc). In Greece, the support from incubators that provide small scale financing for the validation phase is limited. In contrast, in economies with more developed structures that support innovation (i.e. USA), the role of incubators and business angels is more impactful[26] .

During the demonstration phase, the idea/innovation is implemented at a small/medium scale aiming to identify bottlenecks and opportunities that are not evident in the validation phase. Again, in Greece this phase does not usually retrieve large funds, while again any funding sources do derive from national and European public funds.

The next and last phase refers to the upscaling of innovation. During this phase, the innovative idea is more mature and usually has a marketable and bankable character. In countries where the innovation system is more mature and expanded, the cost of upscaling innovation (i.e. construction of a manufacturing unit, personnel cost, dissemination and wider advertisement costs etc) is usually covered also by the capital and stock markets. In contrast, as it is being noted in previous chapters, the low level of private investment and the qualitative characteristics of the Greek capital market hinder the full scale-up of the innovation into a business opportunity that can increase climate adaptation/ mitigation potential and generate jobs and growth for the Greek economy. It is quite frequent that innovative climate and environmental concepts that have been developed in a research project (I.e. Horizon 2020, Horizon Europe) or in a demonstration project (I.e. LIFE) do not progress post the second phase. Full up-scale is available only to a very small number of start-ups and other business opportunities in general (i.e. project teams that continue the third phase in other EU Member States).

[26] The incubator "Evergreen climate innovations", located in Chicago USA, funded 37 climate related start-ups and companies in 2021 generating 857 jobs , catalysing $6.6 million in seed capital (from private contributions, gains from realised investments etc). In 2021, the seed funding was multiplied by 39 times reaching $259 million.

In Greece, the penetration of sustainable finance is low. By the end of 2021, 6 corporate green bonds were issued (€2.6 billion), while 1 corporate sustainability linked bond was registered in 2021 (approximately €300 million). On the policy-makers side, the Greek Ministry of Finance is implementing an EU funded project, part of which will lead in the design of specific mechanisms that will a) provide incentives for the enhancement of sustainability financing and b) support the provision of finance in sectors identified in the EU taxonomy. Furthermore, the Greek stock exchange market has recently developed an ESG (Environment – Social – Governance) based index, focused mostly on companies that implement climate mitigation activities.

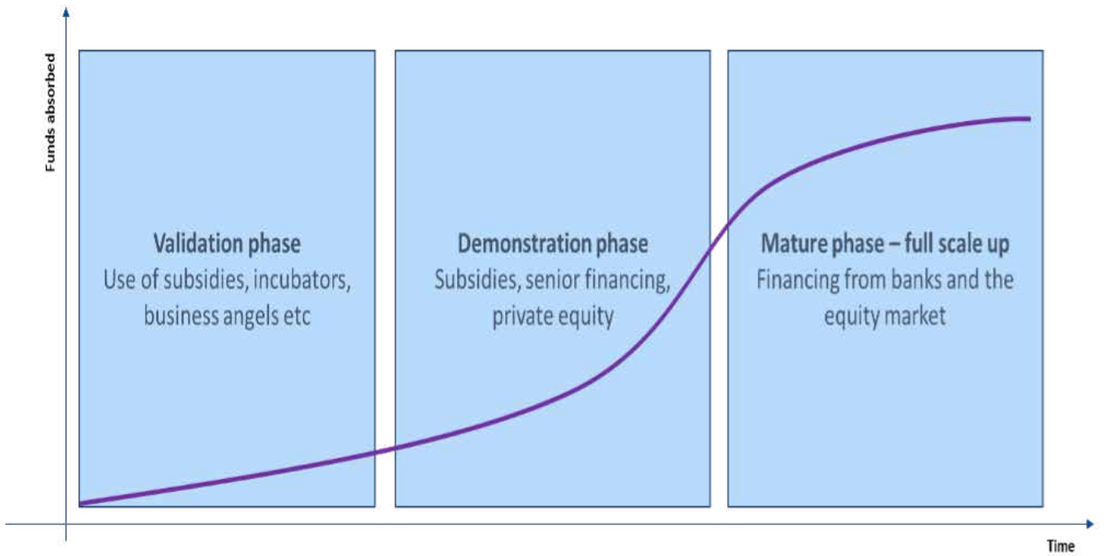

Figure 23 - Maturing innovation and funding sources. Source: (Polzin et al., 2017)

The business exploitation of innovation related with environmental and climate protection needs to be based not only on EU/national public financing, but also on private. Sustainable financing instruments have been developed and progressed significantly in the last 5 years. Green bonds, sustainability linked loans and bonds, as well as ESG related stock-market products have been developed and provide private financing to established private companies, world-wide. Global climate financing (bonds, loans etc) was assessed at $632 billion in 2019-2020, while by the Q3/2022, the global green bond market reached $2 trillion (CPI, 2021).

Greece is one of the Southern European countries that are already affected significantly from climate change. Increase in mean temperature, more frequent and abrupt weather phenomena lead to the deterioration of natural ecosystems, loss of human lives and decrease in the productivity of the Greek economy. On the other hand, the investments needed both for mitigation and adaptation to climate change are related to public infrastructure and the development/adoption of innovative solutions. The development of the capital market with the incorporation of sustainability aspects and the enhancement of the link with the academia are prerequisites for bridging the financing gap and ensuring that innovative ideas of higher technology readiness level will reach the market up-scale phase, generating added value for the Greek economy and jobs.

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