

COLDSPARK® DRIVEN ENERGY AND COST-EFFICIENT METHANE CRACKING FOR HYDROGEN PRODUCTION

D7.7. Report on synergies with relevant initiatives, projects and programmes

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Nature of the deliverable

R	Document, report (excluding the periodic and final reports)	<input checked="" type="checkbox"/>
DEM	Demonstrator, pilot, prototype, plan designs	<input type="checkbox"/>
DEC	Websites, patents filing, press & media actions, videos, etc.	<input type="checkbox"/>
DATA	Data sets, microdata, etc.	<input type="checkbox"/>
DMP	Data management plan	<input type="checkbox"/>
Ethics	Deliverables related to ethics issues.	<input type="checkbox"/>
SECURITY	Deliverables related to security issues	<input type="checkbox"/>
Other	Software, technical diagrams, algorithms, models, etc.	<input type="checkbox"/>

Dissemination level

PU	Public — fully open (automatically posted online on the Project Results platforms)	<input checked="" type="checkbox"/>
SEN	Sensitive — limited under the conditions of the Grant Agreement	<input type="checkbox"/>

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The ColdSpark® project will validate a novel non-thermal plasma technology to produce hydrogen at an industrial scale from methane, with a process energy efficiency of 79%, achieving a conversion rate of 85% aiming at zero CO₂ emissions. This will be achieved by designing an industrial-relevant reactor that leverages the best features of the non-thermal plasma technologies, gliding arc and corona discharge, to ensure high efficiency and scalability. The innovation addresses for the first time the critical step of matching the reactor with a pulsed power supply. It enables a perfect fine-tuning of the cracking process parameters, to find the right electron density and energy distribution in the plasma reactor, to maximise energy efficiency. The up-and-downstream gas management will be optimised to further contribute to the system’s compatibility with the existing infrastructure. The project will develop and test a novel plasma reactor at a lab scale and validate it in conjunction with the power supply at a large scale, pursuing the industry’s most power-efficient generation of hydrogen alongside high-value carbon. The technology will assess its application for both, natural gas and biomethane producers. A low energy cost (< 15 kWh/kg H₂ produced) without the need for catalysts and water, makes the proposed solution the most cost-competitive, environment-friendly, and less complex to implement. The reactor design and modularity bring lower CAPEX and OPEX and make it easily scalable and flexible. The project gathers the expertise of a mix of academic, research, and industrial partners from five

countries, which bring both outstanding research and topic competence, as well as knowledge and access to the solution for end-user industries.

ColdSpark® is built on a strong consortium of 7 partners from Norway, Spain, Bulgaria, Germany, and the UK with SEID AS as a Coordinator.

More information about the project can be found at: www.ColdSpark.eu

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EXECUTIVE SUMMARY

The purpose of D7.7. Report on synergies with relevant initiatives, projects and programmes is to document the actions undertaken by the ColdSpark® consortium to build meaningful, long-term collaborations beyond the project's specific scope and duration. This report provides a consolidated overview of the strategies, outreach activities, and dialogue mechanisms implemented throughout the project, together with a mapping of all contacted initiatives, programmes, and projects. The document is structured as follows:

- Introduction, which provides the context of the Synergy Task, its methodological approach, objectives, and its relation to other deliverables within WP7 and the wider project framework.
- Cooperation network section, describing the categories of external projects, initiatives, and platforms engaged during ColdSpark®'s implementation, including participation in events, joint activities, meetings, and strategic exchanges.
- Action Plan implementation, offering an overview of the Synergy Action Plan, summarising the planned activities, their execution, and final observations on their effectiveness.
- Established synergies and success stories highlighting concrete examples of successful collaboration with other projects and initiatives, demonstrating how ColdSpark® leveraged complementary expertise and ongoing research efforts.
- Conclusions and Lessons Learned section reflecting on the consortium's experience in building synergies, identifying key lessons learned and recommendations for future cross-project cooperation.

Overall, the report captures the work undertaken by the ColdSpark® consortium to establish strategic connections with European and international initiatives in the fields of clean hydrogen

production, methane conversion technologies, energy systems, and carbon valorisation. It also presents the structured framework adopted by the consortium to support systematic synergy building and to ensure that ColdSpark®’s results contribute to and benefit from the broader innovation landscape.

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Abbreviation	Definition
GA	Grant Agreement
CA	Consortium Agreement
EC	European Commission

DEC	Dissemination, Exploitation and Communication
M	Month
LCA	Life Cycle Assessment
KER	Key Exploitation Result
KPI	Key Performance Indicator

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INTRODUCTION

Covering the entire duration of the ColdSpark® project, from M1 to M42, this deliverable consolidates the activities implemented under Task 7.4. Synergy with Relevant Projects and Initiatives. The aim of this task has been to identify, establish, and expand strategic collaborations that enhance the project's visibility, strengthen the relevance of its results, and ensure that ColdSpark® contributes effectively to the wider European innovation landscape in clean hydrogen production, methane conversion, and carbon valorisation.

Synergy-building has played a central role in ColdSpark®'s communication, dissemination, and exploitation strategy, being part of the actions described in Deliverables D7.1, D7.2, D7.3, where the initial Synergy action plan was developed. By connecting with related EU-funded research projects, industrial actors, scientific networks, and policy-driven initiatives, the consortium sought to broaden the project's reach, avoid duplication of efforts where possible, and maximise added value through joint activities. These included shared dissemination opportunities, participation in common events and platforms, coordinated messaging, cross-promotion, exchanges of technical insights, and alignment with ongoing European policy frameworks and strategic agendas. These interactions enabled the consortium to position ColdSpark® within a larger landscape of European innovation efforts, support knowledge exchange, and continuously validate the project's relevance in emerging scientific and industrial contexts.

In addition, the current report describes the methodologies applied for mapping relevant initiatives and selecting meaningful collaboration opportunities, outlines the cooperation network established during the project, and summarises the implementation of the Synergy Action Plan. It also highlights concrete examples of successful synergy actions, including joint events, strategic dialogues, and coordinated outreach activities carried out with projects such as TITAN, STORMING, and other Horizon Europe initiatives.

By documenting the results achieved under Task 7.4, this deliverable provides a comprehensive overview of ColdSpark®'s contribution to broader cross-project collaboration and its alignment with European research and innovation priorities. It also identifies lessons learned and suggests pathways for maintaining and expanding these connections beyond the end of the project, ensuring that the value of ColdSpark® extends into future scientific, industrial, and policy developments.

CONTEXT AND RELATION TO OTHER DELIVERABLES

Since the start of the project, Europroject, as the leader of communication and dissemination activities, has coordinated the practical implementation of the Synergy Action Plan with support from the project coordinator and all partners. A systematic approach was established early on,

including the creation of a structured mapping file to track relevant EU-funded projects and initiatives, their objectives, points of contact, communication channels, and potential areas of complementarity. This internal tool was continuously updated as new opportunities emerged and served as the operational foundation for outreach activities.

Engagement with projects funded under the same call topic, TITAN and STORMING, began in a very early implementation phase. Regular exchanges included email communication, online coordination meetings, and discussions on areas of mutual interest. These efforts led to the signing of an agreement for joint collaboration between project coordinators, enabling coordinated communication actions and shared participation in events.

Throughout the project, the synergy-building process remained dynamic. The mapping database was continuously enriched with new projects, networks, and initiatives, allowing the consortium to diversify its outreach. This resource supported multiple purposes, such as identifying opportunities for mutual promotion, aligning event participation, and targeting recipients for newsletters and announcements about project milestones. By broadening this cooperation network, the consortium enhanced its ability to disseminate results, attract relevant stakeholders, and create opportunities for cross-project engagement.

Through these ongoing efforts, ColdSpark® ensured that synergy-building was embedded in its communication and dissemination strategy, reinforcing the project's presence in the wider hydrogen and clean-energy research landscape and supporting the long-term impact of its results.

OBJECTIVES OF SYNERGY BUILDING ACTIONS

The synergies built through task 7.4 aimed to create meaningful and durable connections with actors operating in fields relevant to ColdSpark®'s scientific objectives, technological development, and long-term exploitation potential. The main goals were to:

- Explore **opportunities for cross-dissemination** and joint activities, including shared participation as speakers at scientific and industry events, co-organisation of webinars or workshops, and the establishment of a collaboration network capable of supporting continued exchange beyond the project duration.
- Improve **coordination** with complementary research efforts in hydrogen production, methane splitting, plasma technologies, carbon valorisation, and related sustainability assessment methodologies, reducing fragmentation and promoting convergence across European and global initiatives.
- Facilitate **structured knowledge transfer** between ColdSpark® and other projects or stakeholders by sharing insights on technological approaches, challenges, validation results, and

lessons learned at different stages of development and prepare the lessons learned transfer in the post-project phase.

- **Enhance dissemination and exploitation potential** by broadening the audiences reached through joint actions, strengthening visibility, and connecting ColdSpark® to communities that can support the uptake and industrial deployment of its results.

- Support **policy-relevant research** efforts of the European Union, particularly those aligned with the EU Hydrogen Strategy, the Green Deal, methane emissions reduction, energy system integration, and the Critical Raw Materials Act. Synergies contributed to aligning ColdSpark® with broader EU objectives while promoting its relevance within ongoing strategic dialogues.

Throughout the project lifetime, ColdSpark® partners actively explored opportunities for collaboration through proactive communication, attendance at networking events, and participation in scientific conferences both online and onsite. These efforts resulted in active dynamic collaboration with more than 20 initiatives, leading to joint dissemination actions, participation in shared events, exchanges on technological topics such as methane cracking and plasma processes, and increased awareness of ColdSpark® across the hydrogen innovation ecosystem. The collaborations contributed both to the scientific visibility of the project and to the strengthening of its exploitation pathway by aligning ColdSpark® with emerging trends and complementary research directions.

METHODOLOGICAL APPROACH

The synergy-building activities implemented under Task 7.4 followed a structured and iterative methodology designed to ensure that ColdSpark® could systematically identify, prioritise, and engage with relevant actors across the European research and innovation landscape. This approach aligned with best practices applied in Horizon Europe collaborative projects and ensured that synergy actions contributed meaningfully to ColdSpark®'s scientific, technological, and strategic objectives.

The methodological framework was shaped by the following overarching principles:

- **Relevance and complementarity** was the first of the applied guiding principles that was adopted in order to prioritise the most important collaborations. When reaching out to other projects, initiatives, and companies, the consortium tried to do so primarily with actors operating in sectors aligned with ColdSpark®'s scientific and technological focus having in mind the future exploitation pathways. The outreach strategy targeted initiatives connected to clean hydrogen production, methane splitting, carbon utilisation and advanced carbon materials, plasma-based conversion processes, etc. This ensured that engagement efforts were directed toward stakeholders with the

highest potential for meaningful collaboration, knowledge exchange, and post-project exploitation opportunities.

- **Alignment with Technological Advancement.** Synergy activities were continuously adapted to reflect ColdSpark®'s evolving technological maturity and strategic priorities. As the project advanced and the growing importance of carbon utilisation became a fact along with the increasing interest from industrial stakeholders in it, the focus of collaboration developed accordingly involving the higher level of cooperation with industries needing carbon.

- Although ColdSpark® is positioned in the highly specialised niche of methane splitting where the **risk of overlapping research** efforts was naturally limited and duplicating research efforts was not a primary concern, the consortium prioritised creating opportunities for shared learning and constructive comparison of technological approaches for hydrogen production, like water electrolysis and steam methane reforming. On the one side, this was needed for checking the efficiency of the cold methane splitting research path compared to other methods, and on the other side, it supported the development of the ColdSpark® technology itself and planning the utilisation of its products. This ensured that ColdSpark® could be consistently positioned within the broader hydrogen innovation ecosystem and contributing to the collective advancement of low-emission hydrogen technologies. Benchmarking against alternative hydrogen production routes formed a key element of the LCA and TEA analyses performed in WP6: Sustainability and techno-economic assessment of plasma methane cracking process. This comparison enabled the consortium to assess the environmental and economic sustainability of methane splitting in relation to established pathways for hydrogen and carbon production.



Figure 1. Benchmarking against other hydrogen production technology as part of the LCA analysis. Isabella Bulfaro presenting ColdSpark® during the 12th conference on Life Cycle Management 2025 in Palermo, Italy

- **Integration of synergy activities within all the communication, dissemination and exploitation** activities performed by the project partners ensured that they were fully embedded in the consortium’s broader strategy. This approach strengthened ColdSpark®’s outreach, visibility, and stakeholder engagement, while ensuring consistency in interactions with the project’s target audiences and coherence in the messages communicated by all partners.

A preliminary analysis of the European funding landscape covering Horizon Europe, Horizon 2020, national programmes, and thematic initiatives was conducted during the early months of the project with the support of all project partners. This initial mapping was the basis for the development of the first Synergy Action Plan submitted as part of the Dissemination, Exploitation and Communication Plan and a foundation for continuous monitoring of relevant projects throughout the project lifetime. As scientific and industrial developments evolved, the plan was adapted to incorporate new opportunities for collaboration, joint events, or exchanges on technical findings, especially in areas related to hydrogen production efficiency, plasma reactor performance, and carbon material applications. All these collaborations were continuously tracked in the same file.

The methodological approach also emphasised the importance of tracking the progress and outputs of other relevant European projects. Monitoring public results, scientific publications, and stakeholder activities in the fields of hydrogen production and raw materials enabled the

consortium to maintain awareness of emerging insights and trends. This information that was regularly shared by the partners during the Monthly Technical Committee meetings informed ColdSpark's communication priorities, facilitated technical exchanges on shared topics of interest, and ensured alignment with ongoing work across the broader European research community.

The synergy methodology in ColdSpark® adopted a multi-level perspective considering:

- **Project-level synergies**, with a high focus on initiatives funded under the same call topic and projects addressing similar technological challenges that included numerous meetings (both online and in person) with the ColdSpark® sister projects TITAN and Storming leading to internal discussions on how the technologies complement each other but also to the implementation of two webinars attracting the interest of relevant stakeholders. This level includes, however, other initiatives on hydrogen production, such as the Robinson project.
- **Cluster-level interactions** played an important role in positioning ColdSpark® within broader hydrogen and clean-energy innovation landscapes. Throughout the project, the consortium engaged with sectoral networks, research clusters, and professional associations working on hydrogen, energy transition, and plasma-based technologies. An example is ColdSpark®'s visibility within [Energy Transition Norway](#), where the project is featured as part of the national portfolio of clean-energy innovations. Through this platform, ColdSpark® benefited from cluster-level exposure to industry stakeholders, policymakers, and investors, including participation in outreach activities and investor dialogues highlighting Norway's emerging hydrogen solutions.

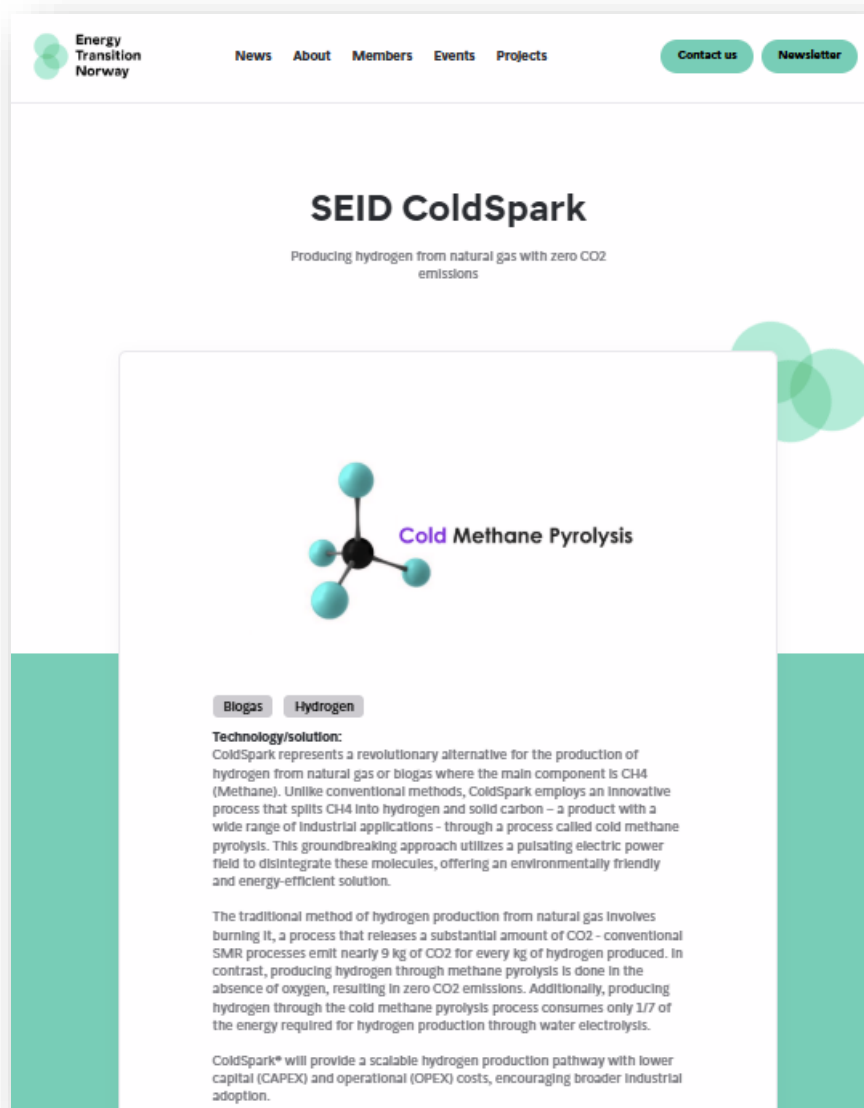


Figure 2. ColdSpark®'s subpage on the Energy Transition Norway website

Engagement with wider European associations, such as [Hydrogen Europe](#), further supported ColdSpark®'s understanding of sectoral roadmaps and regulatory developments, even though no formal cooperation framework is in place. These interactions helped ColdSpark® situate its technology within established hydrogen and decarbonisation networks, enhance its visibility among relevant stakeholders, and ensure coherence with broader industry trends and strategic priorities.



Figure 3. Dr. Maximilian Kuhn from Hydrogen Europe presenting during the [Critical Raw Materials and Beyond Webinar](#)

- **Strategic-level linkages**, connecting ColdSpark® with EU policy frameworks, industrial roadmaps, and long-term initiatives aimed at supporting the deployment of low-emission hydrogen and carbon-based materials. Throughout the project, its work was positioned in relation to flagship initiatives such as the EU Hydrogen Strategy, REPowerEU, the EU Industrial Strategy, and the Critical Raw Materials Act, all of which emphasise the need for low-emission hydrogen production and secure, sustainable carbon value chains. ColdSpark®’s participation in events like the European Biomethane Week and the European Biogas Conference further strengthened these connections by engaging the project with industrial roadmaps, sectoral associations, and ongoing policy dialogues shaping Europe’s decarbonisation trajectory. Through these interactions, ColdSpark® contributed to the broader strategic conversation on emerging methane-splitting technologies, reinforcing their potential role in Europe’s future hydrogen system and materials economy.

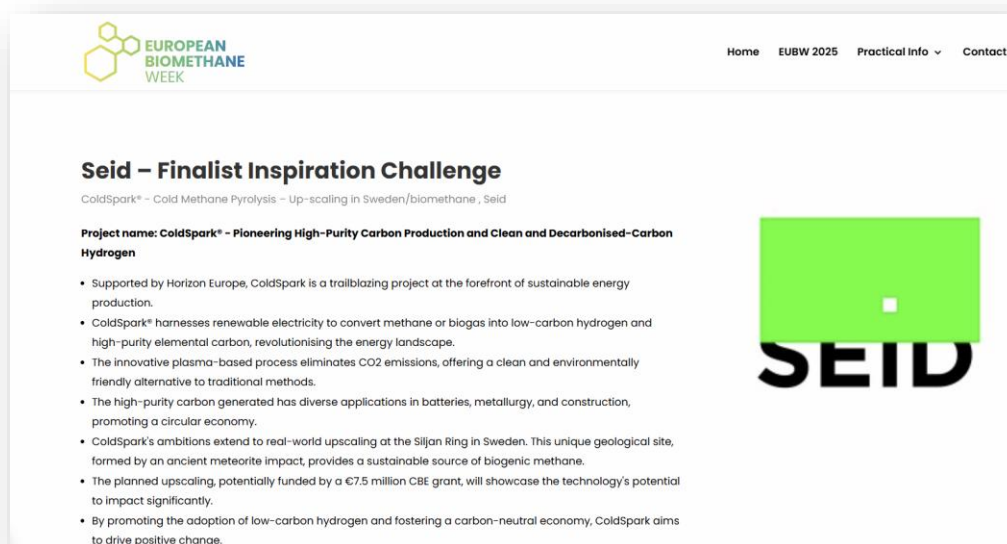


Figure 4. Information about SEID and ColdSpark® on the [European Biomethane Week website](#)

The adopted methodological framework ensured that ColdSpark® maintained a proactive and structured approach to synergy building, supported by coordinated efforts across all consortium partners. This also included the systematic assessment and handling of incoming requests from projects, initiatives, and stakeholders seeking collaboration, ensuring that opportunities were addressed consistently and aligned with the project’s strategic priorities.

It should be highlighted that from the very start of the project, partners recognised that synergy-building was an integral component of their work within the project, not an isolated activity. By consistently highlighting its importance in internal discussions and project management, the project coordinator helped ensure that this shared commitment translated into efficient use of resources and strong visibility, positioning ColdSpark® at the forefront of European innovation efforts. Thus, the cooperation framework was continuously viewed as a strategic opportunity to enhance the future development of the project’s results and to pave the way for new collaborations and partnerships during and beyond the project’s duration.

METHODOLOGY FOR ESTABLISHING SYNERGIES

The identification of potential synergies began with a systematic categorisation of external actors relevant to ColdSpark®’s scientific and strategic domains, which was a process in which all project partners were involved. This process was based on five major categories, reflecting different types of EU-funded, regional, and national initiatives with which synergies could be established. These categories supported the consortium in structuring the outreach strategy and defining different levels of priority, as explained below.

KEY AREAS FOR ESTABLISHING SYNERGIES

At the very beginning of the project, several thematic areas were identified as strategic priorities for establishing synergies with relevant initiatives. These priorities were directly derived from ColdSpark®'s scientific objectives, its technological positioning within methane splitting, and its ambition to explore viable industrial pathways for clean hydrogen production and carbon valorisation.

- **Hydrogen Production**

ColdSpark®'s core contribution to the European hydrogen landscape guided early collaboration efforts toward projects working on low-emission hydrogen pathways. The intention was to compare methodologies, conversion efficiencies, and techno-economic assumptions across different hydrogen production routes, and to explore complementarities with projects pursuing turquoise, blue, or renewable hydrogen solutions.

- **Methane Splitting and Pyrolysis Technologies**

As a project situated in a specialised field of non-thermal plasma methane cracking, ColdSpark® focused on engaging with consortia advancing various forms of methane pyrolysis. Collaboration provided opportunities to exchange knowledge on reactor designs, plasma performance, energy consumption, gas management, and pathways for CO₂-free hydrogen production.

- **Carbon Utilisation and Material Development**

Given the project's aim to valorise solid carbon co-products (eCarbon®), synergies were sought with initiatives working on carbon materials, circular carbon strategies, and advanced material applications. These exchanges enabled ColdSpark® to position its carbon output within broader carbon market trends and identify emerging industrial use cases.

- **Process and System Integration**

As the project progressed toward validation and optimisation, process-related synergies became increasingly relevant. These included collaboration on gas separation, energy efficiency, heat management, safety considerations, and integration of plasma reactors within broader energy or industrial systems. Such exchanges supported ColdSpark's internal optimisation work and its benchmarking against other state-of-the-art processes.

- **Industrialisation and Scale-Up Pathways**

In the later stages of the project, as ColdSpark® advanced toward TRL5 and began shaping its exploitation vision, synergies related to industrial deployment gained importance. Collaboration with stakeholders focused on market uptake, scalability, modularisation, cost competitiveness, and

industrial hydrogen strategies provided valuable insights for positioning ColdSpark® within emerging industrial value chains.

Together, these thematic areas guided the selection of relevant projects and stakeholders throughout the project lifetime. They provided the foundation for strategic engagement, the evolution of the Synergy Action Plan, and the development of meaningful collaboration opportunities aligned with ColdSpark's scientific progress and long-term ambitions.

As with communication and dissemination priorities, these thematic areas were dynamic and evolved alongside the project's technical development. In the second half of the project, the growing relevance of carbon utilisation, as both a source of potential revenue and a key component of the exploitation strategy, significantly increased the importance of collaboration in this domain. Exchanges with initiatives working on carbon materials, circular carbon practices, and industrial carbon applications became more important, reflecting ColdSpark's advancing TRL and the consortium's ambition to position eCarbon® within emerging markets. This adaptive approach ensured that synergy activities remained aligned with ColdSpark's technological advancement and exploitation needs.

STATIC AND DYNAMIC SYNERGIES

As a step further to the developing the collaborations, distinction was made between **static and dynamic synergies**. This distinction ensured that interactions with external projects, initiatives, associations, and industrial actors were categorised according to their intensity, strategic value, and expected impact, enabling flexible planning and effective follow-up throughout the project's lifetime.

Static synergies included low-intensity, visibility-oriented cooperations that do not require continuous interaction or joint activities. These synergies aim primarily to build mutual awareness and reinforce the project's presence within relevant EU and international innovation ecosystems. Such cooperations included discussions with other projects during events, sharing promotional materials, following each other on the social media and supporting each other through likes, resharing and comments, etc. Although these collaborations do not involve systematic effort, they contributed largely to broadening ColdSpark's outreach and ensuring that the project remains visible to stakeholders working on related technologies, policy areas, or industrial applications. The primary objective for static synergies implemented in the ColdSpark® project was cross-dissemination and mutual visibility. These synergies will continue to be actively pursued beyond the end of the project to support the transfer of ColdSpark's legacy, ensure uptake by other EU-funded initiatives, and disseminate the lessons learned. Ongoing collaboration with stakeholders will further contribute to sustaining engagement and will play a key role in post-project exploitation

activities, helping position the technology for future development and potential market deployment.

In contrast, **dynamic synergies** involve active, engagement-driven collaboration built on regular interaction, shared activities, and a clearly defined mutual interest. These synergies implemented during the lifetime of ColdSpark® required planned and coordinated effort and continuous follow-up from the consortium. A primary example for dynamic synergies implemented during the project implementation is our collaboration with the ColdSpark®'s sister projects TITAN and STORMING, which led to joint webinars, coordinated communication campaigns, and structured exchanges on technical topics such as the carbon valorisation, industrialisation opportunities and policy impact of the technologies developed. These collaborations will continue beyond the end of the project through ongoing communication via email and online meetings, enabling the partners to exchange insights, support one another's exploitation pathways, and disseminate the lessons learned. This continued dialogue may also create opportunities for forming new consortia and jointly pursuing future research and innovation initiatives continuing the achievements reached during the projects' lifetime.

Another important form of dynamic synergies involved large industrial stakeholders such as Michelin, Elkem, and others, who demonstrated sustained interest in ColdSpark®'s progress and closely followed the project's development throughout its different stages. These interactions took multiple forms, including continuous engagement through comments and feedback on the ColdSpark® LinkedIn account, participation in project-organised events such as the Critical Raw Materials and Beyond webinar and the Final Event, as well as bilateral meetings and discussions exploring potential areas of cooperation. These exchanges provided valuable insights into industrial needs and market expectations, particularly regarding eCarbon® applications and clean hydrogen pathways. It is anticipated that these relationships will continue beyond the project's lifetime, directly supporting post-project exploitation activities and fostering opportunities for future industrial uptake of the methane splitting technology.

The static and dynamic synergies developed throughout the project complemented each other and generated tangible added value for ColdSpark® by strengthening the project's visibility and ensuring mutual support across the wider innovation ecosystem. They enabled deepened engagement with industrial stakeholders, policymakers, and sectoral associations, supporting the project's efforts to position methane-splitting technology within the European hydrogen and carbon-materials landscape. Importantly, the breadth and diversity of these interactions contributed to a visible increase in global interest in methane splitting as an emerging technological pathway, reinforcing ColdSpark®'s relevance within international discussions on low-emission hydrogen and sustainable carbon production and supporting the wider scientific research on the topic. An example of the growing global interest and investment in methane splitting is the

[announced interest of ExxonMobil and BASF](#) to advance methane pyrolysis, which was followed by a communication with the project coordinator, relating these actions to the encouraging results achieved within the ColdSpark® project lifetime.



ExxonMobil and BASF join forces to advance low-emission hydrogen through methane pyrolysis technology

- Industry leaders team up to accelerate methane pyrolysis—a technology that produces low-emission hydrogen and solid carbon.
- Methane pyrolysis complements both companies’ technology portfolios.
- A demonstration plant is planned in Baytown, Texas, to validate the technology at scale.

Figure 5. ExxonMobil and BASF announcing their interest in further development of methane pyrolysis technology

The methodology adopted for synergy-building followed a step-by-step, structured approach that ensured consistency, transparency, and the effective use of project resources.

• Mapping relevant projects and initiatives

The consortium conducted a systematic analysis of active and past projects in areas linked to hydrogen production, methane splitting, plasma technologies, carbon utilisation, and sustainability assessments. A dedicated synergy database was created and maintained on the project internal workspace, serving as a central reference for mapping potential collaborations and monitoring engagement activities. Full list of the mapped opportunities is provided in Annex 2.

Major categories	Number of identified synergies
On-going projects	10
Ended projects	7
European initiatives	1
Clusters and associations	6
TOTAL	24

Table 1. Identification of potential synergies

- **Establishing initial contact**

Once a project or initiative was identified as relevant, the consortium initiated communication with its representatives via email and if the interest was confirmed, the communication was continued on a later stage with virtual meetings and/or in-person meetings. These exchanges aimed to introduce ColdSpark®, identify areas of mutual interest, and explore opportunities for collaboration.

- **Developing collaboration mechanisms**

Where mutual interest was confirmed, the consortium discussed internally and suggested suitable formats for collaboration, such as cross-dissemination activities, co-organisation of events, etc.

- **Continuous engagement and monitoring**

Maintaining active communication was a critical component of the methodology. Regular follow-up ensured sustained collaboration, timely exchange of updates, and alignment with ColdSpark®'s evolving research activities. This also allowed the consortium to monitor other projects' developments and incorporate relevant insights into ColdSpark's dissemination and exploitation strategies.

The continuous engagement with stakeholders via regular email communication, sharing of newsletters and project updates, bilateral meetings, LinkedIn tags and messaging, participation in events, etc. helped build trust, foster a sense of mutual support, and strengthen long-term relationships. This sustained interaction significantly enhanced stakeholder commitment and is expected to support their active involvement in future activities related to ColdSpark®'s technological development and exploitation pathways.

Although not unnecessary complicated, this methodology was implemented continuously on consortium level and allowed ColdSpark® to maintain a well-organised and purpose-driven approach to external engagement, ensuring that synergies contributed effectively to the project's visibility, outreach, and long-term impact.

SYNERGY BUILDING ACTION PLANS AS PART OF THE DISSEMINATION, EXPLOITATION AND COMMUNICATION PLANS OF THE PROJECT

From the outset of the project, the ColdSpark® consortium adopted a structured and iterative Synergy Action Plan designed to guide cooperation with relevant EU-funded projects, initiatives, networks, and industrial stakeholders. The Action Plan was first outlined in D7.1 Plan for Dissemination, Exploitation and Communication (M6) and subsequently refined in D7.2 (M12) and D7.3 (M24) updates, as new opportunities emerged and in line with the project's technical advancement. The overarching objective of all Synergy Action Plans was to maximise ColdSpark®'s impact by fostering collaboration, avoiding duplication of effort, and supporting knowledge exchange across complementary research and innovation activities.

The **initial synergy framework** was created as part of D7.1. It focused on several initial actions that had to be implemented by the whole consortium:

- Identifying running and completed EU projects, initiatives, clusters, and networks with similar or complementary objectives.
- Analysing their relevance to ColdSpark®'s themes (hydrogen, methane splitting, carbon utilisation, plasma processes, LCA/TEA methodologies).
- Establishing first contact with coordinators and consortium partners.
- Initiating possible collaboration mechanisms, including cross-dissemination, joint participation as speakers, co-organisation of events, and cross-project demonstrations.

These actions were foreseen to run from M1 to M42, with a flexible structure allowing newly identified opportunities to be integrated throughout the project's lifetime.

Operationalisation of the synergy action plan was pushed with the creation and submission of the M12 update of the Plan for Dissemination, Exploitation and Communication (D7.2). EP operationalized the created in the first months shared mapping database documenting relevant projects, their objectives, websites, social media channels and contact points. The main actions during this period included:

- Close collaboration with the two sister projects (TITAN and STORMING) started earlier through email exchanges, online meetings, and the signing of an Agreement for joint work. Both projects expressed interest in ColdSpark® and confirmed participation in the first joint workshop.
- Additional projects and initiatives were added to the mapping file as the consortium broadened its network.
- Outreach activities, such as including mapped projects in email campaigns was already operationalized.

This phase marked the transition from planning to active engagement.

The **expansion of synergy actions** was further supported by the M24 update of the Plan for Dissemination, Exploitation and Communication (D7.3). It presented a more mature version of the Action Plan, reflecting the increased volume of interactions and the emergence of several dynamic synergies. The plan focused on three main topics providing more detailed guidelines to all project partners:

- Exchange of Information, including regular sharing of project updates, results, and key outputs with TITAN, STORMING, and other identified initiatives (e.g., ROBINSON).
- Conducting online meetings and thematic discussions to explore complementarities.
- Joint Participation in Events
- Identification of conferences and policy events offering opportunities for shared presence.
- Planning and executing co-organised activities such as joint workshops, panel discussions, and coordinated event attendance.
- Supporting visibility through participation in EU-level events and relevant sectoral conferences.
- Alignment of dissemination activities including cross-promotion on LinkedIn and coordinated social media campaigns linked to key milestones and events, publishing joint updates, news items, and dedicated articles on websites especially ones concerning the joint webinars organised.

Across D7.1–D7.3, the Synergy Action Plan evolved from an initial strategic framework into a fully operational and dynamic mechanism supporting ColdSpark®'s collaboration efforts. By the end of the project, it had facilitated the following actions within the project:

- Systematic outreach to relevant EU-funded projects and initiatives.
- Strong cooperation with sister projects TITAN and STORMING.
- Coordinated participation in conferences, webinars, and events.
- Active engagement with industry stakeholders and research clusters.

This structured progression ensured that synergy building remained aligned with ColdSpark®'s scientific development, communication objectives, and exploitation priorities, ultimately contributing significantly to the project's visibility and impact.

ESTABLISHED SYNERGIES AND SUCCESS STORIES

COOPERATION WITH TITAN AND STORMING PROJECT

(Bio)methane cracking: solutions for carbon-negative hydrogen and solid carbon production webinar

One of the most successful synergy actions carried out under Task 7.4 was the organisation of the joint webinar [“\(Bio\)methane Cracking: Solutions for Carbon-Negative Hydrogen and Solid Carbon Production,”](#) held online on 27 September 2023. The event brought together the three sister projects ColdSpark®, TITAN and STORMING publicly for the first time and attracted a remarkable audience of 111 participants from industry, academia, research, and policymaking across Europe.

The webinar showcased the strong interest in methane splitting as a route to clean and carbon-negative hydrogen and demonstrated the power of collaboration between projects funded under the same Horizon Europe call topic. Participants included experts, innovators, investors, and public-sector representatives that clearly showed their high interest in understanding the new technology the three projects are working on and their possible role in the hydrogen use in Europe.

The event was opened with a high-level policy presentation delivered by Piero Carlo Dos Reis (DG CLIMA C1, European Commission), highlighting EU policy developments for methane and hydrogen and outlining critical gaps for the coming years and Luigi Crema (Hydrogen Europe), emphasising the role of research and innovation across the entire hydrogen value chain and discussing opportunities and constraints influencing the sector’s development. These presentations set the scene for understanding how the new technologies developed by TITAN, Storming and ColdSpark® can support Europe’s climate-neutrality objectives. The core of the webinar featured presentations from the three organising projects:

- ColdSpark® was presented by Terje Hauan, the ColdSpark® project coordinator who explained in details the non-thermal plasma process for splitting methane into clean hydrogen and high-purity eCarbon®.
- The TITAN coordinator, David Farrusseng, introduced the developed within their project microwave-heated catalytic reactor for producing hydrogen and solid carbon with high thermal efficiency, using bio-based methane streams.
- Patricia Benito from STORMING demonstrated the catalytic reactors generating hydrogen and valuable carbon nanotubes from methane and biogas.

Together, these presentations offered an excellent comparative overview of plasma, catalytic, and thermochemical approaches to methane pyrolysis providing attendees with a perspective on the promising new technologies developed by the three projects.

The webinar concluded with an interesting panel discussion moderated by Dusan Jakovljevic (EEIP), bringing together Marina Pasteris from the European Biogas Association (EBA), Anton Scholten from HyGear, and Zhixin Yu from the University of Stavanger (UIS). In the discussion, the panelists explored the synergies among the projects, their replication potential and possibilities for industrial

uptake, regulatory challenges, and the future of methane splitting in Europe’s clean energy transition.

This first joint event organised by the three sister projects was widely recognised as an important step forward in strengthening collaboration among the consortia. It was evaluated as highly successful due to its rich and well-structured content, the strong interest demonstrated by attendees, and the high level of engagement throughout the session. Additionally, the webinar facilitated better communication between the projects, supported cross-project learning, and significantly increased visibility for all three initiatives. By bringing their audiences together, the projects succeeded in initiating productive discussions and fostering a shared understanding of emerging technological pathways.

The webinar and its outcomes were further promoted across the websites and social media channels of the three projects. Each consortium published dedicated posts highlighting the key messages. ColdSpark® in particular published a [short video](#) on its LinkedIn account capturing the event’s highlights.

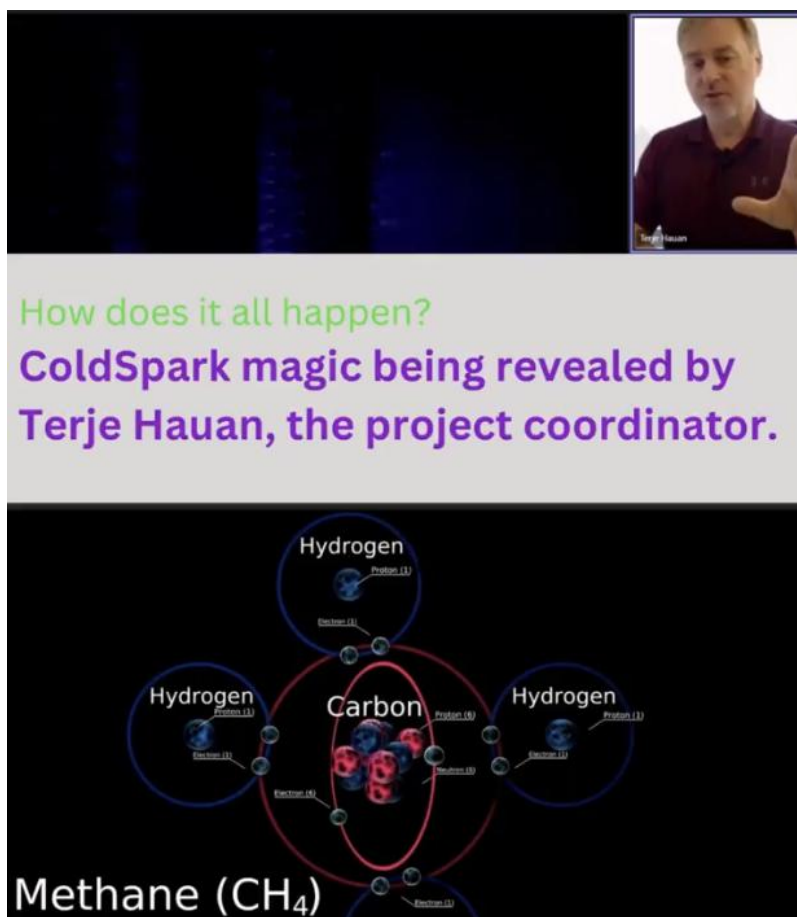


Figure 6. Terje Hauan explaining the idea behind the ColdSpark® technology during the (Bio)methane cracking webinar

“Critical Raw Materials and Beyond: Methane Splitting for Strategic Value Chains” Webinar

Another significant milestone in ColdSpark®’s synergy activities was the successful organisation of the international webinar “[Critical Raw Materials and Beyond: Methane Splitting for Strategic Value Chains](#),” held on 25 June 2025. Initiated, organised, and managed entirely by the ColdSpark® consortium, the event gathered more than 120 participants from across the globe. Our sister projects TITAN and STORMING readily joined as co-speakers, strengthening cross-project collaboration and demonstrating the value of coordinated outreach between projects funded under the same Horizon Europe call.

The webinar attracted a broad audience of researchers, policymakers, industrial partners, investors, and technology developers, reflecting the growing interest in methane splitting as a pathway for clean hydrogen production and strategic carbon materials. A notable highlight was the active participation of [Michelin](#) and [Elkem](#), which was a clear sign of concrete industrial interest in the technologies being developed under the three EU projects and especially by ColdSpark® that initiated the interaction and invited them to the event.

The session opened with a keynote by Maximilian Kuhn ([Hydrogen Europe](#)), who outlined the strategic role of methane splitting for reducing Europe’s CO₂ footprint, lowering hydrogen transport costs, and strengthening access to critical raw materials such as graphite and carbon black. His presentation provided a solid policy and industrial framework for the technical presentations that followed.

All three projects, ColdSpark®, TITAN, and STORMING, presented their technological concepts and results, with particular emphasis on exploitation opportunities considering the fact that all of them were approaching their final stages. The webinar highlighted the diversity of the projects’ technological pathways, namely cold methane splitting, microwave-heated catalytic reactors, and structured iron-based catalytic systems but at the same time the possibilities for productive cooperation. Special attention was given to opportunities for scaling, validation, and continuation of research towards market-readiness.

The industry contributions mentioned above offered valuable insights into potential applications of carbon by-products.

- Pierre Laurent (Michelin) discussed the potential of sustainable carbon blacks to support circularity and reduce the tyre industry’s environmental impact.
- Kristian Stangeland (Elkem) emphasised the increasing demand for low-carbon carbon materials and the importance of diversifying carbon sources within European value chains.

The webinar included 8 [SLIDO-based polls](#), which were an excellent snapshot of stakeholder expectations from the projects and the hydrogen and raw materials context in general and

provided guidance on the projects’ future exploitation. The [results of the poll are available on the ColdSpark® webpage](#) and show some major insights that can be summarised as follows:

- There is a strong interest in clean hydrogen from (bio)methane, industrial decarbonisation, and solid carbon materials, while identifying sector-wide challenges, such as technological maturity, scale-up needs, policy incentives, and carbon market development as key barriers to deployment.
- A majority of the participants viewed methane splitting or pyrolysis as promising routes for low-carbon hydrogen by 2030, provided that sustainability performance is demonstrated and solid carbon is effectively valorised.
- Respondents also indicated potential markets for solid carbon by-products, particularly in steel, construction, rubber, and battery materials, though further validation is needed.

Audience engagement remained high throughout the event, with more than 30 questions received during the interactive Q&A session. The closing panel, moderated by Michael Köttner (IBBK), addressed technological challenges, industrial uptake conditions, regulatory enablers, and research needs for advancing methane splitting technologies. Participants expressed interest in maintaining the dialogue beyond the event, recognising that while the technologies are still maturing, they hold significant potential for Europe’s clean energy transition and raw-material resilience.

Overall, the webinar stands out as a very successful example of dynamic synergy-building, demonstrating ColdSpark®’s leadership in convening research, industry, and policy actors. It strengthened cross-project cooperation, enhanced visibility for the three projects, and supported the emergence of a shared European vision for low-emission hydrogen and strategic carbon materials.

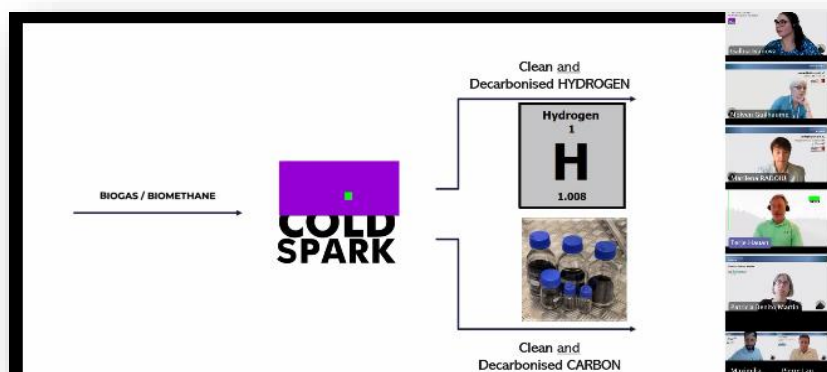


Figure 7. ColdSpark presentation during the Critical Raw Materials and Beyond webinar

COLLABORATIONS WITH PROJECT STAKEHOLDERS

Engagement with industry stakeholders has been an essential component of ColdSpark®'s synergy-building activities, supporting the project's aim to align the developed methane-splitting technology with real industrial needs and future exploitation pathways. Throughout the project, the consortium maintained an active dialogue with companies from sectors such as advanced materials, energy production, hydrogen utilisation, and carbon-intensive industries. These interactions helped validate ColdSpark®'s technological direction, identify potential markets for eCarbon®, and explore opportunities for technology deployment.

A key moment in this cooperation were meetings of all partners with industry stakeholders that were organised as part of the ColdSpark® meeting and stakeholder visits held in Stavanger in April 2024, where the project consortium met with representatives from companies that showed clear interest in the development of the ColdSpark technology, and especially in the potential of solid-carbon products derived from methane splitting.

A visit to [CealTech](#), a company specialising in the development and commercialisation of graphene-enabled products and advanced carbon solutions, provided valuable insights into the potential applications of ColdSpark® e-Carbon®. CealTech's broad portfolio including raw graphene materials needed for diverse products offered concrete examples of market segments where high-purity solid carbon could be deployed. The project partners were able to receive first-hand information from the company managers and to learn a lot about the carbon properties that the company needs. This information was quite useful for better understanding of the performance requirements and inspired further exploration of e-Carbon®'s suitability for advanced material applications.

Another important synergy activity took place during a meeting with [Beyonder](#), where discussions focused on the potential utilisation of ColdSpark® e-Carbon® in battery production. The exchange provided partners with a deeper understanding of battery manufacturing processes, material specifications, and the specific properties required for carbon to serve as an effective component in energy-storage applications. This dialogue contributed to shaping ColdSpark®'s exploitation strategy by highlighting both the opportunities and technical criteria associated with the battery sector.



Figure 8. ColdSpark® team visit to the Beyonder premises

SEID AS as the main technology developer continuously complements these interactions with on-site visits to the SEID plasma centre, offering industry representatives the opportunity to observe the plasma reactor environment, understand process requirements, and engage directly with engineers working on the technology. These visits foster trust and strengthen the awareness of important stakeholders of ColdSpark®'s unique low-temperature methane splitting approach increasing the possibilities of attracting future investments allowing the continuation of the project development to its full market deployment. Started quite early in the project implementation, these visits are not limited to the project lifetime and will be actively continued beyond it. So far, SEID's plasma center has been visited by more than 100 industry representatives including possible investors.

The continuous communication with industrial actors such as Michelin and Elkem, which was demonstrated during the 2025 webinar but also supported by continuous communication and meetings, contributed to identifying potential application areas for eCarbon® in rubber, construction, battery materials, etc. This feedback from industry representatives supports greatly the framing of ColdSpark®'s value proposition and the development of the exploitation strategy of the project fully developed in D7.6. Overall, the cooperation with industry stakeholders provided significant added value to ColdSpark®, enabling the consortium to:

- test the relevance of its innovations against real market conditions,
- explore industrial use cases for both hydrogen and solid carbon,
- refine its exploitation planning with direct industrial input, and
- create foundations for future partnerships beyond the end of the project.

These synergies ensured that ColdSpark® remained connected to industrial developments and market expectations, supporting the long-term positioning of its methane-splitting technology within European strategic value chains.

Robinson Project presentation and site visit

ColdSpark® has established a continuous cooperation with the [ROBINSON project](#), whose core objective was to develop and deploy a smart, modular energy-management system for industrialised islands, integrating renewable energy sources, biomethane production and hydrogen-related technologies. The ROBINSON system includes renewable-electric, anaerobic-digestion, biomethane, hydrogen electrolyser and gas-turbine solutions. The continuous cooperation and exchange of ideas and experience between the ColdSpark® and ROBINSON coordinators was further developed in an [in-person meeting with all project partners held in Norway in April 2024](#).

Both consortia identified the value of aligning their activities. A valuable experience was to explore how methane-derived hydrogen technologies can integrate with local hydrogen clusters and island applications. Given ROBINSON's focus on biomethane and modular hydrogen systems, the collaboration offered a promising opportunity for sharing insights on feedstock flexibility, hydrogen supply systems and value-chain integration.



Figure 9. Discussions with Robinson project

The dialogue was concentrated on the exchange on biomethane sourcing, joint stakeholder outreach, knowledge transfer on techno-economic and sustainability assessment and more. This collaboration enhanced ColdSpark®’s visibility beyond the technology developed and positioned it more firmly within a broader hydrogen ecosystem. It also encouraged partners to discuss actively the future applications of the technology and supported the planning of the project’s exploitation routes. The cooperation between ColdSpark® and ROBINSON marks a strategic synergy that aligns ColdSpark®’s cutting-edge methane-splitting technology with system-level hydrogen deployment initiatives.



Figure 10. Visit to the Electrolyser developed within the Robinson project

ColdSpark® at Storming Final Event

ColdSpark® actively contributed to the STORMING Final Event, held on 7 October 2025 in Arnhem, the Netherlands. Organised by STORMING in collaboration with HyGear, the event marked the conclusion of this Horizon Europe project and gathered partners, sister projects, and stakeholders. ColdSpark®'s participation was an important opportunity to strengthen cross-project collaboration, exchange results, and highlight complementary approaches to CO₂-free hydrogen production.

During the morning session dedicated to sister-project collaboration, ColdSpark® was represented by project coordinator Terje Hauan, who presented the project's non-thermal methane-splitting technology. His presentation provided an overview of ColdSpark®'s reactor concept, experimental results, and the project's approach to producing CO₂-free hydrogen and high-purity solid carbon without the need for catalysts or high temperatures. This presentation complemented the catalytic

and electrically heated reactor technologies showcased by STORMING and TITAN, illustrating the diverse pathways currently under development in Europe for methane cracking.

ColdSpark®'s contribution played a central role in positioning the project within the broader clean hydrogen value chain discussed at the event. Together with TITAN and STORMING, ColdSpark® demonstrated how shared research and coordinated dissemination under the same call topic contribute to advancing European know-how in hydrogen production, process electrification, and carbon valorisation. The Storming final meeting also included insights from related Horizon Europe projects eQATOR and e-CODUCT, enabling cross-project learning on catalytic systems and electrical heating methods relevant to the wider methane-splitting community, which provided an opportunity for ColdSpark® to engage deeper in discussions with them.

Participation in the event offered the consortium valuable exposure to the latest scientific and technical advances presented by STORMING, including reactor electrification strategies, structured catalytic designs, additive manufacturing of monoliths, and pilot-scale validation. These results provided ColdSpark® with additional reference points for comparing methane splitting with catalytic routes and informed ongoing discussions on technology readiness, scalability, and environmental performance.

In the afternoon, ColdSpark® joined the on-site visit to HyGear's laboratories, where STORMING showcased its prototype reactor. This demonstration provided insight into the design and performance of an electrified catalytic system and created opportunities for technical dialogue on reactor configuration, integration into industrial settings, and potential future upscaling.

Overall, ColdSpark®'s participation in the STORMING Final Event contributed significantly to dynamic synergy-building between the three sister projects. It reinforced ColdSpark's visibility within the European methane-splitting ecosystem, supported knowledge exchange across technological pathways, and highlighted the importance of coordinated European research efforts in supporting the transition toward cleaner hydrogen and sustainable carbon materials.



Figure 11. ColdSpark® Project Coordinator Terje Hauan Participation in a Discussion During Storming Project Final Event

ColdSpark®'s Workshop during Biogas VI Conference and Collaborations with biogas and biomethane sectors

Cooperation with the biogas sector has played a crucial role throughout the entire project implementation. Almost from the start of the project IBBK has started communicating ColdSpark®'s ambition for hydrogen and elemental carbon production via non-thermal plasma to the biogas and biomethane sector by actively looking for speaker opportunities and by presenting the project through roll-up, poster and flyers at national and international conferences and trade shows. Starting from M2 of the project IBBK has presented ColdSpark® in 17 national and 24 international conferences and trade fairs either in oral presentation, with a poster or using IBBK's vast network

for spreading flyers directly to contacts. Amongst the conferences were such prestigious events as the International Water Associations (IWA) 18th World Conference on Anaerobic Digestion where more than 500 participants, mainly from academia and research, from 43 countries were present. Michael Koettner from IBBK gave an oral presentation about the benefits and technology of ColdSpark®'s non-thermal plasma. During presentations at the Future of Biogas Europe Conferences in 2022, 2023, 2024 and 2025 IBBK reached beyond the typical biogas and biomethane sector by delivering the presentation to oil and gas industry representatives who use this format to assess business opportunities in the biogas and biomethane sector. Specifically with the focus of reducing their CO₂-footprints. Through these activities IBBK has reached approximately 5.300 persons, thus contributing considerably to the project's communication activities. In addition to attending conferences and trade shows, IBBK used its own events – from national and international online and face-to-face trainings to its own international conferences – to inform every participant about the project using multiple tools like including ColdSpark® into presentations, supplying project flyers to every participant, displaying the roll-up and not least direct conversations on the ambitions, the status and the (intermediate) results of the project. Via these activities at least 700 flyers have been distributed throughout the whole project period.

Direct conversations proved to be valuable to get feedback from the biogas community and relay this back to the project team. Over the period of the project a clear shift in perception became visible. While the audience in the beginning can be described as “carefully interested, but skeptical” the combined efforts of the project team in communicating the main messages and the stakeholder specific messages conversations at the end of the project showed that especially the eCarbon® raised interest. Especially when produced from biomethane this carbon is seen as a means to withdraw carbon from the atmosphere, provided it is used in long-lasting applications. This view is in line with the findings of the LCA and TEA that have been done in WP6. An important game changer in the perception was the visible carbon product from the demonstration unit, proving the technical development that has continuously been going during the project period. To the very end of the project that has led to interest from the biogas sector to visit the test site at SEID which will be followed up after the end of the project as part of post-project communication.



Figure 12. Introductory presentation of the project during the ColdSpark® workshop organized as part of the Progress in Biogas VI Conference

ColdSpark® strengthened cooperation with the biogas and biomethane sector through the organisation of a [dedicated workshop](#) at [the Progress in Biogas VI Conference](#), organized by IBBK and held on 3 September 2024 in Stuttgart, Germany. As one of Europe’s major forums for anaerobic digestion and renewable gas solutions, the conference provided an effective platform to present ColdSpark®’s plasma-based methane splitting technology to a highly relevant stakeholder community.

The workshop featured four scientific presentations from SEID AS, the University of Liverpool, the University of Stavanger, and IREC, each highlighting the potential of methane splitting to complement and enhance the anaerobic digestion value chain—ranging from plasma electrification and Power-to-X integration to the production of ultra-pure carbon materials and the environmental performance of the ColdSpark® process. Moderated by Katrin Kayser from IBBK, the session attracted strong interest and sparked lively discussions with technology developers, plant operators, researchers, and consultants active in the German biogas sector.

Importantly, the event created a valuable networking opportunity with German biogas stakeholders. Many participants expressed interest in potential applications of plasma-based methane conversion within existing biomethane infrastructures, including options for carbon valorisation and low-carbon hydrogen production. These exchanges broadened ColdSpark®’s outreach within one of Europe’s most advanced biogas markets and generated new contacts for potential collaboration.

The workshop was followed by several technical site visits to biogas plants in the region, organised by IBBK. These visits offered an excellent opportunity for ColdSpark® partners to gain first-hand insights into plant operations, upgrading pathways, feedstock challenges, and market conditions in Germany. The direct dialogue with plant operators helped the consortium better understand practical needs and constraints in the sector, informing future considerations on possible integration scenarios between anaerobic digestion, biomethane upgrading, and plasma-based methane splitting technologies.



Figure 13. Technical visits and discussions organized as part of the Progress in Biogas VI Conference

Overall, the engagement at Progress in Biogas VI and the subsequent biogas plant visits significantly contributed to ColdSpark®’s synergy-building efforts. They reinforced the relevance of the technology for the biogas industry, expanded the consortium’s stakeholder network, and laid foundations for future cross-sectoral collaboration in the field of renewable gases, biohydrogen production, and circular carbon valorisation.

European Biomethane Week

ColdSpark®’s involvement in [European Biomethane Week 2024](#) (EBW 2024) marked a key moment of cross-sector outreach and strategic positioning within the European biogas/biomethane community. EBW 2024, organised by European Biogas Association (EBA), took place 21–25 October 2024 and gathered stakeholders from across the renewable gases value chain including industry, research, policy, and finance.

At EBW 2024, [ColdSpark® was selected as one of the six finalists](#) in the “EBA Inspiration Challenge 2024,” an initiative aimed at showcasing innovative ideas across the biogas and biomethane sector. The final selection emphasized the credibility of ColdSpark®’s novel methane-splitting process as a technological route aligned with sustainability and circular-economy goals. This recognition also provided strong external validation of ColdSpark®’s value proposition and opened a window for dialogue with a broad network of stakeholders active in biomethane, biogas upgrading, waste-to-energy, and renewable gases.

Participation in EBW 2024 contributed to ColdSpark®’s synergy objectives in several important ways:

- Exposure to a broad EU stakeholder community including actors from across the biomethane/biogas value chain offering ColdSpark® a unique opportunity to promote methane-splitting as a complementary pathway to biomethane, especially in contexts where biogas or biomethane is available as feedstock.
- Validation of innovation by peers especially as one of the finalists of the Inspiration Challenge and boosting the synergy activities with them. This led to enhanced visibility among peer projects, industrial players, and financiers.
- Informal and formal interactions at the event allowed ColdSpark® to engage with potential stakeholders interested in integrating methane splitting, hydrogen production, and carbon valorisation into existing biogas/biomethane infrastructures and opened paths for future cross-sector synergies, follow-up discussions, and possible pilot or deployment collaborations.

This event turned ColdSpark® into an important part of the European biogas/biomethane agenda and strengthened the case for methane splitting technologies as part of a diversified, low-carbon value chain in the European energy transition context. This was an important step in gaining public recognition through EBA channels and media related to the Inspiration Challenge.



Figure 14. ColdSpark® featured as Inspiration Challenge Finalist on LinkedIn

SYNERGIES DURING THE COLDSPARK® FINAL EVENT

The ColdSpark® Final Event, jointly organised by SEID AS, the University of Stavanger (UiS), and Europroject (EP), represented a major milestone of the project’s outreach and cooperation efforts. Beyond presenting the project’s technological achievements, the event successfully mobilised a highly interested network of research, industry, and public-sector stakeholders, demonstrating the strong cross-sector relevance of methane splitting.

The event attracted over 30 confirmed participants across Europe and internationally, covering key sectors such as hydrogen and energy research, plasma physics, battery technology, public administration, and industrial carbon applications. The event was held exclusively in person to encourage meaningful, face-to-face interaction and to ensure that participation came from genuinely interested stakeholders, thereby maximising the potential for future exploitation opportunities. This deliberate choice prioritised the quality and depth of engagement over numerical attendance, acknowledging in advance that the target of 100 participants will not be reached. Attendees represented organisations including IFE (Institute for Energy Technology), UiS, Elkem, Equinor, and other industry stakeholders, as well as researchers in the field. Their presence

confirmed the growing interest in ColdSpark® technologies from both established industrial players and emerging research groups.



Figure 15. Interaction with the audience through SLIDO session during the ColdSpark® final event

The live demonstration of the ColdSpark® reactor, combined with a dedicated networking and poster session, provided a practical platform for exploring future cooperation. Participants expressed interest in potential applications of eCarbon®, opportunities for integration in existing industrial processes, and further collaboration beyond the project scope. The presence of early-stage researchers alongside senior industrial decision-makers created a balanced environment where technology, policy, and market considerations were meaningfully connected.



Figure 16. Stakeholders visit at the SIED's plasma center organized as part of the ColdSpark® final event

Although the sister projects STORMING and TITAN were contacted and formally invited, their representatives were unable to attend due to a lack of available financial resources following the completion of their projects. Nevertheless, both sister projects consortia expressed strong interest in ColdSpark®’s final results, requested follow-up information, and confirmed their willingness to continue collaboration through online meetings beyond the project’s end.

Through this event, ColdSpark® effectively consolidated the synergy networks built during the project. It strengthened the links with industrial stakeholders and the wider scientific community laying a strong foundation for continued dialogue and future exploitation activities. While marking the formal end of the project, the event also initiated the next phase of engagement, supporting ColdSpark®’s ambition to bring plasma-based methane splitting closer to market readiness and broader deployment.

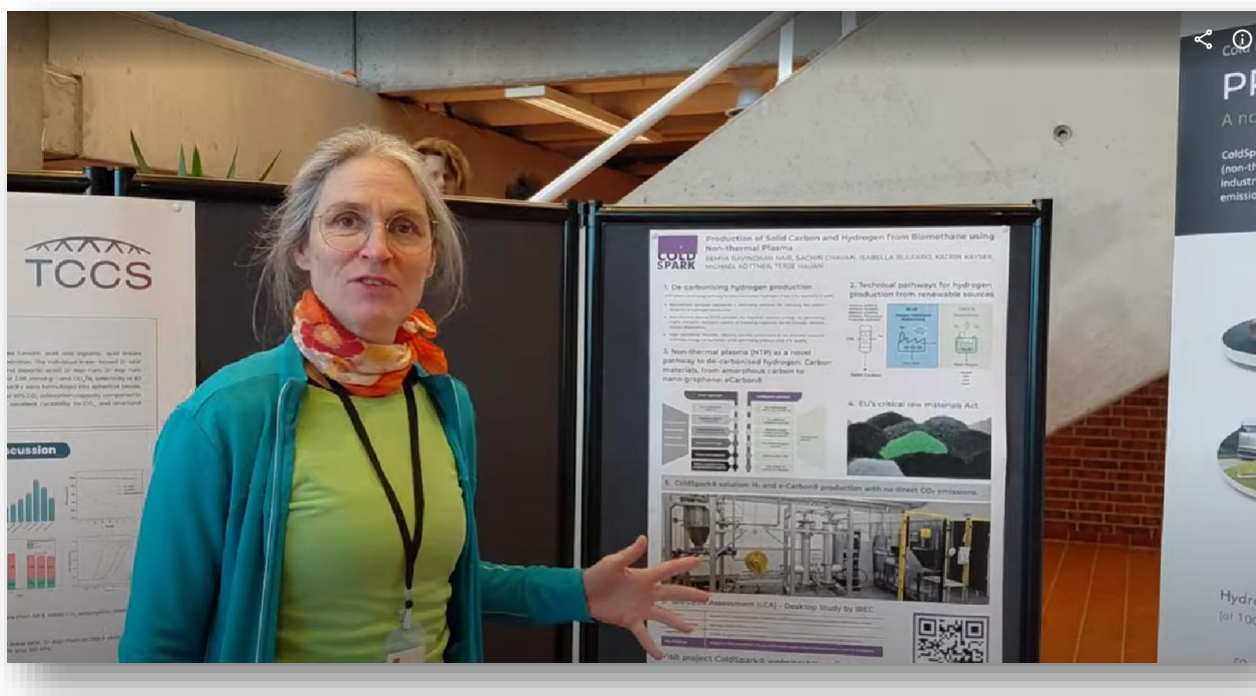


Figure 17. Poster session during ColdSpark® final event

SOCIAL MEDIA AS A DRIVER TO SUCCESSFUL MAINTENANCE OF PROJECT SYNERGIES WITHIN THE PROJECT LIFETIME AND BEYOND IT

The ColdSpark® LinkedIn page has proven to be one of the most effective instruments for both static and dynamic synergies development with projects, industrial stakeholders, and related EU initiatives. Beyond serving as a dissemination channel, it evolved into a dynamic space for

collaboration and dialogue, complementing traditional networking and event-based communication.

Throughout the project, LinkedIn was systematically used to promote joint webinars, stakeholder meetings, final events, and cross-posts from the TITAN, STORMING, and other related initiatives. This approach amplified ColdSpark®'s visibility but also strengthened the sense of a shared innovation ecosystem advancing plasma-based methane splitting and related clean hydrogen technologies.

Analytics data confirms the important role of LinkedIn in the synergy processes. Organic impressions typically ranged up to a hundreds per day, with peaks corresponding to synergy-driven campaigns, eg. in November 2024 (EBA Inspiration Challenge) and June 2025 when the Raw Materials webinar with the sister projects was held.

Engagement metrics demonstrate that synergy-related posts consistently outperformed baseline activity, frequently exceeding a 10% engagement rate and generating higher levels of interaction. These peaks reflect not only audience interest but also the effectiveness of cross-tagging which was implemented during the promotion of cross activities and the power of coordinated reposting and content alignment between the sister projects. This was an excellent asset in the general communication activities of ColdSpark®.

Overall, the ColdSpark® LinkedIn channel has proven to be a valuable synergy and cooperation tool by:

- Reaching and mobilising stakeholders around joint events, webinars, and campaigns;
- Facilitating real-time cross-promotion with sister projects and industry partners;
- Ensuring a consistent presence of ColdSpark® within the wider hydrogen, biogas, and carbon valorisation communities;
- Supporting long-term collaboration and follow-up initiatives beyond the project's formal duration.

Beyond the project's lifetime, the ColdSpark® LinkedIn account will remain active, ensuring continuity of synergy activities and supporting the ongoing exploitation of project results. It will continue to serve as a channel for knowledge transfer, visibility, and engagement with stakeholders interested in methane splitting, hydrogen production, and carbon valorisation. By maintaining and growing this audience, the LinkedIn account together with the project website and Zenodo repository will help sustain the project's legacy and attract potential industrial and research partners for future developments.

The project synergies will continue after their lifetime. An example is the ongoing research by the PhD students in the UiS who contributed actively on the gas separation research in ColdSpark®

project but will continue their work in the FME HyValue centre transferring the lessons learned in a new environment. Both SEID and UiS are active partners in HyValue, where methane cracking through catalytic, thermal, and plasma-based routes forms an integral research theme. The continuation of this work ensures that key scientific questions identified during ColdSpark® will be further explored in a Norway national research framework, maintaining technological continuity and supporting long-term exploitation.

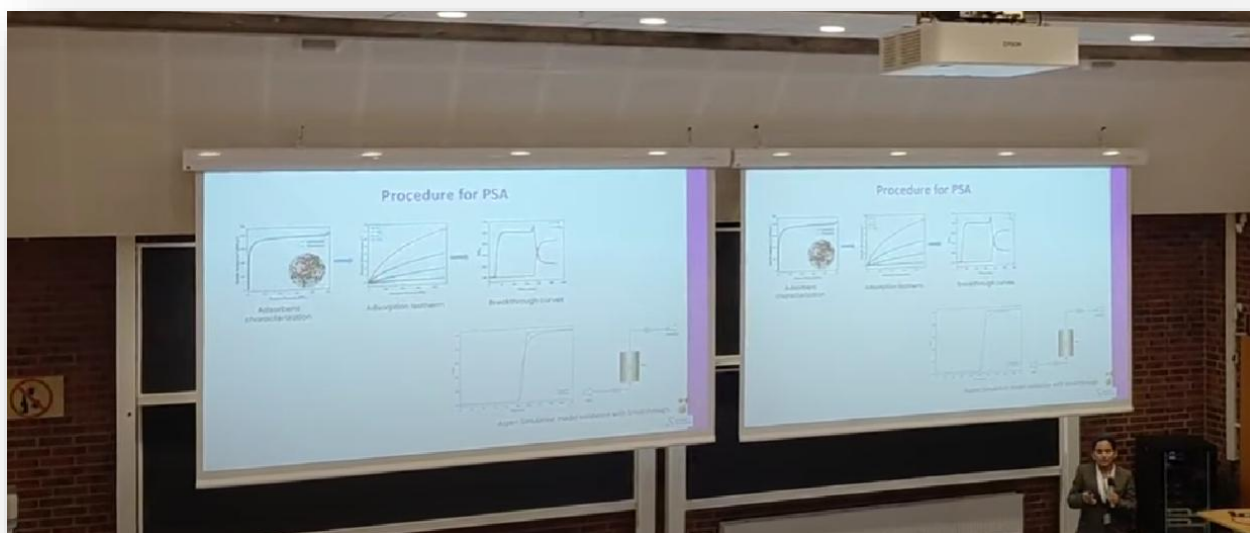


Figure 18. Ashika Gamage, PhD student in the UiS presenting during ColdSpark® final event

CONCLUSION AND LESSONS LEARNED

The activities carried out under Task 7.4 successfully demonstrated the value of a structured and proactive approach to building synergies across European research, industry, and policy communities. Throughout the project’s lifetime, ColdSpark® partners established meaningful connections with sister projects, thematic clusters, industrial stakeholders, and relevant EU initiatives. These interactions supported cross-dissemination, enriched ColdSpark®’s communication and exploitation efforts, and deepened the collective understanding of technological pathways in methane splitting, hydrogen production, and carbon valorisation.

The synergies developed under this task strengthened ColdSpark®’s visibility within the European hydrogen innovation ecosystem and raw materials communities and ensured that the project’s results were positioned within the broader landscape of complementary research. Activities such as the joint workshops, shared participation in conferences, and coordinated outreach initiatives with TITAN, STORMING, and other actors showcased the potential of collaborative actions to amplify impact and connect scientific innovation with industrial and policy priorities.

Despite these achievements, several challenges emerged. A notable obstacle was the natural reluctance of researchers to share detailed technical information due to concerns about intellectual property protection and competitive advantage. This is particularly relevant in emerging technological fields where market applications are rapidly evolving. As a result, establishing deeper technical synergies sometimes required extended trust-building, careful communication, and respect for each party's internal confidentiality boundaries. Nonetheless, these challenges reinforced the importance of transparency, respect for IPR frameworks, and clear communication protocols when engaging in cross-project collaboration. In some cases, the highly innovative nature of the technology initially hindered collaboration, as certain stakeholders had limited familiarity with the underlying scientific concepts and terminology. This required additional communication efforts and the use of accessible techniques such as storytelling and visual explanations. These adapted approaches proved effective and ultimately enabled successful engagement and constructive cooperation.

Overall, the work conducted under Task 7.4 contributed significantly to ColdSpark®'s communication, dissemination, and exploitation objectives. It enhanced the project's outreach, supported knowledge exchange, and created foundations for continued dialogue and potential future partnerships beyond the project duration. The lessons learned include the need for early engagement, flexible collaboration formats, and sensitivity to partners' IPR concerns offer valuable insights for future Horizon Europe projects seeking to build strong and mutually beneficial synergies.

APPENDIX 1: REFERENCES AND RELATED DOCUMENTS

Deliverable 7.7 has been developed in accordance with the provision outlined within the following related documents:

- ColdSpark® Grant Agreement Nr. 101069931,
- ColdSpark® Consortium Agreement
- D7.1. Plan for Dissemination, Exploitation and Communication (M6)
- D7.2. Plan for Dissemination, Exploitation and Communication (M12)
- D7.3. Plan for Dissemination, Exploitation and Communication (M24)
- D7.4. Plan for Dissemination, Exploitation and Communication (M42)
- D7.6. Exploitation plan (Common business plan)

APPENDIX 2: MAPPED PROJECTS AND INITIATIVES

<i>Project acronym</i>	<i>Short description of the project</i>	<i>Relevance to ColdSpark</i>	<i>Programme, level, period</i>
ONGOING PROJECTS AT THE TIME OF COLDSPARK'S IMPEMENTATION			
<u>STORMING</u>	It is possible to convert fossil and renewable methane into hydrogen with zero emissions of CO ₂ . The EU-funded STORMING project has an innovative solution. It will develop structured reactors heated using renewable electricity to make the conversion to H ₂ and carbon nanotubes for battery applications. Specifically, innovative iron-based catalysts, highly active and easily regenerable by waste free processes, will be developed through a smart rational catalyst design protocol. The overall aim of the project is the electrification (microwave or Joule-heated) of structured reactors, designed by computational fluid dynamics and prepared by 3D printing, to enable accurate thermal control resulting in high energy efficiency.	A sister project of ColdSpark® from the same call topic aiming at developing a technology for converting methane into hydrogen.	1.09.22-31.08.25 European project HORIZON EUROPE
<u>TITAN</u>	TITAN will develop and validate at TRL5 the direct conversion of biogas (CO ₂ containing rich-CH ₄ feedstock) into valuable carbon materials and a H ₂ rich stream thanks to MW Technology heated reactors. It will also consider further valorisation of power, chemicals and fuels. TITAN has the potential to produce 0.6 Mt of green H ₂ in 2030 to almost 4 Mt per year from 2045 on,	A sister project of ColdSpark® from the same call topic.	1.09.22-31.08.26 European project HORIZON EUROPE

	corresponding to the saving of 237 Mt CO ₂ by 2045.		
<u>112CO2</u>	<p>The world needs disruptive technology to very quickly decarbonize energy; the success of this technology depends heavily on its social acceptance, sustainability and fast and easy implementation. The proponents of 112CO2 believe to have this technology. Imagine that a new chemical reactor would make it possible to use methane, an easy to transport and to store fuel, either fossil, renewable or synthetic, for producing CO_x-free hydrogen in a cost-effective way. Imagine that this approach could be implemented swiftly, taking advantage of the present infrastructure. 112CO2 project is about producing hydrogen from low temperature methane decomposition (MD), a 100 % selective reaction - $CH_4 \rightarrow C(s) + 2 H_2$. The use of methane from biogas allows actively to remove CO₂ from the atmosphere (negative carbon balance) but, if using fossil methane, there will be no CO_x emissions. 112CO2 project aims at developing a low temperature MD catalyst, easy to regenerate and very active, > 0.45 gH₂/gCat/h and stable for at least 10 000 h. 112CO2 proposes an innovative regeneration step based on the selective hydrogenation of the carbon attaching interface with the catalyst, allowing to release the coke particles and the recovery of the catalytic activity. Proponents succeed very recently in demonstrating, in a 500-h experiment, that this approach is possible and easily accomplishable. A membrane reactor, made of a stack of individual cells for producing hydrogen and a stack for</p>	H2020 project on cold methane pyrolysis; benchmarking	2020-2024 European project HORIZON 2020

	<p>pumping out this fuel cell grade hydrogen, will be developed for running at ca. 600 °C and to display > 0.05 gH₂/cm³/h, an energy density comparable to the PEMFC. The proposed MD reactor is suitable for mobile as well as for stationary applications. 112CO2 project proposes also an ambitious communication strategy, aimed at to involve investors, existing companies, researchers, youngsters, undergraduate and graduate students for this new technology and engage them in the urgent energy decarbonization endeavor.</p>		
<u>eGHOST</u>	<p>eGHOST will be the first milestone for the development of eco-design criteria in the European hydrogen sector. Two guidelines for specific FCH products (PEMFC stack and SOE) will be completed and the lessons learnt will be integrated in the eGHOST White Book, a reference guidance book for any future eco-design project of FCH systems. eGHOST aims to support the whole FCH sector. Therefore, it addresses the eco-(re) design of mature products (PEMFC stack) and those emerging with TRLs around 5 (SOE) in such a way that sustainable design criteria can be incorporated since the earliest stages of the product development.</p>	<p>H2020 project on establishing Eco-design Guidelines for Hydrogen Systems and Technologies. Probably suitable for the further exploitation of the H2 produced.</p>	<p>1.01.2021-31.12.2023 European project HORIZON 2020</p>
<u>PIONEER</u>	<p>PIONEER project is developing innovative plasma/catalysis coupling systems to convert CO₂ into hydrogen, methane, ethanol or methanol.</p>	<p>UOL's major contributions include plasma-catalytic CO₂ conversion to green</p>	<p>1.01.2019-31.12.2022 European project</p>

		chemicals, design of different plasma reactors including DBD and gliding arc, plasma diagnostics, and plasma chemical kinetic modelling.	EXCELLENT SCIENCE - Marie Skłodowska-Curie Actions
Metal-organic framework for the recovery and separation of critical metals	The primary objective of this project is to develop and demonstrate the use of Metal-organic frameworks (MOFs) for the recovery and separation of critical metals relevant to low carbon energy technologies such as the battery, solar photovoltaic, wind energy, catalysis, etc. MOFs and MOF membranes developed in this project will be chemically robust. Both the material (MOFs and MOF membranes) and the process to make the materials may find use in this project in the tasks of impurities management and product purification.	UIS is the principal investigator of this project. Synergies with ColdSpark® lie in the areas of advanced gas separation and impurity management.	2021-2024 National Norwegian Research Council Project number: 314746NFR Forskerprosjekt for fornyelse
New Porous Liquids for Gas Separation and Carbon Capture	UIS is the principal investigator at this project whose primary objective is to develop and demonstrate the use of MOFs for the recovery and separation of critical metals relevant to low carbon energy technologies such as the battery, solar photovoltaic, wind energy, catalysis, etc. MOFs and MOF membranes developed in this project will be chemically robust. Both the material (MOFs and MOF membranes) and the process to make the materials may find use in this project in the tasks of impurities management and product purification.	Absorption is not the first-choice technology for purification of H ₂ however the commercial acid gas removal and gas dehydration of NG is performed with absorption unit operation. Porous organic liquids developed in the project had the potential for cleaning natural gas.	2021-2025 National Norwegian Research Council Project number: 324306 NFR- Forskerprosjekt for fornyelse

Carbon characterization	Partner UIS is collaborating with Scanship As-Norway, characterizing the carbon material developed by the company for gas and water treatment application		2021- Public private collaboration with Scanships As. (2021-present)
Development of HDP-unit	The development of SEID's latest product for energy efficient odour- and VOC-abatement, ModuPlasma(R) HD, to full scale, installation of the pilot at a feed production plant, and characterisation is a project between SEID AS, feed supplier Felleskjøpet Rogaland Agder, and Innovation Norway.	Its synergistically benefits from the parallel ongoing work of ColdSpark®, as the power supplies needed for both reactor types and applications are based on the same technology and in-house intellectual property. A lot of the work is therefore being done at SEID on both projects at the same time.	2021-2023 National Innovation Norway Project number: ddwx7mtbixa8
PROJECTS ALREADY ENDED AT THE TIME OF COLDSPARK®'s IMPEMENTATION			
TeachHy	TeachHy2020 built a repository of university grade educational material, design and run an MSc course in FCHT, accessible to students from all parts of Europe. To achieve this, the project has assembled a core group of highly experienced institutions working with a network of associate partners (universities, vocational training bodies, industry, and networks). TeachHy2020 offers these partners access to its educational material and the use of the MSc course modules available	Disseminating new technology among students	End date 31.10.2022 European H2020

	on the TeachHy2020 site. Any university being able to offer 20% of the course content locally can draw on the other 80% to be supplied by the project.		
Plasma technology for air pollution prevention and control (Innovasjonsprosjekt i næringslivet - BIA)	This project was devoted to the development of an intensified corona shower reactor plus matching power supply for energy-effective air pollution abatement. This intensified corona shower reactor embodies the next generation of SEID AS's flagship product ModuPower®. The development of the plasma cracking system is the next step in the same direction.	This project is directly relevant to ColdSpark® as it advances SEID's plasma reactor and power-supply technologies, forming the technological foundation on which the ColdSpark® methane splitting system was developed.	Ended in June 2019 National Norwegian Research Council Project Number: ES559835
Cell3DitorCost-effective and flexible 3D printed SOFC stacks for commercial applications	The main goal of the Cell3Ditor project is to develop 3D printing technology for the industrial production of SOFC stacks by covering research and innovation in all the stages of the industrial value chain (inks formulation, 3D printer development, ceramics consolidation and system integration). All-ceramic joint-free SOFC stacks with embedded fluidics and current collection will be fabricated in a two-step process (single-step printing and sintering) to reduce in energy, materials and assembly costs while simplifying the design for manufacturing and time to market.	The Cell3Ditor project combines 3D printing and robocasting manufacture of a Solid Oxide Fuel Cell (SOFC) stack. IREC- CERCA conducted the LCA to compare the environmental impact of the new manufacturing method with the traditional one. This study reported results for cradle-to-gate LCA comparison and gives an overview of the EoL scenarios for SOFC stacks.	End date: 30.04.2020 European Horizon 2020

<p>Efficient Electrolyser for Efficient Renewable Energy Storage - ECo</p>	<p>The overall goal of ECo is to develop and validate a highly efficient co-electrolysis process for conversion of excess renewable electricity into distributable and storable hydrocarbons via simultaneous electrolysis of steam and CO₂ through SOEC (Solid Oxide Electrolysis Cells) thus moving the technology from technology readiness level (TRL) 3 to 5.</p>	<p>IREC - CERCA conducted an LCA to compare the environmental impact of the energy conversion technologies (highly efficient co-electrolysis process for conversion of excess renewable electricity into distributable and storable hydrocarbons via simultaneous electrolysis of steam and CO₂ through SOEC to enable the storage of electricity from renewable sources. This study reported results for cradle-to-gate LCA comparison of different scenarios with CO₂ valorisation.</p>	<p>End date: 30.04.2019 European Horizon 2020</p>
<p>Liquid hydrogen to decarbonise maritime transport in Norway (2020-2022)</p>	<p>The goal is to establish a H₂ value chain, from sustainable H₂ production with renewable energy sources, transportation of H₂ to harbour, and bunkering to marine vessels.</p>	<p>NORCE is responsible for safe H₂ handling. The competence, methodologies, and modelling tools for safe H₂ transport and storage within the ISO standard and planning of the H₂ value chain will be highly relevant for the ColdSpark® project.</p>	<p>National Funding from the Research Council of Norway / E-Pilot and ENOVA programs.</p>

Agri-e large-scale pilot project	Reforming of biogas to electricity, H ₂ , CO ₂ at pilot scale, TRL5-7, with plan to upgrade to industrial scale for biogas producers. The demonstration is planned to use NORCE's Risavika Test Centre in the period of late 2021 – 2022.	Competence related to the required purification process for biogas and handling of the outlet products after reforming is highly relevant for ColdSpark®. The equipment and infrastructure at Risavika can be potentially shared with ColdSpark® to further reduce project cost.	National Funding from the Research Council of Norway / Enova, SkatteFUNN programs, plus private investors
EUROPEAN INITIATIVES, CLUSTERS AND ASSOCIATIONS			
EIT Climate-KIC, EIT Climate-KIC Nordic	Knowledge and Innovation Community (KIC), working to accelerate the transition to a zero-carbon, climate-resilient society		
NBIOC – The Norwegian National Bioprocessing & Fermentation Centre	NBIOC- R&D Infrastructure and laboratory being developed at Risavika Test Centre. It is a new national hub and state of the art facility to develop, optimise and scale up fermentation processes based on gaseous feedstocks such as CO ₂ , H ₂ and methane to produce biomass, protein, lipids and chemicals.	The facility and its infrastructure will be flying start for the large-scale prototype. The competence and experience in handling H ₂ will be very relevant. As synergy, the produced H ₂ may be used as supply to NBIOS testing	
BalticNet PlasmaTec working group Plasma & Energy	Plasma & Energy	On request, new working groups could be established. Currently, the potential to build up a working group focusing on energy systems	

		(Plasma & Energy) is in discussion. This working group could address the challenges of energy saving (e.g. low friction coating), energy storage (e.g. fuel cells, accumulators) and energy production (e.g. pyrolysis, hydrogen production, solar energy).	
<u>Women in Green Hydrogen</u>	Women in Green Hydrogen is a network of passionate women working in the green hydrogen sector. Our vision is to increase the visibility and amplify the voices of women working in green hydrogen.	By presenting the ColdSpark® technology via the WH-channels and arrangements by the female participants of our project it will be both promoted within the community of Women in green hydrogen, while the voices of our women working in green hydrogen get amplified.	
<u>European Biogas Association</u>	Biogas association & biomethane & biogas industry	Linking ColdSpark® to the biogas & biomethane sectors	
<u>Hydrogen Europe</u>	Hydrogen Europe is the European association representing the interest of the hydrogen industry and its stakeholders and promoting hydrogen as an enabler of a zero-emission society.	Collaborations in promoting methane splitting as a technology	