MICIE
Mediterranean Island Cleantech Innovation Ecosystem

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Guidebook

Transformative Climate Innovation Action Plans for Island Ecosystems

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Callus, M.A., T. Gallea and D. Spiteri (2023) Malta action plan. Deliverable 4.2 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta). 43 p.

Vryonides, M., E. Nikolaou, A. Charalambides and L. Shakou. (2023) Cyprus action plan. Deliverable 4.2 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Cyprus Institute of Technology and Cyprus Energy Agency. Nicosia (Cyprus). 56 p.

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Background

Research and innovation (R&I) are the cornerstone of our modern economies, and specifically, the cleantech sector generates manifold solutions to many of the pressing challenges in social sustainability and ecology. However, in Europe and across the world, the level of innovation development and the maturity of entrepreneurship ecosystems is not always the same across a certain region. This imbalance poses challenges for public policy interventions, which require a more strategic alignment to anticipate and to induce positive spillover effects onto the economy and society.

In October 2014, the European Council adopted the 2030 climate and energy framework which set EU-wide targets aimed at the transition towards a low-carbon economy for the period from 2021 to 2030. The targets set in 2014 (which have since been updated following the Paris Agreement and the European Green Deal) included:

- Reduction of at least 40% in greenhouse gas emissions by 2030, as compared to 1990 levels
- An increase of the share of renewable energy to at least 32%
- An improvement of at least 32.5% in energy efficiency

To support delivery of the EU-wide 2030 targets, each EU Member State (MS) prepared a National Energy and Climate Plan (NECP) which sets out the national targets, strategies, policies and programmes that each MS will put in place for the period 2021 to 2030. Within each national plan, R&I plays a critical role in supporting the development of cleantech solutions that can lead to breakthroughs in climate action, which is why the EU called upon MS to strengthen their R&I in climate and energy. However, in practice, recent evaluations of those NECPs repetitively describe the insufficient alignment and integration of R&I planning into policy guidelines.

This guidebook is a resource for MS that are willing and/or required to link their climate and R&I policies in a more strategic way, particularly those with emerging cleantech ecosystems in island states and particularly nations with less advanced entrepreneurial ecosystems.

This guidebook is organised as follows: this first section presents some background information, including a brief description of the MICIE project from which this guidebook's conclusions are derived, a description of the state of development of cleantech in Malta and Cyprus, and a succinct explanation of the EIT RIS programme. Following, the second section explains why this guidebook is needed and who would be the targeted user. Next, the third section describes how to implement the MICIE approach to the design of R&I Plans for Transformative Climate Action in Island Ecosystems. Lastly, the document provides additional resources and templates.

Mediterranean Island Cleantech Innovation Ecosystem (MICIE) Research Project

The MICIE project comprised eight partners embodying the quadruple helix, which positioned the research consortium to leverage their strengths and expertise in their respective fields. The traditional triple helix model focuses on the collaboration between universities, industries, and governments to foster innovation and economic development. The quadruple helix is a conceptual model that extends the traditional triple helix model of university-industry-government interactions by adding a fourth helix: civil society/the public. The quadruple helix framework recognizes that innovation is not solely driven by the traditional actors but also involves the active engagement and participation of broader society. It promotes the idea of open innovation ecosystems where diverse stakeholders collaborate, share knowledge, and co-create solutions to complex problems.

The MICIE project convened the following stakeholder groups:

Government and policy makers:
Public authorities, including the **Energy and Water Agency of Malta** and the **Deputy Ministry of Research, Innovation, & Digital Policy of Cyprus**, acted as the ultimate 'end-users' of the Research and Innovation (R&I) Action Plans.

Business and Industry:
Organizations representing the business world (industry entities, businesses, and SMEs) including the **Cyprus Employers and Industrialists Federation** and the **Malta Chamber of Commerce** not only contributed to climate innovation but also played a pivotal role in embracing new technologies and business models.

Innovation, Research, and Academia:
Research and academic institutions, like the **Cyprus University of Technology** and the **Malta College of Arts, Science & Technology,** along with systemic innovation support organizations like **EIT Climate-KIC** were instrumental in the development and testing of new technologies, preparing them for adoption by the market.

Civil Society
Cyprus Energy Agency represented the broader interests of society and provided insights into how it envisioned the role of climate Research and Innovation (R&I).

The main objective of the Mediterranean Island Cleantech Innovation Ecosystem (MICIE) project was to strengthen research and innovation ecosystems of Small Island States to attain the climate and energy targets outlined in the National Energy and Climate Plans (NECP) of Malta and Cyprus, two MS that served as case studies.

The key objectives of the project were as follows:

Benchmarking and Analysis: Conduct an in-depth analysis of leading innovation ecosystems worldwide, identifying exemplary practices and benchmarks.

Mapping of Research and Innovation Ecosystems: Thoroughly map the existing R&I ecosystems in Cyprus and Malta, encompassing all relevant local and national actors, as well as the support instruments currently in place.

Co-creation and Co-development: Facilitate the collaborative creation and development of innovation cleantech ecosystems in Cyprus and Malta through a series of workshops, fostering an environment conducive to innovation across all relevant sectors.

Individual Research and Innovation (R&I) Action Plans: Develop tailored R&I Action Plans for both Cyprus and Malta, with the aim of stimulating innovation procurement and facilitating the successful market adoption of innovative solutions.

Promoting Collaboration: Foster collaboration and knowledge exchange between the research and innovation ecosystems of Malta, Cyprus, and other mature ecosystems across Europe, to leverage shared expertise and accelerate progress[1].

1 Strengthening Research and Innovation across the EU (no date) The Mediterranean Island Cleantech Innovation Ecosystem. Available at: https://micie-project.eu/.

Emerging cleantech ecosystems in Island States: the case of Malta and Cyprus

Although the MICIE project was specifically tailored for the distinct characteristics and objectives of Cyprus and Malta, this Action Plan Guidebook stands also as a resource designed to enhance the energy and climate strategies of other cities, regions, and countries – and particularly those in Island States.

Unfortunately, evidence about the state of the art and about specific methods to strengthen cleantech innovation/ cleantech ecosystems in Island States (and particularly for Malta and Cyprus) is hard to find the scientific and policy literature. One way to understand how emerging innovation ecosystems grown is by means of the identification of relevant cases of technologies or solutions that are being considered of high potential for scaling up or wider diffusion, and to identify known barriers and bottlenecks to their deployment in their national innovation system. However, the available evidence is inconclusive and more of a 'work in progress'.[2]

Fortunately, a handful of studies focused on the topic of innovation policies in Malta and Cyprus do exists. They focus on clean energy transition of islands, and sustainability challenges of island states more broadly. One of the key messages from some of these studies refer to the potential of island ecosystems to serve as living labs and testing grounds for innovative technologies and solutions, for instance in the analysis conducted by Skjølsvold et al (2020) of eight island ecosystems, conditions for systems innovation and sustainable development in EU OCTA territories (Jesic von Gesseneck, et al 2018), or earlier work focusing on small island development states as ideal testing grounds for climate innovation (De Comarmond & Payet, 2010).

In addition, focusing on certain aspects of the R&I process or on framework conditions for sustainability is partly a practical response to the uneven state of development of national innovation, competitiveness or development policies and their corresponding innovation ecosystems (Coenen & Díaz López, 2010), which often require further strengthening of key functions (Hekkert et. al 2007). Amongst those relevant functions for strengthening Malta and Cyprus's sustainability-oriented innovation systems we can suggest: R&I infrastructure, network development and diffusion of knowledge, insufficient human capital, additional financial mobilisation, improved conditions for technology transfer, etc. (e.g. Kapetaniu, et al 2021; Sammut et al. 2020; Musyck and Hadjimanolis, 2002; Hadjimanolis and Dickson, 2001).

The following paragraphs provide a brief characterisation of certain elements of the cleantech innovation ecosystems of Malta and Cyrprus, as an example of the nature of innovation for climate and energy transitions in Island States.

Innovation profile of Cyprus and Malta

Cyprus and Malta are two of the smallest EU states with distinct characteristics as Island States vis-a-vis more mature innovation ecosystems in Europe (and internationally). Despite their growing innovation capacities, available indices and scoreboards suggest that their position around eco-innovation and cleantech innovation are not favourable ones.

In the WIPO global innovation index for 2023[3], Malta ranks in the 25th position globally (49.1 points), whereas Cyprus is a little behind in the 28th place (46.3). In the WIPO metrics, at the top of the list is Switzerland (67.6 points) and the bottom is Angola (10.3 points). Malta is located between Australia (49.7) and Italy (46.6), whereas Cyprus competes with New Zealand (46.6 points) and Spain (45.9 points). WIPO considers that the ranking of both Malta and Cyprus is well-placed according to their level of development (both countries are part of the high-income group of countries in the index).

As it is indicated in the following paragraphs, the position of these countries is not at all outstanding in the eco-innovation/cleantech domain. In 2022, both Cyprus and Malta are part of the 'catching-up' group of eco-innovators for the EU-27 countries (which is the term used by this index to denote the least advanced countries in terms of eco-innovation).

As it can be seen in the figure below, in the year 2022, Cyprus ranked 20th (94.65 points) and Malta 25th (79.76 points) of the European Eco-Innovation Scoreboard. Both positions are well below the EU average (121.47 points).

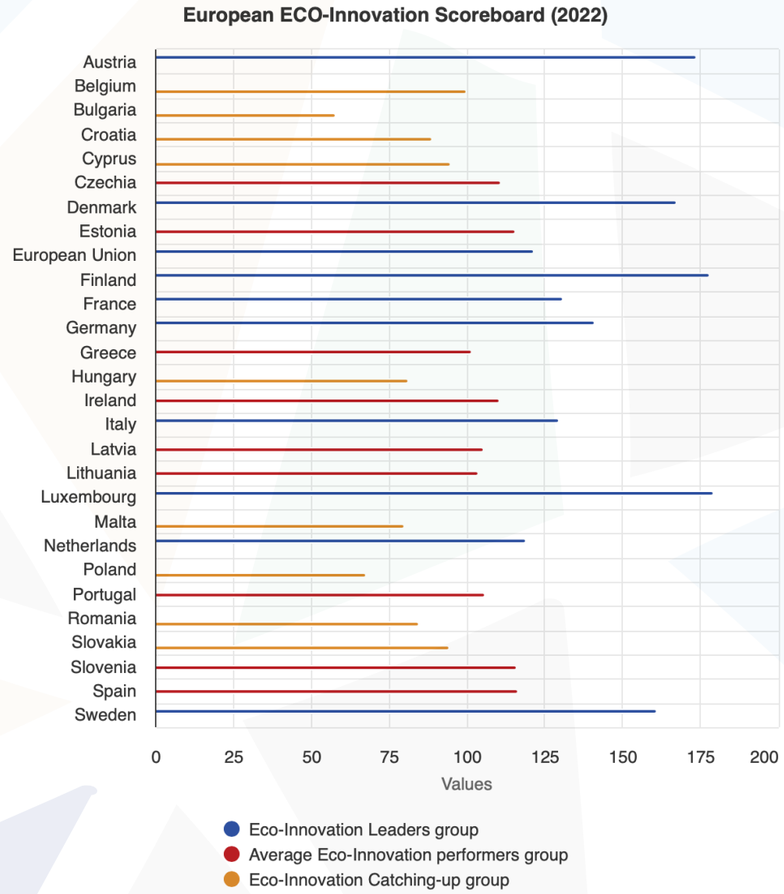

Figure 1 EU Eco-innovation index for the year 2022

For Cyprus, a detailed comparison of the different variables that integrate the eco-innovation index reveals structural weaknesses in the different categories analysed. One of the most relevant of such variables is the amount of public expenditure in green R&D, which is significantly low.

2 There are, nonetheless, an important number of (techno-economic) studies about solar PV and wind energy technologies in Malta and Cyprus.

3 World Intellectual Property Organization (WIPO) (2023). Global Innovation Index 2023: Innovation in the face of uncertainty. Geneva: WIPO. DOI:10.34667/tind.48220

Indicator	Indicator value[1]	Performance relative to EU[2]
Eco-Innovation Index	0.393	94.6
1. Eco-innovation inputs (normalised score)	0.082	15.0
1.1. Governments environmental and energy R&D appropriations and outlays (% of GDP)	0.00%	9.1
1.2. Total R&D personnel and researchers (% of total employment)	0.54%	23.4
2. Eco-innovation activities (normalised score)	0.504	151.5
2.1. Number of ISO 14001 certificates (per million population)	253.3	151.5
3. Eco-innovation outputs (normalised score)	0.546	132.1
3.1. Eco-innovation related patents (per million population)	3.8	14.5
3.2. Eco-innovation related academic publications (per million population)	62.5	515.0
4. Resource efficiency outcomes (normalised score)	0.372	101.9
4.1 Material productivity (GDP/Domestic Material Consumption, €/kg)	1.4	75.2
4.2 Water productivity (GDP/total fresh water abstraction, €/m³)	125.5	196.2
4.3 Energy productivity (GDP/gross inland energy consumption, €/toe)	8.3	122.0
4.4 GHG emissions productivity (GDP/CO2e)	3.4	107.8
5. Socio-economic outcomes (normalised score)	0.435	104.0
5.1 Exports of products from eco-industries (% of total exports)	2.04%	82.5
5.2. Employment in environmental protection and resource management activities (% of total workforce)	#N/A	#N/A
5.3. Value added in environmental protection and resource management activities (% of GDP)	#N/A	#N/A

Country performance relative to EU in 2013 and 2022[3]

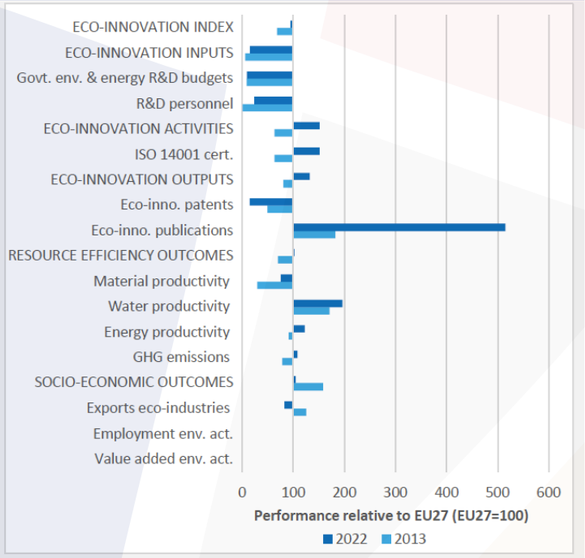

Figure 2 Country analysis of the composition of the eco-innovation index for Cyprus in 2022.[4]

A similar picture can be obtained for Malta, where the indicative figures related to green R&D is also well below the EU average.

4 Orfanidou, T. and Zacharias, S. (2022) Eco-Innovation Country Profile 2022: Cyprus . 16th edn. CIRCABC. Available at: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/793afe29-40c5-4056-b614-b8ce1c011436/details .

Indicator	Indicator value[1]	Performance relative to EU[2]
Eco-Innovation Index	0.331	79.8
1. Eco-innovation inputs (normalised score)	0.123	22.3
1.1. Governments environmental and energy R&D appropriations and outlays (% of GDP)	0.00%	9.1
1.2. Total R&D personnel and researchers (% of total employment)	0.71%	41.3
2. Eco-innovation activities (normalised score)	0.130	39.2
2.1. Number of ISO 14001 certificates (per million population)	93.0	39.2
3. Eco-innovation outputs (normalised score)	0.187	45.3
3.1. Eco-innovation related patents (per million population)	9.4	33.8
3.2. Eco-innovation related academic publications (per million population)	5.8	83.0
4. Resource efficiency outcomes (normalised score)	0.793	216.8
4.1 Material productivity (GDP/Domestic Material Consumption, €/kg)	2.3	157.1
4.2 Water productivity (GDP/total fresh water abstraction, €/m³)	397.5	422.1
4.3 Energy productivity (GDP/gross inland energy consumption, €/toe)	3.6	29.7
4.4 GHG emissions productivity (GDP/CO2e)	8.0	254.8
5. Socio-economic outcomes (normalised score)	0.166	39.6
5.1 Exports of products from eco-industries (% of total exports)	0.73%	44.4
5.2. Employment in environmental protection and resource management activities (% of total workforce)	1.57%	49.2
5.3. Value added in environmental protection and resource management activities (% of GDP)	1.08%	24.3

Country performance relative to EU in 2013 and 2022[3]

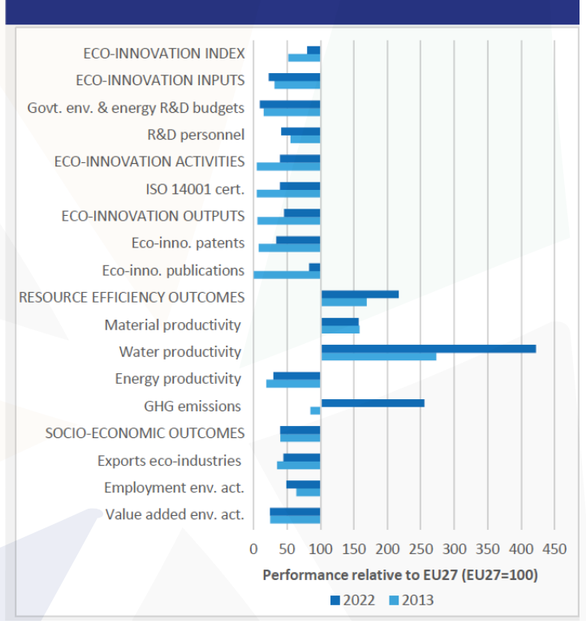

Figure 3 Country analysis of the composition of the eco-innovation index for Malta in 2022[5]

The 2017 Global Cleantech Innovation Index ranks the state of cleantech in 40 countries worldwide, but Cyprus and Malta are not even included in this index, which is led by strong innovators such as Denmark (4.07 points), Finland (3.96 points) and Sweden (3.86 points). [6]

5 Orfanidou, T. and Zacharias, S. (2022) Eco-Innovation Country Profile 2022: Cyprus . 16th edn. CIRCABC. Available at: https://circabc.europa.eu/ui/group/96ccdecd-11b4-4a35-a046-30e01459ea9e/library/793afe29-40c5-4056-b614-b8ce1c011436/details

6 Global Cleantech Innovation Index - Country Rank. i3 Connect - Insight and Data Across the Global Clean Technology Marketplace. Available at: https://i3connect.com/gcii/country_rank.

Venture capital is often used as a measure of the emerging nature of cleantech ecosystems. The most relevant study comes from Ambroise et al (2023), which focuses on characterising the emerging cleantech sector in Europe using data mining techniques, specifically machine learning applied to the Orbis dataset[7], now called Moody's dataset. According to this study, a total of 23,858 cleantech companies can be identified (including 2,990 cleantech innovation startups and 20,868 cleantech ecosystem companies).

	Cleantech companies		Cleantech innovators		Cleantech ecosystem	
	# companies	%	# companies	%	# companies	%
Germany	4,444	18.7%	515	17.3%	3,929	18.9%
Italy	4,254	17.9%	559	18.7%	3,695	17.7%
France	3,414	14.3%	371	12.4%	3,043	14.6%
Spain	2,072	8.7%	329	11%	1,743	8.4%
Poland	1,443	6.1%	152	5.1%	1,291	6.2%
Sweden	845	3.6%	141	4.7%	704	3.4%
Czech Republic	743	3.1%	99	3.3%	644	3.1%
Belgium	706	2.9%	101	3.4%	605	2.9%
Norway	677	2.8%	79	2.7%	598	2.9%
Austria	598	2.5%	85	2.9%	513	2.5%
Romania	550	2.3%	47	1.6%	503	2.4%
Finland	500	2.1%	71	2.4%	429	2.1%
Portugal	456	1.9%	47	1.6%	409	2%
Hungary	413	1.7%	30	1%	383	1.8%
Netherlands	387	1.6%	66	2.2%	321	1.5%
Denmark	334	1.4%	51	1.7%	283	1.4%
Bulgaria	312	1.3%	27	0.9%	285	1.4%
Slovakia	267	1.1%	29	1%	238	1.1%
Serbia	239	1%	18	0.6%	221	1.1%
Greece	226	0.9%	41	1.4%	185	0.9%
Croatia	192	0.8%	24	0.8%	168	0.8%
Lithuania	153	0.6%	18	0.6%	135	0.7%
Slovenia	151	0.6%	24	0.8%	127	0.6%
Latvia	112	0.5%	5	0.2%	107	0.5%
Estonia	83	0.4%	13	0.4%	70	0.3%
United Kingdom	70	0.3%	22	0.7%	48	0.2%
Luxembourg	45	0.2%	7	0.2%	38	0.2%
North Macedonia	43	0.2%	2	0.1%	41	0.2%
Switzerland	41	0.2%	3	0.1%	38	0.18%
Iceland	15	0.06%	1	0.03%	14	0.07%
Malta	13	0.05%	3	0.1%	10	0.05%
Turkey	13	0.05%	3	0.1%	10	0.05%
Montenegro	11	0.05%	0	0%	11	0.05%
Ireland	5	0.02%	1	0.03%	4	0.02%
Cyprus	1	0.00%	1	0.03%	0	0%
Total	23,828	100%	2,985	100%	20,843	100%

Table 1 Distribution of Cleantech Companies in Europe. Source: Ambrois, et. al. (2023)

Using specialised cleantech investment data, it is indeed possible to characterise the cleantech sector at the country level. Using the NetZeroInsights database that includes over 40,000 ClimaTech/cleantech innovators, it was possible to identify a larger set of cleantech startups and their corresponding investments. For the year 2023, this database reports the existence of 40 cleantech innovators in Cyprus and 28 in Malta, with a corresponding aggregate investment value in the order of 1.5 million EUR (1.2 million in Cyprus and 314k EUR in Malta).[8]

Table 2 Venture Capital investments and number of Cleantech/Climatech Startups in Selected countries. Source: NetZeroInsights (2023)

Country	# companies	# deals	Total funding	# investors
Monaco	10	0	$0.0K	0
Malta	**24**	**1**	**$314.5K**	**1**
Cyprus	**40**	**13**	**$1.2M**	**10**
Morocco	42	8	$2.6M	10
Croatia	69	27	$831.5M	16
Egypt	74	67	$110.1M	61
Luxembourg	84	44	$106.8M	58
Slovenia	105	15	$4.9M	12
Greece	188	31	$568.6M	23
Estonia	194	232	$2.5B	232
Portugal	488	435	$525.8M	235
Turkey	514	110	$779.2M	175
Israel	808	1,075	$6.9B	940
Spain	2,021	921	$3.7B	651
Italy	2,647	545	$1.5B	376
France	2,900	1,836	$18.1B	1,408
Germany	3,522	2,553	$25.0B	2,171
UK	5,410	4,877	$29.3B	2,602
USA	16,051	17,022	$265.6B	8,254

From the information presented in the above, it is possible to discern the emerging landscape of a cleantech ecosystem in both Malta and Cyprus, despite the relatively good positioning of both countries in the innovation domain more generally. In the table above, it is possible to also identify in blue those countries with positions comparable to Malta and Cyprus, and more mature ecosystems in grey. This is explained in more detail in the following section.

7 h Orbis. BVD is now Moody's. Available at: https://www.moodys.com/web/en/us/capabilities/company-reference-data/orbis.html.

8 This data was provided in-kind by Federico Cristoforoni, CEO of Netzero Insights. See: https://netzeroinsights.com/platform-2/ The MICIE consortium is grateful for this contribution.

International comparison of other mature and similar ecosystems.

The identification of countries with more mature ecosystems and those with similar profiles to Cyprus and Malta can serve as an indication of the degree of the transferability of the lessons learnt from Malta and Cyprus to other countries.

A template with specific criteria and guiding questions can be used in researchers' analyses of the different countries/territories. A template allows the standardisation of the data extracted from many different sources and helps the comparability of the results. The guiding questions and criteria for the analysis included the following:

- The owning entity of the project.
- Timing of the implementation of the project.
- Main objectives of the project.
- Positive outcomes and how they were achieved.
- Negative outcomes and how they developed.
- Challenges met during implementation.
- Lessons learnt.
- Stakeholder involved in this project.
- Measure types used and how they might differ in the case of Malta and Cyprus.
- Future opportunities and possible barriers to overcome.
- Details of project's budget.
- Conditional resemblance to Malta and Cyprus.
- Execution and financial feasibility.

A screenshot of the template used in the MICIE project is found below:

Name territory	Type	Country	Land_Size	Population	
Antigua & Barbuda	State island	Antigua & Barbuda	443	100.335	$
Australia	State island	Australia		7.741.220	
Austria	No Island	Austria			
Belgium	No Island	Belgium			
Canada	No Island	Canada			
China	No Island	China			
Cyprus	**State island**	**Cyprus**	**9.251**	**896.007**	**€**
Czech Republic	No Island	Czech Republic			
Samsø (Midjylland DK04)	Island	Denmark	114	3.716	€
Anholt (Midjylland DK04)	Island	Denmark	22	150	€
Sjælland	Island	Denmark	7.227	2.342.353	€
Fyn (DK03 Syddanmark)	Island	Denmark	1.086	473.201	€
Læsø (Nordjylland DJ05)	Island	Denmark	122	1.769	€
Finland	No Island	Finland			
Sardegna	Island	France	24.100	1.590.044	€
Germany	No Island	Germany			
Ionia Nisia	Island	Greece	2.306	202.371	€

Figure 4 Extract from datasheet used as template for the analysis of cases in Deliverable 2.1

From an initial long list of 50 potential cases[9], a final list of 14 cases were retained for this section. The table below presents a summary of the results of the analysis of innovation ecosystems of mature countries/ comparable islands worldwide. In the table below, the cases 1-10 are mature ecosystem countries (Samso, Denmark; Finland; Hawaii; Iceland; Okinawa, Japan; Israel; Singapore; Sweden, the Netherlands; and the UK), whereas 11-14 were considered by the MICIE researchers to be similar to Malta and Cyprus (Acores, Portugal; Crete, Greece; Ireland; Sardinia, Italy).

9 The list included different cases or projects in islands or countries worldwide. It included cases from: Antigua & Barbuda, Australia, Austria, Belgium, Canada, China, Czech Republic, Denmark (Samsø, Anholt, Sjælland , Fyn and Læsø), Finland, Italy (Sardegna, Sicily), Germany, Greece (Ionia, Nisia, Crete), Hong Kong, Iceland, Northen & Western Ireland, Israel, Japan (Okinawa), Luxemburg, Netherlands, New Zealand, Norway, Portugal (Regiao Autónoma dos Açores), Singapore, Slovak Republic, Slovenia, South Korea, Spain (Balearic Islands, Canary Islands), Sweden, Switzerland, Taiwan, United Kingdom, United States (Hawaii).

Table 3 Results from the benchmark analysis of 14 countries' innovation ecosystems

SELECTED COUNTRY	Main implications of the case study
1. Samso, Denmark	The case study included Denmark's project in the Samso Islands for a 100% transition to self-sufficiency with renewable energy without using any fossil fuels. The project is currently in progress and involves carrying out various actions aimed at decreasing yearly emissions stemming from fossil fuels while enhancing the adoption of renewable energy sources. This effort involves the expansion of wind turbine utilisation and the establishment of district heating systems powered by straw and solar energy. One of the best practices identified in this case was the use of renewable energy in transportation field to and from Samso Island. Another good practice that can be applied in both Malta and Cyprus is the transition of the agriculture field to a circular economy. An important emphasis is also made for heating savings. No barriers have been identified within this case study (Jørgensen, 2007).
2. Finland	Finland's National Energy and Climate Change Plan objective is for Finland to become the globe's pioneer in transitioning away from fossil fuels, aiming for this transformation by 2030. This goal will be accomplished by attaining distinct domestic benchmarks concerning the reduction of carbon emissions, advancements in energy efficiency, ensuring energy security, fostering internal energy markets, and promoting research and innovation. The **best practices** of Finland's case were the increase hydropower production from rain, Increase wind power and the investment in education. The general public and the industrial community culture were identified as the main barrier for the for the implementation of the country's goals (MinistryofEconomicAffairsandEmployment, 2019).
3. Hawaii	In this case Hawaii's Climate Innovation Strategy and The 2021 Annual Report of the Hawaii's State Energy Office were studied. One of the **best practice** identified was the investment in green startups that will contribute to finding innovative practices and solutions (ElementalExcelerator, 2021). Since technologies for energy production from renewable energy sources around the world have advanced to a maximum extent, Hawaii has invested in the research to implement batteries with low production costs. At the same time, Hawaii invested in nation education in the field of sustainability and circularity (StateofHawaii, n.d.) . No **barriers** have been identified within this case study .

4. Iceland

Iceland's R&I Funding, Policies and Actions strategy centres around capitalizing on its expertise in particular renewable energy technologies, particularly geothermal energy. The **best practice** identified in this case is the country enhances its research and innovation sector by concentrating on every level of the education system and the various phases of project development. On the other hand, a **barrier** that was identified was that according to OECD criteria, there are inadequate rates of completion for doctoral degrees in science and engineering, as well as insufficient proficiency in science among young individuals. Iceland's public support in innovation is generally low (GovernmentofIceland, 2019).

5. Okinawa, Japan

In this country case, the "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" was studied. The Green Growth Strategy is an industrial strategy that, in collaboration with the business community, seeks to establish a beneficial cycle of economic expansion and environmental protection. Grant funding, tax incentive, guidance policy on finance, regulatory reform, and international collaboration are the 5 policy measures developed to support the plan. Okinawa's **best practices** focuses on the development of next generation technologies and the integration of sustainability principles into existing policies and regulations, ensuring a consistent approach across different sectors. No **barriers** have been identified within this case study (Secretariat, et al., 2021).

6. Israel

In this case, Israel's national climate change action plan was considered. The plan includes a number of activities, such as a review of legislation and regulatory frameworks in the transportation, residential, and electrical sectors, city buildings, industry, funding, public education, and the handling of agricultural waste. Various initiatives are included in the plan in order to achieve climate targets. Israel's **best practices** which can be implement in Cyprus and Malta were the improvement of environmental financial regulation and the creation of database with open access to everyone that will include information about climate risks and other related information. No **barriers** have been identified within this case study (StateofIsrael, 2020) .

7. Singapore

Singapore's approach strengthens their R&D by growing their human resources. As **best practices**, Singapore is planning to develop smart technologies that are connected to building systems, energy saving cleantech and cost-effective technologies. The main **barrier** that was identified in this case were the high energy consumption of Singapore cause its hot climate (IMCCC, 2020).

8. Sweden

The project studied in Sweden's case was about climate neutral cities by 2030. Through climate-neutral and sustainable cities, Sweden inspires and plays a pioneering role in the global energy and climate transition. Digitalization and public participation are prioritized in the initiative, which focuses on an all-encompassing approach to urban change. To hasten the transition, this effort is mobilizing 23 cities and 6 authorities in Sweden. A tool for this mobilization is Climate Contract 2030, which is updated and changed yearly. In order to achieve the nation's targets, **best practices** that are planning to implement its citizen involvement in action plans, societal transition and the simplify and visualization of needed transition for politicians, decision-makers, stakeholders, and the general public. The **barrier** identified to this plan is the different cities conditions such as their size, geography, business, politics etc (Anon., n.d.).

9. Netherlands

The Circular Economy Strategy for Amsterdam was analysed. The aim is to reduce the consumption of new raw materials by 50% by 2030 and transform into a fully circular city by 2050. The **best practices** that pointed out from this case is the collaboration of cities and strategic partners in order to achieve the nation's goal, the creation of database platform for exchange of information and the conversion of waste into secondary materials. No **barriers** have been identified within this case study.

10. United Kingdom

The project studied at this point was the "Strategic Innovation Fund on energy network innovation" launched by Ofgem and Innovate UK. The fund intends to assist consortia and other networks that have creative ideas for achieving net zero. There are 44 initiatives that are receiving funding. UK's **best practices** include the Improvement of predictions for extreme weather events, the use of hydrogen as a back-up to electric vehicle and the use of various large-scale thermal energy storage sources. No **barriers** have been identified within this case study (OFGEM, 2023).

11. Açores, Potugal

The sustainable charter for Açores has been analysed. It is a tool developed to encourage the participation of the private sector in SDG, and it is based on the SDG Compass. An exemplary approach in the Acores involves designing and administering tourism activities in a manner that safeguards and preserves the region's natural and cultural assets. The Charter further emphasizes the need for tourism to be environmentally sustainable, economically viable, socially just for local communities, and enduringly sustainable for generations to come (Borges, 2019).

12. Crete, Greece

Analysis was done also on the Crete Innovative Business Observatory initiative which was started on 2020. It is a centralized repository of knowledge and assistance for Crete's research and innovation. Its main objective is to link commercial organizations with academic and research institutes. The **best practices** identified are the Promotion and support of entrepreneurship and the promotion of innovative good practices. On the other hand, the main **barrier** is the need for external funding.
(Anon., n.d.)

13. Ireland

Northern Ireland Energy Strategy 'Path to Net Zero Energy' was studied in this case. It lists 22 initiatives for 2022 as the first stage in lowering emissions connected to energy by 56% by 2030. Providing short-term action plans to ensure the long-term implementation of the energy strategy is a crucial component of the overall strategy. In order to inform and support important stakeholders in the fight against climate change, the action plan specifies essential objectives. Ireland's **best practices** to achieve its goals are the additional funding for green projects, the creation of a database for sharing related information and gathering better quality data and the Implement of a support scheme to bring forward investment in renewable electricity generation. No **barriers** have been identified within this case study (SustainabilityCommittee, 2022).

14. Sardinia, Italy

The projects have been reviewed were Bankable projects/ actions, Alternatives to "necessary bad" and Mechanisms behind green technologies. The purpose of this strategy is to examine how innovative companies can respond to the growing market potential for green technologies brought on by increasingly strict environmental regulations by forming strategic technological collaborations. From these three cases the **best practices** identified was the collaboration networking system between all the related stakeholders of Sardinia. On the other hand, the **barriers** identified were the lack of strict environmental regulations and the unwillingness to collaborate and/or externally sources (Arras, et al., 2022).

Using the information in the table above, it is possible to extract a handful of lessons about similarities and differences between Island Ecosystems. Although most of the mature ecosystems are dissimilar to Malta and Cyprus in terms of resources availability, geographic and social traits, there are still good practices which can be considered by both islands. For instance, all mature ecosystems in the table above aim to improve their R&I by investing in their human resources. This is done by giving importance to the education system, where circularity and R&I are being integrated in the curricula at all levels up to tertiary education. Education is also being attained through promotional campaigns targeting the public and the business community, especially SMEs. To enhance implementation, action plans in circularity and R&I are monitored through specific targets and key performance indicators.

Additionally, to win the commitment of stakeholders, stakeholder consultation persists even at implementation stage. Feedback mechanisms such as websites are introduced where stakeholders can continuously communicate their feedback through the project implementation process. In most cases the projects/plans are backed by a strong regulatory framework which is properly enforced. This together with the provision of grants and related schemes make government bodies (e.g. innovation ministries) an important stakeholder in the local, regional, or national R&I ecosystem. In contrast, less mature innovation ecosystems face insufficient development of R&I planning, financing and skill development.

Strengthening Research and Innovation across the EU: the EIT Regional Innovation Scheme (RIS) Programme.

Programmes aimed at increasing the advancement of R&I ecosystems are a policy mechanism to level the playing field and to create a positive enabling environment for entrepreneurship and for the uptake of climate innovations. Through the EIT RIS Programme, EIT Climate-KIC (CKIC)has been actively involved in fortifying innovation ecosystems through their RIS Hubs (Regional Innovation Scheme Hubs) for several years. This effort aimed to bring together the European Insitute for Innovation and Technology (EIT) and RIS stakeholders through collaborative activities such as the co-organisation of policy events, exemplified by a joint initiative with the Joint Research Centre (JRC) as part of the Stairway to Excellence project.
In addition to its broader role, EIT Climate-KIC, through the facilitation of its local EIT Hubs, has provided support to various RIS national authorities in implementing their policies. Notable examples include support to the Ministry of Environment in Greece and the Ministry of Economy of the Republic of Bulgaria in the incorporation of the Circular Economy National Strategy into the country's smart specialization strategy.
In addressing shared challenges faced by regions with limited innovation capacity, CKIC's business programs identified a significant gap: the lower business maturity of young entrepreneurs in RIS countries. Over several years, EIT Climate-KIC tailored business creation and acceleration programmes to cater to the specific needs of these countries. For example, the EIT Climate-KIC RIS Accelerator focused on preparing early-stage startups for their initial investors and customers while assisting them in scaling their businesses. EIT Climate-KIC also conducted the EIT RIS Pioneers program to tackle professional mobility for over three years. [10]

10 Özbolat, N. K., Haegeman, K., & Sereti, K. (2019). EIT Knowledge and Innovation Communities: Collaboration in a RIS3 context. Smart Specialisation Platform.
https://s3platform.jrc.ec.europa.eu/en/w/eit-knowledge-and-innovation-communities-collaboration-in-a-ris3-context

Why this guidebook?

When it comes to the MICIE project in particular, Cyprus and Malta, two of the smallest EU island states, currently demonstrate 'moderate' and 'modest' innovation levels respectively. Both member states have received EU recommendations concerning their National Energy and Climate Plans (NECPs) to enhance their climate and energy Research and Innovation (R&I) initiatives. The EU has urged both countries to formulate more concrete policies and targets.

Since the inception of the initial NECPs, the significance of R&I in climate action has escalated, particularly with the introduction of the European Green Deal in 2019, which commits the EU to becoming the first carbon-neutral continent by 2050. In pursuit of this flagship goal, the intermediate targets for 2030, initially established in 2014, have been revised and heightened in ambition. The emission reduction target under the European Green Deal has increased from 40% to 55% by 2030, necessitating corresponding adjustments in the targets for each member state, which should be reflected in updated NECPs.

The EU is advocating for a more ambitious role for R&I across member states, emphasizing its crucial role in driving the transformative changes required to fulfil the European Green Deal. Given the deadline for member states to revise their NECPs by 2024, the current period offers an opportune moment for Cyprus and Malta to collaborate, expand, and advance their R&I activities to achieve their national climate aspirations[11].

Specifically, a NECP defines relevant 10-year targets and implementation strategies for each of the following dimensions:

- Securing energy supply, including through promotion of renewable energy sources
- Expanding the internal energy market, including using interconnectors which enable energy to flow freely across the EU
- Increasing energy efficiency.
- Reducing emissions and decarbonising the economy.
- Supporting R&I in order achieve the climate targets, including through the promotion of breakthroughs in low carbon technologies.

11 Strengthening Research and Innovation across the EU (no date) The Mediterranean Island Cleantech Innovation Ecosystem. Available at: https://micie-project.eu/.

Why would you use this guidebook?

The core utility of this Action Plan Guidebook lies in its multifaceted approach.

- This guidebook aims to be a comprehensive toolkit employable by any island or region engaged in the monumental task of ecological transition. This blueprint has been structured to support Island Ecosystems in optimising their R&I strategies, nurturing robust, actionable practices, and fostering public support for transformative R&I.
- It functions not just as a guide but as a conduit for ideas, innovations, and a library of guiding principles.
- Its structural design, informed by analysis of the stakeholder mapping outcomes in the MICIE project, presents a comprehensive yet flexible framework, enabling a systematic approach to refine and structure energy and climate strategies.
- This manual delineates a series of 6 clear steps that assist in breaking down complex strategies into more digestible, coherent parts.
- Hopefully, it can support you in bridging policy and action, helping stakeholders and policymakers ensure clarity in execution and alignment with your government's overarching environmental objectives.

Who should use this manual?

The primary target audience of this document encompasses policy specialists in public bodies, industry associations and civil society. In addition, academic entities, including universities, centres of excellence, research institutes, PhD students, researchers, and professors would benefit from the approach to the policy-science interface used in this document

Designing Research Innovation Plans for Transformative Climate Action in Island Ecosystems: the MICIE approach

Introduction to the MICIE Approach

There has been a marked shift in understanding innovation over the past two decades, emphasizing the importance of entrepreneurial ecosystems for the development and growth of innovative start-ups. These ecosystems, defined by interconnected social, political, economic, and cultural elements, create a fertile ground for knowledge exchanges. Specifically tailored for cleantech innovation, the methodology in this guidebook adopts a EIT Climate-KIC Systems Innovation Approach (SIA), recognizing the role of policy makers as orchestrators and enablers rather than innovators.

The theoretical and empirical base for the transformative innovation approach in this guidebook is based on the following publications:

- Co-creation for Policy (Matti et al., 2022).
- Challenge-led system mapping. A knowledge management approach (Matti et al., 2020).
- Innovation camp methodology handbook: realising the potential of the entrepreneurial discovery process for territorial innovation and development (Martínez et al., 2018.
- Visual toolbox for system innovation (De Vicente and Matti, 2016).
- Science, technology, and innovation policy roadmaps for the SDGs (Miedzinski, et. al. 2019).
- 'Governance Assessment Tool (GAT)' by Bressers et al., (2016).

Practically, the MICIE methodology comprises six steps broken down into three categories as illustrated in the below flower diagram.

Figure 5 Overall implementation framework of the MICIE approach for the elaboration of R&I action plans for transformative climate action.

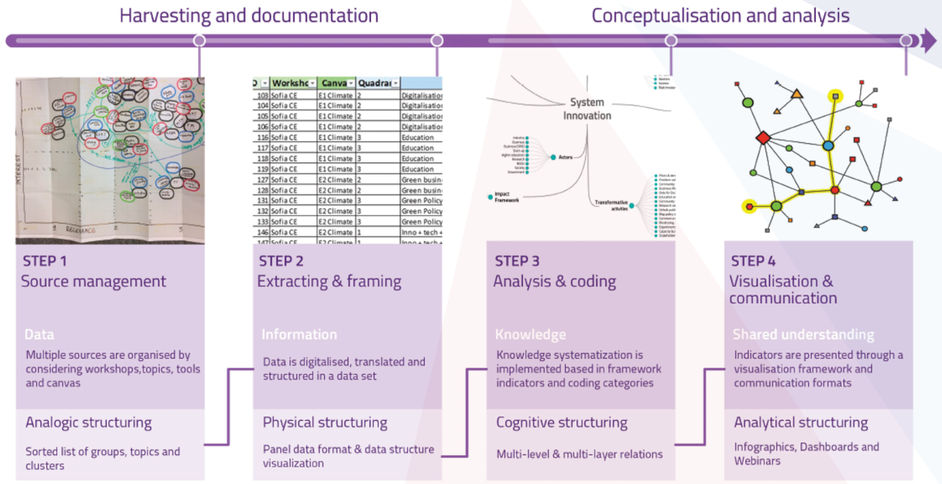

Table 4: A visualisation of steps 1-4 in the MICIE Approach. Step 5, which is not represented in the graphic, would be to finally synthesize recommendations in an Action Plan given to the governments of Cyprus and Malta. [12]

Step 1: Baseline assessment & ecosystem analysis

The baseline data is crucial, as it serves as the initial stage for the Guidebook user to gain insights into the existing conditions within the Research and Innovation (R&I) field or their area of interest. This data establishes a practical groundwork for setting goals, continuous monitoring, and evaluation. Additionally, it acts as a reference point for impact assessment and assists in pinpointing areas that may need improvement. This section provides guidance on conducting a pertinent and efficient baseline study for the action plan. [13]

The initial mapping of the Maltese and Cypriot innovation ecosystems

In the initial phase of establishing a baseline, the team conducted a comparative analysis of the innovation ecosystems in Cyprus and Malta with those present globally. Eventually, the researchers identified 14 analogous ecosystems, considering factors such as land size, population, GDP, and various indices gauging the strength of national innovation.

12 Camacho, Beatriz (2022) Quality Assurance Plan. Deliverable 5.1 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. EIT Climate KIC, Valencia (Spain). Page 16

13 Callus, M.A., and D. Spiteri (2023) Action Plan Template. Deliverable 4.1 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta). Page 9.

Name territory	Type	Country	Land_Size	Population	GDP	Region	Continent	European and Regional Innovation Scoreboards 2021 AT COLUMN A TERRITORY LEVEL
Antigua & Barbuda	State island	Antigua & Barbuda	443	100.335	$ 176.000.000,00	Caribbean	Central America and the Caribbean	N/A
Australia	State island	Australia		7.741.220		Pacific		N/A
Austria	No Island	Austria				Europe		N/A
Belgium	No Island	Belgium				Europe		N/A
Canada	No Island	Canada				America		N/A
China	No Island	China				Asia		N/A
Cyprus	**State island**	**Cyprus**	**9.251**	**896.007**	**€ 21.548,37**	**Mediterranean**	Europe	Moderate
Czech Republic	No Island	Czech Republic				Europe		N/A
Samsø (Midjylland DK04)	Island	Denmark	114	3.716	€ 65.329,92	Baltic	Europe	Leader
Anholt (Midjylland DK04)	Island	Denmark	22	150	€ 65.329,92	Baltic	Europe	Leader
Sjælland	Island	Denmark	7.227	2.342.353	€ 31.534,51	Baltic	Europe	Moderate
Fyn (DK03 Syddanmark)	Island	Denmark	1.086	473.201	€ 58.012,11	Baltic	Europe	Strong
Læsø (Nordjylland DJ05)	Island	Denmark	122	1.769	€ 26.325,02	Baltic	Europe	Strong

Name territory	Column1	Type	Country	European and Regional Innovation Scoreboards 2021 AT COLUMN A TERRITORY LEVEL	Information Technology and Innovation Foundation's (ITIF's) Global Energy Innovation Index (GEII) provides	Global Innovation Index 2021 by WIPO
United Kingdom	CEA	Several options	United Kingdom	Strong	4	4
Samsø (Midjylland DK04)	CEA	Island	Denmark	Leader	**2**	9
Israel	CKIC/TMC	No Island	Israel	N/A	N/A	15
Netherlands	CKIC/TMC	Mainland	Netherlands	Strong	7	6
Hawaii	CUT	Island	United States	N/A	17	3
Okinawa	CUT	Island	Japan	N/A	12	13
Singapure	EWA	State island	Singapore	N/A	N/A	8
Norway	EWA	Mainland	Norway	Strong	11	20
Iceland	EWA	State island	Iceland	Strong	N/A	17
Sweden	MCAST	Mainland	Sweden	Leader	3	2
Finland	MCAST	Mainland	Finland	Leader	1	**7**
Anholt (Midjylland DK04)	CEA	Island	Denmark	Leader	2	9
Sjælland	CEA	Island	Denmark	Moderate	2	9

Figure 6: Snapshot of MICIE case study selection[14]

Step 2: System and stakeholder mapping

STAKEHOLDER MANAGEMENT

Stakeholder mapping involves a two-phase process. The first phase, Stakeholder Network Analysis, focuses on comprehending the network before actively engaging with it. This entails understanding the components (stakeholders), their behaviours, relationships, potential barriers to their collaboration, and overall network performance.

In the second phase, Stakeholder Network Engagement, the actual engagement process takes place, with planned activities involving actors throughout the entire process that can include workshops and dissemination activities (to showcase the recommendations in the Action Plan). One notable distinction in the socio-technical transition approach, compared to other perspectives, lies in the dynamic nature of the analysis. Socio-technical transition is an ongoing and evolving process, necessitating repeated analysis of participants and their roles at the beginning, during, and at the end of the process. This means that the stakeholder network map will evolve throughout the project as the researcher gleans more information about how the network interacts with itself and how important certain actors are.

Engaging stakeholders in one's problem definition (for example in R&I ecosystem barriers), ideation, and solution development yields several advantages:

1. Enrichment of knowledge, experience, and perspectives at the table, maximizing the likelihood of success.
2. Reduction of conflicts among different involved or affected parties in the uptake of the recommendations in the Action Plan
3. Mitigation of the chances for absent stakeholders to disrupt the process.
4. Cultivation of a sense of ownership and belonging to the process, objectives, proposed solutions, and the stakeholder network, fostering a community-like environment.
5. Increased acceptance and sustainability of outcomes.
6. The "multiplier" effect of the network facilitates triggering system changes easily.

14 Case selection from Camacho A, B. (2022). IDEM.

STAKEHOLDER NETWORK ANALYSIS

Identification of participants:

The initial phase involves determining who will participate based on their proximity to the project, interest, relevance, etc. Participants can be individuals or institutions. It is essential to include significant representatives from various sectors, so this phase should encompass a broad range of actors.

Understanding the profile of the different participants:

The second step delves into gaining a strong understanding of the stakeholders. This entails exploring their expectations, explicit and implicit assumptions, pain points regarding your research topic (for us, this is the R&I network in their country), motivations, knowledge, and resources. In sociotechnical transitions, the aim is to categorise stakeholders based on their distinctive roles and their influence on the innovation process, considering factors such as interests and resources.

Analysis of networks:

The third and most comprehensive step involves analysing and characterising the stakeholder network. Through the relationships between actors, a specific network emerges, introducing new barriers to action and trends. The objective here is to assess the roles of different stakeholders within the network and understand how these roles impact the network's performance. This analysis employs both quantitative and qualitative approaches to uncover the underlying information within the network.

Participation Process:

This stage represents the conclusive and tangible step in the entire Stakeholder Network Engagement process: collaborating with stakeholders throughout the system innovation or transition process. Participants may either join or exit the network, driven by factors such as interest or no longer being affected by the project. At times, an actor's role undergoes significant changes, either becoming irrelevant or emerging as a crucial hub in the new network.

As mentioned earlier, it is advisable to periodically reassess the stakeholder analysis during this process. This involves checking whether new actors have joined the network or if the roles of existing stakeholders have experienced significant shifts. [15]

STAKEHOLDER MAPPING TOOLS

Stakeholder mapping serves as both a visual exercise and analytical tool. Individual stakeholders are assessed based on two or three key attributes, such as influence and expertise, and then plotted on a graph. This visual representation allows for the identification of differences and the discovery of affinity groups or conflicting relationships.

Commonly used criteria include influence, necessity or urgency, relevance, interest, attitude, adaptation or resistance to change, and expertise.

When to use: This tool is beneficial when you have already identified and characterised most of your stakeholders and need to prioritize whom you want to engage with in a long-term relationship. It helps in deciding the optimal level of engagement for each stakeholder—whether to keep them informed or actively involve them in the project decision-making process.

Why it is useful: A simple graph enables you to observe where stakeholders stand when evaluated against the same key criteria and compared to each other. Simultaneously, it aids in visualizing the complex interplay of relationships that could potentially derail your project. This visual insight facilitates better decision-making regarding the appropriate strategies to engage each participant or sector in the quadruple helix.

Crating a Relevance - Interest - Expertise Map

To create a threefold criteria map it is necessary to first complete the Relevance Map to categorize actors based on relevance. Create a Relevance/Expertise/Interest Matrix, where the vertical axis represents interest, and the horizontal axis represents relevance..

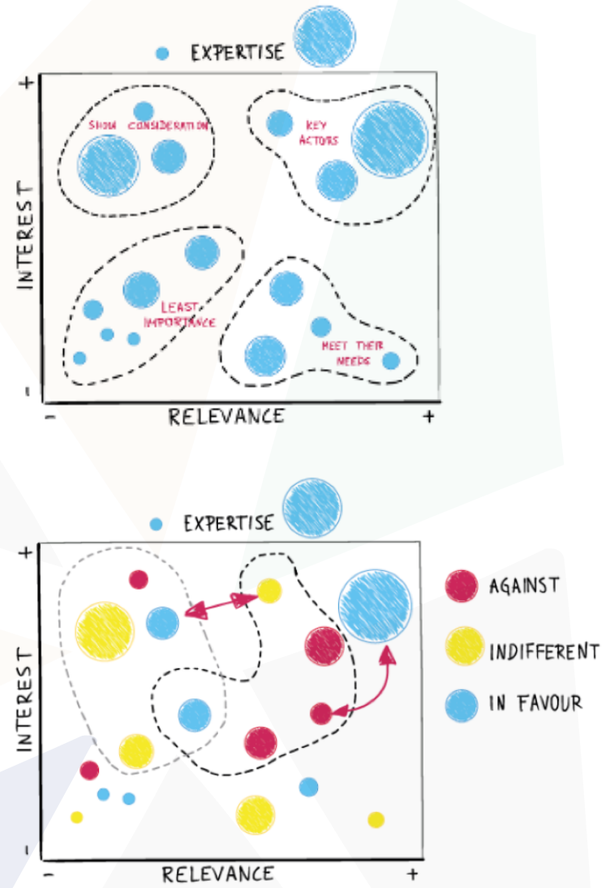

Figure 7 Illustration of a relevance-interest-expertise map

From the Relevance Map, identify actors with medium to high relevance (red and yellow areas) and use them to populate the Expertise/Relevance matrix. Actors within the green area should not be excluded but rather included in further analysis to make decisions about their engagement over time and the way they engage.

15 de Vicente, J. (2016) Visual toolbox for system innovation. Edited by C. Matti. Brussels: Climate-KIC https://transitionshub.climate-kic.org/publications/visual-toolbox-for-system-innovation/

Place actors on the matrix based on the combination of their attributes, with expertise reflected in differing plot sizes. The larger the plot, the more expertise an actor possesses, allowing for a comparison of stakeholders using the three criteria. Like in the relevance map, distinct areas provide insights into the strategy for actors within them. For actors with little or no interest in the project but high relevance, meeting their needs is sufficient, and further engagement may not be necessary. Conversely, if an actor demonstrates high interest in the project, engagement should be considered, particularly when they are also relevant. This combination of high interest and high relevance identifies key actors crucial for the project. The fourth area, in the lower left-hand side of the map, comprises actors with little relevance and interest. While they should not be overlooked, they are not as vital as others.

Beyond this initial analysis, assessing the influence of expertise is essential. Generally, actors with high expertise should be involved in the process if their relevance is medium to high or their interest is high, even if relevance is low. In other cases, informing or communicating with them may be sufficient. If the information aligns with their interest, they may express a desire to join the process. Overall, actors with high expertise should be engaged in the process when their relevance is medium to high or their interest is high, despite having low relevance. [16]

STAKEHOLDER GOVERNANCE ANALYSIS

This part focuses on governance analysis, particularly if the Action Plan's context involves dealing with regional or local governments.

The Governance Assessment Tool (GAT) operates across five dimensions encompassing levels and scale, actors and network, problem perspective and goal ambition, strategies and instruments, and responsibilities and resources. These governance dimensions can be elucidated and refined through a series of questions, facilitating the identification of barriers and outcomes aligned with the project's requirements. The table below provides an outline of potential questions for each dimension. [17]

16 de Vicente, J. (2016) Visual toolbox for system innovation. Edited by C. Matti. Brussels: Climate-KIC https://transitionshub.climate-kic.org/publications/visual-toolbox-for-system-innovation/

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Table 5 Main descriptive questions used in a GAT analysis

Gouvernance Dimension	Main descriptive questions
Levels and Scale	Which administrative levels are involved and how? Do they depend on each other or are they able to act productively on their own?
Actors and networks	Which actors are involved in the process? To what extend do they have network relationships also outside of this case under study? What are their roles? Which actors are only involved as affected by or beneficiaries of the measures taken? What are the conflicts between these stakeholders? What forms of dialogue between them? Are these actors with a mediating role? Have any of these changed over time or are likely to change in future?
Problem prospective and goal ambition	Which various angles does the debate of public, and stakeholders take towards the problem at hand? What levels of possible disturbances are current policies designed to cope with? What goals are stipulated in relevant policies? Have any of these changed over time or are they likely to change in future?
Strategies and instruments	Which policy instruments and measures are used to modify the problem situation? To what extend do they reflect a certain strategy of influence (regulative, incentive, communicative, technical etc.)? Have any of these changed over time or are they likely to change in future?
Responsibilities and resources	Which organization have responsibility for what tasks under the relevant policies and customs? What legal authorities and other resources are given to them for this purpose, or do they possess inherently? What transparencies are demanded and monitored regarding their use? Is there sufficient knowledge on the topic? Have any of these changed over time or are likely to change in future?

Example: The MICIE Approach to Systema and Stakeholder mapping.

The MICIE research team heavily relied on Matti and Risola's Co-creation for Policy processes to map the innovation ecosystems in Malta and Cyprus, which 'offers a concrete and practical response to the growing demand of policymakers for tools and methodologies to address societal challenges while empowering citizens

The increased level of complexity in EU policymaking and the rapid evolution of societal and environmental issues create a twofold need for policymakers at all levels to encourage:

- A clear and strong impact of the policies designed to address current society al challenges with public accountability
- Greater engagement of all relevant stakeholders at the various stages of the policy cycle to co-create efficient solutions for formidable challenges.[18]

TIP For a step-by-step guide, please refer to the '3 Stakeholder Interaction chapter' in the MICIE Action Template book.

After relevant stakeholders were mapped, the next step would be to effectively engage them. In MICIE, this process involved workshops, with the first workshop aimed at gathering stakeholder opinions, ideas, and suggestions related to research and innovation efforts. The subsequent workshops refined these ideas into high-level R&I sub-priorities and identify required resources.

The main goal was to ensure that all relevant stakeholders were identified, categorised, and engaged according to their interests and influence with the aim of fostering a sense of ownership and commitment among stakeholders, aiding the development and success of the action plan. [19]

Further stakeholder engagement occurred during the Action Plan development, where stakeholders contributed knowledge in their areas of expertise.
To identify additional stakeholders, the Maltese partners conducted a thorough analysis of invitees who did not participate in the workshops and researched new relevant stakeholders. Multiple stakeholders within the same organization were approached, recognising the diversity within large entities. Malta's stakeholder list included 71 new stakeholders, identified during the analysis of actions and among previously invited non-participants. All stakeholders, totalling 201, were contacted, inviting them to provide feedback through online meetings or written responses. The consultation period, initially set for two weeks, was extended by another 2 weeks to accommodate pertinent stakeholders who required additional time for feedback. Stakeholders were duly informed about the extension and encouraged to contribute their insights.

RELEVANCE - INTEREST - EXPERTISE MAP IN MICIE[20]

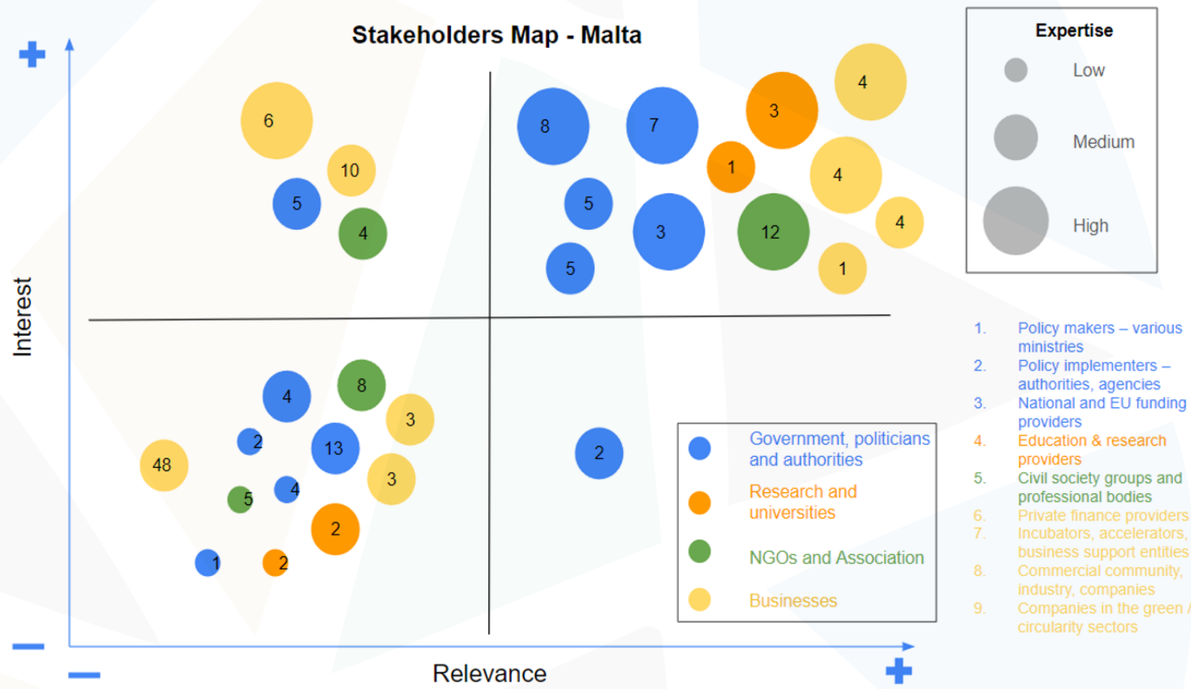


Figure 8

18 Matti, C. and Rissola, G. (eds.) (2022) Co-creation for policy: participatory methodologies to structure multi-stakeholder policymaking processes. Luxembourg: Publications Office of the European Union. Page 6.

19 Callus, M.A., and D. Spiteri (2023) Action Plan Template. Deliverable 4.1 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta). Pages 20-36.

20 Frendo, C., Franco, R., Kara, G., (2023) Report on Stakeholder Mapping. Deliverable 2.2 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Malta College of Arts, Science, and Technology (MCAST), Paola (Malta)..

GAT TOOL IN MICIE

The below table represents sample questions to be used as a base to discuss with each interviewee from the stakeholder groups - government, civil society groups and businesses. [21]

CIVIL SOCIETIES

Questions	Governance dimension	Quality of the Governance regime
Is there a strong impact from a certain level towards behavioural change or management reform?	Levels and Scale	Intensity
Do the levels work together, and do they trust each other between levels?	Levels and Scale	Coherence
Are all the stakeholders involved?	Actors and Networks	Coherence
Do stakeholders interact regularly? Is their interaction institutionalised through formally set meetings?	Actors and Networks	Coherence
To what extent do the various perspective and goals support each other, or are they in competition or conflict?	Problem prospective and goal ambition	Coherence
How different are the goals/perspective from the status quo?	Problem prospective and goal ambition	Intensity
What types of instruments are included in the policy strategy?	Strategies and instruments	Extent
Is there any overlap/conflict between the incentives in the plan? Or are there any synergies?	Strategies and instruments	Coherence

21 Franco, R., Frendo, C., Charalambides A., Skouroupathi, M., Kanari, Y., (2023) Report on Governance Analysis. Deliverable 2.3 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Malta College of Arts, Science, and Technology (MCAST), Paola (Malta).

CIVIL SOCIETIES

Questions	Governance dimension	Quality of the Governance regime
To what extent do the assigned responsibilities create competence struggles or cooperation within across institutions?	Responsibilities and resources	Coherence
Are there any important levels missing?	Levels and scales	Extent
Are all the stakeholders involved?	Actors and Networks	Extent
Do they interact regularly with each other? Formally or informa-lly?	Actors and Networks	Coherence
Do stakeholders support each other?	Actors and Networks	Flexibility
Is there a strong pressure from an actor or actor coalition towards behavioural change or management reform?	Actors and Networks	ntensity
To what extent are the various perspectives of the problem considered?	Problem prospective and goal ambition	Coherence
Do the various perspective/ goals support or are they in competition/conflict?	Problem prospective and goal ambition	Coherence

GORVERNMENT BUDIES

Questions	Governance dimension	Quality of the Governance regime
Are there any levels (ministries, authorities etc...) missing, but who should be included?	Levels and Scales	Extent
Are these levels working together? Are they aware of the mutual dependence among them?	Levels and Scales	Coherence
Is there any level who is dominant on the others?	Levels and Scales	Flexibility
Are all relevant stakeholders involved? Are there any stakeholders not involved or even excluded?	Actors and Networks	Extent
In what ways are these interactions institutionalized in stable structures?	Actors and Networks	Coherence
Is there a strong pressure from an actor or actor coalition towards behavioural change or management reform?	Actors and Networks	Intensity
What is the implied behavioural deviation from current practice and how strongly do the instruments require and enforce this?	Strategies and instruments	Intensity
Are all responsibilities clearly assigned and facilitated with resources?	Responsibilities and resources	Extent
Is the number of allocated resources sufficient to implement the measures needed for the intended change?	Responsibilities and resources	Intensity

BUSINESS

Questions	Governance dimension	Quality of the Governance regime
Are there any instruments which are being excluded?	Strategies and instruments	Extent
What changes are needed? What instruments are needed to spur these changes?	Strategies and instruments	Intensity
Are all the responsibilities clearly assigned and facilitated with resources?	Responsibilities and resources	Extent
Are the responsibilities considered legitimate by the main stakeholders?	Responsibilities and resources	Coherence
Is the number of allocated resources sufficient to implement the measures needed for the intended change?	Responsibilities and resources	Intensity

Step 3: Co-creation workshops

Co-creation workshops are interactive problem-solving events facilitated, overseen, or attended by policymakers. In practical terms, these workshops involve collaborative activities where all crucial stakeholders identified in Step 2 actively participate, employing principles of self-organization and design thinking to address socially significant challenges. Quadruple-Helix actors are mobilised with the aim of collectively developing and testing actionable solutions.

Though the MICIE project used workshops, the same participatory approach can manifest as innovation camps, or policy labs.

As components of a multi-stakeholder policymaking approach, these events bring together participants from diverse backgrounds, countries, and disciplines. Collaboratively, they explore both conventional and innovative opportunities to address challenges. During workshops, participants identify, refine, and analyse challenges faced by key stakeholders from various perspectives. These challenges are then transformed into opportunities that can be further developed and implemented in the Action Plan (Step 5). Tackling such challenges necessitates bottom-up viewpoints, full engagement of stakeholders, and collective ownership of decision-making processes. [22]

Figure 9: the ecosystem of actors in Co-creation for Policy processes. Source: Matti and Risola[23]

22 Matti, C. and Rissola, G. (eds.) (2022) Co-creation for policy: participatory methodologies to structure multi-stakeholder policymaking processes. Luxembourg: Publications Office of the European Union.

23 code Vicente, J. & C. Matti (2016). IDEM Page 40.

PENTAGONAL PROBLEM

The workshops aimed to identify the needs, barriers and vision for the R&I ecosystem in Cyprus and Malta used a tool called the Pentagonal Problem.

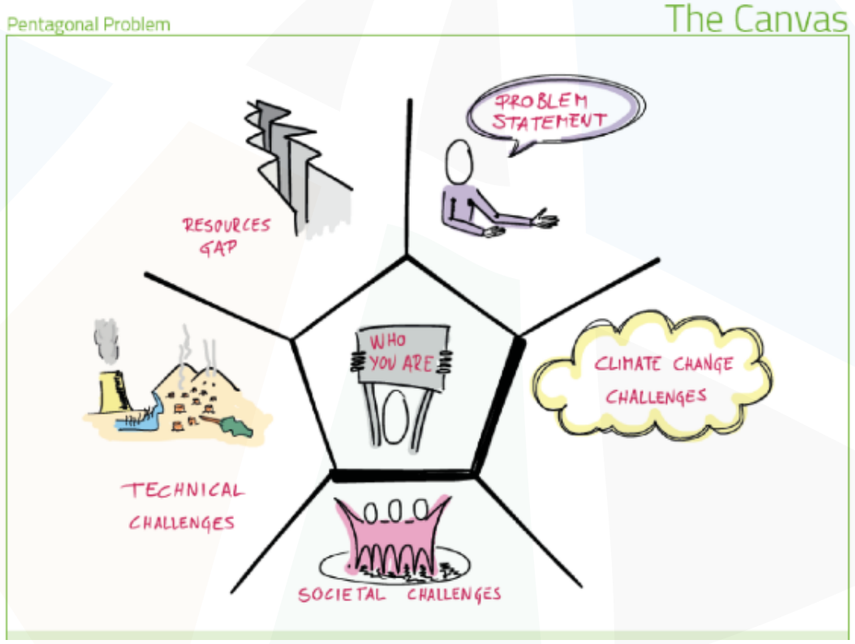


Figure 10: de Vicente, J. (2016) Visual toolbox for system innovation. Edited by C. Matti. Brussels: Climate-KIC.
https://transitionshub.climate-kic.org/publications/visual-toolbox-for-system-innovation/. Page 16.

Clearly defining the issue or challenge that the workshop participants would be working on was the first step. The pentagonal problem exercise enables teams to formulate 1) a challenge statement, 2) the challenge owner (the person or entity that owns the problem), 3) social and technical challenges, and 4) the resource gap between challenge and potential solutions.

TIP Refer to *'de Vicente, J. (2016) Visual toolbox for system innovation. Edited by C. Matti. Brussels: Climate-KIC. Page16'* for a full overview on the methodology for this tool.

https://transitionshub.climate-kic.org/publications/visual-toolbox-for-system-innovation

When to use

This tool is valuable when confronting intricate problems characterized by multiple facets, perspectives, and nuances, making it challenging to define them succinctly in a single sentence or paragraph. Issues related to climate change serve as a prime example of such complex problems.

Why it is useful

System innovation demands a distinctive approach to defining and addressing problems. Problems are no longer simple or isolated; they can impact numerous stakeholders with diverse perceptions and interests. These challenges are cross-sectoral, long-term, and interconnected with the broader ecosystem and societal structures. Consequently, more comprehensive tools are needed to define, articulate, and comprehend current problems effectively. The Pentagonal Problem tool begins by considering the user's perspective and then delves into different aspects of the problem, enhancing readiness to seek systemic solutions.

STEPS

STEP 1
Define Yourself

Create a large pentagon in the center of a large sheet of paper and start by defining your identity, whether as an individual or a team. Clearly specify your role, such as a company, government entity, or user association.

STEP 2
The Basic Statement

Describe the problem in a single sentence or short paragraph, focusing on conveying the overall challenge in a conversational manner, avoiding unnecessary details.

STEP 3
The Climate Change Challenges

Specify climate change-related challenges associated with your problem. Use post-it notes to write down individual climate change issues or challenges, considering problems like CO2 emissions or water scarcity.

STEP 4
The Technical Challenges

Identify technical challenges related to your problem. If you are considering technical solutions, think about technological bottlenecks, areas for improvement, and potential solutions. Write down one idea per post-it note.

STEP 5
The Social Challenges

Consider societal impacts and influences on the problem. Explore how societal behaviour affects or worsens the problem, identify societal challenges, and pinpoint expected changes. Write down ideas on post-it notes.

STEP 6
The Gaps

Identify gaps in resources needed for your project. Determine if there is a need for new technology, knowledge, or regulatory adjustments. Write down one idea per post-it note.

STEP 7
Debrief

Review the pentagonal description of your project, assessing how the initial problem statement has been enriched with various perspectives. Consider whether you obtained a thorough understanding of your challenge, if there is anything unnecessary in your description, and if any crucial aspects are missing. Reflect on whether your challenge is primarily technical, social, environmental, or a combination. Reevaluate your problem statement considering the gathered inputs and aim for a consensus on the new definition. Consider the ease or difficulty in broadening the definition. [24]

24 de Vicente, J. & C. Matti (2016). IDEM

THE MICIE APPROACH TO THE PENTAGONAL PROBLEM AND CO-CREATION WORKSHOPS

The participatory process is the backbone of MICIE's approach, and the project started with the Pentagonal Problem and expanded the process with workshops. 3 workshops per country were used to validate the innovation areas pertinent to Cyprus and Malta, along with validating the system map that the MICIE team had created in Step 1 of the process (baseline assessment and ecosystem analysis) and shared with external stakeholders. It is recommended to organise a series of three workshops with stakeholders in each country with a preparation time of 2-3 months in advance.

- **Learning goals of the workshops:** overall understanding of system innovation and socio-technical transitions by focusing on selected specific policy challenges in their respective R&I ecosystem.

- **Format:** Full participatory process consisting of 3 workshops per country, one dissemination event and in-between activities.

- **Outcome:** a system map created by the researchers and validated by external stakeholders in the workshops, along with a validated list of innovation areas and potential actions aligned with the policy challenge.

The MICIE project amended the Pentagonal Problem canvas to identify resources needed across human, infrastructure, funding, and policy for the implementation of each idea.[25]

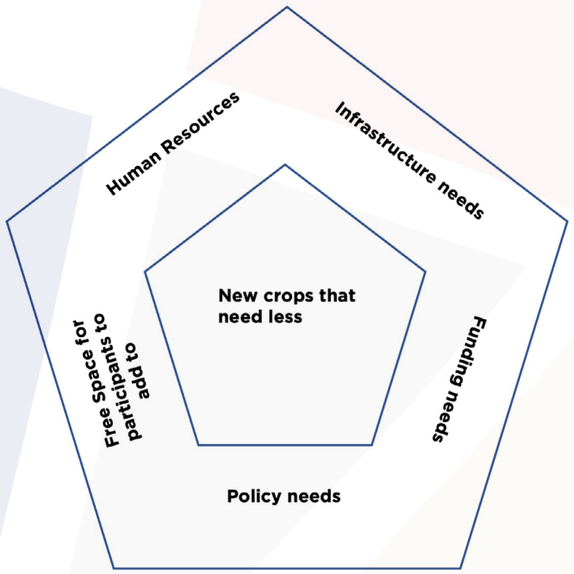


Figure 11: A modified pentagonal problem schematic used in MICIE workshops. The 'problem' to be discussed amongst participants of 'new crops that need less fertiliser' was an example to get stakeholders thinking. For the original pentagonal problem schematic, please refer to the above Pentagonal Problem Canvas. The MICIE project also left one side of the pentagon free so that workshop participants could suggest another category of needs that may not have considered at the beginning. After presenting the Pentagonal Problem Canvas to participants, they were the encouraged to ideate with post-it notes. This canvas was specifically used in the Resource Gap section of the workshop agenda below [26]

25 Mediterranean Island Cleantech Innovation Ecosystem (MICIE) Deep Dive Workshops Agenda document.
26 Mediterranean Island Cleantech Innovation Ecosystem (MICIE) Deep Dive Workshops Agenda document. Page 2.

Considering MICIE's goals, the kaleidoscope of workshop participants could have varied from people with very low decision-making power and expertise (e.g. civil society representatives) to ones with very high decision-making power and expertise (e.g. national government representatives). The composition of participants was important, since it would influence the outcomes level, depth, and impact of the dialogue.

Based on initial decisions about important participants, a 1-2 page 'call for action/'innovation' with general information about the workshop was created. This was then published on relevant websites and used as a save-the-date. This should be done as early as possible (2 months before the workshop).

AGENDA

Feel free to use the below MICIE agenda as inspiration for your workshops.

Themes of the workshops:

1. Smart Grid Management and Storage Solutions
2. Green Buildings & Circularity -New materials, new approaches
3. Agriculture and Forestry
4. Urban Planning for Sustainability Mobility

9:00-9:15 Welcome and recap of first workshop

We will have a brief introduction to MICIE, the purpose of the workshops (all workshops) and provide a summary of the results of the first workshop.

Note: *Here we will summarise the information from the SWOT canvas completed in the first workshop. The SWOT specific to the theme will be presented only.*

9:15-9:45 Idea generation

10' individual idea generation with post-its- we will ask them to think of sub-thematic areas within the broader theme of the workshop. Here we suggest that we develop our own suggestions based on the first workshop (where this information is available). After this process, we can present their ideas + the ideas from the 1st workshop and collectively we will select 3 of the most relevant ideas.

Note: *As we may have participants that were not involved in the first workshop, we recommend that we allow them to make their own suggestions without showing them the results of the first workshop first so that they are not influenced.*

9:45-10:15 Resource gap

Using an amended Pentagonal Problem canvas, we will identify the resources needed across human, infrastructure, funds and policy for the implementation of each idea. See (1) for canvas schematic.

Note: *We have also left one side of the pentagon free, for participants to suggest any other category of needs that we may not have realised.*

10:15-10:30 **Presentation**
Each group/facilitator presents their canvas

10:30-11:00 **Tools identification**
Participants will be asked to match the needs identified in the pentagonal problem with tools and instruments that can overcome them. The tools and instruments will be printed on cards created in advance, using the best practices that we identified from our research as well as our own ideas (e.g. clustering, regulatory sandboxes etc), but they will have the opportunity to add their own. See photo.

11:00-11:10 **Presentation**
Each group/facilitator presents their canvas

11:10-11:20 **Next steps**
Facilitator will pick up on threads from the presentation and will explain the next steps for the project.

** To manage the uncertainty in the number of participants that will take part in the end, exercises 2 + 3 will be conducted as follows:*

(a) if we have only up to 5 participants, the discussion will happen all together, with each idea rotated (i.e. after 10 mins we switch idea),

(b) up to 10 participants, the discussion will have the format of a World Café- one idea/canvas per table with a permanent facilitator and the participants will be split into smaller groups that will rotate and visit each table (switch table after every 10 mins),

(c) more than 10 participants, they will work in groups on one idea only.

VISUAL TOOLS USED IN THE WORKSHOPS

The participatory process involves guided conversations, facilitated by science-based visual tools to pool knowledge based on input from different sectors.

Figure 12: The researchers printed out green cards, which served as the tools and instruments identified prior to the workshops and printed out white cards which represented their needs (across human, infrastructure, funds and policy etc). Participants matched them in the workshops [27]

27 Agenda MICIE Deep Dive Workshops page 2

Below is another type of canvas used to provoke discussion in a Deep Dive workshop which attempted to zoom in on Cyprus' most crucial R&I topics.

Greenhouse gas emissions and removals (Απαλλαγή από τις εκπομπές αερίων του θερμοκηπίου)	Renewable energy sources (Ανανεώσιμες πηγές ενέργειας)	Energy efficiency (Ενεργειακή απόδοση)	Security of supply (Ενεργειακή ασφάλεια)	Internal energy market (Εσωτερική αγορά ενέργειας)

Cyprus University of Technology · Deputy Ministry of Research, Innovation and Digital Policy · OEB · Cyprus Energy Agency · The Energy & Water Agency · The Malta Chamber · MCAST · Climate-KIC · Funded by the European Union

MICIE Mediterranean Island Cleantech Innovation Ecosystem

This project is funded by the Horizon Europe Framework Programme for Research and Innovation of the European Union. Grant Agreement Number: 101070800

Figure 13: R&I Topics Canvas for a Deep Dive workshop, MICIE Project.

LOGISTICS

The MICIE researchers made sure that the space responded to the workshop needs, i.e., a plenary space as well as breakout spaces/separate rooms for smaller group discussions. The below was considered whilst choosing a venue:

Plenary space

- Plenary space for all participants.
- Ideally, this is not an auditorium with fixed seats but an open space where seating is possible, and where it is possible to move the seats to the side of the room for more interactive activities.
- The space should have a stage and audio-visual facilities, including a screen, projector and at least one cordless microphone (for making presentations).

Subgroup workspaces

- A separate workspace should be available for all work groups – depending on the size of the workshop, each suitable for workgroups of approximately 10-12 people.
- These rooms should be large enough for tables and chairs for 12 people.
- Tables and chairs should not be fixed but can be rearranged according to the group's needs.

Material (per workspace)

- Small table for coffee, tea, water and cups/glasses.
- Flip-over, with enough paper.
- Coloured markers (4 colours: black, blue, red, green) – at least 2 sets per room.
- Several ballpoint pens.
- Masking tape (for hanging papers on the walls).
- Post-its (ideally A-5 size, also smaller ones).
- Scissors.
- Blank A-4 paper, blank A-3 paper.

Communication & Dissemination

- Secure a camera to record the session or to take pictures.
- Consider making audio recordings of the speeches, session wrap-up and individual group presentations.
- Think about branding: roll-up banners, flyers and posters.

CATERING

- The venue should be able to supply tea/coffee/water (in the workspaces or at a central location several times each day).

- Lunch should be available at a central location, ideally served at the workshop venue.

- It should be possible to have an informal reception the evening before the workshops begin, or at the end.

Figure 14: A photo from the first workshop held in Cyprus. Participants are grouped around a canvas with sticky notes to direct their discussion. [28]

28 Mediterranean Island Cleantech Innovation Ecosystem (MICIE) first workshop 23.03.23.

Figure 15: A photo from the Deep Dive workshop held in Malta. Participants are grouped around several pentagonal problem canvases with sticky notes

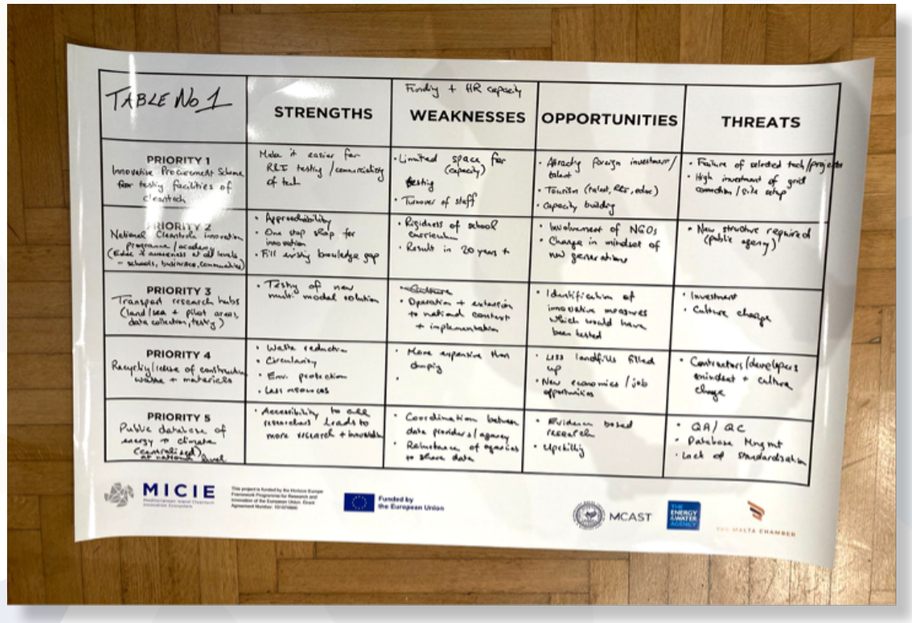


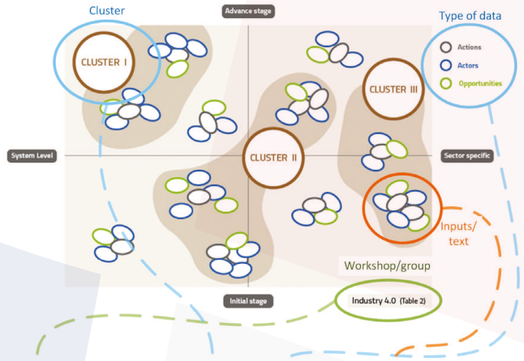
Figure 16: Example of R&I priorities analysis against a SWOT framework during the first workshop held in Malta.

Step 4: Analysis of the knowledge and information

Knowledge management is not a concluding stage but rather an ongoing endeavour that is integrated into various phases of the policy process and sustained over time. Participatory processes primarily centre around workshops but encompass research meetings, pre-event preparations, actual implementations, and post-event follow-ups. Additionally, managing relationships with participants is an integral part of this process. The data gathered during these activities also becomes part of the knowledge management process.[29]

Analysis of the knowledge and information involves two main sets of practices:

1. Harvesting and Documentation: This begins with the challenge's design and continues throughout the participatory process, emphasising information management. It comprises two interconnected actions: managing the flow of information and continually reframing ideas. Various narrative layers can be developed, incorporating concise information packs such as factsheets, posters, and more comprehensive documents like webinars, online dashboards, and reports.



ID	Workshop	Canvas	Quadrant	Cluster	Colour	Text	Coding/category
142	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	-video shooting - creative campaigns	Awareness and engagement
138	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from wast water	fuels and energy sources
139	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	renewable energy from food waste	fuels and energy sources
140	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero carbon emissions in cities	local and urban intervention
144	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	zero food waste	waste management
145	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Action	turn food waste into fertilizer	waste management
146	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
150	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	business	Business
156	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Business	Business
151	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
153	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Municipalities	Local government
147	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	mass media	Media
159	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Media incl social	Media
148	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	NGOs	NGOs
152	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Universities	Universities
154	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Actors	Universities	Universities
160	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Opportunities	Accelerator	Accelerator
161	Sofia CE	Industry 4.0	1	Inno + tech + infrastructure	Opportunities	Pathfinder	Pilots & Demostrations OP

Dataset structure | Tool framework & layers | Inputs and indicators

Figure 17: The harvesting and documentation process (Matti et al., 2020). page 59.)

2. Developing Actionable Knowledge: Focused on conceptualising and analysing the co-creation workshop results, this aims to gather the main patterns and synthesise the main take aways. These outcomes are designed to support the challenge owner and stakeholders in implementing proposed interventions, practices, actions, or changes, fostering decision-making at specific points in the policy process.

The figure below illustrates how these knowledge flows manifest in terms of inputs and outputs within the three strategic information processes of the knowing cycle: sensemaking, knowledge creation, and decision-making.

29 Matti, C. and Rissola, G. (eds.) (2022) Co-creation for policy: participatory methodologies to structure multi-stakeholder policymaking processes. Luxembourg: Publications Office of the European Union

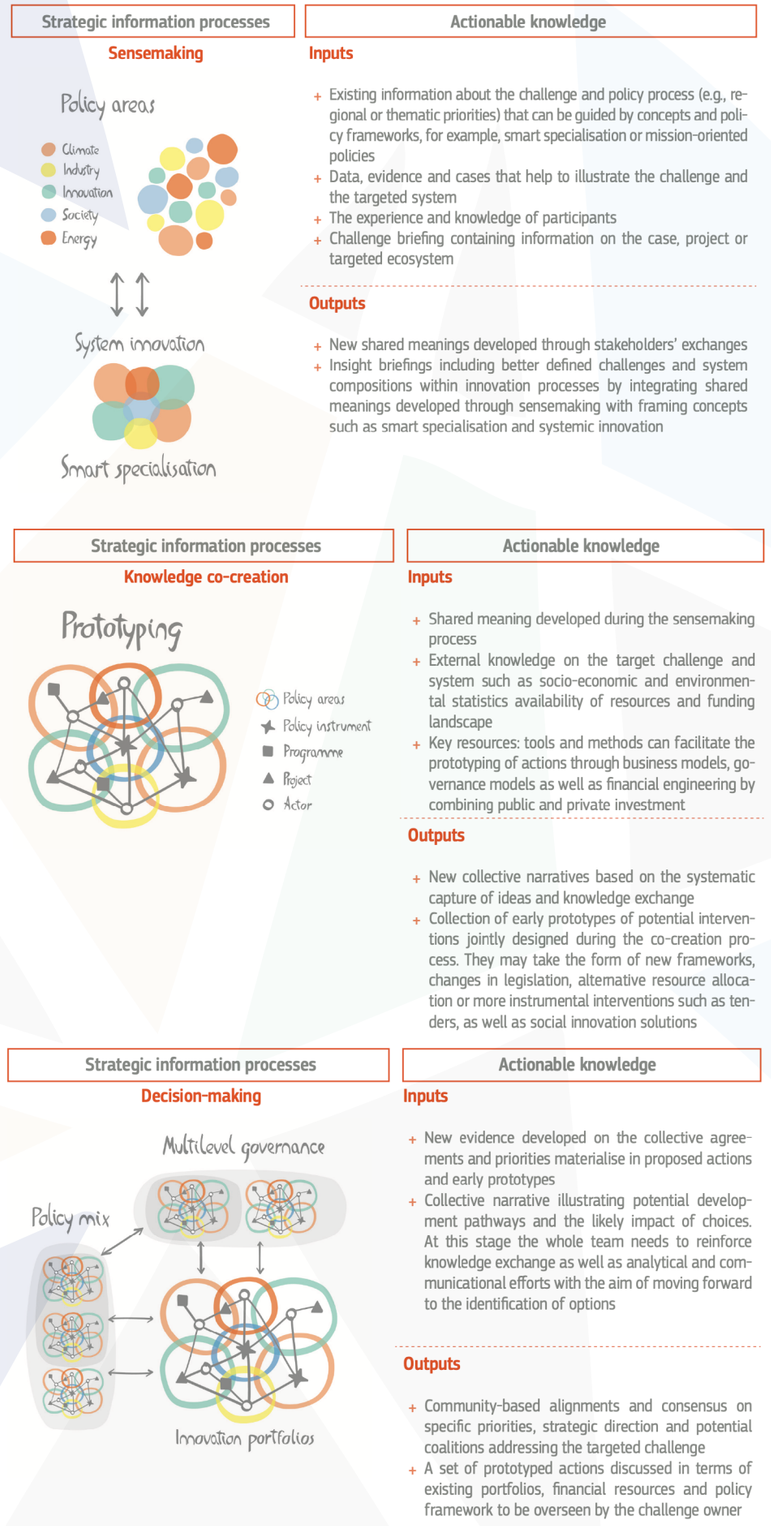


Figure 18: from MATTI, C., RISSOLA, G., MARTINEZ, P., BONTOUX, L., JOVAL, J.-M., SPALAZZI, A., & FERNANDEZ, D. (2022). Co-creation for policy: Participatory methodologies to structure multi-stakeholder policymaking processes.

THE MICIE APPROACH TO ANALYSING THE KNOWLEDGE GATHERED

After the workshop

- MICIE researchers saved a reasonable amount of time (an hour or two) after the mapping session to type up notes and record reflections to be integrated into Step 4: Analysis of the knowledge and information.
- Researchers held a group analysis session with the team members participating in the mapping session.
- Researchers then analysed the stakeholder maps validated in the workshops, the content of conversations, and reflections produced by all the facilitators.
- Each canvas used in the workshop were labelled and their text recorded.

Once the data extracted from the workshop was organised in the panel data format, researchers then engaged in data analysis. Values are then assigned through a simple coding or 'tagging' process based on content analysis techniques to produce indicators for further analysis.

The coding process seeks to unpack the information in the data set into a more comprehensive and simple groups of data to be analysed.

DATA STRUCTURING THROUGH PANEL DATA

Data units such as Post-it notes and stickers were converted into text entries, maintaining the sectional structure of the physical tool/canvas.
The panel data format was used to organise all these levels and components better and guarantee optimal use of the data for statistical analysis.
This data set format is suitable for gathering data from mapping exercises since science-based visual tools include multiple elements that can be organised in different sections and levels (see table below).

DATA SET STRUCTURE

ID: a unique identifying number for each element, used to avoid duplications and to manipulate relations, run statistical processes and clustering.

Workshop name: used to organise different origins. The formula Location + Topic is mostly applied.

Canvas: refers to the analogue artefact, such as a flipchart or printed canvas, used by a group of participants during a mapping session based on a specific tool, and indicates the grouping logic (e.g. topic, city, sector).

TOOLS FRAMEWORK AND LAYERS OF DATA

Quadrant or Section: indicates the different spaces represented by the visual tool, which serves as a guiding principle for the expected indicators. Generally, these are scales and subsections based on the main concepts provided by the visual tool.

Cluster: indicates a collection of elements grouped under a meta-category by following affinity relations referring to thematic or geographical proximity (see Chapter 5, p. 84). Isolated elements can be categorised as 'non-clustered', guaranteeing further analysis.

Type of element: expresses as an attribute the kind of information on the Post-it note or sticker, such as action, actor, resource or output.

INPUTS AND INDICATORS

Text: the most accurate translation of the written input/unit of data such as a Post-it note or sticker. Data entry involves an iterative translation process requiring data cleaning, merging, and consolidating inputs and elements.

Coding/category: the codes assigned to written input through the coding or tagging process.

Please refer to Chapter 4 Action in the companion book, the MICIE Action Plan Template, which section provides step-by-step guidelines for identifying actions from these stakeholder workshops and offers templates to help users record their action plans.

Tables are provided in the companion book to guide users through the creation of their action plan. These include templates for identifying actions derived from stakeholder engagement, quantitative actions, summary and SMART criteria process, action prioritisation, and actions for R&I thematic areas.

Each template outlines key components to fill in, from defining objectives and enabling factors to explaining how the actions contribute to the overall aim of the plan. The goal is to support Guidebook users in developing a clear, comprehensive, and strategic action plan that aligns with overarching national strategies, involving stakeholder engagement and a detailed understanding of the key actions needed to achieve their R&I thematic area goals. [30]

30 Callus, M.A., and D. Spiteri (2023) Action Plan Template. Deliverable 4.1 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta). Pages 43-49.

1 Understanding the stakeholders

Considering the main categories/groups of such stakeholders, these have been further analysed based on their specific relationship to the cleantech innovation ecosystem challenge, their expected contribution to the project, strength of relationship with other stakeholders, as well as varying levels of power/influence and interest in the cleantech ecosystem.

The stakeholders who attended workshops in Cyprus and Malta were categorised in 7 clusters:

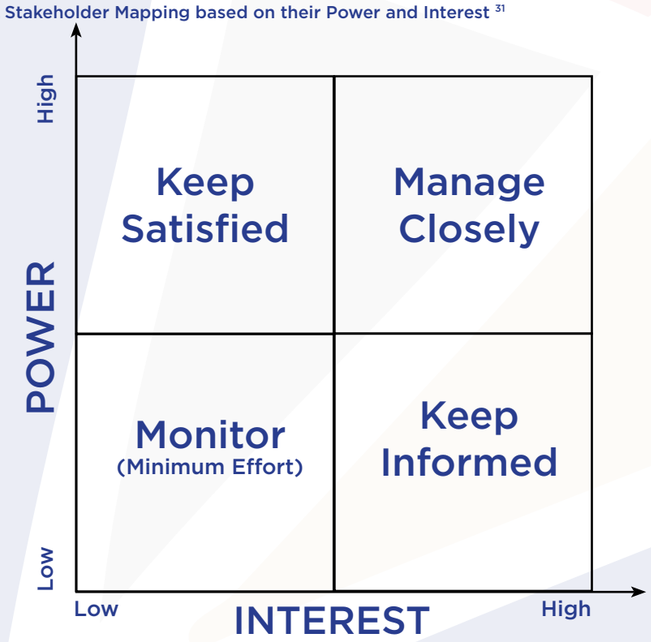
1. Policy makers
2. Policy implementers
3. Civil society groups
4. Education & research
5. Providers of funds
6. General public
7. Commercial community

2. Prioritising the stakeholders

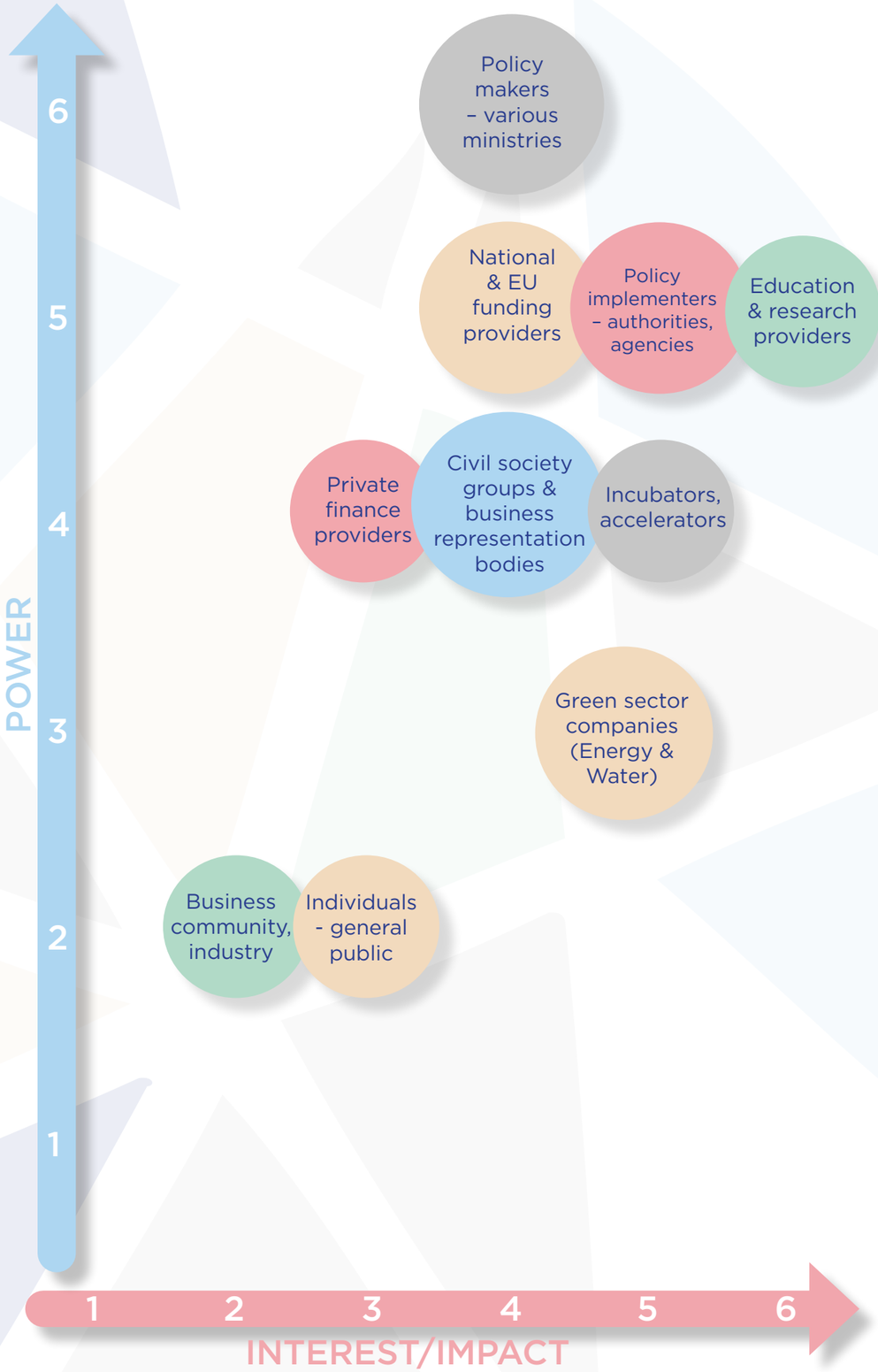
Based on the main stakeholder groups' interest and influence, these have been mapped along the two vectors of power (influence) and interest in the MICIE project in support of driving innovation and entrepreneurship for cleantech in Malta and Cyprus. This exercise helped identify which stakeholders are most likely to actively support and get involved in the project, as well as the key actions needed to manage them.

The most powerful and interested stakeholders, who can clearly influence the project in a positive or negative way were earmarked as needing close management. They were also the ones that the project researchers started to engage with early on and with continue to do so.

Table 6. Stakeholder Mapping based on their Power and Interest [31]



31 Frendo, C., Franco, R., Kara, G., (2023) Report on Stakeholder Mapping. Deliverable 2.2 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Malta College of Arts, Science, and Technology (MCAST), Paola (Malta).



MALTA

In total, more than 130 stakeholders received invitations to participate in the initial workshop in Malta. Participants put into groups and asked to create a SWOT analysis to identify key R&I Priority Areas. Three strong themes emerged for Malta:

- Clean energy and efficient solutions (including urban planning and mobility)
- Renewable solutions for islands
- Integration of renewable electricity (including smart grid management and storage solutions)

Dedicated workshops for each priority area allowed stakeholders to pinpoint ideas and needs, shaping high-level resources. Based on these outcomes, the MICIE project formulated specific actions that will feed into writing Step 6: Transformative Policy Roadmaps.

- **Action 1:** Identification of R&I Testing Facilities
- **Action 2**: Creation of an Open Science Database
- **Action 3:** Strengthening the Local Researcher Workforce

CYPRUS

In total, 40 stakeholders were invited to participate in the initial workshop in Cyprus, representing the National R&I Technical Committee responsible for supporting the Green Deal. This committee, consisting of stakeholders from academia, research, government, and business, aligned MICIE's efforts with those of the Deputy Ministry of Research, Innovation, and Digital Policy. Similar to the Maltese workshops, Cypriot participants, representing the quadruple helix were tasked with suggesting R&I priority areas based on their expertise and the four dimensions of the Cypriot NECP.

After assessing and selecting the most relevant thematic areas, stakeholders conducted a SWOT analysis, leading to the identification of four key R&I Priority Areas:

- Green Buildings and Circularity (including new materials)
- Smart Grid Management and Storage Solutions
- Urban planning for the Promotion of sustainable Mobility
- Agriculture, Forestry and Land Use Change

These priority areas were the focus of dedicated workshops, allowing stakeholders to outline ideas, needs, and high-level resources. The local Cyprus partners developed specific actions based on these outcomes. Following extensive stakeholder engagement through workshops in March and May 2023, the proposed actions were formulated:

- **Action 1:** Policy – Academia Collaboration
- **Action 2**: Creation of an Open Science Database
- **Action 3:** Regulatory Sandboxes
- **Action 4:** Demonstration and Pilot Sites

Further stakeholder engagement occurred during Action Plan development, where stakeholders contributed knowledge and insights related to the proposed actions. In total, nine stakeholders actively assisted the consortium partners in shaping the action plan [32]

32 Spiteri, D. (2023) Stakeholder Engagement during Action Plan drafting. Deliverable 4.4 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta).

Step 5: Resourcing, budgeting, KPIs and multi-annual programming for Policy Action Plans

A policy action plan is a strategic and visual document that outlines the key steps, actions, and milestones necessary for the development, implementation, and evaluation of a specific policy. It serves as a guide for policymakers, stakeholders, and the public, providing a clear and transparent path for achieving policy objectives. The roadmap typically includes timelines, responsible entities, and performance indicators to measure progress.

Such plans are valuable tools for enhancing transparency, fostering collaboration among stakeholders, and are often used in complex policy areas where multiple actors and factors are involved.

RESOURCING, PER ACTION RECOMMENDED

The chapter on Resource Mobilization in the companion Action Plan Template outlines a comprehensive approach to acquiring and managing the diverse resources needed to execute specific actions effectively.

THE MICIE APPROACH (MALTA)

Given the detailed requirements for implementing the actions outlined in the Malta Action Plan, a substantial amount of information needs to be gathered from stakeholders. Therefore, the remaining resource to be defined is the workforce needed for action implementation. To address this, a hybrid approach is suggested, involving the allocation of hours from both internal and external human resources. The internal team will manage project tasks, handle R&I Site Identification responsibilities, and provide support for other mentioned tasks. Simultaneously, external resources will be sought through a procurement call, aimed at securing legal expertise for Regulatory Sandbox and Policy Framework implementation, as well as aiding internal resources with legal aspects as required. The allocated hours encompass the attendance of meetings related to the Joint Action between Malta and Cyprus. [33]

BUDGETING

The Indicative Budget chapter provides a structured process for estimating costs associated with resource needs outlined in the Resource Mobilization section. It guides users through budget calculations for different resource types and Action/sub-Actions in a detailed manner.

THE MICIE APPROACH (MALTA, RECOMMENDED ACTION 1)

The suggested resources were used to formulate the tentative budget, which was then distributed based on the estimated timeframe as detailed below. Given that internal human resources will handle most tasks, with only legal aspects outsourced, the allocated work hours mirror this distribution. It was recommended to assign 3,000 hours and 2,000 hours, respectively. These hours were then distributed according to the tentative timeframe and multiplied by hourly rates obtained through market research, resulting in the values presented in Table 7. An indirect cost rate of 25% was subsequently applied to these values, encompassing administrative costs related to managing, monitoring, and reporting action progress. The overall indicative budget is displayed below.[34]

33 Callus, M.A., T. Gallea and D. Spiteri (2023) Malta Action Plan. Deliverable 4.2 of the MICIE | Mediterranean Island Cleantech Innovation Ecosystem project. Grant Agreement 101070800. Energy and Water Agency (EWA), Qormy (Malta).

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TABLE 7 - ACTION 1 INDICATIVE BUDGET

RESOURCES	2025	2026	2027	TOTAL
Contracted Services	€20,000	€40,000	€20,000	**€80,000**
Human Resources	€24,920	€15,529	€10,738	**€51,187**
Indirect Costs	€11,230	€13,882	€7,684	**€32,797**
Total	**€56,150**	**€69,412**	**€38,422**	**€163,984**

KPIS AND MONITORING OF PROGRESS

The “Monitoring of Progress” chapter delves into establishing Key Performance Indicators (KPIs) to gauge the effectiveness and advancement of research and innovation actions.

In this section, two Key Performance Indicators (KPIs) are introduced for monitoring action progress within their respective implementation timeframes. The selection of these KPIs aligns with the SMARTER criteria, guided by the following acronym:

S – Establish Specific and focused targets
M – Ensure Measurable progress as a clear indication of reaching targets
A – Confirm Achievability with the available tools
R – Assure Relevance to the Action’s goal while maintaining ambition
T – Set Time-bound KPIs for improved progress tracking, prioritization, and success measurement
E – Ensure KPIs are Easy to Evaluate, understand, communicate, and contextualize
R – Readjust if the chosen KPI does not align with the above criteria

It is essential to recognise that sometimes having a few impactful KPIs is preferable to having several that do not adhere to the outlined process. Additionally, KPIs are flexible and can be adjusted to reflect changes in the Action if objectives or goals progress or shift.

TIMEFRAME KPI

This Key Performance Indicator (KPI), as indicated by its name, will supervise compliance with the planned progress of the Actions based on the predetermined timeline for each respective Action. The monitoring process for this KPI will follow the methodology outlined in the provided table and equations.

TABLE 8 - TIMEFRAME KPI CALCULATION METHOD

SCENARIO	Percentage
Target has been reached in less time than expected	100% + y
Target has been reached in the selected timeframe	100%
Target has been reached but required an extension (up to 50% extra)	100% - x
Target was not reached	50%
Target was not reached despite an extension (up to 50% extra)	50% - x

The factors for which will be calculated using the below equations:

$$\text{Time extensions (x)} = \frac{\textit{Total time spent on action}}{\textit{Total time expected to be spent on action}} - 1$$

$$\text{Time reduction (y)} = 1 - \frac{\textit{Total time spent on action}}{\textit{Total time expected to be spent on action}}$$

It is advisable to provide more detailed elaboration on these timeframes before the initiation of the respective Action, facilitating more effective progress monitoring and milestone reporting. It is proposed that reporting for all three actions should occur either quarterly or through the submission of periodic reports, similar to the practice in EU-funded Projects.

BUDGET KPI

Like the Time KPI explained in section 5.1, the Budget KPI monitors the flow of funds for the respective Action using the indicative budget as a primary reference point. The method of monitoring proper budget use is explained below through the table and equations provided.

TABLE 9 - BUDGET KPI CALCULATION METHOD

SCENARIO	Percentage
Target has been reached using less funds	100% + y
Target has been reached using the proposed budget	100%
Target has been reached but required further funding (up to 50% extra)	100% - x
Target was not reached	50%
Target was not reached despite additional funds (up to 50% extra)	50% - x

This KPI will be monitored on a quarterly basis for the duration of the implementation of each of the actions.[35]

MULTIANNUAL WORK PROGRAM

The Multiannual Work Programme is the master plan for the Action Plan's journey. It's where everything previously discussed comes together in an easy-to-understand document outlining what will happen during the Action Plan. It's essentially an organised document that explains the goals, plans, and expected outcomes for each action, creating a roadmap for the entire Action Plan's journey.

The Action timeframe for Action 1 in Malta was developed based on the outlined action details and the assumption that action implementation will begin in 2025 at the earliest, aligning with the National Strategy for R&I in Energy and Water 2021-2030 implementation period. As depicted in the accompanying image, the tasks related to the site identification of the R&I Testing Facility are proposed to run concurrently and span a total of one and a half years. The Regulatory Sandbox assessment is also suggested to occur simultaneously with the site identification tasks but with a delayed start, considering that the site identification process may yield early insights into the type of sandbox needed, if any. This also allows for potential inclusion of a Regulatory Sandbox within the Policy Framework if deemed necessary. The proposed joint action with Cyprus is anticipated during the assessment for the need of a regulatory sandbox. Finally, the Policy Framework creation tasks are planned for implementation following the preceding tasks and are expected to take approximately one year to complete.

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THE MICIE APPROACH (MALTA, RECOMMENDED ACTION 1)

Based on the outlined action details and the assumption that action implementation will begin in 2025 at the earliest, aligning with the National Strategy for R&I in Energy and Water 2021-2030 implementation period mentioned in Section 2, the indicative action timeframe has been developed. As depicted in the accompanying image, the tasks related to the site identification of the R&I Testing Facility are proposed to run concurrently and span a total of one and a half years. The Regulatory Sandbox assessment is also suggested to occur simultaneously with the site identification tasks but with a delayed start, considering that the site identification process may yield early insights into the type of sandbox needed, if any. This also allows for potential inclusion of a Regulatory Sandbox within the Policy Framework if deemed necessary. The proposed joint action with Cyprus is anticipated during the assessment for the need of a regulatory sandbox. Finally, the Policy Framework creation tasks are planned for implementation following the preceding tasks and are expected to take approximately one year to complete. [36]

Tasks	2025				2026				2027			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Identification of suitable Offshore Sites												
Identification of suitable Onshore Sites												
Regulatory Sandbox necessity assessment												
Policy Framework Creation for R&I Testing Facilities												

Figura 19 Proposed duration of action 1

Step 6. Transformative Policy Roadmap

Key components of a policy action plan may include some elements of Step 5, but will expand on those elements to paint a holistic story:

1. **Policy Objectives:** Clearly defined goals and objectives that the policy aims to achieve.
2. **Key Stakeholders:** Identification of relevant stakeholders involved in the policy development and implementation process.
3. **Timeline:** A chronological outline of the major steps and milestones involved in the policy lifecycle, from conception to evaluation.
4. **Action Items:** Specific tasks and activities required at each stage of the policy process, including research, consultations, drafting, approval, and implementation.
5. **Responsibilities:** Assignment of responsibilities to different entities or individuals involved in the policy process, indicating who is accountable for each task.
6. **Resources:** Allocation of necessary resources, including funding, personnel, and technology, to support policy implementation.
7. **Performance Indicators:** Clear metrics and benchmarks to assess the success and effectiveness of the policy at various stages.
8. **Feedback and Evaluation:** Mechanisms for obtaining feedback from stakeholders and conducting periodic evaluations to assess the policy's impact and make necessary adjustments.

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Then there are two templates specifically for each Action in the companion MICIE Action Plan Template. The first one outlines a yearly progression, giving a general path for the action. The second one is more detailed and is used for actions with shorter timeframes, enabling monthly monitoring, but is versatile and can be used for actions with longer timeframes.

MICIE APPROACH TO THE TRANSFORMATIVE POLICY ROADMAP (MALTA)

As discussed before, the Malta R&I Policy Roadmap is the outcome of various stakeholder engagement workshops, which led to the proposal of three core actions in the energy and climate themes detailed below:

1. Identification of R&I Testing Facilities
2. Creation of an Open Science Database
3. Strengthening the Local Researcher Workforce

Each recommended action in the Malta Policy Roadmap comprises a comprehensive background, offering insights into local strengths and limitations and a concise overview of the necessary steps to achieve the intended goals. These steps were formulated based on proposed specific tasks for each action that grew out of stakeholder workshops. Once the action steps were established, the action timeframes were delineated, ensuring implementation occurs between the years 2025 to 2030.

Table 10 is an example of the proposed roadmap for the first action identified in MICIE for Malta: Identification of R&I Testing Facilities.

Action Title	**1. Identification of R&I Testing Facilities**
R&I Priority Area (MALTA)	· Renewable Solutions for Islands · Integration of RES Electricity · Energy Efficient Solutions for Industry and Services
Action Tasks	1. Identify suitable location/s for an offshore facility for testing innovative renewable technologies/systems. 2. Identify suitable location/s for an onshore facility for testing innovative solutions to serve for energy and climate projects such as renewable energy and/or energy efficiency. 3. Assess the necessary policy framework for the creation of these testing facilities. The assessment is to consider different aspects, such as data sharing, site ownership, maintenance, funding, and facility renting costs. 4. Assess the need for the creation, or otherwise, of a regulatory sandbox to be carried out in parallel with Cyprus.
Action Duration	Action proposed timeframe is of around two to three years starting from 2025, with the R&I Site Identification tasks being carried out in parallel. The Regulatory Sandbox necessity assessment will also be carried out in parallel to the Site Identification tasks but delayed by half a year. These are then followed by the Policy Framework creation tasks which upon completion is expected to signify completion of the Action end first half of 2027.
Action Resources	Task implementation is proposed to be split between internal and external human resources, through the publication of a procurement call for services for the latter. In total, 5,000 work hours are being proposed to be split between the two
Budget	A total budget of around €164,000 was proposed for the completion of this action considering the workhour distribution and researched hourly rates.
Action Coordinator	To be established.
Action Coordinator Assistant	To be established.
Action Partners/ Associates	To be established.
Action Description	· One or more sites shall be identified for consideration for the creation of R&I Testing Facilities onshore and offshore respectively. · The assessment for the need for the creation, or otherwise, of a regulatory sandbox. · The creation of the necessary Framework/s for the creation, management, and operations of said Facilities.
Monitoring KPIs	Monitoring of Action Duration and Action Expenses (see Section 5 for further details).

TABLE 10 – ROADMAP FOR IDENTIFICATION OF R&I TESTING FACILITIES (MALTA)

Roadmaps often follow a visual representation of the different steps, or stages that can be followed for an action plan to be implemented. Below, a generic representation of a policy R&I roadmap is presented for illustration purposes.

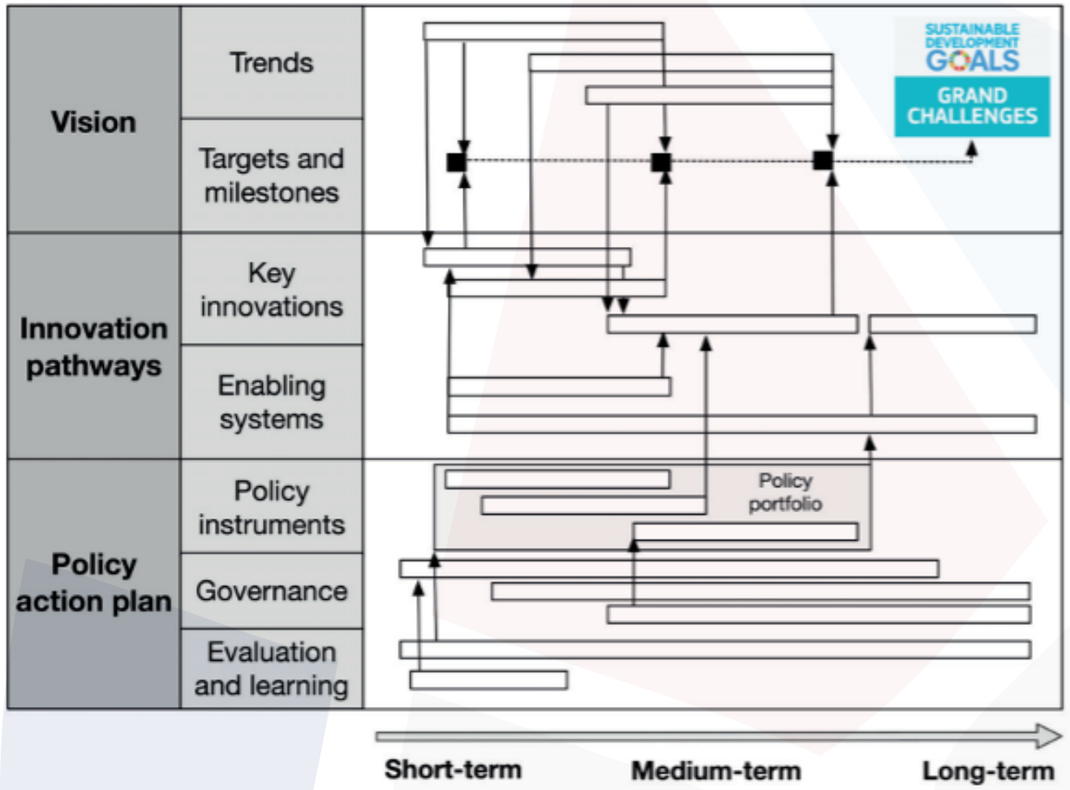

Figure 20 Generic structure for a R&I policy roadmap. Source: Miedzinski et al 2019.

TIP the methodology of STI for SDGs roadmaps of Miedzinski et al (2019) can be used to implement the additional step to produce a visual representation of a policy roadmap. (see additional references).

POLICY UPTAKE

The adoption of a policy action plan is a key step in the systemic and transformative approach for the integration of climate, energy and R&I policies.

The creation of dialogue sessions and tasks forces are useful tools to gain wider political support for the integration of the policy action plan. Thus, it is always recommended to include a 'champion' in the operationalisation of the approach proposed in this guidebook.

For instance, EWA and the Ministry of Innovation pushed for their recommended actions within the Cypriot Government, whilst the rest of the consortium members based in Cyprus presented the Policy Roadmap to the Presidency directly.
It is also important to properly publicise and disseminate the Action Plan to a wider national audience to increase societal awareness of its importance, impact, and increase uptake in sectors outside of government, namely in industry and civil communities.

The MICIE consortium presented this project and its final Action Plan to 29 participants at an in-person meeting in Brussels, whose location outside of the Mediterranean was chosen strategically to boost European Commission awareness of the project. Each country also held their own press releases. The Cypriot, Maltese, and general European public were also engaged through social media posts.

Additional resources

Guidelines / Manuals

- De Vicente Lopez, J. and C. Matti (2016) *Visual toolbox for system innovation. A resource book for practitioners to map, analyse and facilitate sustainability transitions. Transitions Hub Series.* EIT Climate-KIC, Brussels, ISBN 978-2-9601874-1-0.
https://transitionshub.climate-kic.org/publications/visual-toolbox-for-system-innovation/

- Kemp, R., Arundel, A., Rammer, C., Miedzinski, M., Tapia, C., Barbieri, N., Türkeli, S., Bassi, A., Mazzanti, M., Chapman, D., Diaz Lopez, F. J. & McDowall, W. (2020). *Maastricht Manual on Measuring Eco-innovation for a Green Economy, Maastricht, Innovation for Sustainable Development Network,* Maastricht, 141p. ISBN 9789090329987.
https://www.inno4sd.net/uploads/originals/1/inno4sd-pub-mgd-02-2019-fnl-maastrich-manual-ecoinnovation-isbn.pdf

- Martinez, P., Kune, H., Rissola, G (2018)., I*nnovation camp methodology handbook: realising the potential of the entrepreneurial discovery process for territorial innovation and development,* European Commission, European Committee of the Regions, Joint Research Centre, Publications Office, Luxembourg, https://data.europa.eu/doi/10.2760/92409092-76-52215-7, doi:10.2760/211431, JRC128771

- Miedzinski, M., McDowall, W., Fahnestock, J., Muller, G., & Diaz Lopez, F. J. (2019). *Science, Technology and Innovation Policy Roadmaps for the SDGs: a guide for design and implementation. Innovation for Sustainable Development Network,* London, 50 p.
https://www.inno4sd.net/uploads/originals/1/inno4sd-pub-mgd-01-2019-fnl-sti-policy-roadmap-sdgs.pdf

- Matti, C., Martín Corvillo, JM, Vivas Lalinde, I., Juan Agulló, B., Stamate, E., Avella, G., and Bauer A. (2020). *Challenge-led system mapping. A knowledge management approach. Transitions Hub series*. EIT Climate-KIC, Brussels.
https://transitionshub.climate-kic.org/publications/challenge-led-system-mapping-a-knowledge-management-approach/

- Matti, C., Rissola, G., Martinez, P., Bontoux, L., Joval, J., Spalazzi, A. and Fernandez, D., (2022) *Co-creation for policy: Participatory methodologies to structure multi-stakeholder policymaking processes*, Matti, C. and Rissola, G. editor(s), EUR 31056 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-52215-7, doi:10.2760/211431, JRC128771
https://publications.jrc.ec.europa.eu/repository/handle/JRC128771

- Silvestri, G., Diercks, G., and C. Matti. (2022). *X-Curve: a sensemaking tool to foster collective narratives on system change.* Transitions Hub series. DRIFT and EIT Climate-KIC, Brussels
https://transitionshub.climate-kic.org/publications/x-curve-a-sensmaking-tool-to-foster-collective-narratives-on-system-change/

- Pontikakis, D., Gonzalez Vazquez, I., Bianchi, G., Ranga, L., Marques Santos, A., Reimeris, R., Mifsud, S., Morgan, K., Madrid Gonzalez, C. and Stierna, K., Partnerships for Regional Innovation Playbook, EUR 31064 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-52325-3, doi:10.2760/775610, JRC129327.
https://publications.jrc.ec.europa.eu/repository/handle/JRC129327

Websites

EIT CKIC Transitions HUB, knowledge library:
https://transitionshub.climate-kic.org/knowledge-library/

JRC Partnerships for Regional Innovation https://s3platform.jrc.ec.europa.eu/pri

TIP Consortium, resource lab: https://tipresourcelab.net/

List of abbreviations and acronyms

CKIC	EIT Climate-KIC
CY	Cyprus
EIT	European Institute of Innovation & Technology
EC	European Council
EU	European Union
HE	Horizon Europe
JRC	Joint Research Centre of the European Commission
MS	EU Member State
MT	Malta
NECP	National Energy and Climate Plan
R&I	Research and Innovation
RIS	Regional Innovation System

MICIE

Mediterranean Island Cleantech
Innovation Ecosystem