COST Action
Progress Report at 24 months
(03/10/2023 to 03/10/2025)

CA22123: European Materials Acceleration Center for Energy

The Action was approved by the Committee of Senior Officials (CSO) on 12-5-2023 and has the MoU reference COST 033/23.

This report shows the data entered into e-COST to enable the Action Chair to verify the completeness and accuracy of the report with the MC prior to submitting the report via e-COST in fulfilment of the rules for COST Action Management, Monitoring and Final Assessment.

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Funded by the European Union

Action leadership and participants

Leadership positions

Position	Name	Contact details	Country*
Chair	Dr sawako nakamae	sawako.nakamae@cea.fr +33169087538	France

Position	Name	Contact details	Country*
Action Vice-Chair	Dr MONICA FABRIZIO	monica.fabrizio@cnr.it +393887606819	Italy

Working groups

#	WG Title	# of participants	WG Leader	Country*
1	Perovskites	142	Dr Dorottya Kriechbaumer gubandorka@gmail.com	Germany
2	Metallic Alloys	189	Dr Jaroslaw Jasinski Jaroslaw.Jasinski@ncbj.gov.pl	Poland
3	New Materials	349	Dr Kourosh Malek k.malek@fz-juelich.de	Germany
4	Training	211	Prof David Lacroix david.lacroix@univ-lorraine.fr	France
5	Dissemination, Communication & Promotion	170	Ms Gloria Botton g.botton@eera-set.eu	Belgium

Other key leadership positions

Position	Name	Contact details	Country*
Science Communication Coordinator	Ms Gloria Botton	g.botton@eera-set.eu	Belgium
GH Scientific Representative	sawako nakamae	sawako.nakamae@cea.fr	France

* The country displayed is:

- for the Action Chair, the country that nominated that person to the Management Committee before they were elected Action Chair;
- for the Action Vice-Chair the country that nominated the person as a Management Committee Member,
- for all other leadership positions, if the person is a MC Member the country displayed is the country of nomination, otherwise it is the country of the person's primary work affiliation.

Participants

COST members having accepted the MoU

AL	08/06/2023	AM	08/06/2023	AT	08/06/2023	BE	08/06/2023	BA	08/06/2023
BG	08/06/2023	HR	08/06/2023	CY	08/06/2023	CZ	08/06/2023	DK	08/06/2023
EE	08/06/2023	FI	08/06/2023	FR	08/06/2023	GE	08/06/2023	DE	08/06/2023
EL	08/06/2023	HU	08/06/2023	IS	08/06/2023	IE	08/06/2023	IL	08/06/2023
IT	08/06/2023	LV	08/06/2023	LT	08/06/2023	LU	08/06/2023	MT	08/06/2023
MD	08/06/2023	ME	08/06/2023	NL	08/06/2023	MK	08/06/2023	NO	08/06/2023
PL	08/06/2023	PT	08/06/2023	RO	08/06/2023	RS	08/06/2023	SK	08/06/2023
SI	08/06/2023	ZA	08/06/2023	ES	08/06/2023	SE	08/06/2023	CH	08/06/2023
TR	08/06/2023	UA	08/06/2023	UK	08/06/2023				

Other participants

Institution Name	Country

Summary

The main aim and objective of the Action is to

create a new form of alliance across the entire innovation value chain of materials for clean energy applications by overcoming the fragmentation of materials research and technology development and via supporting informed decisions by diverse stakeholders

During its first two years the Action progressed the achievement of this as described below

EU-MACE's ultimate vision (main aim) is to create a new form of alliance across the entire innovation value chain of materials for clean energy applications by overcoming the fragmentation of materials research and technology development and via supporting informed decisions by diverse stakeholders. The secondary objectives and associated goals are all designed to achieve this aim. To this end, we have made concrete progress in both research coordination and community building terms. Several new research collaborations are being born, connecting researchers with complementary skills (materials science, data-science, automation, sustainability and sociology). Our unique approaches to involve all levels of stakeholders in the energy materials innovation are being translated into two roadmap papers, both of which will be disseminated to reach not only fellow researchers but also industries and science policy decision makers. The training schools offered by EU-MACE educates the both YRIs and more senior researchers for acquiring necessary skills to tansform conventional research settings (legacy labs) into digital-ready environment. Thanks to the participation of motivated researchers and investigators from MAP, conventional laboratories and industries, we are now connected to a few standing international research networks in materials science and energy, ensuring the continuation of EU-MACE efforts after the Action lifetime.

The Action will implement the following measures in the coming two years to overcome any issues identified in this report as potentially endangering the achievement of the objectives of the Action

While it is a real challenge to 'involve' more members to our action, we are advancing well toward all of our objectives. Together with WG and Task leaders, many of whom are MC members, we have cultivated our unique approaches to building a new and vibrant research eco-system which we will continue in the remainder of the Action Lifetime.
To overcome the underspending of budget, we identify that conference grants and WG & Task workshops/training schools are where our members are most enthusiastically involved. After discussing with COST officer at one of the external events, we will previledge the participation of active members to our actions such as WG & Task workshops and training schools rather than MC meetings, where we experience high numbers of cancellations.

Action website

https://eu-mace.eu/

Achievement of MoU objectives, deliverables and additional outputs/ achievements

MoU objectives

Please self-assess and describe the level of achievement of each MoU objective. For any MoU objective that is 25% or less achieved, please add an explanation.

Mou objective	To coordinate human resources, knowledge exchange and existing infrastructure among the Action participants to facilitate collaborations and to foster inclusiveness within Europe via a platform sharing agenda with a specific time allocation for scientists from Inclusiveness Target Countries.
Type of objective	2.b Building a community around a new or emerging field of research 2.e Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	Currently, 3 leadership positions are occupied by members from ITC, compared to just 1 in GP1, this increase attests to a strong interest from ITCs. The working group 4 (training) leader will be replaced by another member from ITC (Portugal) in GP3. By construction, most of EU-MACE's activities are carried out by transversal tasks. In GP1 and GP2 there have been many actions with 'Legacy Labs' and 'MAP and expert mapping.' The former is dedicated to creating collaboration between MAPs and Legacy Labs, one of the main inclusiveness goals of EU-MACE. As MAPs are concentrated in wealthy countries, and therefore, this task's actions naturally created the knowledge exchange between ITC members and researchers from MAPs, producing new collaborations among them. Thanks to Legacy Labsn EU-MACE is currently preparing a MCSA DN proposal involving 11 Action members including 4 from ITCs. Furthermore, the online "Experts & MAP list" created in GP1 has been expanded. The list is consultable for any Action members and open to submit their own information on expertise, infrastructure and research interests to be shared with other members. It is currently being used to identify possible future collaboration partners. There are two on-going discussions among the members for possible research project building in response to Horizon EU calls, both of which are coordinated by members from ITCs. Lastly, an STSM conducted in GP1 where a researcher from an ITC has been invited to access experimental platform at a member MAP has give rise to a publication: https://www.mdpi.com/2076-3417/15/4/1917 We will continue these efforts in the remainder of Action life-time.

Mou objective	To create a collaborative knowledge platform accessible to the public beyond the Action duration.
Type of objective	1.b Coordination of information seeking, identification, collection and/or data curation 2.a Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	The online "Experts & MAP list" created in GP1 has been expanded. The list is consultable for any Action members and open to submit their own information on expertise, infrastructure and research interests to be shared with other members. It is currently being used to identify possible future collaboration partners. There are two on-

	going discussions among the members for possible research project building in response to Horizon EU calls, both of which are coordinated by members from ITCs. It is a simple tool that allows creating a comprehensive and easy to navigate knowledge graphs connecting researchers. We will continue to expand the dataset as more members are joining. Furthermore, we are proposing other COST Actions to consider joining the effort

Mou objective	To provide an example R&D roadmap for accelerated material integration built upon a truly systemic approach to become a future EU centre of excellence for advanced materials.
Type of objective	1.d Comparison and/or performance assessment of a theory, model, methodology, technology or technique 1.f Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.) 2.c Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	EU-MACE strives to build a new type of research eco-system using cutting-edge digital and automation tools. In the past two years, this objective has been addressed particularly and specifically, through three actions. WG3 – new materials and two WG-transversal tasks “Legacy Labs” and “sustainability”. WG3, its primary objective is to choose most promising material classes for low-carbon energy applications and identify ways to accelerate their development. Here we have undertaken a techno-economic driven approach known as Technology Development Analysis. First, the members selected three material classes, then by utilizing the state-of-the-art AI tool (large language model specifically trained for energy technologies and materials science), we identify the most promising energy applications that can be competitive or superior to the existing ones, as well as a set of priority materials properties that require at most improvement and that can be accelerated. This is a market-guided method that takes into account the societal needs from the end-users’ perspective, which is rarely practiced, until now, among EU-MACE’s member scientists. We are currently working on a roadmap paper describing the successful use-case of human-AI collaborative decision making on shaping the direction of materials research. The WG-transversal task ‘Legacy Labs’ methodology has already been described in MoU objective 1. In ‘Sustainability’ task, we have gathered liaised with European Energy Research Alliance’s joint programme E3S (Economic, Environmental and Societal impact of clean energy transition) https://www.eera-e3s.eu/ and AMPEA (Advanced materials and processes for energy applications) https://eera-ampea.eu/, and utilized the aforementioned database platform of EU-MACE (see ‘Experts & MAP’ list described in Objetive 2) to find common research interests between materials scientists and human science and social science experts. Many non-materials scientists are now joining EU-MACE to enrich our community and simultaneously, link our members to a larger, more permanent EU network (EERA) for ensuring the continuation of our community after the Action life-time.

Mou objective	To coordinate strategic dissemination of activities and results targeting not only research communities, but also companies, policymakers, certification bodies and citizens.
Type of objective	1.g Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications

	1.i Dissemination of research results to the general public 1.j Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)
Level of progress	76 - 100%
Description of progress with achieving the MoU objective	During the first two GPs, we have distributed 27 conference grants of which 12 for dissemination conference grants and 15 scientific conference grants (6 ITC and 9 YRI). All scientific conference presentations were chosen based on the applicant's research methodologies' and results' alignment with our Actions' scientific objectives "Create a new form of alliance across the entire innovation value chain of materials for clean energy applications by overcoming the fragmentation of materials research and technology development and via supporting informed decisions by diverse stakeholders." Dissemination conference grants were used to present our unique research eco-system building strategies and tools at international conferences and events including: research-oriented conferences, focused events on materials acceleration, one policy–industry–research forum (EU Big Data Value Forum, Budapest, October 2024) and one cross-industry trade conference and exhibition (FutureLabsLive, Basel, May 2025). In addition, the Action chair, Vice chair and active members were invited to several external events (not funded by EU-MACE) to present our Action's structure, vision, methods and objectives. These include: E-MRS Spring meeting (France Chapter, Paris 2024), COST-Action EuMINe (Porto?, 2025) Nanoinnovation (Rome, when and when), European Commission and Mission Innovation event on … (Brussels, when). The latest creation of EU-Industry partnership on advanced materials (IAM4EU) proves the EU's recognition of the importance of advanced materials in all areas of technology. In this regard, EU-MACE members have been very active through their organizations to join the IAM-I, the association piloting IAM4EU. They participate in its working group and task force meeting to voice our vision (inclusiveness, MAPs, etc.) to the relevant stakeholders and to share the first-hand information among our community.

Mou objective	To create inclusive and interdisciplinary knowledge-sharing space for investigators from all innovation value chains, naturally promoting new collaborations from several communities and countries to "close the loop" between the R&D and innovation cycle while keeping focus on societal challenges.
Type of objective	1.b Coordination of information seeking, identification, collection and/or data curation 1.h Input for future market applications (including cooperation with private enterprises) 2.e Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	EU-MACE considers a wide spectrum of stakeholders: from **materials discovery** (knowledge creators, stakeholders types :researchers), **technology translation & development** (proof of concept, prototypes, sustainability analysis, stakeholder types: applied institutes, innovation driven SMEs, industrial R&D labs, lifecycle and SSbD specialists etc.), **manufacturing** (products, scale-up; stakeholder type: suppliers, manufacturers, etc.) to **deployment** (market adoption, regulations, stakeholders: end-users, investors, etc.), all of which ultimately operating under local, national and inter-governmental **policy frame work** (strategy alignment, funding, stakeholder type: policy makers, partnerships, etc.) With the vast majority of Action members focuses on fundamental materials research of

	materials property understanding and optimization, expanding the network to include additional stakeholders was a real challenge. However, we have made clear progress by combining traditional approaches—such as *dissemination conference presentations*, t*raining school organization* and *personal invitations* (word of mouth) —with our unique methodologies of '**Legacy Labs**' and '**TDM analysis'**. **Legacy Labs** has resulted in not only creating a new research eco-system where conventional and localized laboratories are connected to MAPs to and together create a cloud-connected continuous workflow, but also succeeded in attracting innovation-driven SMEs and sustainability experts. By doing so our new scheme will accelerate the technology translation and development. **TDM (technology development matrix, WG3)** employs a techno-economic approach to identify the most promising application pathways for a given advanced material. This approach helps researchers focus on the most critical material parameters to optimize and to accelerate via MAPs, while ensuring the future technology's market potential and societal benefits. It also provides greater confidence for investors and policymakers to support and adopt such emerging technologies. The first selection of analysis are done on three such material classes and the results will be showcased to relevant conferences, forums, policy workshops and tradeshows. Further, EU-MACE members have given over 20 presentations disseminating our Action objectives and methodologies at scientific conferences, policy workshops, tradeshows and international stakeholder events, advocating the need for accelerating advanced materials research, the impact of MAPs and associated digital and automation tools as well as the importance of 'inclusiveness' of all types of laboratories and stakeholders to succeed clean energy transition. It should also be noted that many Action members take part in working groups and task forces of new European partnership IAM4EU (overseen by IAM-I association) where we contribute in formulating mateials research priorities in key industrial sectors. Lastly, at TOTEMIC training school organized in April 2025, provided classes on AI techniques (machine learning, neural networks, etc.) that are revolutionizing energy materials research and hands-on exercises with state-of-the-art tools for modeling and characterizing materials to 49 trainees (including 47 PhD, post-docs and early stage researchers). Plenary lecture was given by an invited speaker from Oracle discussing the future of AI in research, while the out-reach seminar focused on the use of AI for creating sustainable future. Combined, we have doubled the number of industrial partners (from 8 at the Action's start to 17 in November 2025), most of whom are R&D service providers, and one manufacturer of thermoelectric modules.

Mou objective	To ensure the generation and the gender balance, and thus minimize the prejudice in the decision making processes when seeking future application and market opportunities for newly developed advanced materials.
Type of objective	2.e Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action
Level of progress	76 - 100%
Description of progress with achieving the MoU objective	Currently, EU-MACE consists of 426 WG participants. Of which 51% are from ITCs, 44% YRIs and 36% female. These numbers can be compared to Action's statistics from 2 years ago (November 2023) of ITC 53%, YRI 30% and Female 38%. **About YRI:** Since GP1, we have made effort in attracting young researchers through special provisions for attending our workshops, creating 'young EU-MACE' webinar series (3 of them have been made in GP2) and encouraging students, post-docs and young permanent faculty members to apply for conference grants. These actions have

	resulted in EU-MAE to welcome 136 new YRIs in the last 2 years. **About female researchers and investigators (FRI)** As it was explained in the previous GP's report, the representation of female researchers and investigators (FRIs) within the Action (36% now, 38% in 2023) mirrors the percentage of FRIs in the field of materials science. We note, however that FRIs occupy 46% of leadership positions, and similarly, represent about 50% of 'active member' who regularly attends our monthly upodate meeting and contribute in our task-oriented workshops and discussion meetings.

Mou objective	To increase the preparedness of ECI and PhD students for leading the future 'systemic approach' pursued by the Action via Fostering innovation and entrepreneurship.
Type of objective	2.c Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	Materials Acceleration Platforms (MAPs) combine combinatorial synthesis, high-throughput characterization, automation and machine learning to accelerate materials discovery and optimization. Although early implementations have showcased the disruptive potential of MAPs, significant gaps remain in Europe and worldwide. One of the most pressing challenge is that of equitable geographic distribution of facilities and skills, allowing researchers to bridge materials science, data science, and systemic innovation. EU-MACE is motivated by this urgent need to train the future materials scientists on essential digital and interdisciplinary skills required to operate MAP infrastructure and cloud-connected research workflows. Our training topic focus is therefore on sustainability assessment, automation, data engineering and artificial intelligence and their effective use in materials science research as can be witnessed by the workshops and traing school organized by the Action.

Mou objective	To foster continued growth (further education) among senior investigators for adapting the digital-driven and holistic research approach, which will ultimately increase the acceptance-rate of 'new' methodologies and collaboration schemes, and speed up the implementation of SDL/MAP-like platforms across Europe.
Type of objective	1.a Development of a common understanding/definition of the subject matter 1.f Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.) 2.e Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action
Level of progress	51 - 75%
Description of progress with achieving the MoU objective	One of the originality of EU-MACE is the attention we give to the older generation of scientists who do not work in advanced MAP infrastructure. Indeed such convetional research methods (called 'legacy labs' in our Action) represent the vast majority of today's materials research community. It is difficult to transform ones methodolgy as most senior researchers spend substantial time in research management, and thus cannot dedicate the necessary time to acquire new set of skills in such as combine combinatorial synthesis, high-throughput characterization, automation and machine learning. Another limiting factor is the funding. Automation, and data-infrastructure creation are both costly and not accessible to most of the researchers today.

	Our Legacy Lab tandem collaboration scheme precisly tackles this challenge. By creating new Legacy-MAP connections, we were able to launch 3 new research collaborations through STSMs and the building of a future MCSA DN project. This effort will continue to provide novel research collaboration opportunities for older generation of researchers through which they can learn how to connect their legacy equipment to MAPs via cloud-platform and identify the parts of their research processes that can be automated at a reduced cost.

Mou objective	To incubate trans-national education programmes for generating a pool of young scientists whose academic knowledge spans all facets of advanced materials development prior to settling their PhD research agenda.
Type of objective	1.e Development of knowledge needing international coordination, pertaining to a new or improved theory, model, methodology, technology or technique 2.b Building a community around a new or emerging field of research 2.d Acting as a stakeholder platform or trans-national practice community, pertaining to a certain area of socio-economical or societal application, or to a certain market sector
Level of progress	26 - 50%
Description of progress with achieving the MoU objective	Deliverable 6: Report on future ERASMUS programme scheme reflecting Action's systemic research approach for materials research, development and innovation. This deliverable is due one September 2027. A dedicated task exists within WG4 in connection with other technical working groups (WG1/2/3). A series of discussion meetings (online and 1 face-to-face) is forseen to this end in GP3.

Mou objective	To increase awareness about the potential and challenges of materials research among private and public decision makers in order for them to take informed decisions, and among a wider public in order to feed an informed public discussion.
Type of objective	1.g Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications 2.d Acting as a stakeholder platform or trans-national practice community, pertaining to a certain area of socio-economical or societal application, or to a certain market sector
Level of progress	26 - 50%
Description of progress with achieving the MoU objective	Two roadmap documents are under preparation within WG3 (new materials) and transversal task Legacy Labs. These documents will summarize the methodolgies we are developing in EU-MACE that will reshape the accelerated materials research. Once published, we will disseminate them at suitable conferences and policy forums as well as at the Action invents inviting research policy makers, as well as international materials research communities to showcase the promise held by our approach and the impact to the society. This will be our first step toward transforming EU-MACE into a true center of excellence after the lifetime of the Action.

Deliverables

This section covers only deliverables that were foreseen for the Action, not additional outputs that were generated during the Action (these additional outputs will be added in the following section). Please select and comment on the progress with achieving each deliverable.

For deliverables that are:

- Delivered, please provide proof to enable the Action Rapporteur to confirm the delivery
- Not delivered but delivery is foreseen within 2 years please explain how the delivery will be achieved
- Not foreseen to be delivered please explain why not

Deliverable	Experts & MAP (Materials Acceleration Platform) lists including similar structures, data repositories, etc., to be updated yearly		
Progress with achieving deliverable	Delivered	**Month deliverable due**	6
Proof of progress with achieving the deliverable	https://eu-mace.chainmap.ca/		

Deliverable	Position paper based on Action results (WG Actions, bilateral meetings, workshops, STSMs etc.) to be updated yearly		
Progress with achieving deliverable	Not delivered, but expected before end of Action	**Month deliverable due**	12
Explanation	This position paper (whitepaper) is being written within the WG-transversal task "Legacy Labs." It has been delayed as the implicated parnters are also preparing a project proposal for MCSA-DN. We have chosen a suitable outlet: Digital Discovery (The Royal Society of Chemistry) and a pre-print on our website. We hope to deliver this paper within the first trimester of .		

Deliverable	Roadmap on advanced materials development & integration in renewable energy sector (final version in year 4). Includes subsections dedicated to specific materials		
Progress with achieving deliverable	Not delivered, but expected before end of Action	**Month deliverable due**	24
Explanation	This roadmap's first edition is being written within WG3 (New Materials) and we foresee its release by the end of 2025 or early 2026.		

Deliverable	Selection of 3rd pilot materials for a winning strategy for applying Action's digitally-assisted fast-track advanced materials and technology development		
Progress with achieving deliverable	Delivered	**Month deliverable due**	12
Proof of progress with achieving the deliverable	https://eu-mace.eu/event/5437:euromat-2025-forum.html		

Deliverable	Publication of training course materials and tutorial videos - 3 months after each workshop/training school organization		
Progress with achieving deliverable	Delivered	**Month deliverable due**	18

Proof of progress with achieving the deliverable	https://iesc.universita.corsica/arborescence.php?id_site=46&id_menu=0&id_rub=819&id_cat=417&id_art=8127&lang=fr

Deliverable	Report on future ERASMUS programme scheme reflecting Action's systemic research approach for materials research, development and innovation		
Progress with achieving deliverable	Not delivered, but expected before end of Action	**Month deliverable due**	48
Explanation	Planning and proposition on future ERASMUS programme is one of the central tasks of GP3 (2026). We have a dedicated meeting planned.		

Deliverable	Action logo, website (public and members' only) and social networks accounts available – updated regularly with news, summaries, demos, announcements		
Progress with achieving deliverable	Delivered	**Month deliverable due**	6
Proof of progress with achieving the deliverable	https://eu-mace.eu/		

Deliverable	Setting up of B2B platform for match-making between industries, researchers, MAP & SDL (self-driving lab) platforms.		
Progress with achieving deliverable	Not delivered, but expected before end of Action	**Month deliverable due**	24
Explanation	It is partially delivered. The expert list is operational and being used by Action members for research collaborations. We are now working to create additional databases for creating a meaningful B2B platform		

Deliverable	Summary of all dissemination actions toward targeted audiences outside the Action (e.g., international research communities, students and educators, EU and national energy communities) via press-releases, popular-science events, promotion events and actions, etc.		
Progress with achieving deliverable	Not delivered, but expected before end of Action	**Month deliverable due**	48
Explanation	This deliverable is not due until the end of Action		

Additional outputs / achievements

Co-authored Action publications

Please enter below ONLY publications (including publications that are submitted but not yet accepted):

- that are on the topic of the Action, and
- that are co-authored by at least two Action participants from two countries participating in the Action, and
- for which the Action networking was necessary.

Please pay special attention to the COST Excellence and Inclusiveness policy and ensure the inclusion of publications with authors from COST Inclusiveness Target Countries (ITCs), from the underrepresented gender in the Action and from Early Career Investigators/Young researchers.

	Bibliographic data		Countries participating in the Action among authors	Open Access	COST cited?	COST funds?	Relevance to H2020 Societal challenge	Peer Reviewed?
1	doi:10.3390/app15041917 Title Authors DOI Type Published in Published by ISSN Link	 Deposition and Characterization of Cu-Enhanced High-Entropy Alloy Coatings via DC Magnetron Sputtering Arcadii Sobetkii; Laurentiu-Florin Mosinoiu; Stefania Caramarin; Dumitru Mitrica; Laura-Madalina Cursaru; Alexandru-Cristian Matei; Ioan-Albert Tudor; Beatrice-Adriana Serban; Mihai Ghita; Nicoleta Vitan; Julia Witt; Ozlem Ozcan; Bogdan Postolnyi; Alexander Pogrebnjak doi:10.3390/app15041917 Journal article Applied Sciences MDPI AG 2076-3417 https://www.mdpi.com/2076-3417/15/4/1917/pdf		Other	Y	Y		Y

Projects resulting from Action activities

Please enter below all the projects on the topic of the Action resulting from Action activities, involving at least one Action participant, and for which the Action networking was necessary.

The Action reported 0 project(s) and 1 proposal(s) resulting from the Action networking.

#	Title	Countries participating in the Action among proposers	Main proposer name	Funder	Amount	Call identifier	Relevance to H2020 Societal Challenge

Other outputs / achievements

Please enter below any additional outputs/ achievements on the topic of the Action that contribute to the COST mission: “COST enables break-through scientific developments leading to new concepts and products and thereby contributes to strengthen Europe’s research and innovation capacities", and for which the Action networking was necessary (e.g. a patent, standards, white paper).

Output / achievement description	Dependence of achievement on the Action networking

Impacts

Please describe the impacts (the short- to long-term scientific, technological, and / or socioeconomic changes produced by a COST Action, directly or indirectly, intended or unintended) that have resulted, or might result, from the Action in the following table (one impact per line).

Description of the impact, i.e. what will change, and for whom, as a result of what the Action achieved	Type of impact	Timing of impact
Legacy Lab Task has brought transformation to conventional and non-automated laboratories to connect with highly automated and autonomized MAPs. This has provided opportunity to evaluate legacy labs' experimental research process for determining which steps can be accelerated (e.g., proxy measurements, automation of small, simple but repetitive tasks) and simultaneously given a new exploration pathways for MAPs. We are currently preparing a MCSA DN proposal to solidify these new collaborations. If successful, it will generate 15 PhDs and create permanent data pipeline between collaborating laboratories.	• Scientific / Technological	Achieved
TOTEMIC Training School 2025: "Tools for Energy Materials Modelling Acceleration" gathered nearly 50 young researchers to gain insights into the latest advancements in energy conversion, storage, and high-performance materials, as well as strategies for maximizing the utility of data generated in materials science, adhering to the FAIR principles. More specifically in TOTEMIC, 13 leading experts in materials science and AI gave courses on: - How AI techniques (machine learning, neural networks, etc.) can revolutionize energy materials research.- Hands-on experience with state-of-the-art tools for modeling and characterizing materials.- Numerical tools that can contribute to the global push for sustainable energy solutions.	• Scientific / Technological	Achieved

Please describe how the Action is advancing the careers, skills and network of researchers, including ECIs (for example: joint supervision of graduate and PhD students, research exchanges not funded by the Action, collaborations, Training Schools with ECTS accreditation, joint projects and jobs prospects).

STSM grants have been awarded to 5 researchers (among them 2 YRIs), all travelling to MAPs to use the platform for testing/characterizing material samples or to learn how MAPs are operated and can be integrated to in their own research. An additional visit (not funded by EU-MACE) has also taken place where a PhD student performed an experiment to start a new collaboration between two EU-MACE laboratories.

The career benefits are mainly to researchers with the following amount of experience after their PhD: 9–15 years.

Which of the stakeholders described in the “Plan for involving the most relevant stakeholders” in the Action’s MoU have been engaged and how? What additional stakeholders have been, or will be, engaged and how?
Policy makers: During the workshop held in September 2024 in Cyprus, a special session was organized inviting several international networks on materials research and related fields. To this event, EIC (European Innovation Council) and Cyprus's EU representative were invited. We were able to present the sginificance of MAPs in accelerating advanced materials development, and more importantly why it is necessary to involve legacy labs into this new research eco-system. The same argument was also presented at "International Cooperation on Innovative Materials for Energy Workshop" to the European Commission and Mission Innovation. Industries: In GP2 we have expanded our research focus on advanced materials to include application and increased the participation of industrial partners. Our attendance at Future Labs Live, a trade show has been successful. We will continue to solicit SMEs and large energy companies to our events. Social Science: We have reached out to sustainabiilty study and human science researchers through common project building efforts. Currently there are 4 such proposals being built.

Dissemination and exploitation of Action results (other than co-authored Action publications listed previously)

Please describe the Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of the Action results and the effectiveness of these activities.

Dissemination and exploitation approach of the Action

The EUMACE's dissemination (and exploitation) approach is meant for maximizing visibility, engagement, and long-term impact of the 'new' research eco-system under construction. The overall objective is to build and strengthen a lasting community of researchers and stakeholders connected through MAPs, promoting effcient yet secure data exchange, for the benefit of advanced energy materials community beyond the Action's lifetime. To this end, our dissemination acitivites have focused on not only the importance of automation and autonomization tools in accelerating the matierals research, but also the need for the inclusion of less, or little, automated and autonomized research entities, which indeed make up the vast majority of all materials research labs. This crucial point needed and still needs to be understood by scientists as well as policy makers such that the whole of the materials research community can progress together and become more efficient.

Dissemination

Dissemination meetings funded by the Action (possible only until 31st October 2021)

Title of Dissemination meeting	Meeting date	Meeting country	Action participant	Event name and hyperlink to the website	Title of presentation	Description of added value to the Action
N/A						

Other dissemination activities

E.g. participation to non-Action meetings, e.g. EU Parliament, meetings with policy makers, experts in the field, regional authorities.

Item/activity	Target audience	Outcome	Hyperlink
Future Labs Live 2025 tradeshow, Booth for disseminating EU-MACE, its concept and its member MAPs Basel, Switzerland, 26/02/2025-29/05/2025 3 seminars given on Building an ecosystem around autonomous Materials Acceleration Platforms for scale-up production of advanced functional materials for	Over 3000 visitors/participants from around the world at this exhibition event from a wide range of sectors: start-ups, innovators from academia (not only in materials science, but also from architecture, biotech, chemicals, agriculture, etc.) to discover new ways of researching, prototyping, manufacturing and expand our	We have gained at least 5 new members and liaised with several more companies including CAS (Chemical Abstract Service), TEC-Connection (http://www.tec-connection.com/) with whom we are in discussion to build common projects on materials and chemical research	https://www.terrapinn.com/conference/future-labs-live/index.stm

sustainable energy technologies. - how to connect legacy labs to MAPs (O. Ozcan, Task leader, DE) - EU-MACE network (S. Nakamae, AC) - Effective scientific communication methods (G. Botton, Comm coordinator, BE)	vision for the lab of the future.		
Workshop “Impacts of hydrogen technologies on society”, Torino (Italy) 26 March 2025. Presentation of objectives, structure, activities of the Action. Organized by the EERA Joint Programmes e3s and Fuel Cells and Hydrogen (FCH), the event brought together European experts to discuss the societal, economic, and social impacts of hydrogen technology deployment during the clean energy transition jointly organised by JPs Hydrogen and e3s of the European Energy Research Alliance.	The workshop was designed with early-career researchers in STEM and SSH disciplines in mind, to foster interdisciplinary dialogue between social sciences and STEM fields to understand the societal implications of hydrogen technology and to identify actions needed for its effective and responsible integration	Participation in the workshop facilitated the establishment of connections with early-career researchers who were not yet cognizant of the Action's capacity to function as a conduit for networking and the generation of novel knowledge in situ, facilitated by STSM tools.	https://www.materials-science.unito.it/do/avvisi.pl/Show?_id=ws8l
"NanoInnovation 2025", Conference and Exhibition, Rome, IT September 15-19, 2025. The conference included sessions on COST Actions. The presentation at NanoInnovation 2025 was designed to demonstrate how the Action foster collaboration and knowledge exchange for accelerating the development of innovative materials for energy applications.	The target audience was academic researchers, PhD students, and young entrepreneurs involved in innovative start-ups.	Participation in the workshop provided an opportunity to meet researchers in the early stages of their careers who were not yet aware of the potential of the Action as a tool for networking and developing new knowledge. Furthermore, the opportunity arose for the exchange of opinions and ideas with researchers from other sectors who were also involved in different Cost Actions.	https://www.nanoinnovation2025.eu/home/
Action DAEMON General Meeting, Porto Portugal February 3-5, 2025, at INESC TEC – Institute for Systems and Computer Engineering, Technology and Science. The presentation was designed to demonstrate how EU-MACE Action foster collaboration and knowledge exchange for accelerating the development of innovative materials for energy applications	Action DAEMON partecipants for a discussion on past, present, and future network activities	Discussion on shared objectives in the framework of cross-disciplinary and pan-European network, for building capacity and promoting excellence in education and research on innovative materials.	https://cost-daemon.eu/project/daemon-general-meeting-03-05-02-2025/
Presentation at 21st Global Conference on	Safe and sustainable manufacturing	Attendance at the Sustainable	https://gcsm.eu/

Sustainable Manufacturing Bologna, Italy, 10/09/2025/12/09/2025 Next-Generation Flame Retardant Additives: A Path Toward Sustainability and Safety by A. Serrano (Sustainability Task member and WG3 member, ES)	research and development community from European countries	Manufacturing conference last week provided valuable insights into current advancements and challenges in sustainable production, including industry best practices and innovative strategies for environmental improvement. The presentation highlighted emerging topics such as circular economy models, life cycle assessment, material recycling, and the integration of digital technologies to drive resource efficiency and emission reduction. Overall, the conference delivered practical knowledge applicable to ongoing projects, fostered new professional connections, and inspired ideas for integrating sustainability principles for material design. Many people asked about the COST Action and express their interest in participating so hopefully they will contact the coordinators soon.	
Workshop: REACH2 Network 3rd Planning Workshop - NSF Network of Networks: Research and Education Accelerated by Connections in Clean Hydrogen (REACH2) Presentation of Education and training activities in EU-MACE by J. Pakarinen (MC, FL)	Members of NSF Network of Networks: Research and Education Accelerated by Connections in Clean Hydrogen (REACH2) and other international research networks on hydrogen	Overall, the workshop provided a comprehensive view on the global hydrogen production and hydrogen as an enabler of the green transition. I had my presentation on the last day of the workshop in a session called “Training and education for energy transition technologies – Introduction to Educational/Training models”. My presentation, titled “COST ACTION:EU-MACE (CA22123) European Materials Acceleration Center for Energy”, was well taken by the audience and especially the examples from training and education actions were appreciated. Of the presented actions, the workshop organized in Corsica and the legacy lab approach resulted in several follow-up questions and further discussions. Maybe the most interesting aspect as a follow-up for the legacy lab approach was proposed by Steve Bruce from University of Ottawa who has been	https://hydrogenconnections.engineering.uconn.edu/

		developing educational methods applying avatars instead of being physically presence. Development towards this direction could, eventually, lead to sophisticated learning of MAP lab operations without physical presence in the MAP lab.	
Materials Development for Batteries 2025 Enabling CLoud-connected labs of Future for Energy Materials by K. Malek (WG leader, DE)	Battery research and industrial development community. Participants of the event ranged from academics, government, industry from South Korea, Germany, US, Canada, Spain, Japan, Taiwan, France and other countries. Focus areas: novel electrode and electrolyte materials for different classes of batteries, Lithium ion (LIB) and Solium ion (SIB) batteries, in particular. Research topics spanned from materials fabrication, synthesis and novel in-operando characterization techniques to application of DFT and other computational methods for materials design, as well as applying AI/ML models for inverse design of new electrode and electrolyte materials (Solid Polymer Electrolytes, for example)	Invited talk was part of the session AI/ML for materials design. The entire session provided very relevant communication means for introducing, presenting and sharing our work in EU-MACE for Development of TDM results for energy materials, for solid-state batteries. In addition, the current activities within EU-MCE cost action for supporting digitalization of legacy labs cloud connected labs and self-driving labs implementation were among the topics that were presented and were of high interest to broader communities in the event from research organizations and industry. The talk was received very highly with few contacts and follow up for further exchanges in the future.	https://mdbpc.org
Conference presentation: 18th European Congress and Exhibition on Advanced Materials and Processes – FEMS EUROMAT 2025, Granada, Spain, 14/09/2025-18/09/2025 title: Bringing Cutting-Edge Research to the Classroom: Material Acceleration Platforms for Applied University Students by Dorottya Kriechbaumer (WG1 leader, DE)	Advanced materials science research and innovation community attending Europe's largest conference in this domain. Researchers, Students, Industries and educators	Presentation focused on a methodology demonstrating how materials acceleration platforms (MAPs) can be effectively integrated into undergraduate education curricula. A key element of the presentation was the introduction of the EU MACE project, including its objectives, current progress, and opportunities for collaboration, highlighting the project's mission to establish a European network for materials acceleration, its achievements in developing shared infrastructure and open data concepts, and how other universities and research institutes can join the consortium and contribute to advancing the mission. Several participants	https://euromat2025.com/

		expressed interest in connecting with the MACE initiative, which helped to increase its visibility within the broader materials research community.	
YRI Conference poster presentation at 21st European Conference on Thermoelectrics Title: A Structured, Standardized, and Accessible Data Format for Thermoelectric Materials by Beatriz Aguiar (YRI, ES)	Thermoelectrics materials and device researchers and industrial developers, manufactures, students and educators	The poster had a significant interest from the audience. Being part of an emerging topic, and with low availability on the literature regarding A.I. development for thermoelectric materials, curiosity from audience was directed mostly to the process itself. Future collaborations could be envisaged with a new collaborator sharing similar interest in the use of A.I. for the discovery and/or optimization of chalcogenide-based thermoelectric materials.	https://ect2025.com/
European big data forum, 02/10/2024-04/10/2024 Budapest, Hungary 3 conference presentations in Enabling Cloud-connected labs of the Future session. "Enabling cloud connected labs of future for energy materials" by K. Malek (WG3 leader, DE) "Bringing Materials AI as a Scalable Scientific Process into the Lab-of-the-Future" by. C. Kreisbeck (WG3 member) "Object-Oriented Linked Data Schemas for MAPs / SDLs" by M. Popp (WG3 member)	European Big Data Value Forum is BDVA's flagship event, bringing the whole European data-driven AI research and innovation community together. EBDVF 2024 was organised in collaboration with local partners, EU and international projects.	The presentations directly addressed work done in WG3 on materials selection as well as availability of self-driving labs (WG2) across Europe, required data and AI knowledge to support their development and role of EU-MAC action to empower further adoption. This includes Advanced materials modelling and characterization and Knowledge and Data management; have strong overlap with those of our Action's notably with WG2 and WG3: This was a great opportunity for the Action members to be exposed to the AI and data community in Europe. Morever, the EU-MACE participants contributed to many sessions related to AI policy, safety, AI for energy, digital twins and overall impact of GenAI in advanced materials, energy and manufacturing.	https://european-big-data-value-forum.eu
CONNECT-NM Kick off meeting, Madrid, Spain 02/102024-04/10/2024 Presentation of EU-MACE title: COST Action EU-MACE: European Materials Acceleration Center for Energy by S. Nakamae (Action Chair)	CONNECT-NM is the co-funded European partnership dedicated to advancing research, development, and innovation in the field of nuclear materials. This was the partnership's inauguration event, gathering	One of CONNECT-NM program's objective is to create a MAP for nuclear materials. In this regard, the MAP and Expert list of our Action, as well as our approach on selecting the new materials (WG3) was	https://www.eera-set.eu/events/4469:connect-nm-kick-off-meeting.html

	all members of CONNECT-NM	found to be of particular interest that can benefit both networks. Another important mission of CONNECT NM lies in the data and metadata management. It appeared to me that the nuclear materials' community's approach serves as a use-case that can be introduced to EU-MACE. We shall continue our network-to-network interactions on these regards. Several members now belong to both networks, which will facilitate our continuous and meaningful communications throughout the lifetime of our Action.	
AHRC2024 – Australian Hydrogen Research Conference Perth, Australia, 04/09/2024 to 06/09/2024 titel: Plasma-Treated 1D Transition Metal Dichalcogenides for Efficient Electrocatalytic Hydrogen Evolution Reaction: Experiment and Accelerated Materials Modelling by A. Laikhtman (IL, MC)	More than 250 delegates attended the AHRC2024 conference: ~60% from the academy and ~40% from the hydrogen-related industry, as well as public/government organizations. The participants were from all over the world: Australia, New Zealand, Europe, USA/Canada, Japan, China and other countries.	The significant part of the presentation was dedicated to the COST Action program in general, to the EU-MACE action, and to the DECODE European project. (Several members of DECODE are in EU-MACE, creating new network around hydrogen.) Numerous questions were posed: some related to the scientific part of my talk on electrocatalysis of hydrogen evolution reaction by inorganic nanoparticles, but many - about the COST program in general and the EU-MACE action projects.	https://ahrc2024.com.au
2024 Accelerate Conference, University of British Columbia, Vancouver, Canada: 06/08/2024 to 09/08/202 Title: COST Action EU-MACE: European Materials Acceleration Center for Energy by S. Nakamae (Action Chair) in Session: The global ecosystem of research, AI, and accelerated innovation	The conference was the 3rd event of the same series organized by the Acceleration Consortium of Canada. It is the largest conference series on the theme of accelerated materials research focusing on the democratization of SDL (Self Driving Laboratories). Over 350 attendees from around the world were gathered with approximately 60 presentations (both panel and contributed speakers).	Through the presentation of COST-Action EU-MACE and the ensuing discussions with the attendees, it was possible to introduce our network of MAPs as well as that of materials science researchers in Europe who are eager to incorporate SDL methodologies into their research activities. New members have been recruited to join our Action, notably; Germany, the Netherlands and the USA, who have all agreed to present their materials acceleration platforms, or their networks at our Action's annual conference in September. Additional contacts made in the UK, Singapore and China are also expected to join EU-MACE.	https://www.accelerate24.ca/

Exploitation activities

Please describe below any activities undertaken to ensure exploitation (use, in particular in a commercial context) of the Action's achievements.

Item/activity	Target audience	Outcome
N/A		

Other matters

This section is confidential to the Management Committee, the Action Rapporteur and the COST Association, and is not included in the version of the report that is published on the COST website.

Difficulties in implementing the Action

If any difficulties are experienced in the implementation of the Action (e.g. imbalances of participation across the Working Groups, inactive country representatives) please describe these below. Please also describe the efforts made by the MC to address these.

EU-MACE's GH Institution has experienced difficulties in executing both administrative and financial duties causing stress on event organizations and reimbursement procedures. The Action has decided to nominate another organzation as the GH Institution for the 3rd GP.
EU-MACE counts over 400 WG members. However, more than half of them are silent observers who do not respond to invitations to join Action activities, or attend the monthly update meeting to stay informed. With MC members' advice, we now use Slack as a quick communication tool, to which all members were invited. Only 120 of them joined. There are currently between 50-80 who are truly active.
There is an over-representation of members from one country, Turkey, distorting the geographical balance between countries. The discussions with the MC members from Turkey and the Action officer have led to stop accepting application from Turkey until the balance is restored. In the GP3, we consider terminating non-active individual's membership from EU-MACE.
EU-MACE also has repeatedly underspent in the first GP2s due to a small number of STSM applications in alignment with the Action goals, and last minute cancellations to the face-to-face meetings. For the latter, a new measure will be implemented.

Endangerment Measures

Taking into account the issues identified throughout this report, please summarise the measures the Action will implement in the coming two years to overcome any issues identified as potentially endangering the achievement of the objectives of the Action.

While it is a real challenge to 'involve' more members to our action, we are advancing well toward all of our objectives. Together with WG and Task leaders, many of whom are MC members, we have cultivated our unique approaches to building a new and vibrant research eco-system which we will continue in the remainder of the Action Lifetime. To overcome the underspending of budget, we identify that conference grants and WG & Task workshops/training schools are where our members are most enthusiastically involved. After discussing with COST officer at one of the external events, we will previledge the participation of active members to our actions such as WG & Task workshops and training schools rather than MC meetings, where we experience high numbers of cancellations.

Suggestions for improvements to COST framework/ procedures

The mandate of the Scientific Committee includes providing advice to the COST Committee of Senior Officials on possible improvements to the COST framework. Please describe below any improvements that you believe should be made to the COST framework.

COST Action EU-MACE has given the possibility to build and transform materials science research community in a way the secondary proposal had dreamed of. It has been a great journey so far. Two possible improvements are: It would be of great benefit if COST officers could come to our face-to-face meetings to share our enthusiasms and encourage MC members to take more leading roles! The current amount of FSAC is too small for GH institutions to allocate sufficient amount of manpower for managing the Action.

Sustaining the network beyond the Action

Are there any plans to sustain the network beyond the end of the Action?	YES

Please describe how the network will be sustained beyond the end of the Action.

We are currently building several educational/training networks with the members of EU-MACE. MCSA Doctoral network will involve more than 20 Action members. In GP3 we will start building ERASMUS+ network, which will involve even more partners.
We are also collaborating with European Energy Research Alliance's (EERA) joint programmes. Members of EU-MACE are encouraged join EERA to keep the momentum of EU-MACE beyond the Action lifetime

Emerging topics/ developments in the field of the Action

Please describe any emerging topics or potentially important future developments identified during the Action and that could potentially be addressed by future COST activities such as Actions S&T Conferences or Exploratory Workshops.

Annex 1: Types of objectives

1 - Coordination of scientific and technological activities at a European level

1.a - Development of a common understanding/definition of the subject matter

1.b - Coordination of information seeking, identification, collection and/or data curation

1.c - Coordination of experimentation or testing

1.d - Comparison and/or performance assessment of a theory, model, methodology, technology or technique

1.e - Development of knowledge needing international coordination, pertaining to a new or improved theory, model, methodology, technology or technique

1.f - Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

1.g - Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications

1.h - Input for future market applications (including cooperation with private enterprises)

1.i - Dissemination of research results to the general public

1.j - Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)

2 - Community building

2.a - Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

2.b - Building a community around a new or emerging field of research

2.c - Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach

2.d - Acting as a stakeholder platform or trans-national practice community, pertaining to a certain area of socio-economical or societal application, or to a certain market sector

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action

Annex 2: Dimensions of successes

1 - Breakthroughs

- 1.a - Scientific breakthrough
- 1.b - Technological breakthrough
- 1.c - Breakthrough in socio-economic or societal applications

2 - Policy contribution

- 2.a - Contribution to regulatory policy
- 2.b - Contribution to environmental, infrastructural or agricultural policy
- 2.c - Contribution to economic or socio-economic policy
- 2.d - Contribution to social, cultural or legal policy

3 - Capacity building

- 3.a - Building capacity in an existing field of science and technology
- 3.b - Building capacity in bridging separate fields of science and technology
- 3.c - Building capacity in a new or emerging field of science and technology
- 3.d - Building capacity in valorising and implementing advances and applications in science and technology
- 3.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the under-represented gender and teams from countries/regions with less capacity in the field of the Action