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1 Introduction

Advancing the green transition – the shift towards a sustainable, environmentally-friendly and resource-efficient economy and society – requires innovative solutions that can only be developed with the joint efforts of diverse actors, such as academics, researchers, businesses, public authorities and citizens.

This document presents synthesised notes of co-creation initiatives for the green transition from 9 OECD countries and an international consortium. The cases focus on universities' involvement in partnership initiatives with citizens and industry actors in three main areas: green mobility, green energy, and green products, services and processes (Table 1.1).

To develop these case studies, in-depth interviews with initiative leaders were conducted based on a template to enable comparisons (see section 3). An associated document explores main policy insights from these cases.

Table 1.1. Overview of 10 selected case studies

No.	Initiative name	Country	Short description
Green mobility			
1	**aspern.mobil LAB**	Austria	Initiated by Vienna University of Technology, aspern.mobil LAB offers a space for universities, companies, citizens, and the government to participate in joint innovation for a green and inclusive local mobility system in Vienna.
2	**HyMethShip**	International	This international consortium of 13 partners involving universities, research centres and industry partners aimed at jointly developing a hydrogen-fueled combustion solution to reduce emissions of ships.
Green energy			
3	**Centre TERRE**	Canada	Created by the Jonquière College and his automation Center (CPA), the Centre TERRE co-creates renewables and automated energy solutions jointly with SMEs, universities and other partners to respond to the needs of businesses and citizens located in remote areas that are not served by the national electricity grid.
4	**GreenLab**	Denmark	Green industrial park and a national research and development facility aimed at accelerating innovation in the field of green energy generation, storage and sharing. It provides testing the ground for green energy solutions co-created by industry, academia and government.
5	**NEWRAIL project**	Netherlands	Initiated by ProRail, this co-creation project involves TNO, the Hague University of Applied Sciences and local authorities to develop a new solution to install solar panels on existing noise barriers along railway lines.
6	**MIT Plasma Science and Fusion Center (PSFC) and Commonwealth Fusion Systems (CFS) Fusion Technology project***	United States	This partnership between the MIT Plasma Science and Fusion Center (PSFC) and the spin-out Commonwealth Fusion Systems (CFS) aims at developing advanced superconducting magnets for fusion technology devices aimed at generating carbon-free electricity.
Green products, services and processes			

No.	Initiative name	Country	Short description
7	**SUSBINCO**	Finland	Co-creation project involving 18 partners (incl. businesses and public research institutions) to develop innovations to substitute fossil-based binders and coatings (i.e. materials used in various industries and applications to provide adhesion, protection and desired properties to surfaces) with bio-based solutions to use in packaging, paints, adhesives, sealants, and abrasives.
8	**Lorraine Smart Cities Living Lab**	France	Located in the Université de Lorraine, the living lab collaborates with local authorities/municipalities, companies, citizens and incubators to co-create user-centered solutions related to the green transition. For example, the lab has co-created new objects based on plastic waste.
9	**GreenCoLab**	Portugal	Initiated by the Centre of Marine Sciences and other five founding partners with the objective of bringing together researchers and businesses to drive innovation in the field of algae biotechnology (i.e. the application of biotechnological techniques to use algae for the production of valuable products or for environmental purposes).
10	**Low Carbon Eco-Innovatory (LCEI)**	United Kingdom	Initiated by Liverpool John Moores University, University of Liverpool and Lancaster University to co-create jointly with regional SMEs for the development of a wide variety of goods, processes and services that are environmentally-friendly (e.g. alternative packaging from naturally degradable materials such as starch, vegetable oil and seaweed).

Note: * For brevity, this initiative is referred to as “MIT-led fusion technology initiative” throughout the document.

2 Case study notes

2.1 Initiatives on green mobility

aspern.mobil LAB -Austria

Short description

The aspern.mobil LAB (AML) offers a collaborative space that universities, companies, citizens, and the government can access to co-develop innovative solutions for green and inclusive local mobility system. Located in the district of aspern Seestadt (Vienna), the AML provides a real-world test environment to pilot and optimise new solutions. The initiative aims to contribute to the development of a sustainable mobility culture locally and create a blueprint for transformation that can be applied in other locations.

This initiative prioritises co-creation with citizens using a diversity of tools, including design games, where citizens and researchers playfully develop new ideas and solutions to specific mobility challenges; do-it-yourself lab hours offered to citizens and other stakeholders to develop their own products and services with the support of lab researchers; and idea competitions, where citizens can propose new projects and the winning ones are then awarded implementation funding or prize money.

Established in 2014 by the Vienna University of Technology (TU Wien) and funded by the Austrian Ministry of Climate Action (BMK), the AML became one of the six Austrian Mobility Labs in 2017. The Austrian Mobility Labs are an initiative of the BMK within the framework of the Mobilität der Zukunft (MdZ) programme, which aims to increase the effectiveness and acceptance of research and innovation in green mobility.

Table 2.1. Main features

	Overview	Description
Timeline (Starting date, end date)	2014 - today (current funding runs from 2021 to 2026)	
Initiating organisation(s)	Vienna University of Technology (TU Wien)	Two researchers from TU Wien started working in setting up a mobility lab in 2014, after the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) opened its first funding call for Urban Mobility Labs. The AML proposal was selected to be one of the six labs supported by the BMK between 2017 and 2021; it has been granted follow-up funding between 2021 and 2026.
Size (number of participants)	Currently, 16 employees at the TU Vienna; 5 employees at partners institutions.21 ongoing projects, and 36 completed projects (as of November 2023). In total, AML has been involved in more than 100 research projects and is involved in exchanges with 3-4 start-ups.	
Types of actors involved	Universities (3 departments), think tank (1), private-public consortiums (2)	Professors and students from TU Wien (research unit Traffic System Planning, Artifact-based Computing and User Research and research unit Law) Citizens of aspern Seestadt, Vienna UrbanInnovation Vienna (a ThinkTank), Wien 3420 AG (joint venture of public and private entities) and Neighborhood Management aspern Seestadt (run as a consortium between Caritas, planning consultancy PlanSinn Planung und Kommunikation GmbH and in partnership with the sub-contractor abz*Austria)

Budget and funding sources	USD 2.14 million (EUR 2 million)	50% funding by the Ministry of Climate Action (BMK), 35% co-financing by TU Wien, 10% co-financing by Wien 3420 AG, 5% co-financed by other partners
Citizen engagement	A range of instruments have been implemented to engage citizens in the design, research and development of green mobility solutions, including games, do-it-yourself lab hours and idea competitions.	
Green innovation domain	Green urban mobility	AML can contribute to behavioural change by raising awareness and encouraging green mobility choices and actions that support climate protection. AML serves to develop strategic intelligence about citizens' green mobility choices that can inform policy within BMK.
Geographic scope (local /regional, urban/rural area)	Local / neighbourhood	Aspern Seestadt, Vienna

Key takeaways

- **Diverse innovative tools can support citizen engagement in developing green mobility solutions.** Examples include connecting students at TU Wien with citizens to develop prototypes for new green mobility solutions, establishing temporary pop-up labs in public spaces for citizen interaction, utilising games for co-creation, and organising idea competitions where citizens propose projects. These activities create diverse avenues for citizens to actively contribute to the co-creation process and provide insights for greener transportation systems.
- **AML embraces experimentation as a core component of its co-creation mechanisms**. One notable aspect is the integration of gamification in the research and development of innovative mobility solutions, which introduces playful elements into the co-creation process such as idea competitions or research mats (i.e. carpets with a representation of Aspern where citizens can explore urban mobility). This gamification aspect creates opportunities for new approaches to co-creation, enhancing engagement and creativity among participants.
- **A co-funding business model ensures the financial sustainability of the initiative and improves stakeholder commitment**. The initiative operates on a public-private funding model, with 50% of the funding coming from the Ministry of Climate Action, 35% from the Vienna University of Technology, 10% from Wien 3420 AG, and 5% co-financed by other partners. This co-funding approach enhances the university's sense of ownership and commitment to the initiative.
- **AML has established dedicated spaces for co-creation within the Aspern Seestadt neighbourhood**. This infrastructure serves as a means to encourage the active participation and collaboration of citizens, as well as generating interest in the initiative.

Co-creation dimension(s) of the initiative

- *Startup solution testing*: AML enables start-ups to test their mobility solutions in real-world urban environments in Vienna and receive feedback from users. AML also facilitates testing such solutions in other European locations, leveraging their international network. This iterative process fosters business growth and ensures that mobility solutions are tailored to the specific needs of the community.
- *Co-creation of green mobility solutions with citizens.* This is encouraged with the use of a range of tools, such as:
    - *Seestadt Design Game*: The game board, a representation of Seestadt Aspern, encourages players to communicate and learn from each other to decide on setting scenarios, answer research questions and find mobility solutions. The goal of the game is to explore micro-mobility and sharing transportation options in Aspern, but it could be adapted to other topics and scenarios.

- *Do-it-yourself lab hours*: Offers citizens and stakeholders lab hours to create their own products and services with the support of lab researchers.
- *Design thinking* (i.e. user-centred problem-solving method that prioritises iterative development to create innovative solutions): In the course "Design Thinking and Project: Media and Human-Centred Computing," students collaborated with Seestadt citizens to follow a typical design thinking process aimed at developing mobility research prototypes within the Smart City Seestadt context. These student projects resulted in tangible, interactive artifacts that showcased collaborative knowledge production and serve as pilot studies for advancing tools within AML.
- *Research Mat*: Mobile carpet with a scale image of aspern Seestadt, which creates a space for exchange and joint learning between citizens and the research community. Residents and project partners (incl. business, public administration and researchers) have used the mat to explore daily routes, points of interest, transport routes, hot spots and cold spots in the neighbourhood. It is also used to locate areas facing specific mobility challenges and jointly devise potential solutions.
- *Idea competitions:* AML organises workshops allowing citizens to propose new projects, helping researchers to identify and better understand local mobility challenges.
- *Pop-up lab:* Temporary labs set up in public spaces to encourage interactions with citizens. These labs provide access to the Seestadt Design Game and the Research Mat. The pop-up lab is accessible to everyone, and members of AML are available to answer questions, and facilitate discussions with citizens. The goal is to encourage citizens to reflect on their mobility practices and actively participate in discussions related to urban mobility and transportation solutions.

Actors involved

Table 2.2. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Government agency (AustriaTech, Agency of the Ministry for Climate Action – BMK)	Co-financer of the projecting	One of the key missions of the Agency is to support the development of innovative solutions to fight climate change. Since 2020, AustriaTech supported the creation of the "Cooperation and Exchange Platform of Mobility Labs Austria" with the aim of enhancing learning and synergies among Mobility Labs Austria. AustriaTech benefits from the network to achieve government's mission of supporting the development of climate change solutions.
University (Vienna University of Technology - TU Wien)	Project-co-lead and co-funder Three university research units involved: Traffic System Planning, Artifact-based Computing and User Research, and Law.	Researchers engage in the project with motivations including scientific interest and contributing to the green transition. They benefit from gaining insights into specific research landscapes in Austria and Europe, expanding their networks, and generating direct and indirect impact on societal transformation, innovation, and knowledge dissemination. University students benefit from engaging in hands-on projects. The university builds beneficial synergies between AML's activities and the university's teaching and research endeavors, for instance by gaining access to new data generated in AML, providing opportunities to students, and generating academic publications based on AML activities.
Thinktank (Urban Innovation Vienna, owned by the city of Vienna)	Project partner	Opportunity to gain insights into state-of-the-art projects within the sector of mobility, and to access technical infrastructures, tools, and data of AML. It also benefits from exchanges with local networks.

Large company (Wien 3420 aspern development AG)	Project partner	Opportunity for testing mobility solutions, as well as to access technical infrastructures, tools, and data of the lab. It also benefits from exchanges with local and international networks.
Intermediary (Neighbourhood Management aspern Seestadt)	Project partner	It acts as a bridge, facilitating the transfer of citizens' mobility-related concerns to AML and creating connections between citizens and the lab.

Policy context and main outcomes of the project

AML is part of the Austrian Mobility Labs – an initiative of the Austrian Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) within the framework of the Mobility of the Future (Mobilität der Zukunft - MdZ) programme, which aims to support research projects that address social challenges in transportation, promote sustainability, enhance accessibility, and stimulate innovation and international collaboration in the transport sector. The AML was established in a first exploratory phase in 2014 and became fully operational by 2017.

Table 2.3. Project outcomes

Type of outcome	Description
Technologies / innovations	Several sensors and other tools have been developed by AML (https://www.mobillab.wien/tools/): • Sensorbox: compact box equipped with sensors used to collect various environmental data combined with GPS coordinates. Citizens place the sensorbox in their surroundings to collect data on temperature and ambient noise transmitted to the AML's services every 20 minutes. • Vibro-Walk: device with a mobile sensor and microcontroller that measures CO2 levels and emits vibrations accordingly. More CO2 triggers stronger vibrations, making it easier to sense normally imperceptible environmental factors. The device also records the user's location for future online data display and analysis. • POCOBO (Air Pollution Data Collection Cycling Bottle): air quality sensor that citizens can build and install on their bicycles themselves. The sensor measures PM10, PM2.5, CO2, and volatile organic compounds and the data is used for public awareness and route planning, to combat air pollution and promote green mobility in cities. Data acquired with these sensor boxes and other tools are collected in the DataHub that is an open source for citizens, stakeholders, and service providers. The data is available on https://www.mobillab.wien/datahub
Skills	The university has gained structural knowledge on how to effectively operate a living lab. They also gained insights about residents' mobility patterns for advancing research in the field of mobility.
Organisational capabilities	AML has expanded capacities to effectively engage citizens, students and local businesses in innovation for sustainable mobility. It has developed specific tools and methodologies to do so.
Networks	Member of the Cooperation and Exchange Platform of Mobility Labs Austria, which organises 3-4 meetings a year, fostering learning and exchange between Mobility Labs in Austria Member of the network of the European Mobility Labs (EUML) community, which facilitates collaboration and knowledge exchange with mobility labs across Europe. Within Vienna, the project has facilitated networks like the Core Group Action Network Innovative Mobility Vienna (KAIM), enhancing local connectivity and collaboration among various stakeholders. The project has fostered a network of participating companies, keeping them informed about current topics and developments in the mobility and sustainability sectors, and proving them with opportunities to test their solutions through collaboration
Socioeconomic impacts	Design of mobility systems that are more responsive to people's needs. This outcome leads to improved transportation options and services that enhance accessibility, convenience, and overall quality of life for communities.
Green impacts	It contributes to altering community behaviour toward sustainability and climate protection, fostering environmentally conscious mobility choices and practices. It also contributes to creating a sustainable mobility culture that prioritises eco-friendly transportation options and practices, ultimately reducing environmental impact.

Further information:

- Project website: https://www.mobillab.wien/

HyMethShip – International

Short description

The international HyMethShip project – Hydrogen-Methanol Ship Propulsion System Using On-board Pre-combustion Carbon Capture – ran from 2018 to 2021. The initiative involved a consortium comprising 13 partners from six EU member states, including two universities, an engineering research institute, component and plant manufacturers, a shipyard, a shipping company, a classification society, which acted as a regulatory body that verifies the regulatory compliance of newly developed technologies, as well as scientific partners.

The project developed and tested an innovative approach to powering ships using renewable energy (hydrogen) and storing hydrogen on board with the aim of reducing CO2 emissions. The project also tested new approaches to enhance the energy efficiency of ships by combining a hydrogen-fuelled engine with methods to capture excess heat and carbon emissions on-board. The project responded to the growing pressure on the shipping industry to significantly reduce greenhouse gas emissions and the negative impacts of the sector on air and water pollution.

Table 2.4. Main features

	Overview	Description
Timeline (Starting date, end date)	2018 – 2021	
Initiating organisation(s)	Large Engines Competence Center (LEC)	It initiated the project idea and conceptualised, planned, and coordinated the project responding to a Horizon 2020 funding call.
Size (number of participants)	Consortium consists of 13 partners from 6 EU member states. On average about 40 – 50 people work on projects. A total of 18 students were involved in the project work (4 PhD students, 7 Master's students and 7 Bachelor's students).	
Types of actors involved	Two universities, a research center, component and plant manufacturers, a shipyard, a shipping company, a classification society and scientific partners	
Budget and funding sources	USD 9.9 million (EUR 9.3 million.)	EU research and innovation funding programme (Horizon 2020) provided USD 9.1 million (EUR 8.4 million). The rest was match-funding: not-for profit organisations received 100% FEC (full economic costing), industry partners received 70% FEC and offered a contribution of 30%.
Citizen engagement	A variety of mechanisms have been used to connect with citizens and stakeholders, including communication campaigns, stakeholder workshops, collaboration avenues, social media communication, and public consultations	
Green innovation domain	Green mobility (shipping sector) Energy efficiency	The project developed and tested an innovative approach to ship propulsion based entirely on renewable energy, developing a hydrogen-based combustion system to reduce the emissions of ships.
Geographic scope (local /regional, urban/rural area)	International partners in 6 EU countries: Austria, Belgium, Germany, Netherlands, Sweden and United Kingdom	

Key takeaways

- The recognition of researchers' social impact activities motivated their engagement in green transition co-creation. The universities' recognition of researchers' broader societal engagement and impact as reflected in promotion and tenure evaluations facilitated researcher engagement in the initiative.
- Close engagement of a regulatory body (a classification societies) from the project's inception contributed to better project outcomes. The classification society in the shipping industry issues

safety certificates. Collaborating with the ship classification society from early stages of the project facilitated regulatory approval for co-created outputs for their commercialisation.

- The signature of a non-disclosure agreement facilitated the co-creation between universities and companies. An initial agreement regarding intellectual property rights ownership was established. While universities retained the rights to publish materials and held copyrights, the IPR for the developed technologies were granted to the partners who created them and have the ability to commercialise them.. Others were permitted to utilise these technologies under licensing agreements.

Co-creation dimension(s) of the initiative

- *Joint research and technology development*: project partners (universities, research institutions, engine manufacturers, component suppliers, ship designers, shipyards, and a classification society) conducted research and experimentation together to develop and refine the hydrogen-methanol ship propulsion system. Most research was conducted at the LEC in Graz (Austria), but also at the facilities of other partners (e.g. Jenbach, Austria; Erfurt, Germany; Southampton, United Kingdom; and Gothenburg, Sweden). Regular monthly consortium meetings, attended by all project partners, were critical for the progress of joint research.
- *Involvement of PhD and university students*: A total of 18 students (4 PhD students, 7 Master's and 7 Bachelor's students) were involved in the project co-creation activities, allowing them to apply their knowledge practically, enhancing their understanding of sustainable practices and technologies. Senior researchers and professors provided guidance, mentorship, and supervision for students and junior researchers. PhD and Master's theses linked to the project activities were supervised by both academic and industry researchers.
- *Joint communication and dissemination activities*. Project partners also jointly organised workshops and dissemination events to share the project advancements, including 20 publications for the general public and 9 radio and television interviews.

Actors involved

Table 2.5. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Research institute (LEC - Large Engines Competence Center)	Initiating and leading actor Management and project administrator	LEC benefited from the opportunity to harness and highlight its research achievements, and provided a platform to demonstrate its capabilities. It also allowed establishing collaborative relationships with other project partners and stakeholders.
Universities (Chalmers University and Graz University)	Project partners involved in the analysis, simulation, and design processes for the HyMethShip technology	Participating in this project empowered universities to play an active role in the development and implementation of sustainable technologies, and fostered valuable collaborations with industry partners and stakeholders, facilitating knowledge exchange, interdisciplinary research, and innovation. It also enhanced the university's reputation as a leading hub for sustainable development and opened avenues for funding opportunities to further research and development in this area. Additionally, it equipped students with hands-on experience in real-world applied technology projects.
Other research institutes (Fraunhofer IKTS and SSPA)	Scientific partners engaged in the development of membranes, the design of the methanol-hydrogen steam reformer, and the creation of a case study vessel equipped with the HyMethShip systems onboard	Opportunity to collaborate with industrial partners, access real-world data and testing facilities, and contribute to technological advancements.

		They seized the opportunity to validate, publish, and disseminate their research findings, secure potential funding for further research, showcase their capabilities, and cultivate collaborative relationships with other project stakeholders. In doing so, they bolstered their reputation and network within the maritime industry and beyond, expanding their consultancy capabilities to assist marine industry clients in reducing energy consumption and emissions.
Large enterprises (Exmar Marine, INNIO Jenbacher, HOERBIGER Wien, MEYER Werft)	Four industry partners engaged in the project: a ship operator focusing on exploring technologies and solutions (Exmar Marine); an expert in engine technology (INNIO Jenbacher); a component supplier (HOERBIGER Wien); and a shipyard (MEYER Werft).	Opportunity to develop and gain access to cutting-edge technology and knowledge. They benefited from enhanced reputation, heightened market demand for sustainable vessels, and promising business opportunities in the rapidly expanding market for zero-emission shipping solutions.
SMEs (Colibri, MUW, Screentec, SE.S)	Three industry partners engaged in the development of the cooling system (Colibri), fabrication and supply of the methanol-hydrogen reformer for the technology demonstrator (MUW Screentec), design of an on-board carbon capture system and experimental validation on a small-scale prototype (SE.S)	Opportunity to showcase its specific competencies in a state-of-the-art application, receive feedback on their performance, and potentially secure future contacts or collaborations. They benefited from greater visibility, access to potential partners, and the opportunity to align their products with sustainable and innovative solutions
Classification society (Lloyd's Register)	Regulatory body responsible for identifying applicable maritime standards and requirements, performing hazard analysis and maritime compliance analysis to ensure safe integration, and operating the HyMethShip system	Lloyd's Register's participation in the project was driven by their commitment to upholding maritime shipping standards, ensuring safety and reliability, and championing sustainable practices within the industry. Their involvement provided them with insights into emerging technologies, regulatory requirements and green shipping. This active engagement allowed them to broaden their industry knowledge, bolster their reputation as a trusted authority in maritime matters, and paved the way for potential business opportunities related to certification and classification in future green shipping projects.
Port authority (HPA - Hamburg Port Authority – Flotte Hamburg)	Public agency responsible for the management, development, and maintenance of the Port of Hamburg fleet. HPA participated in the project's external expert advisory board and in the establishment of the Sustainable Shipping Technology Forum (LSSTF) as a partner of LEC.	They benefited from the creation of the LSSTF, which facilitates collaboration and knowledge sharing with other EU-funded projects in the field of sustainable shipping.

Policy context and main outcomes of the project

The HyMethShip project received funding from Horizon 2020, the European Union's research and innovation funding programme for the period 2014-2020.

The progress, impact, outcomes, and effectiveness of the HyMethShip project were monitored and evaluated by the European Executive Agency for Climate, Infrastructure and Environment (CINEA). This evaluation process included two reviews: a mid-term review and a final review upon project completion. These reviews encompassed both technical and financial assessments, which were concluded satisfactorily.

Table 2.6. Project outcomes

Type of outcome	Description
Technologies / innovations	The project successfully obtained two patents for an innovative membrane reactor design and developed six prototypes for various system components and demonstrations. These prototypes included the engine cylinder head and combustion chamber, hydrogen port, direct injection systems, membrane reactor housing, and a small-scale reformer prototype. Three consortium partners introduced innovations to their respective companies: an enhanced membrane manufacturing and quality control processes, and a large-scale system test bench.
Skills	Participants in the HyMethShip project have gained knowledge and skills to develop innovative products and prototypes in various system components.
Organisational capabilities	Partner organisations developed capabilities for effective collaboration in multidisciplinary teams. The project also provided partners the opportunity to leverage the knowledge and infrastructure of other organisations. To address potential challenges arising from this diversity, a dedicated individual with prior experience in multidisciplinary work was assigned the task of integrating outputs from different disciplines.
Networks	Inspired by positive collaboration with other EU-funded projects, LEC initiated the LEC Sustainable Shipping Technologies Forum (LSSTF) in partnership with the Hamburg Port Authority. LSSTF organised annual events alternating between Graz, Austria, and Hamburg, Germany, fostering pre-competitive collaborations and offering insights into ongoing research projects. The LSSTF community has grown to over 600 members worldwide.
Socioeconomic impacts	By promoting the development and implementation of new technologies and solutions, the project stimulated demand for a skilled workforce. The adoption of sustainable practices and technologies can lead to cost savings and increased competitiveness for businesses.
Green impacts	The HyMethShip system integrates multiple components, including a membrane reactor, a CO2 capture system, a storage system for CO2 and methanol, along with a hydrogen-fueled combustion engine, into a single system. This integrated approach significantly reduces CO2 emissions and increases energy efficiency of ships.

Further information:

- Project website: https://www.hymethship.com/index.html

2.2 Initiatives on green energy

Centre TERRE - Canada

Short description

Centre TERRE, abbreviation for Technologie des énergies renouvelables et rendement énergétique (Renewable Energy and Energy Efficiency Technologies), was created in 2019 by the Jonquière College and is one of the Technology Access Centres (TACs) of the National Natural Science and Engineering Research Council in Canada (CRSNG). The Centre reports to the Automated Production Center (CPA) at Jonquière College and co-creates about 200 projects with more than a hundred partners per year, including SMEs, business associations, and other universities, colleges, centres of technology, non-profit organisations, suppliers, citizens, and government to jointly develop and deploy innovations in the field of energy efficiency and digitalisation.

One of the main projects of the Centre focuses on co-creating sustainable energy solutions to respond to the needs of groups that are not served by the national electricity grid. In this project, Centre TERRE researchers carry out technical analyses, study suitable sustainable energy installations for sites isolated from the national grid (e.g. camping sites, cabins, forest chalets, etc), and work with site managers on funding applications and the deployment of solutions.

Table 2.7. Main features

	Overview	Description
Timeline (Starting date, end date)	2012-ongoing	
Initiating organisation(s)	Jonquière College (Canada)	Starting in 2008, Jonquière College has engaged in research and education within the field of renewable energy. In 2012 the Centre was created as an Industrial Research Chair of the Natural Sciences and Engineering Council of Canada (NSERC). TheAutomated Production Centre (CPA), created in 1984, evolved in 2019 into an NSERC-recognised Technology Access Centre, consolidating its mission in the community and securing financial support from both the Canadian and Quebec governments.
Size (number of participants)	15 - 20 full time core workers in the Centre. The Centre has engaged with 500 external organisations (SMEs and property owners) since 2019. It conducts about 200 projects per year with more than 100 partners	
Types of actors involved	SMEs, business associations, colleges, universities, non-profit organisations, suppliers, citizens, and government	
Budget and funding sources	A basic grant covers daily operations of the Centre, worth USD 74 000 (CAD 100 000) per year for 5 years. The Centre is actively engaged in securing other sources of funding. For each project, partners co-fund between 20% to 100% of total project costs.	Sources of funding include: • Basic grant (i.e., the Technology Access Centre Grant) from the National Natural Science and Engineering Research Council in Canada (CRSNG) to cover daily operations of the Centre worth USD 74 000 (CAD 100 000) per year for 5 years. • The Centre has raised more than 20 different types of funding, which are mainly provided by the Ecoleader and Eco-Performance programmes of the Quebec government or funds raised by the Federation of Quebec Outfitters (FPQ). • The College is contributing approx. USD 558 000 (CAD 750 000) to the new laboratory infrastructure project of the Centre, which will include multiple research buildings, thermal storage systems and three satellite sites, and which has secured governmental funding worth USD 12.64 million (CAD 17 million).
Citizen engagement	Citizens, including cabin and cottage owners in remote locations, actively participated in collaborative efforts with researchers by sharing insights into their energy consumption practices, providing valuable feedback on research reports, and assisting in the identification of specific equipment requirements to enhance energy efficiency. Furthermore, they played a crucial role in implementing the recommended changes as suggested by the researchers.	
Green innovation domain	Renewable energy Energy efficiency	

	Overview	Description
Geographic scope (local /regional, urban/rural area)	These projects are specifically directed towards rural areas across Canada	

Key takeaways

1. Synergies between the university's strategic goals and its engagement in co-creation increased the commitment of, and benefits to, the university. This includes enhanced opportunities for the university to showcase their impacts, increase students' enrolment due to improved reputation, enhance strategic networks with regional, provincial, national and international bodies, engage in knowledge dissemination and attract additional funding.
2. The Centre combines top-down and bottom-up approaches. The Centre has a portfolio of simultaneously running projects. The leadership team offers general direction and support for initial set up of the projects and the development of financial strategies; teams are then autonomous to conduct their projects within those general directions.
3. IPR provisions aim to ensure the Centre's projects serve both commercial and academic interests. When the Centre co-creates with commercial partners, IP rights are often retained by the commercial partners in return for their financial contribution. Yet, academics can publish materials by following a transparent process aimed at ensuring relevant research findings but not commercially sensitive material is released.
4. The initiative exemplifies partnering with underserved niche groups in the green innovation context. The Centre targets groups, such as outfitters, forest camps, cottages owners, and holiday homeowners, who are not served by the national electric grid to co-develop sustainable energy solutions.

Co-creation dimension(s) of the initiative

- *Collaboration with citizens and small business owners for green energy technology deployment:* Researchers from the Centre collaborate closely with citizens and business owners (e.g. cottage and forest camping owners) residing in areas that are not served by the national electricity grid. The collaborative effort involves property owners sharing their practices, providing valuable feedback on research reports, working hand-in-hand with researchers to identify the specific equipment needs for enhancing energy efficiency, and implementing the recommended changes. Additionally, the Centre operates an information hotline to assist citizens with their energy-related inquiries.
- *Collaboration with businesses in applied R&D:* The Centre provides technical assistance and R&D support to develop solutions for challenges faced by businesses, particularly in the sectors of aluminum smelters, agriculture, forestry, manufacturing, and tourism. These projects embody co-creation throughout the entire innovation process, spanning from the initial concept stage, through rigorous testing, to the ultimate development of innovative new products.

Actors involved

Table 2.8. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
University College (Jonquière College)	Leadership of the project	For the university, the project brings many benefits, including the revitalisation of training programmes and the continuous improvement of educational provision, an increase in student numbers and the enhancement of the university's reputation. It creates and fortifies partnership networks with regional, national, and international organisations. Individual academics' engagement in the Centre is incentivised by way of reduced teaching workload for academics engaged in the Centre, opportunities to generate publications and impacts, recognition of the contribution through awards, and in some instances, monetary rewards for engaging in centre work above their assigned workload.
Business association (Outfitters Business association, FPQ)	Partner of the project Engages in selecting of suitable partners in the outfitters sector and funding opportunities for co-creation projects.	Opportunity to access to technical expertise provided by the Centre and empower its members and the broader industry to effectively integrate sustainable energy sources in underserved regions.
Government (Regional Council for the Environment and Sustainable Development of Saguenay Lac-St-Jean)	Coordination of financial, administrative and dissemination activity	It benefits from the project by taking concrete actions in the fight against climate change.
Business association (Association of holiday homeowners)	Support and dissemination of projects to recruit cottage owners	The association benefits from improvements to the energy efficiency of the sector
Other university (Nordic Institute of Quebec)	Expertise support and venues for projects	The Nordic Institute of Quebec has cultivated novel research collaborations, expanded its network of partners, and actively engaged in co-creation projects.
SMEs (20 independent outfitters, who are not members of the FPQ and 5 forest camping site companies)	Co-creation collaborators for hospitality, input support, and progress tracking	They participate in collaborative projects aimed at enhancing their energy resilience, diminishing their reliance on fossil fuels, and cultivating more financially robust and environmentally-friendly operations to attract new clientele.
Citizens (30 cottages owners)	Co-creation collaborators for input support, and progress tracking	They increase their energy resilience by reducing their dependence on fuels

Policy context and main outcomes of the project

Centre TERRE is a Technology Access Center (TAC) of the National Natural Science and Engineering Research Council in Canada (CRSNG). Thes TACs are applied research and innovation centres, affiliated with a Canadian college, that provides companies and citizens with access to cutting-edge technology and equipment, and the expertise of multi-disciplinary teams. CRSNG offers a basic grant (the Technology Access Centre Grant) to cover daily operations of the centre worth USD 100 000 a year for 5 years.

Table 2.9. Project outcomes

Type of outcome	Description
Technologies / innovations	Solar, wind and tidal turbine technologies for application in specific sites.
Skills	Academics enhance their knowledge and understanding of the needs and challenges faced by energy users in isolated areas, students obtain training and work experience, and outfitters obtain knowledge and training on best practices to increase their energy efficiency.
Organisational capabilities	A new laboratory is currently at the planning and specification phase. This laboratory will provide the Centre with additional infrastructure and research capabilities, through the construction of new research facilities, provisions of new forms of renewable energy, thermal and electrical storage systems, an experimental microgrid and three satellite sites. Additionally, the laboratory could be used for teaching, research and dissemination activities benefiting the college. Participating business partners develop greater energy autonomy and increase their capabilities to collaborate with other actors.
Networks	Partners (incl. SMEs, governmental and business associations, society, and universities) engage in multisectoral and multidisciplinary co-creation teams, contributing to expanding their networks. The dissemination and sharing of acquired expertise has made it possible to establish international partnerships.
Socioeconomic impacts	The income generated by the Centre has led to the creation of new positions and opportunities for researchers. The project also provides sustainable energy solutions to isolated sites in Quebec, not served by the national electricity grid. These energy savings support the economic viability of businesses located in remote areas.
Green impacts	Diffusion of green energy technologies for enhancing energy efficiency and limiting the utilization of fossil fuels.

Further information:

- Project website: https://www.cegepjonquiere.ca/centre-terre-1.html
- News article about Centre TERRE's new laboratory: https://www.lequotidien.com/2022/06/21/le-centre-terre-du-cegep-de-jonquiere-aura-un-nouvel-espace-7145b3ae413dbd8a17d258a6dd3104c5/#Echobox=1655854612
- Facebook profile: https://www.facebook.com/centreTERREcegepJonquiere/

GreenLab - Denmark

Short description

GreenLab is a green and circular energy park, a technology enabler and a national research facility in Spøttrup (Denmark). It aims at accelerating research and innovation in the field of green energy generation, storage and sharing. GreenLab offers a testing ground for Denmark's technical universities and industry partners to co-create such sustainable energy solutions. The technologies developed and scaled up on its platform are a proof of concept with potential for commercialisation in national and global markets. New companies selected to be hosted in the park must have an energy profile, have a green purpose, and the desire to contribute to the industrial park through collaboration, data sharing and other mechanisms.

Examples of specific projects include the EnergyRocks project, which aims at finding ways to turn extra wind electricity into heat stored in rocks, making heat storage more eco-friendly; the Molten Salt project, which tests if salt can be used as thermal storage that can power a steam generation system; and the GreenLab Designer Lite, a project aimed at developing and demonstrating a tool to design efficient energy systems for green industrial parks.

Table 2.10. Main features

	Overview	Description
Timeline (Starting date, end date)	December 2012 - ongoing	
Initiating organisation(s)	Skive Municipality, The Climate Foundation Skive, Spar Vest Fonden, and Norlys	The idea of GreenLab was firstly designed by the Skive municipality and carried out by the Climate Foundation Skive as a separate entity (foundation), which established and transferred the project to a limited liability company, GreenLab Skive A/S, which later has been capitalised and now is a commercial company with predominantly equity-based funding.
Size (number of participants)	About 112 individuals	27 employees in GreenLab LLP, 55 full-time equivalent (FTE) employees in the industrial park, 30 R&D participants
Types of actors involved	Public and private actors, mainly companies and universities	
Budget and funding sources	Initial equity funding of USD 11 million (DKK 75 million) in 2019 from a municipal fund (1/3), a local development fund (1/3) and a regional energy company (1/3) to set up the GreenLab. More public and private funding has been provided to support different projects.	Further scale-up funding includes: • USD 11.5 million (DKK 80 million) granted by the Danish Energy Agency (DEA) and USD 32.6 million (EUR 30 million) grant from the EU Horizon 2020 programme to fund Power-to-X projects. • Private equity funding from local industrial partners and farmers of about USD 205.2 million (EUR 187 million) [as of November 2023]. • USD 2.9 million (EUR 2.7 million) contributions by The Villum Foundation to fund mission-driven research fellowships.
Citizen engagement	Citizen engagement is mostly at the level of awareness raising of the social benefits generated by the GreenLab through workshops and social engagement events (e.g., Annual GreenLab Summit, Annual Open House, newsletters, site tours, social media communications)	
Green innovation domain	Green energy	Green energy generation, storage and sharing, eco-industrial clusters, industrial symbioses, circular and integrated energy.
Geographic scope (local /regional, urban/rural area)	Local / regional	The GreenLab is located in a rural area characterised by agriculture, fishing and industry, and where renewable energy sources are available. The model has potential to be replicated in other regions.

Key takeaways

1. **The cooperative model of funding adopted by the GreenLab has enhanced local commitment and engagement and allowed project scaling.** An equity fund worth USD 11 million was initially created from three parties, a municipal fund, a local development fund and a regional energy company, to establish the science park. GreenLab has since established a project funding model based on funding from public sources (i.e., the Danish Energy Agency (DEA) and EU Horizon 2020 programme) as well as private equity funding from local industrial partners and farmers of about USD 205.2 million (EUR 187 million) [as of November 2023]. Founders have different percentages of equity of the companies located in the industrial park. Private companies invest on the opportunities they receive to co-create and co-develop in the industrial park with different types of companies and universities.
2. **Multi-disciplinarity is an important feature of GreenLab collaborations.** The GreenLab brings together experts from various fields, including thermal heat, water systems, electrolysis, power systems, and digitalisation, to foster a holistic approach towards mission-driven research. This cross-sector and cross-functional collaboration is crucial for scaling up initiatives.
3. **The initiative illustrates the importance of geographical proximity and how to engage the local community for green co-creation.** Having different partners located within the same cluster has facilitated enhanced communication, fostered a shared understanding among diverse actors, and simplified the resolution of any potential miscommunications or misunderstandings. Efforts to engage the local community have been put in place to achieve these inclusive outcomes.
4. **The GreenLab Academy offers opportunities for skill development to support green innovation.** GreenLab collaborates with higher education institutions as well as commercial partners in the GreenLab Academy, which offers opportunities for skills development due to unique infrastructure and partners of the GreenLab around green energy and hybrid solutions.

Co-creation dimension(s) of the initiative

- *Joint research and innovation projects*: Based on the explored potential for collaboration, university researchers and companies together apply for mission driven research funding from the GreenLab. The decisions on these applications are made in four weeks and the team is offered one year to complete the project. While the project is undergoing, the GreenLab prepares necessary elements for commercialisation, thus increasing the speed of research to market.
- *Research fellowships*: GreenLab runs theme-based research fellowships with VILLUM Fonden – a philanthropic foundation that supports technical and scientific research in Denmark and abroad –, the Technical University of Denmark (DTU) and Aarhus University (AU) that address specific challenges related to the interplay between the agricultural and energy sectors, production of green fuels and sustainability initiatives in agricultural production, and attracts specialists and researchers from around the world.
- *Experimentation in the regulatory test zone*: As an officially designated regulatory test zone, GreenLab enjoys exemptions from electricity regulations, creating a unique environment in which researchers and companies can work together to test and scale new technologies without being hindered by typical regulatory constraints. For example, the SymbiosisNet system, a smart grid solution that allows companies to share their surplus energy with other companies operating in the industrial park, offers potential for experimentation in energy sharing, storage and reuse.

Actors involved

Table 2.11. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Public institutions (Skive Municipality)	Co-owner and co-developer, the municipality drafted the concept and vision of the project.	As a co-owner and local authority, it has been a key player in creating local green growth and facilitating the establishment of the green industrial park, with a potential expansion of 70 hectares and more.
Private Energy Company (Norlys A.M.B.A)	Majority owner and co-developer	Accelerate the development of green energy solutions.
Private funds (The Climate Foundation Skive and Spar Vest Fonden)	Co-owner and co-developer	Accelerate the development of green energy solutions and create local green growth.
Government agency (Danish Energy Agency)	It designated GreenLab as an official regulatory energy test zone, giving GreenLab dispensation from electricity regulations for 10 years. It also provides support for thePower-to-X project (12MW) (i.e. projects that transform green energy from the wind and sun into other forms of energy stored for use as sustainable fuels for heavy transport and process industries)	Accelerate the development of green energy solutions by facilitating experimentation with new technologies, and proposing new regulations to permit replication.
Universities (Danish Technical University, Aarhus University, Aalborg University, and Southern University of Denmark)	Partners on research projects and innovation activities	Opportunity to conduct research to respond to real-life challenges, turning theory into practice. Opportunities to work with businesses on technical topics relevant to the universities' strategies. Individual researchers also improve their reputation working with the GreenLab and access to industrial infrastructures. Interdisciplinary engagement in green and circular economy projects has also resulted in developing a wide array of expertise.
Private companies (Quantafuel, Stiesdal, GreenLab Skive Biogas, Vestjyllands Andel's Starfish factory, Nomi4s - waste facility)	Companies located in the park	Opportunity to produce circular energy and supply of renewable energy or production, as well as the opportunity to share and utilise excess energy resources and explore their own green innovation concepts. This leads to a lower cost of CO2 neutral production for companies involved.
Private wind and solar energy developer (Eurowind Energy)	Establishment of GreenLab Skive Vind (54MW wind and 26MW solar energy that go into the lab), provides consultation and expertise	Experience with innovative energy projects (Power-to-X), collaboration with firms in the cluster, and new integrated models for future replication.

Policy context and main outcomes of the project

The idea of GreenLab was initiated by Skive Municipality and carried out by the Climate Foundation Skive as a separate entity (foundation), which established and transferred the project to a limited liability company, GreenLab Skive A/S, and later developed into a commercial company.

The GreenLab project receives support from local authorities, regulatory agencies, governmental programmes and initiatives, as well as international funds. Supporting organisations include the Danish Energy Agency, Horizon 2020, the EU project Circular Industrial Symbioparks Scandinavia (CISKA), and the philanthropic foundation Villum Foundation.

Table 2.12. Project outcomes

Type of outcome	Description
Technologies / innovations	The GreenLab has created multiple innovation in the field of energy sharing and storage: • SymbiosisNet: an intelligent network of data and energy allowing companies to share their excess resources. • MECO: a software system collecting data and tracking resource streams to optimise energy usage. • Power-to-X: project to transform green energy from the wind and sun into other forms of energy stored for use as sustainable fuels for heavy transport and process industries. In 2023, GreenLab will host one of the world's first and largest commercial Power-to-X facilities, slated to achieve 12MW energy production capacity by the same year. In the subsequent year, construction will commence on another 100MW energy production facility. • Other research projects focused on heat and energy storage in molten salt and stone beds.
Skills	Development of specific expertise and skills to deal with the development of Power-to-X projects, including water usage and on how to distribute excess heat for local benefits.
Organisational capabilities	Capabilities in managing a green and circular industrial cluster model.
Networks	GreenLab Research Community is a connecting platform for researchers and companies who want to contribute to green innovation, proving a space to share progress, challenges, and results. GreenLab Summit is an annual conference where GreenLab partners can exchange ideas and learn from each other's projects.
Socioeconomic impacts	Creation of new full-time positions (approximately 100), contracts for local companies. Business tourism of an average of 1.000 stays at local hotels. GreenLab has attracted R&D activities related to green energy themes to the Skive municipality.
Green impacts	Development of green energy solutions, eco-industrial partnership, circular, and integrated energy systems. Development of an intelligent network of energy and data that allows companies to share their excess of energetic resources, and establishment of a bankable model for global sites to adapt to their own use.

Further information:

- Project website: www.greenlab.dk
- The Climate Foundation Skive website, co-owner and co-developer of the initiative: https://www.klimafondenskive.dk/en/
- Short branding video, GreenLab in a nutshell: https://www.youtube.com/watch?v=RYrfOZxQ2Q0
- For more details about the GreenLab research platform: https://www.youtube.com/watch?v=nerAqEnigfs

NEWRAIL – the Netherlands

Short description

NEWRAIL (Noise Energy Wall Rail America in Limburg) is an initiative led by ProRail in collaboration with TNO (Netherlands Organisation for Applied Scientific Research), the energy cooperative Reindonk Energie, and the Hague University of Applied Sciences. This co-creation project involves the installation of solar panels on existing and new sound barriers along railway lines (i.e. structures designed to protect residents from noise pollution). The project's objectives include developing knowledge and gaining hands-on experience of the technical possibilities and associated risks of solar panel installation.

Installing these solar panels requires thorough research to determine the most effective and safe construction, installation methods, and monitoring approach. As a result, the project partners have collaboratively designed the construction and installation method. The prototype of the total set-up includes solar panels and fixation to the noise barriers is currently in the assembling phase. In addition to this, the project actively engages in consultations with citizens and local energy cooperatives to gather their insights about the design, installation and operation. This project is expected to support the use of the country's scarce available space in an optimal way to produce sustainable energy.

Table 2.13. Main features

	Overview	Description
Timeline (Starting date, end date)	February 2020 – December 2024	
Initiating organisation(s)	ProRail, TNO, The Hague University of Applied science, Reindonk Energie & Co	
Size (number of participants)	4 organisations – 20 people involved	
Types of actors involved	State owned rail infrastructure organisation, Innovation centre, University and Local energy cooperation	
Budget and funding sources	Total funding of about USD 1.28 million (EUR 1.2 million)	It includes three sources of funding: • USD 857 000 (EUR 800 000) by ProRail, a state-owned infrastructure organisation; • USD 429 000 (EUR 400 000) of subsidy programme from the Ministry of Economic Affairs and Climate Change for innovations; • The university is responsible for providing a 20% matching fund for the portion of the subsidy allocated to them.
Citizen engagement	Since the sound barriers had the potential to impact the local community, who had expressed disapproval in the past, citizen engagement was deemed crucial. Citizen engaged through meetings with the village council and a survey to gather insights and feedback from the community, ensuring their concerns and preferences were taken into account in the project's decision-making process.	
Green innovation domain	Integration of renewable energy in the build environment	The rapid growth of solar energy and the imperative to maximise the utilisation of limited space have driven the integration of solar panels into noise barriers. These barriers are typically positioned in urban environments, where the generated energy is in high demand. This localised energy production reduces the need for extensive transportation of energy
Geographic scope (local /regional, urban/rural area)	Local implementation in urban and rural areas	Demonstration site close tothe town of Dronten. The objective is to expand their implementation in other urban areas where noise barriers are placed along railways.

Key takeaways

1. **Multi-disciplinary skills spanning the social and hard sciences facilitated multidisciplinary engagement.** This co-creation project spanned various disciplines, including engineering, economics, law, governance, and management. Different university departments actively participated in the project and maintained regular interactions with the co-creation team, bolstering the culture of multidisciplinary co-creation.
2. **University-industry collaboration was crucial across the full product's lifecycle.** Co-creation predominantly occurred during the design phase of the solar panel prototype for installation on noise barriers. ProRail subsequently outsourced the prototype's manufacturing. However, ProRail encountered challenges in transitioning from the initial prototype to the final product as research inputs proved also necessary during the manufacturing phase.
3. **The university served as a neutral mediator when engaging with citizens about adoption.** Initial efforts to instal solar panels in the America region of the Netherlands failed as the local community did not approve of their installation. Consequently, community acceptance was a priority for the project. The university acted as a neutral mediator, and facilitated exchanges between the project team and the community by organising meetings and conducting surveys to gather insights.

Co-creation dimension(s) of the initiative

- *Citizen consultation*: ProRail, The Hague University of Applied Science, and the applied scientific research organisation TNO, in collaboration with the local energy cooperative Reindonk Energy & Co, investigated how the presence of solar panels on noise barriers impact public acceptance of these structures. Moreover, they explored the feasibility of community ownership of these panels instead of ownership by a large energy company. The project dedicated efforts to examine methods for involving citizens in the design and operation of solar panels and noise barriers. The ultimate goal was to ensure that these interventions were acceptable to all parties involved.
- *Collaborative research:* ProRail, The Hague University of Applied Science, and the applied scientific research organisation TNO co-created the design specification of the solar power mounting system on noise barriers along railways. They will also monitor the performance of the system such as the energy, degradation of the solar panels and their impact on noise reduction.

Actors involved

Table 2.14. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
State-owned and state-funded rail infrastructure company. Part of the Ministry of Infrastructure (ProRail)	The initiation actor, which also served as the lead partner, took on the role of contracting the system	ProRail benefits from the project as it owns 500 km of noise barriers with a potential of generating 20- 30 GHh/y of solar energy.
Innovation center (TNO - Organisation for Applied Scientific Research)	Responsible for the design and development of the innovative solar panel mounting system on noise barriers and the subsequent monitoring of the system's performance	TNO benefits from the project for the opportunity to develop innovative construction and monitoring methods for solar panel systems.

University (Hague University of Applied Science)	Expertise on social and engineering sciences to conduct research on the solar system's integration with the electrical grid, the community participation from neighbouring villages or districts, and monitoring the system's performance	The NewRail project provides the opportunity to obtain additional funding that serve as a vital financial source of income for the research groups. Consequently, the Center encourages researchers to actively participate in these projects.
Local energy cooperative (Reindonk Energy & Co in the municipal Horst aan de Maas)	Advisor with experience in dealing with the community	Reindonk was initially selected as the local energy cooperative in the municipal Horst aan de Maas, the location of the original project. It was the intended owner of this installation motivated to benefit the community it serves. After the change of location, due to citizens' disapproval, they remained involved in the project assessing socio-economic demand in a specific location.
Citizens	Participants in the design phase of the project	Recognising that residents are the primary beneficiaries of the infrastructures, the core team highly values their input and strives to integrate their preferences into the project's final outcomes.

Policy context and main outcomes of the project

ProRail, a wholly state-owned company funded by the State, operates within the Ministry of Infrastructure, which allocated EUR 800 000 to the project. ProRail received a subsidy of EUR 400 000 through a competitive tender process from the Ministry of Economic Affairs and Climate.

Table 2.15. Project outcomes

Type of outcome	Description
Technologies / innovations	New solar panel modular mounting system for sound barriers.
Skills	Skill development of university students, who engaged in the project, supported the activity of academics, and gain hands-on work experience.
Organisational capabilities	The project provided the opportunity to expand the capabilities of the state-owned rail infrastructure organisation, traditionally focused on the management of existing infrastructure rather than actively engaging in innovative endeavours. It also enhanced the collaboration and co-creation capabilities of firms less accustomed to partnering with state-owned entities.
Networks	New networks for future (practical) research and collaboration on energy transition and development of solar energy.
Socioeconomic impacts	
Green impacts	Generation of 20- 30 GHh/y of solar energy along 500 km of noise barriers (ongoing installation)
Other (please specify)	Direct engagement of citizens in the design of the project to explore their preferences and opinions. It lead to a significant change of the original plan.

Further information:

- Project website: https://www.thuas.com/research/centre-expertise/newrail

MIT-led fusion technology initiative– United States

Short description

The MIT Plasma Science and Fusion Center (PSFC) at the Massachusetts Institute of Technology collaborates with Commonwealth Fusion Systems (CFS) – a private spin-off from PSFC – as well as several US National Labs, academic institutions, startups, and large companies to develop new high-temperature superconducting magnets for use in fusion devices.1 Currently, the PSFC and CFS are jointly developing SPARC, a prototype fusion device that capitalises on cutting-edge magnet and materials technology.

This initiative serves as a precursor to the development of ARC, a scalable fusion power plant with the goal of being ready for implementation by 2030. The initiative leverages the ecosystem of the MIT Energy Initiative's (MITEI) – a hub dedicated to energy research, education, and outreach – including MIT faculty, students, and other MITEI industry members, and is supported by industry investors in breakthrough energy technologies.

Activities to stimulate co-creation at the centre include seminars where experts and academics from different institutions, including other universities, government and industry, share their perspectives on the progress of fusion technologies; a hackathon where PSFC invited students to use data science to solve challenges in the development of fusion energy; and collaborative research projects that combine the capabilities of the university with those of companies.

Table 2.16. Main features

	Overview	Description
Timeline (Starting date, end date)	2018-2025	
Initiating organisation(s)	MIT Plasma Science and Fusion Center (PSFC), and its spinout named Commonwealth Fusion Systems (CFS)	
Size (number of participants)	number of employees: 150 PSFC, 450 CFS	
Types of actors involved	Academic Institution, Private Sector	
Budget and funding sources	Sponsored research agreements and private investments	Two sources of income: • USD 12 million annually via PSFC's sponsored research agreement. This is funded by the consortium of industry members of PSFC, who commit to contribute a specific amount per year to MIT to spend on research that aligns with their strategic goals and their business development activities. • About USD 1.8 billion via CFS private investment
Citizen engagement	Awareness raising and acceptance	Since the work is highly technological-oriented, co-creation with citizens was not feasible. Yet, having their acceptance was crucial. The University's social science departments conducted research into public attitudes towards renewable and other low-carbon energy sources, and organised awareness-raising events to ensure that the public recognises the value of fusion reactors, accepts them as a safe alternative and appreciates the low-carbon nature of the technology.
Green innovation domain	Green energy	The project contributes to the green transition by developing fusion technology as a sustainable and clean energy source. Fusion has the potential to significantly reduce carbon emissions and reliance on fossil fuels, which is a critical step in mitigating climate change.
Geographic scope (local /regional, urban/rural area)	Regional collaboration, global reach	

[1] Magnets are crucial to create the powerful magnetic fields required to contain and stabilise the high-temperature plasma, enabling the fusion process to occur. This is an important milestone on the path towards developing economically viable fusion power plants to generate carbon-free fusion energy

Key takeaways

1. **The transformation of CFS into a spin-out company, while maintaining a close collaboration with PSFC, has helped scale the activity**. Establishing CFS as a spin-out entity facilitated the attraction of equity-based investors and harnessed the inherent flexibility of a spin-out for accelerated development, ultimately leading towards commercialisation. Furthermore, having the support of large corporations capable of rapidly scaling up research efforts has proven instrumental in achieving results. As a university spin-out, CFS continues to enjoy access to PSFC's state-of-the-art laboratories, a skilled workforce, and financial backing. Consequently, the spin-out model emerges as a strong organisational structure for streamlining the scaled-up development of mid-TRL technologies originating from the university.
2. **The funding model - a blend of membership and equity-based investments - has made the project financially self-sustainable**. While the early stages of fusion energy development were funded by the government, with the establishment of CFS as a spin-out, two funding pathways are used. Firstly, a consortium of industry members associated with PSFC, offering specific membership contributions, redirected their support towards CFS. These member companies commit to an annual contribution to MIT to spend on research aligned with their strategic objectives and business development activities. Secondly, companies that directly invest in CFS on an equity basis also funded the project.
3. **An additional motivation for companies to invest has been the opportunity to develop skills and participate in knowledge exchange**. The MIT Energy Initiative Agreement has provided opportunities for researchers from industry to join MIT and participate in the research activities. Students at MIT have also been given the opportunity to develop unique skills relevant to industry by engaging with the project.
4. **Considering the nascent nature of the fusion industry, CFS generated flexible collaborative agreements with industry**. Since the fusion energy field is still emerging, it is not possible to offer and agree on concrete deliverables when companies make investments. The cooperation agreements are therefore flexible and it is important to find a group of companies willing to make a speculative and long-term commitment to the programmed activities. While the long-term objective remained unchanged, short-term goals are changed with the development of the technology. Once a specific technology is developed, MIT retains the patent and has an obligation to licence technology to the industry party that is most likely to successfully commercialise.

Co-creation dimension(s) of the initiative

- *Research collaboration:* The primary co-creation activity involves collaboration between scientists and engineers from the MIT Plasma Science and Fusion Center (PSFC) and Commonwealth Fusion Systems (CFS). This collaboration includes joint research and development efforts aimed at advancing fusion technology. In addition to academic collaboration, with a strong emphasis on working closely with industry researchers.
- *Hackathon with students*: the initiative organised a hackathon inviting students and researchers to apply machine learning techniques to help solve challenges in fusion research at the Centre.

Actors involved

Table 2.17. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
University (MIT Plasma Science and Fusion Centre, PSFC)	Research partner providing research expertise and facilities. The technology transfer office, MIT Technology Licensing Office, is responsible for designing the agreements and licensing between the university and the private sector	For individual researchers, the Centre offers a gateway to pursue projects of personal interest, unrestricted by public funding constraints. It grants access to laboratory facilities and fosters collaborative opportunities that extend beyond the conventional confines of academia.
Private company (Commonwealth Fusion Systems, CFS – which is a spin-out of MIT PSFC)	Research partner. The launch of the company is the result of private investments raised through the connections established within PSFC for the development of the prototype fusion device SPARC and the scalable fusion power plant ARC.	CFS also benefits from the ecosystem fostered by the MIT Energy Initiative (MITEI) including access to MIT faculty, students, and other industry members associated with MITEI.
A portfolio of companies (the consortium of industry member of PSFC and companies that directly invest on CFS on equity basis)	Investment and company researchers working with university researchers	Two primary factors attracting industry contributions to the project are: • the CFS's access to resources, such as laboratory facilities and highly skilled human resources, which render it a more cost-effective option for companies compared to conducting in-house research; • the crisis facing energy companies encourages them to engage in alternative ventures that may lead to innovation within their current business operations.

Policy context and main outcomes of the project

Commonwealth Fusion Systems (CFS) is supported by the United States Department of Energy (DOE) Milestone-based Fusion energy development programme, designed to solidify the US leadership in commercial fusion energy. Moreover, the DOE Fusion Energy Science (DOE-FES) and the Advanced Research Projects Agency-Energy (ARPA-E), which support fusion science and technology, have provided public funding indirectly to the programme.

Table 2.18. Project outcomes

Type of outcome	Description
Technologies / innovations	REBCO (Rare-earth barium copper oxide) high-field magnets for fusion devices. REBCO compounds exhibit high-temperature superconductivity with stronger magnetic fields than other materials.
Skills	Learning and skills development have remained the central focus throughout the entire process, from skills in the development of high-temperature superconducting magnets to the establishment of companies, the creation of technologies for SPARC, and the construction of a commercial fusion device. CFS is collaborating with the PSFC to initiate a workforce development programme, with an assessment of the current vocational landscape slated to commence in 2024.
Organisational capabilities	Universities develop capacities in multidisciplinary collaborations outside of traditional academic silos and increase projects impacts. Companies and business partners gain access to laboratory facilities and get the opportunity to develop new products.
Networks	PSFC and CFS set up an ecosystem to tackle the challenges in developing green energy technologies. The ecosystem has created a collaborative environment where investors, major industry players, PSFC, and CFS unite their efforts to advance in this technology area.
Socioeconomic impacts	Since its establishment in 2018, CFS has already hired over 600 people.
Green impacts	Research and development of technologies for green energy generation and diffusion.
Societal engagement	

Further information:

- Project website: https://www.psfc.mit.edu/research

2.3 Initiatives on green products, services and processes

SUSBINCO project- Finland

Short description

SUSBINCO (Sustainable Binders and Coatings) is a collaborative research initiative with 18 partners, including industrial and research organisations. Co-funded by industry and Business Finland, a national innovation funding agency, its goal is to develop innovative bio-based alternatives to fossil-based binders and coatings, essential materials in various industries. These eco-friendly solutions can be applied in packaging, paints, adhesives, sealants, and abrasives, contributing to sustainability efforts and reducing reliance on fossil fuels.

SUSBINCO, led by Åbo Akademi University's Laboratory of Natural Materials Technology and coordinated by CLIC Innovation Ltd, sets its research focus through a method that involves identifying industry challenges, gathering input from companies in evaluation workshops, and fostering company engagement in project development. SUSBINCO places a special focus on mid-sized, growth- and export-oriented firms with limited resources and R&D capacities.

Examples of activities include projects aimed at preparing raw materials and the development of bio-based ingredients to produce the final products; exploring the potential uses of materials and processes without toxic chemicals; and testing and evaluating the environmental impact and the end-of-life and safety aspects of new materials developed in the project.

Table 2.19. Main features

	Overview	Description
Timeline (Starting date, end date)	2021-2024	
Initiating organisation(s)	CLIC Innovation Ltd Laboratory of Natural Materials Technology, Åbo Akademi University	CLIC Innovation Ltd, is a non-profit intermediary that operates on a public-private partnership model. It brings together prominent international companies, universities and Finnish research organisations in the fields of forest and bio-economy industries, energy sector, chemical and process industries, machinery and some equipment manufacturers. The purpose of CLIC is to build and manage open innovation collaboration to create sustainable solutions and address the systemic challenges arising from the scarcity of natural resources.
Size (number of participants)	About 100 individuals from 18 organisations have participated in the initiative since its inception (2021)	
Types of actors involved	Universities, research institutes, large companies, SMEs, government funding agency, and non-profit intermediary (i.e. organisation that facilitates collaboration and communication between different stakeholders)	
Budget and funding sources	USD 11.24 million (EUR 10.45 million)	There is a public-private co-funding model. Business Finland offers co-funding for projects, covering 50% of the costs of business and 70% of the costs of universities.
Citizen engagement	No specific citizen engagement activities are conducted	
Green innovation domain	Sustainable packaging and bio-based chemicals	The main objective of the initiative is to enable 80 – 100 % bio-based content in the developed binders and coatings. The project tests and evaluates environmental impacts, end-of-life and safety issues of the new materials and products in packaging product demos.
Geographic scope (local /regional, urban/rural area)	National project, with global market impact	

Key takeaways

1. **The project addresses potential tensions between industry preferences for confidentiality and university interest in the dissemination of results upfront**. Business Finland funding requires dissemination of results, so companies are aware of this requirement from the beginning. Before any publication is submitted, there is a collaborative review process to allow companies to suggest amendments, maintaining confidentiality prior to the dissemination of results.
2. **A co-funding model ensures wider projects scale and the engagement of partners.** Public funds provide only for a share of the project costs, requiring participating institutions to provide their own funding to complement. This not only allows the SUBINCO initiative to undertake more projects, but also ensures participating partners engage.
3. **Involving companies in identifying and shaping the research agenda strengthens industry engagement.** This proactive engagement allows research initiatives to align closely with industry needs. This, in turn, supports the development of solutions that effectively address practical industry issues.

Co-creation dimension(s) of the initiative

- *Joint project identification between universities and industry*: SUSBINCO defines its thematic objectives and research topics through a process they call "Project Booster". This process begins by identifying and defining research topics based on industry challenges. To ensure relevance and practicality of projects, SUSBINCO organises evaluation workshops where companies express their needs which will later shape the research agenda. During the Project Booster process companies also participate in workshops and one-to-one company meetings to discuss their interests, project development plans, and to contribute to project preparation.
- *Collaborative research between universities and industry:* Following the pitch event, companies selected and commit to work with researchers to co-create project proposals. The proposals are then jointly implemented by companies and university researchers to co-develop technologies and innovative solutions for sustainable binders and coatings.

Actors involved

Table 2.20. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Universities (Åbo Akademi University, University of Oulu, University of Eastern Finland, Lappeenranta-Lahti University of Technology, Tampere University)	Project leader and research partners	The scope of the project is in line with the strategic focus of universities and research institutes. For individual researchers, the project provides external funding for their research team, enabling them to recruit more team members, pursue further academic careers and publish more. In addition, the project provides an opportunity to translate innovation into potential business and to be involved in projects focused on the transition to the bio-economy.
Intermediary institute (CLIC Innovation)	Project management, communications and coordination	As an open innovation intermediary, its main mission is facilitating the creation of breakthrough solutions, and to build and manage open innovation collaboration between companies, academia and other relevant stakeholders in bioeconomy, energy and circular economy themes.

Universities (members of CLIC: Åbo Akademi University, University of Oulu,University of Eastern Finland, Lappeenranta-Lahti University of Technology, Tampere University)	Research partners	As the project is funded by Business Finland, 70% of the costs are covered, which attracts additional funding to the university. The scope of the project is in line with the strategic focus of universities and research institutes. For individual researchers, the project provides external funding for their research team, enabling them to recruit more team members, pursue further academic careers and publish more. In addition, the project provides an opportunity to translate innovation into potential business and to be involved in projects focused on the transition to the bio-economy.
Research institutes (members of CLIC: Natural Resources Institute Finland, VTT Technical Research Centre of Finland Ltd)	Research partners	
Large companies (members of CLIC: UPM-Kymmene Oyj,Metsä Board Oyj,Mirka Oy,CH-Polymers Oy,Teknos Oy,Valmet Technologies Oy)	Research partners	Company partners share the joint interest in developing bio-based materials and creating knowledge on bio-based raw materials for various applications. Companies have a business interest to join research project and to utilise this knowledge and findings in their R&D projects. They also look for new collaboration partners of other companies and research institutes.
Other partners (Largo company: Kiilto Oy; SMEs: Montinutra Oy, Brightplus Oy, CH-Bioforce Oy, Metgen Oy)	Business partners, co-founders or partners with parallel project	As project-based partners with limited R&D resources, they benefit from collaboration. However, to be accepted for funding, SMEs need to show they have a growth and export-oriented strategy.

Policy context and main outcomes of the project

The initiative is supported by the Bio and Circular Finland policy programme funded by the innovation agency Business Finland. Projects obtain two-year funding, with the possibility for some to obtain EU funding subsequently.

Table 2.21. Project outcomes

Type of outcome	Description
Technologies / innovations	Pilot-scale production of suberin, a polyester biopolymer (i.e. a natural, environmentally friendly plastic-like material derived from renewable sources like plant cell walls) for various applications, such as biodegradable packaging or soil erosion control. Project partners tested the technological feasibility of their project's proof-of-concept (i.e. assess whether their proposed concept or idea could be implemented using available technology and resources).
Skills	Development of expertise on bio-based raw materials for various applications.
Organisational capabilities	Participating companies gain capabilities in the development of new products, and opportunities for testing and scaling their existing products and services.
Networks	The project offered the opportunity to create additional collaborations and interactive communication in between research organisations and industries.
Socioeconomic impacts	
Green impacts	Development of innovations to substitute fossil-based binders and coatings with bio-based solutions, which can be used in packaging, paints, adhesives, sealants, and abrasives.

Further information:

- Project website: https://www.abo.fi/fi/projekti/sustainable-binders-and-coatings/
- Clic Innovation website: https://clicinnovation.fi/project/susbinco-sustainable-binders-and-coatings/

Lorraine Smart Cities Living Lab - France

Short description

The Lorraine Smart Cities Living Lab (LSCLL) is a collaborative research project created in 2008 by a group of researchers (ERPI) and academics (ENSGSI) in innovation from the Université de Lorraine (France). The LSCLL serves as a platform that pools the resources of actors who wish to collaborate on an operational issue, or a research question requiring user-driven approach and citizens in the development of responses to societal challenges. LCSLL covers a wide range of topics, including territorial resilience, digital transitions, green and frugal innovation, mobility, as well as forests, health and well-being.

Working with local authorities, SMEs, large companies, citizens, local agencies (e.g. local economic and urban planning agencies) and incubators, the LSCLL is supported by a physical platform, the Lorraine Fab Living Lab and merges two main activities: a Living Lab, an open innovation ecosystem in which researchers, businesses and citizens develop new ideas and concepts in real-world settings, and a Fab Lab, which provide people with access to infrastructure and equipment (e.g. 3D printers, laser cutters) to experiment and make prototypes. Since 2009, through its umbrella organisations and their partners, the LSCLL has been involved in more than 30 collaborative projects with local, national and international partners (as of November 2023).

Examples of projects at the LSCLL with a focus on green innovation include the GreenFabLab, which focuses on co-creating new products from recycled plastic using 3D printing technologies with citizens; DHDA, which involves more than 100 regional partners, the LSCLL, with its Forest InnLab, and contributes to actively mobilising citizens for innovations around trees and wood; and Linky by Makers and Smagrinet EU project, which supported user-driven innovation by involving citizens in the creation of products or services that can generate solutions for more efficient electricity consumption in France.

The LSCLL is connected to other activities across Europe as part of the European Network of Living Labs (ENoLL) since 2010. In 2013, LSCLL became a co-founding member of France Living Labs (later expanded and renamed as Francophonie Living Labs), a network of living labs and innovation centres that operate in French-speaking regions and countries around the world.

Table 2.22. Main features

	Overview	Description
Timeline (Starting date, end date)	2008 – ongoing	In 2010 the Lab became part of the European Network of Living Labs (ENoLL).
Initiating organisation(s)	Research group (Equipe de Recherche sur les Processus Innovatifs, ERPI) and the industrial engineering school (ENSGSI), at the Université de Lorraine	In 2008 the initial project was launched as the LSCLL by the ERPI laboratory team and ENSGSI in partnership with a local European Community Business Innovation Center (Promotech CEI, no longer active)
Size (number of participants)	About 70 individuals	Co-ordinating and organisational team of 10 people. About 60 researchers from the university engage over the year across specific project needs.
Types of actors involved	Local authorities and agencies, universities, incubators, small, medium or large companies, citizens and students.	
Budget and funding sources	EU, national, and private-sector project funding	Funding per project ranges from USD 107 000 (EUR 100 000) to USD 1.07 million (EUR 1 million). Funding resources are managed by ERPI, ENSGSI and their partners. Around USD 328 000 to 440 000 (EUR 300 000 to 400 000) is spent annually on Lab activities (30% EU, 40% national, 10% local authorities, 20% private sector).
Citizen engagement	Citizens are involved through workshops, the open citizen lab, open science initiatives and promotion of the lab's projects in trade fairs.	
Green innovation domain	General sustainability	LSCLL objective is to engage in user driven co-creation for the green transition.
Geographic scope (local /regional, urban/rural area)	Regional	Regional living lab of the region of Lorraine. It engages however in national and international living labs networks, and in global dissemination and capacity building activities in universities abroad.

Key takeaways

- **The initiative is an example of how bottom-up initiatives can scale.** LSCLL offers a good example of how a simple bottom-up project, initiated by academic researchers, can scale over time. The knowledge, resources, networks, and reputation developed over time have enabled the LSCLL to scale-up the engagement in an economically sustainable manner.
- **Tax subsidies provided for companies engaging with universities have facilitated partnerships.** The French government's approach of evaluating universities every five years, considering their impacts generated, ensures university top-management support for labs that engage with citizens and companies. Furthermore, the government offers tax subsidies to companies engaging with universities, covering a significant portion (around 60-70%) of project costs. This tax subsidy model provides businesses with strong incentives to invest in such collaborative partnerships.
- **The initiative exemplifies how local initiatives can support global "green innovation" efforts.** Through the ClimateLabs Erasmus+ capacity building project, Université de Lorraine is involved in global dissemination and capacity building supporting ten universities in Latin America, Brazil, Mexico and Colombia (https://climate-labs.org). The aim is to support the creation of multidisciplinary groups in these universities to tackle issues related to climate change. Université de Lorraine transfers its capabilities and methodologies used to work with local stakeholders, tested via the LSCLL, with these universities. Furthermore, LSCLL is a member of the European Network of Living Labs, which facilitates capacity building, international exchanges, and the sharing of best practices in co-creation with citizens.
- **Involving students in co-creation projects enhances capacity building by proving them with practical experience.** Undergraduate and postgraduate students actively participate in in co-creation projects with companies and citizens in various LSCLL projects. These opportunities are

important to enhance student professional experience and to train engineers with expertise in co-creation in complex industrial projects.

Co-creation dimension(s) of the initiative

- Co-creation between researchers, businesses and citizens in the Living Lab – an open innovation ecosystem to develop and test new ideas and technology solutions in real-world settings. Co-creation with citizens is encouraged with the use of a range of tools from ERPI and ENSGSI, such as:
    - *Lorraine Fab Living Lab*: collaborative and fabrication space that provide people with access to infrastructure and equipment they need (e.g. 3D printers, laser cutters, immersive technologies) to experiment and make physical or virtual prototypes. For example, the GreenFabLab project gives start-ups, researchers, engineers and citizens access to 3D printers to transform plastic waste into new objects and raw materials. Through a "do-it-together" approach, LSCLL has held collective projects to create furniture and other objects made of recycled plastic.
    - *Idea competition*: the 48h Innovation Makers event, created and organized by ENSGSI, involved 1 500 students from different academic backgrounds in France and abroad in tackling real business challenges presented by partner companies. Participants had two days to work together to develop ideas that could solve the challenges presented.

Actors involved

Table 2.23. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
University (Université de Lorraine)	The university leadership provides guidance on project priorities in view of the strategic direction of the university. Within the university, the Research team on innovation process Laboratory (ERPI Laboratory) leads the project by organising and overseeing the different project activities; The Engineering School on Innovation (ENSGSI)provides for human resources, including researchers and students, to contribute to projects.	LSCLL contributes to raising the university's profile and scores in government evaluation, supporting grant applications. The project also presents an opportunity to experiment innovative collaborations with partners (e.g., Lorraine Fab Living Lab Platform, Open Citizen Labs). For individual researchers, it provides the opportunity to develop scientific publications and improve their academic career. The LSCLL also offers opportunities for students to engage in problem-based learning.
Local authorities (Metropolis Grand Nancy)	Provider of financial resources and co-developer and co-designer in urban projects: From 2014 to 2022 local authorities covered the payment of the rent of the LSCLL, amounting to approx. USD 481 000 (EUR 450 000).	Local authorities benefit from a project that enhances the local university, fosters collaboration with industry, and supports social initiatives, leading to overall community development.
Public research institution (depending on project)	Collaborators or initiative leaders on specific projects. providing expertise, facilities, and other resources.	Participation in LSCLL projects provides an opportunity for researchers to connect with citizens. They can also increase and improve their publications and expertise.
Universities (depending on project)	Collaborators on specific projects providing human resources and expertise.	Universities enhance their reputation and expand their educational offerings. LSCLL provides opportunities to their students to engage in problem-based projects preparing future engineers, executives, doctors, and managers in the fields of life sciences and the environment. Such engagement also allows achieving higher scores in government evaluations of university performance.
Companies (depending on project)	Participants on specific projects.	They benefit from the development of innovative processes, products, and services as well as from a better understanding of the consumers, the market and societal trends.

Association and private incubators (Incubateur Lorrain & Grand Nancy Innovation)	Innovation and business development facilitator on specific initiatives.	Incubateur Lorrain and Grand Nancy Innovation are interested in the LSCLL's Lab dynamic to support entrepreneurs and innovative companies to validate concepts as early as possible andcreate an early adopter community.c.
Citizens	Participants to specific projects (e.g. participants to Living Lab and the FabLab).	Generally, the Lab's projects aim at generating value to the local area or tackle societal challenges.
Other municipalities	Participants to specific projects.	Generally, the Lab's projects aim at generating value to the local area or tackle societal challenges.

Policy context and main outcomes of the project

The project, initiated by academics, overtime was developed into a host of several large EU, national, and private sector funded projects. Since 2019, the Lorraine Smart City Living Lab's umbrella organisations won several National and European projects.

Table 2.24. Project outcomes

Type of outcome	Description
Technologies / innovations	The LSCLL has co-created products and services driving ecological transition, including furniture made of recycled plastic, the use of 3D simulations to optimise traffic, and explore alternative uses for smart meters that measure electricity consumption to support the French public electricity distribution. The LSCLL umbrella organisation has used the feedback from this Living Lab project to develop a physical platform to materialize the "Lab" approach and help partners to leverage it. In 2014, the Lorraine Fab Living Lab (LF2L) was created, with machines, immersive technologies, additive manufacturing, an electronics workshop, etc.
Skills	Knowledge is developed regarding skills and methodology for co-creation. Undergraduate and postgraduate students are involved in co-creation projects with companies and citizens, and engineers are trained in complex industrial projects. Researchers working with the LSCLL produced over 157 scientific publications, theses and reports on innovation methodologies, capitalisation and dissemination, and over 161 media and events for the general public.
Organisational capabilities	Businesses gain experience with user-centric processes to develop new products and services, and obtain a better understanding of consumer demands and societal trends. Universities develop capabilities in navigating regulatory and policy landscapes, and building collaborations.
Networks	Since 2010, LSCLL is part of the European Network of Living Labs (EnoLL): a collaborative network of living labs that fosters open innovation by connecting diverse stakeholders to co-create and test innovative solutions in real-life environments. In 2011, the FabLab activities, supported by ENSGSI, allowed to join the global Fab Lab Network of the Fab Foundation – a US non-profit that emerged from MIT's Centre for Bits & Atoms Fab Lab Program. In 2013, LSCLL co-founded France Living Labs, a collaborative network of living labs across France In 2015, LSCLL co-founded Francophonie Living Labs, a collaborative network that promotes co-creation across French-speaking regions. LSCLL also participates in local, regional, EU and international collaborations that have extended its networks. With the LF2L platform, LSCLL is also part of the Learning Lab European Network, a section of the European Network of Living Labs, dedicated to bringing together a community of participants and experts to share knowledge on the key elements of Living Labs.
Socioeconomic impacts	Engagement of local citizens and supporting the local region and building links with businesses/firms.
Green impacts	Innovation in energy, ecological and urban transitions.

Further information

- LSCLL website: https://erpi.univ-lorraine.fr/projects/lorraine-smart-cities-living-lab/
- Lorraine Fab Living Lab platform : https://lf2l.fr/
- Green FabLab project: https://lf2l.fr/fr/projects/green-fablab/
- Linky by Makers project: http://linkybymakers.fr/
- Climate Labs project: https://climate-labs.org

GreenColab - Portugal

Short description

The GreenCoLab – an abbreviation for Green Ocean Technologies and Products Collaborative Laboratory – located at the University of Algarve, Portugal, is a private not-for-profit organisation aimed at driving innovation and economic diversification in the field of algae biotechnology (i.e. the application of biotechnological techniques to use algae for the production of products or for environmental purposes). Established in 2018, the GreenCoLab works with relevant industry and public actors to develop innovative solutions based on algae and disseminate them to develop the sector and support the environment.

Examples of projects conducted by the GreenCoLab include the LOCALITY project), which focuses on reusing waste nutrients of algae cultivation to develop innovative products for markets such as food, aquafeed, agriculture and textiles; the ProFuture project), aimed at developing sustainable and nutritious food and feed products using microalgae; and the Algae4IBD project), which involves researchers, companies and hospitals in using algae to develop bioactive compounds for disease treatment.

The GreenCoLab is one of Portugal's 41collaborative laboratories (CoLABs). Launched in 2017 by the Ministry of Science, Technology and Higher Education, CoLABs aim to create interface institutions between academia and industry, to increase knowledge transfer and co-creation. A competitive funding call was started in 2017 for the establishment of the CoLABs, followed by the opening of several similar calls until 2022. Currently, there are 41 CoLABs covering different fields of research (including agriculture, digitalisation, forests, food, and bioeconomy). CoLABs have a minimum of three partners, of which at least one should be a business firm and one an academic institution.

Table 2.25. Main features

	Overview	Description
Timeline (Starting date, end date)	2018 – ongoing	The GreenCoLab was stablished in March 2018, and became fully operational by November 2019. In 2021, the University of Aveiro (UAVR) became an associated partner. In 2022, the company Iberagar also became an associated partner.
Initiating organisation(s)	Centre of Marine Sciences (CCMAR) with the support of 5 founding partners: the National Laboratory of Energy and Geology (LNEG) (research institute), Allmicroalgae Natural Products S.A. (company producing microalgae products), Algaplus Lda (company cultivating microalgae)., Necton S.A. (company producing microalgae) and Sparos Lda (company proving research services to companies within the Aquaculture sector)	In 2018, the GreenCoLab responded to the first round of approvals in Portugal's collaborative laboratories initiative (CoLABs). GreenCoLab was established by the Centre of Marine Sciences (CCMAR) with the support of 5 founding partners, 4 from the private sector and 1 state laboratory.
Size (number of participants)	32 staff [as of November 2023]	Initial team of 12 in 2019.
Types of actors involved	One public research center and four SMEs (initiating organisations, see detail above), one university, one large business, one state laboratory.	
Budget and funding sources	Initial base funding of USD 1.15 million (EUR 1.07 million) provided by national (81%) and EU (19%) sources of funding in 2019 to set up the GreenCoLab.to	GreenCoLab received 100% of public funding (EU and national funding) to hire the initial team of 12 highly qualified personnel. Additional funding for equipments, consumables, remaining human resources and indirect costs was obtained from national and European projects (competitive funding). GreenCoLab (and all other CoLABs) are expected to move towards a one-third funding model:33% of budget would come from government funding, 33% from competitive funding, and 33% from products and services.

Citizen engagement	GreenCoLab conducts online surveys open to all citizens in Portugal on their algae consumption and their knowledge about their benefits. The outcomes are used to inform new product and service developments. GreenCoLab participates in a project with 37 institutions in Portugal (i.e Blue BioEconomy Pact – ALGAE VERTICAL), as part of which a survey will be launched in 2024 to assess consumer awareness and knowledge about algae and related themes. GreenCoLab participates in several educational initiatives mostly targeting Algarve university students In order to inform about the GreenCoLab activities and potentially attract research talents. As part of the ALGAE VERTICAL project, it also plans to conduct non-formal educational sessions and events in schools and high-schools which will raise awareness about environmental benefits of algae feedstocks, highlighting the potential of algae-based products as sustainable raw materials for different industries.	
Green innovation domain	Algae biotechnology	The lab specifically focuses on algae-based products in industries such as food, feed, nutraceuticals, cosmeceuticals, agriculture and textiles, and aims at improving the sustainability and economic diversification within the algae sector.
Geographic scope (local /regional, urban/rural area)	National and European	

Key takeaways

1. **The initiative focuses on building long-term financial sustainability.** GreenCoLab (and all other CoLABs) is expected to move towards a one-third funding model, where 33% of funding is to come from government sources, 33% from competitive funding, and 33% from products and service partners.
2. **The initiative uses industry-supported capacity-building approaches.** GreenCoLab trains MSc and PhD students and post-doctoral researchers and builds close interactions between laboratories and companies. To this end, the GreenCoLab PhD programme is designed to have three supervisors - one from a university, one from the CoLAB and one from a company. This serves to ensure that it strengthens skills that are in high demand by industry.
3. **Regular independent monitoring of CoLAB activities have been put in place**. The 41 CoLABs are evaluated by a group of international mentors that have a double role as independent advisors (by supporting the CoLAB's processes of strategic planning) and evaluators (by conducting annual assessments of their progress).

Co-creation dimension(s) of the initiative

- *Collaborative research***:** Collaboration between academic researchers and companies is facilitated through systematic working groups that aim at understanding industry needs and research possibilities. The GreenCoLab supports industry-science collaboration on developing technologies in its specific field.
- *Joint PhDs:* GreenCoLab offers training programmes for PhD students, aimed at preparing them for careers in business and industry. These programmes involve guidance from supervisors representing the university, the CoLAB, and industry, with projects that encompass both theoretical and practical dimensions.
- *Citizen consultations*: efforts are made to raise public awareness about the potential of the algae industry and to gather community input for new product and service development in this sector.

Actors involved

Table 2.26. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Public research institute (Centre of Marine Sciences, CCMAR)	Initiative leader andprovider of research capacities, infrastructure and facilities for projects	The CCMAR benefits from the creation of the lab as new resources allow for more research and potentially higher impacts.
University (The University of Aveiro)	Partner of the project since 2021 andprovider of research capacity in the area of chemistry in algae field.	The University benefits from its engagement as it provides for resources and inputs to research and get to access industry infrastructure. The initiative also enhances opportunities for students. Both benefits serve boost the institution's reputation.
State Laboratory (National Laboratory of Energy and Geology, LNEG)	Partner of the project and provider of research capacities.	The Laboratory benefits from the creation of the lab as new resources allow for more research and potentially higher impacts. It also benefits by gaining access industry infrastructure for research.
Large Business (Allmicroalgae)	Partner of the project. Contribute to identifying market demand and constraints.	Engagement is interesting for the company to develop innovative products to commercialise, and to gain access to advanced knowledge, infrastructure, research capabilities and reputation building.
SMEs (Algaplus, Sparos, Iberagar, Necton)	Partners of the project. Contribute to identify market demand and constraints.	Engagement is interesting for the company to develop innovative products to commercialise, and to gain access to advanced knowledge, infrastructure, research capabilities and reputation building.

Policy context and main outcomes of the project

The GreenCoLab is part of Portugal's collaborative laboratories (COLABs) initiative launched in 2017 by the Ministry for Science, Technology and Higher Education to create interface institutions between academia and industry and increase knowledge transfer and co-creation. A competitive funding call was started in 2017 for the establishment of the CoLABs, followed by the opening of several similar calls until 2022. Currently, there are 41 CoLABs covering different fields of research (including agriculture, digitalization, forests, food, bioeconomy).

CoLABs are entities dedicated to the production, dissemination, and transmission of knowledge by pursuing their own R&I agendas. They aim to facilitate the access of companies to global markets through exports, as well as to support the attraction of foreign investment in technology intensive areas (agriculture, digitalisation, wine, forests, food, feed, blue bioeconomy, others).

GreenCoLab is also supported by the European Commission NextGeneration EU programme and the regional development programme CRESC Algarve 2020.

Table 2.27. Project outcomes

Type of outcome	Description
Technologies / innovations	Several innovations have been developed within the GreenCoLab for the algae sector, such as novel photobioreactors (i.e. containers to grow microalge), novel algae with improved phenotypes, kits for early detection of contaminants, and algal-based bio stimulant prototype (i.e. products to provide plants with extra nutrients for improved crop growth and yield)
Skills	Students can develop their research skills further and fill-in the missing gaps in industry. This includes skills in chemistry, biorefinety, molecular biology and sustainability assessment.
Organisational capabilities	SMEs/firms can learn more about how to implement innovative technologies.
Networks	Creation of networks among project partners, academics and as part of the CoLABs network.
Socioeconomic impacts	Economic diversification in the field of algae biotechnology.
Green impacts	Promotion of RDI (Regulated Deficit Irrigation) on the cultivation of algae and algal biomass downstream processing. Biochemical analysis and characterisation of algal biomass by researchers with extensive know-how in algal feedstock. Development of novel and sustainable solutions for the production and processing of algae feedstocks and prototyping of innovative products for the market.

Further information:

- GreenCoLab website: https://www.greencolab.com/
- Portugal's CoLABs website: https://www.ani.pt/en/knowledge-valorization/interface/collaborative-laboratories-colabs/

Low Carbon Eco-Innovatory - United Kingdom

Short description

The Low Carbon Eco-Innovatory (LCEI) is a partnership between Liverpool John Moores University, University of Liverpool and Lancaster University to conduct industry-led research and innovation support in the Liverpool city region (LCR). Created in 2015, LCEI offers local SMEs access to university expertise and facilities to develop goods, processes and services that help reduce carbon emissions.

Examples include developing alternative packaging from naturally degradable materials such as starch, vegetable oil and seaweed; supporting companies developing plastic-eating mushrooms; and setting urban farms using innovative aquaponic technology (i.e. a system for growing plants using waste produced by fish as fertiliser for soil-less vegetable production).

The modes of collaboration between research and industry include collaborative projects with academics, industry-led PhDs, as well as MScs and internships jointly supervised by academic and SME supervisors. The initiative was funded by the European Regional Development Funds (ERDF) from 2015 to 2023. Universities provide match funding in terms of staff time. As of 2023, it is mainly funded by the UK's Shared Prosperity Fund.

Table 2.28. Main features

	Overview	Description
Timeline (Starting date, end date)	2015-ongoing	
Initiating organisation(s)	Liverpool John Moores University (LJMU, lead partner) University Liverpool (partner) Lancaster University (partner)	The Low Carbon Eco-Innovatory (LCEI) was initiated in response to a request from the Liverpool City Region and the Local Enterprise Partnership. The three universities joined forces to provide comprehensive academic expertise and human capital to respond to SMEs' needs.
Size (number of participants)	From 2015-2023, projects with 370 SMEs (of which 71 were start-ups) had been conducted. 12 staff from 3 universities directly engaged in the projects (incl. as project managers, industry liaison officer, administrative and marketing office, 3 PhDs or post-docs and one technician).	
Types of actors involved	SMEs and universities	
Budget and funding sources	Mainly funded by the European Regional Development Fund (ERDF) (2015-23).	• Mainly funded by the ERDF (2015-23). Since 2023, LCEI is mainly funded by the UK's Shared Prosperity Fund administered via de Liverpool City Region's Combined Authority. • Universities match funding in terms of staff time
Citizen engagement		
Green innovation domain	Green products, services and processes	The initiative supports SMEs in developing low carbon products, processes and services, including e.g. in waste reduction and reuse, sustainable materials, and renewable energy and efficient energy use.
Geographic scope (local /regional, urban/rural area)	Regional	Liverpool City Region, United Kingdom

Key takeaways

1. **LCEI's flexibility has helped respond directly to the needs of SMEs.** LCEI addresses the barriers faced by SMEs to reduce their carbon emissions or develop their low carbon ideas due to lack of time, money and knowledge/expertise. The ability to adapt to each participating SME's specific requirements is a key factor contributing to the initiative's success, resulting in collaborations with more than 370 SMEs. LCEI takes a case-by-case approach, adjusting project duration (from weeks to years), the type of support (including assistance from academics, researchers, students, and technicians), and access to infrastructure/resources (such as collaborations with business schools, design schools, and university labs).
2. **Industry liaison officers have helped foster and maintain relationships between SMEs and universities.** Their understanding of the needs, capacities, and interests of both parties enables them to identify collaboration opportunities that generate value for both business and academia. They connect suitable businesses with academic researchers, provide support, and address any issues that may arise during collaboration, contributing to the development and maintenance of trusted relationships.
3. **Intermediary organisations connected committed SMEs.** LCEI collaborates closely with intermediaries such as Local Enterprise Partnerships, Liverpool City Region's Chambers of Commerce, and Local Authorities. LCEI relies on their referrals to engage with SMEs - this supports referrals and SMEs finding out about the project, as well as lending credibility to the project.
4. **Institutional incentives helped build academic engagement with businesses.** In the United Kingdom, the Research Excellence Framework and Knowledge Exchange Framework assess the social and business impacts created by universities. As these evaluations determine government funding allocations, universities are motivated to demonstrate their impacts. Consequently, the generation of impact has become a criterion for academic promotion. These incentives have facilitated collaborations between LCEI and academics in industry-led projects.

Co-creation dimension(s) of the initiative

- *Collaborative research*: LCEI runs technical support projects between SMEs and academics. Projects may be developed in collaboration with a designated academic or team of academics that offer their expertise. Some SMEs collaborate with lab technicians in LCEI to work more on implementation challenges.
- *Industry-led PhDs*: LCEI also offers PhD placements in this field, which involve both an academic supervisor and a supervisor from the SMEs and, if the scope is large enough, are converted into full PhD programmes funded by LCEI (3-year projects).
- *Jointly supervised MScs and internships:* Student engagement (PhDs and master's) in 1-2-year full-time collaborations, 6-month student projects, or 1-month paid internships are also organised. These students are supervised by academics and a supervisor in SMEs.

Actors involved

Table 2.29. Role and motivation of actors involved

Type of actors	Specific role of the actor	Incentives to engage and benefits obtained
Universities (Liverpool John Moores University, University of Liverpool, Lancaster University)	Initiative leader or partners	Through the collaborations: The university gained experience in delivering commercial research addressing societal challenges, improving university impacts and innovation skills. Furthermore, LJMU and its partners have committed to becoming net carbon zero by 2035 and has produced a Climate Action Plan covering the next 10 years. This project contributes to these efforts. The project also allowed retaining skilled talent within Liverpool City region by creating job opportunities in SMEs and within the universities. Some projects have supported university research by providing new challenges to address or new insights. The joint networking events organised by LCEI, which bring together academics and business, provide an opportunity to network and explore opportunities for research and teaching collaboration. Student learning is enhanced. Businesses offer guest speeches enhancing the quality of teaching. Ph.D. students are engaged in industry-led programmes and MSc students had the opportunity to be engaged in hands-on projects with internships
Business association (Liverpool City Region Local Enterprise Partnership)	Business referral, and assistance in the development and delivery of projects Oversight of project funding from the European Regional Development Fund (ERDF)	The project supports the organisation's role of supporting the regional economy and its environmental sustainability by assisting local SMEs with regards to the latter objective.
Local Authorities (Local Council services)	Business referral, and assistance in the development and delivery of projects	The project is part of their services for local SMEs.
Business association (Liverpool City Region Chambers of Commerce)	Business referral, and assistance in the development and delivery of projects	Chambers of Commerce protect their interests and those of their members by referring them to LCEI to receive support.
Company (Liverpool City Region's growth company)	Business referral, and assistance in the development and delivery of projects	The aim of the company is to strengthen and coordinate the business ecosystem within the region. Participation in LCEI supports this objective by encouraging the growth and innovation of local businesses.
SMEs	Propose industrial challenges to be addressed with support from LCEI, and engage in co-creation of the solutions	They benefit of: Free support from academic experts and access to infrastructure. Research and development of sustainable products and services resulting in business growth and revenue streams. Improved embeddedness in local business ecosystem through networking with local stakeholders including the academic community, and local authorities.

Policy context of the project and main outcomes

The LCEI is a follow-up initiative of previous EU funded projects between the LCEI universities: Centre for Global Eco Innovation, coordinated by Lancaster University, and Low Carbon Innovation Hub, started by LJMU. Both initiatives shared a common goal of promoting collaborative eco-innovation across sectors and disciplines. This previous experience and commitment to eco-innovation provided a solid foundation for the current collaboration.

The LCEI, which was until 2023 mainly funded by European Regional Development Fund (ERDF), works closely with organisations in the Liverpool City Region such as local authorities and business associations. Due to the UK's departure from the EU, the ERDF funding expired, and the LCEI is now mainly funded by the UK's Shared Prosperity Fund administered via de Liverpool City Region's Combined Authority.

Table 2.30. Project outcomes

Type of outcome	Description
Technologies / innovations	Developed 245new products, processes or services (e.g. alternative packaging from naturally degradable materials such as starch, vegetable oil and seaweed used by SMEs) (as of November 2023).
Skills	Improved capacities of academics and students to support SMEs become environmentally sustainable.
Organisational capabilities	Development of capabilities among SMEs and local universities on how to reduce carbon footprints and on how to collaborate with multidisciplinary institutions. The funding collaboration between HEIs and businesses has resulted in greater focus on building sustainable business strategies and improved carbon literacy in a variety of fields. Academic staff have also been found to have broadened their research focus through SME interaction beyond what may have otherwise occurred in an institutional environment.
Networks	The universities have collaborated with 432 enterprises (as of November 2023) and improved connection across relevant stakeholders, including via dedicated networking events engaging academics, businesses and intermediaries.
Socioeconomic impacts	Development of several new green products and services used by SMEs, creation of employment (140 jobs during the pandemic period),new enterprises (74 as of November 2023), and improve the reputation of universities in the region.
Green impacts	An external Summative Assessment found that LCEI has had a positive impact in terms of decarbonisation (estimated 57,497.81 tonnes of CO_2 saved).

Further information:

- Project website: https://www.ljmu.ac.uk/microsites/ecoinnovatory

3 Case study template

Name of the initiative

Short description

Table 3.1. Overview

	Project
Name	
Country	
Initiating organization(s)	
Types of actors involved	
Timeline (Starting date, end date)	
Size (number of participants)	
Budget and funding sources	
Collaboration instruments used (collaborative project, hackathon, living lab…)	
Thematic focus (e.g. green mobility, sustainable buildings, energy efficiency…)	
Geographic scope (local /regional, urban/rural area)	

Main features of the project

1. What are the specific objectives of the project? What city/regional challenge(s) related to the green transition does the project address?
2. In brief, what are key project milestones (and timeline)?
3. What are the main factors that motivated the creation of the project?
4. What are the co-creation activities conducted as part of the project?

Role and motivation of different actors in the project

1. Identify the leading/initiating actor of the project and provide a brief overview about the process of partner identification.
2. Identify the role and motivation of all actors involved (universities, public research organisations, businesses, citizens, government, etc.).

Table 3.2. Role and motivation of actors involved

Name of the actor	Type of organization/actor	Specific role of the actor	Why did the actor engage in the project? How did the actor benefit from engagement?

*For example: university, SME, large business, not-for-project organisation, intermediary, government ministry, government agency, citizens.

1. Regarding the involvement of universities:
    a. Incentives:

- Institutional incentives: What are the incentives of universities to engage in co-creation activities contributing to the green transition? How do project goals align with the university strategy?
- Individual incentives: What are the incentives of university researchers to engage in co-creation activities contributing to the green transition? To what extent are university researchers rewarded for their engagement in third mission activities? (e.g. reduction of teaching responsibilities, factor considered for promotion, and financial rewards, etc.)

    b. What are the types of academics engaged in the project and what were their key roles (i.e. PhD students, Post-doc researchers, Lecturers, Senior Lecturers, Professors and University leadership)?

    c. Did individual academics face challenges when engaging in this co-creation project? (e.g. administrative burdens, lack of sufficient time, etc.) How did they overcome these?

2. Regarding business and citizen engagement (if relevant):
    a. What were the incentives for businesses and citizens to engage in the project?

    b. What mechanisms/ initial reach out activities were used to engage citizens? What strategies/mechanisms are in place to ensure their long-term commitment?

    c. What tools are used to gather and process inputs from citizens? How are these integrated in the co-creation process?

    d. What were challenges faced and how were these addressed?

    e. What are lessons learnt from business and citizen engagement in the project? (please provide details here or in question 14 below)

Project outcomes

1. What are the outcomes achieved by the project so far? Please describe them in the table below.

Table 3.3. Project outcomes

Type of outcome	Description	Key beneficiaries
Technologies / innovations		
Knowledge / capabilities		
Networks		
Other (please specify)		

1. Did the project generate any additional benefits in addition to achieving the project goals? For instance:

- Did it contribute to acquisition/development of new skills and learning by those involved?
- Did it facilitate inclusion of entrepreneurs/firms/people/students that were not previously engaged in this type of activity?
- Did it contribute to the creation of jobs/economic opportunities?
- Other:

2. Are project outcomes monitored and evaluated? If so, how?

Policy context of the project

1. Is the project supported by a specific policy programme/scheme?
2. What other factors (e.g. support of local authorities, regulatory conditions, business culture, EU funding, etc.) facilitated or hindered the implementation of the project?

Lessons learned

1. What are the main lessons learned from the experience? Please complete the dimensions that are relevant in the table below, and add any additional dimensions as needed. In order to identify them, please reflect about:

- What would you highlight as key success factors of the project?
- What would you have done differently?

Table 3.4. Lessons learned

Dimensions	Description
Partner selection	
Management of relationship with partners and the broader ecosystem	
Incentives for engagement	
Practices to enhance multidisciplinary engagement	
Innovative approaches adopted	
Intellectual property rights strategies	
Use of digital technologies	
Other (please specify)	

1. Were there any additional challenges faced during the project that you would like to highlight (beyond those raised in questions above)? How were these addressed.