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C2FUEL

Carbon Captured Fuel and Energy Carriers for an Intensified Steel Off-Gases based Electricity Generation in a Smarter Industrial Ecosystem

Deliverable

D7.10 – Social acceptance

WP7 – Communication and dissemination activities

Project information

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L. NAIGLIN	Project Management Officer and WP7 leader	BENKEI	15/12/2021	OK
A. MIQUELOT	Project Management Officer	ENGIE	15/12/2021	OK

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Deliverable report

1 Executive Summary

1.1 Description of the deliverable content and purpose

This deliverable is related to the social acceptance task of the C2FUEL project. This report will first detail the conceptual aspect of the social acceptance issue. Then, it explains the methodology as well as the actions engaged to start this survey. Finally, preliminary results of interviews already managed will be detailed.

1.2 Brief description of the state of the art and the innovation breakthroughs

The preliminary investigation shows that according to the discourses of the interviewees met as well as the main roadmaps linked to the territorial development, the C2FUEL project is consistent with the ambitions shared among the local stakeholders' community. Therefore, social acceptance regarding this project does not seem to be a critical issue.

1.3 Corrective action (if relevant)

N/A

1.4 IPR issues (if relevant)

N/A

2 How to manage a social acceptance survey on an innovative energy technology?

2.1 Concept of social acceptance in the social science literature related to energy

2.1.1 The three types of social acceptance

In the scientific literature related to renewable energy technologies the notion of social acceptance gains in visibility since the 1980's. First research work on social acceptance regarding renewable energy was related to wind power. At the beginning of wind power development, polls show a large support of population to the development of wind energy. Therefore, wind power project's developers did not worry about the conflict that could happen compared to those happening in developing hydropower for instance. However, when first wind power farms were concretely settled, developers faced unexpected local oppositions (Wüstenhagen *et.al* 2007). Then, the social acceptance became for project developers a critical issue to guarantee the success of the implementation of a project, and for each technological project a part was dedicated to a social acceptance survey. In literature, Wüstenhagen *et al.* (2007) distinguish three main types of social acceptance: the sociopolitical acceptance, the community acceptance and the market acceptance.

The "sociopolitical acceptance" could be described as the acceptance of a renewable energy technology at a large scale. For instance, the establishment of regulations favoring the development of a specific renewable energy sector as well as the opinion of a representative population sample collected through a questionnaire survey could be considered as socio-political acceptance.

The second type of acceptance defined in literature as "community acceptance" is the acceptance of a renewable energy project by a local community. A large part of the scientific literature is dedicated to the "community acceptance". Most of these research works focus on the identification of potential factors that could improve the acceptance of a technology in a local community. For instance, some surveys test the influence of the type of information circulated to the population on its acceptance of a project (Itaoka *et.al* 2009) or the influence of trust in different types of stakeholders on the acceptance of a project (Huijts 2007).

The last type of acceptance identified by Wüstenhagen *et al.* is defined as "market acceptance". It refers to the acceptance of a new renewable technology by the stakeholders of a sector, but also to the larger impacts of the development of a renewable energy market on the other type of acceptance. Wüstenhagen *et al.* mentioned the wind power energy market case. As they noticed, more and more consumers are in favor of green power especially renewable energy that consequently entails the development of more and more wind farms. However, customers of some countries (these researchers mentioned the Netherlands) are also opposed to the development of wind turbines in their neighborhood. Therefore, in order to supply the market demand wind turbine may have to be constructed in other countries that could cause community acceptance issues.

2.1.2 *Considering technological and social artefact in the same way : the science & technology study approach.*

Besides the interest of information collected, these kind of surveys on socio-political acceptance, community acceptance and market acceptance are missing a key issue regarding the implementation of technological artifact: the interdependency between technological systems and society. As noticed by the historian of technology Thomas P.Hughes (1987) :

> "Technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping. Among the components in technological systems, there are physical artifacts such as turbogenerators, transformers, and transmission lines in electric light and power systems. Technological systems also include organizations such as manufacturing firms, utility companies, and investment banks and they incorporate components usually labeled scientific, such as books, articles, and university teaching and research programs. Legislative artifacts such as regulatory laws can also be part of the technological system. Because they are socially constructed and adapted in order to function in systems, natural resources, such as coal mines also qualify as system artifact". (Hughes 1987 p. 45)

According to this scientific approach both considering societal assumptions embedded in a technological system as well as the various stakeholders views, opinions and reactions to the implementation of a technological system become a critical issue. Since the 1980's and the seminal research works of a small groups of social scientists (Akrich, Latour, Callon, Law, Hughes) focusing on sciences and technologies (Science and Technology Studies, STS), the development of renewable energy and low carbon technologies (Nadaï, Labussière 2015, Markusson *et.al* 2012,) was largely studied by the STS research community. As illustrated in the citation mentioned above, these research works showed that a generic implementation process did not really exist and that each project entailed at least local stakeholders configurations.

2.2 Our approach of social acceptance notion

2.2.1 *How to consider a "not yet implemented" technological artifact? the technological expectations concept.*

The Science and Technology Studies approach of technological system is at the core of our approach of the social acceptance notion. But regarding the classical approach of STS that focusing on "on going" projects, the social acceptance notion is challenging. Indeed, most of the time a social acceptance survey is required before an effective settlement of a renewable energy project in an identified territory. As social scientist our issue is therefore to understand which concerns, reactions, oppositions that may be caused by a technological system as well as how this system may be reshaped by society before its effective implementation. Again some research works managed by a small group allow us to deal with the "not yet" technology. In a dedicated issue of *Technology analysis & Strategic Management* of 2006, Borup, Brown, Konrad and Van Lente expose the concept of "expectations" related to technological artifacts. They defined it as follows:

"Technological expectations can more specifically be described as real-time representations of future technological situations and capabilities" (p. 286).

According to these researchers, expectations are performative because they provide structure and legitimation of a technological project. In addition, they also play a central role in the building of community of stakeholders involved in the development of a technology in allowing for instance a shared vision of what issues should solve a technology.

2.2.2 From technological expectations to "social acceptance" survey

According to us the concept of expectation related to science and technology is relevant to consider the social acceptance of technology. Through this approach, understanding the social acceptance of a technology consists in identifying the gap between expectations shared by project developers and those shared by other stakeholders regarding a technological system but also understanding expectations differing from those of a technological project expressed on the territory of implementation of this project.

In the methodological perspective, expectations related to a technology are expressed through discourses, scientific articles, newspaper articles or elicited through interviews. In a nutshell, expectations related to science and technology could be considered as narratives. Thus, the role of the social scientist is first to identify, collect and analyze these narratives.

In order to understand the social acceptance of renewable energy or a low carbon technology the researcher will first focus on the narratives spread by project developers of this technology with the objective to target socio-technical configurations envisioned by the project developers and the project development community. Then the social scientist will meet the stakeholders concerned by a project but not belonging to the project development community, in order to identify and collect their narrative related to energy transition, in general on their territory or sector but also to test with these stakeholders, the narrative spread by the project development community. Based on this corpus of narratives, the social scientist could finally identify inconsistencies or opposition between narratives promoted by the project developers' community and those voiced by other stakeholders. Therefore, he could identify core issues related to a technological project and provide recommendations to improve the social acceptance of a technological project.

Regarding the social acceptance issue, understanding the lay population acceptance of a renewable energy or low carbon infrastructure is sometimes needed. But how to ask lay public opinion on a technology they have not heard about? In order to get some insights on the acceptance from populations we based our approach on a constructivist approach of opinion (Corneloup 2004). Corneloup considers opinions as representations of reality that are the results of various influencing factors (medias, public stakeholders, public debates) but also of own experience of an individual. According to him, when an individual expresses his opinion, he chooses in a kind of collective market of available representations or imaginaries available for all individuals of a society, the

representation that matches the most with its own experience and representation of reality. Regarding the social acceptance issue of renewable energy by lay public we assume that each respondent to a questionnaire survey will choose among expectations spread by stakeholders (NGO, political authorities) the ones which match the most with their own representation but also their own experience of a territory.

3 Methodology used in C2FUEL

The C2FUEL project is an innovative combination of technological artifacts (e.g. carbon capture, green hydrogen and CO_2 electrolysis, chemical reaction, etc.) to produce two synthetic fuels: Dimethyl Ether (DME) and Formic acid. As a quite new subject for lay public and also regarding budget constraints, we will not focus in the C2FUEL project on lay public acceptance of this process. Regarding this context, we choose to interview key local stakeholders. The following paragraphs describe how we target the relevant stakeholders and the methodological tools designed to manage the social acceptance survey.

3.1 A documentary survey to target relevant stakeholders to interview

According to our approach of social acceptance, we made the assumption that the history of previous conflicts regarding spatial planning and/or industrial projects may provide us relevant information on which type of stakeholders may be involved to support or to contest a specific project. Our first operation was to identify which debates happened in Dunkirk regarding energetic or industrial projects. We first identified two public debates:

- one related to a project of territorial extension of the port
- another related to the settlement of an offshore wind farm in Dunkirk coastal areas

According to the French regulation, "public debate" is a concertation procedure that could be engaged by a project developer when an infrastructure project has strong territorial impacts. The organization of a public debate implies to set up a dedicated local commission composed by a panel of neutral stakeholders in charges with the organization of public meetings and information events as well as to write the conclusions of the debate for the project developers.

Despites the fact that issues are largely bigger than those related to the C2FUEL project, reviewing the position papers of local stakeholders that chose to express themselves in these concertation process allows us to understand the framing of each stakeholder regarding the major issues for the territory. This first review helped us to build the following mapping of the main NGO of the territory that may likely express their views on the C2FUEL project (see **Erreur ! Source du renvoi introuvable.**).

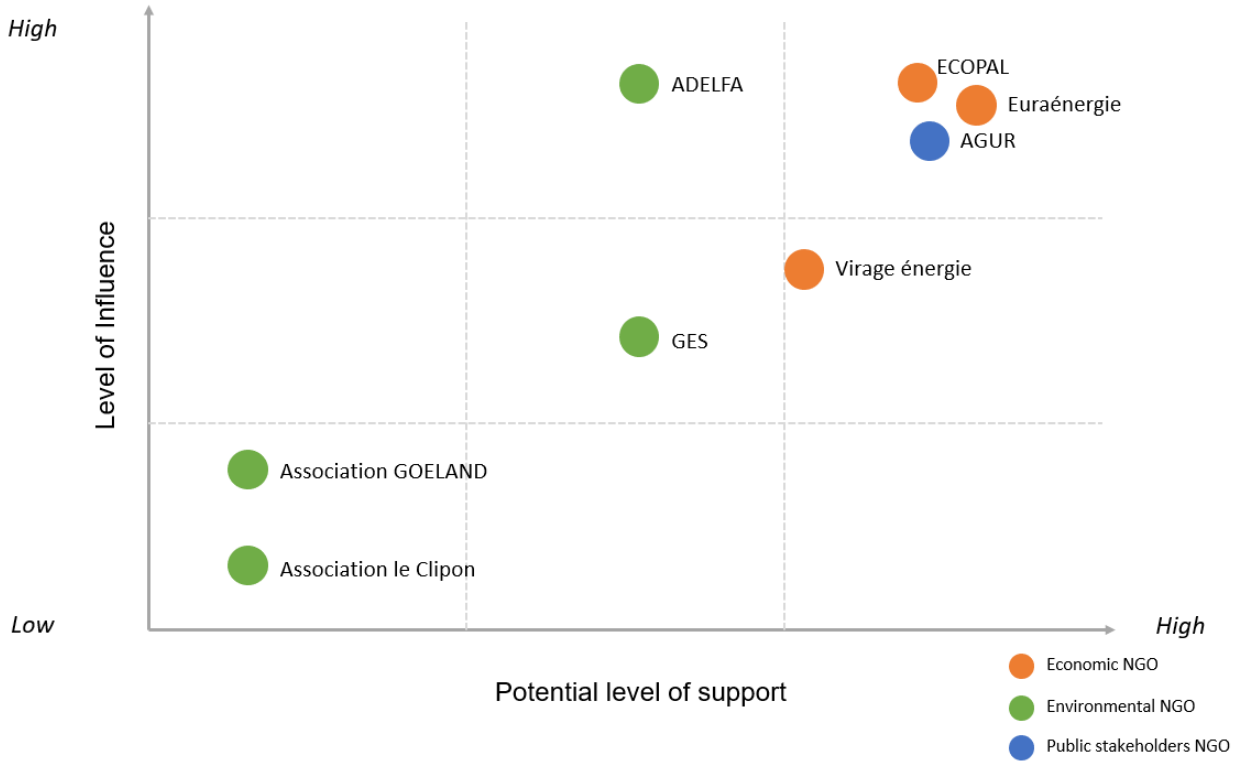

Figure 1: Stakeholder map of Dunkirk relevant organizations to meet regarding C2FUEL project

The two associations located of the left lower side of the map are those which may have the lowest impact on the C2FUEL project according to us. The main goal of the NGO **GOELAND** (Groupe d'Observation et d'Etudes des Lieux Anthropiques et Naturels proches de Dunkerque) is to improve the level of knowledge regarding biodiversity issues among local stakeholder in order to foster the consideration of biodiversity issues at all the territorial scales as well as to optimise the protection of biodiversity. This NGO mainly acts in Flanders maritime plain areas, in inner Flanders area as well as in Artois and Boulonnais areas.

The "**Clipon**" (refers to the name of a pier of the Dunkirk harbour) NGO has for purpose to observe and document maritime birds' migrations. Thanks to this specific location (far from the coast compared to other observation points), members of this NGO are ornithologists providing valuable scientific observations on maritime birds' migration to a European network of ornithologists. However, according to the C2FUEL project location, this environmental NGO is not likely to voice an opinion on the project.

The two environmental NGO located at the middle of the map may voice an opinion that may have more influence on projects such as C2FUEL. **GES** (Groupe Environnement et Société Flandres) focuses its action on the impact of industrial activities on health of local population. According to this focus, we made the assumption that this NGO could voice an opinion on the C2FUEL project and express specific concerns on health impacts.

The **ADELFA** (Assemblée de Défense de l'Environnement du Littoral Flandres Artois) gathers about 30 local environmental NGOs. According to the history of this organization the core mobilization of this NGO is related to the protection of local environment and population from industrial pollutions. In addition, this network of local association belongs to the national Federation "France Nature Environnement". Regarding issues related to the C2FUEL project, the ADELFA may be concerned by such an industrial project and therefore may voice its view on it.

Two additional identified associations could be qualified as economic NGOs. The association "**Virage énergie**" focuses its action on the societal energy forecast as well as on animation on energy transition. Its main goal is to promote the implementation of renewable energy as well as a more energy efficient society. "Virage-énergie" both designs forecast scenarios but also manages participatory approach on energy and climate issues. Regarding the C2FUEL project, this association may voice an opinion on the process and the consistency of the production of DME and formic acid regarding the various transition scenarios promoted.

The second identified association is "**ECOPAL**". The role of this association is to promote and encourage industrial ecology among the network of industrial companies located in Dunkirk harbor and industrial area. This association may find relevant to promote the C2FUEL project which contain by design an industrial ecology principle: Reuse CO_2 to produce new types of fuels.

Finally, in addition to the previous NGOs mentioned, in managing our interview survey we also identified two other organizations we consider relevant to meet: the **spatial planning department of Dunkirk area** as well as **Euraénergie**, an innovation center related to energy transition issue.
We targeted the spatial planning department of Dunkirk area - **"Agence d'Urbanisme et de development Flandres Dunkerque (AGUR**)" – because a decade ago this department designed a tool - La toile industrielle [1]– to better understand the interdependencies between companies of the local economic system but also with companies outside of the region or abroad. For instance, this tool allows this department to understand the consequences of a factory or sector shutdown on other firms or sector. After a first application on the industrial sector, this methodology was applied to energy, water or health system. Having the view of this organization seems relevant to us to understand how they could envision C2FUEL project according to their knowledge of the ecosystem.
The second stakeholder identified during our interview survey was **Euraénergie**[2]. This organization could be defined as an innovation center focusing on energy transition. It gathers stakeholders from public authorities, research sector and companies, with the mission to support the energy and industrial transitions of Dunkirk territory in encouraging the settlement of innovative companies and stimulating the innovative ecosystem.

[1] https://rev3.fr/de-toile-industrielle-toile-maker/ reviewed the 10th of December 2021
[2] https://www.dk-energie-creative.fr/euraenergie reviewed the 10th of December 2021.

According to this short presentation we can consider that the C2FUEL project matches completely with the main mission of Euraénergie

3.2 The design of an interview guide to collect the view of the stakeholders identified

The analysis of position in public debates is a good entry point to understand the various narratives related to a territory shared by local stakeholders. However, this type of analysis faces some limits and gathers "raw data" from stakeholders themselves to get their view both regarding the energy transition as well as on the C2FUEL project itself is a critical issue. In order to manage this survey, we designed an interview guide with a large exploratory approach. Indeed, the main goal of these interviews was to collect the view of the various stakeholders both on the project and on the energy and ecological transition in the territory. Each exchange with interviewees has been structured according to the following guide:

Interview guide structure

Introductive presentation

The C2FUEL project has for objective to demonstrate the technological availability of the production of Dymethyl Ether (DME) and Formic Acid based on renewable hydrogen as well as CO_2 captured from industries. In addition this project also aimed to identify societal & territorial issues related to this innovative technological infrastructure. Being in charge of this aspect of the C2FUEL project I would like to exchange with you about:

- *The ecological transition roadmap of the territory*
- *The hydrogen issues in the territory*
- *The challenge and added value of the DME and Formic Acid production for the territory.*

Main themes and associated questions

Description of key aspect of the territory

- Could you describe me the environmental issues of the territory?
  - What are the environmental challenges?
  - What are the challenges related to energy?
  - How manage the industrial area regarding this context?

Description of the strategy related to energy transition in the territory

- Could you describe me the strategy related to energy transition in the territory?
  - What are the key priorities?
  - How are managed energy transition issues regarding industrial activities?
  - What are the limits regarding this strategy?
  - What are the resources needed to implement this strategy?

Issues related to hydrogen and synthetic fuels in the territory

- Could you describe me the hydrogen role regarding energy transition in the territory?

- Is hydrogen implementation a critical issue for the territory?
- What are the expectations related to H_2 implementation in the territory?
- What are the concrete actions implemented?

- Beyond hydrogen how do you envision the production of synthetic fuels in the territory?
  - According to you what are the key issues related to DME and formic acid production on the territory?
  - What are the constraints to consider?
  - What are the challenges & limits?
  - What are the key stakeholders to consult?

During interviews, we made the most exhaustive transcription as possible. Then these notes served as the analysis basis. The procedure and the template used to obtain the informed consent of the participants are described in **Deliverable 9.1**, and the procedure to protect their personal data is described in **Deliverable 9.2**.

3.3 An analysis of strategic documents identified through stakeholders' interviews.

In addition to the direct information collected, interviews with key stakeholders of the territory also allowed us to identify strategic documents that could allow us to better understand what role could play the Dimethyl Ether and formic acid production regarding the narratives promoted in the territory. The stakeholders we met, mentioned three main strategic initiatives: **the third industrial revolution (Rev3) initiative, the carbon neutral roadmap** and **the European hydrogen backbone**. The following paragraphs describe briefly these documents.

The third industrial revolution initiative (Rev3)

The third industrial revolution initiative (Rev3) in the "Hauts de France" region was launch in 2013. It is based on the approach of the economist Jeremy Rifkin. According to him, each economic revolution emerges from the conjunction of new communication technology and new energy sources. In addition, he considers that the crisis we are experiencing today is due to the fact that we are trying to restore or artificially prolong the "old recipes" of the second industrial revolution, rather than projecting ourselves into a Third Industrial Revolution, based on the coupling of Internet and new energy technologies. Therefore Jeremy Rifkin identifies 5 pillars that enables the third industrial revolution.

1. Shift from fossil to renewable energy: wind, solar, geothermal energy, hydropower
2. Develop buildings that produce energy to multiply energy production site
3. Acquire energy storage capacity to be able to face renewable energy intermittence.
4. Deploy the internet of Energy (smart grids & smart metering systems).
5. Reinvent the mobility of goods and peoples.

In the "Hauts de France" region, the Rev3 initiative associates a range of stakeholders (cities, region, ADEME, EU) who contribute to fund (500 million euros per year) relevant projects or initiatives (more than 800 projects) consistent with the third industrial revolution masterplan designed and applied in the Haut de France region[3].

Carbon neutral Roadmap

In 2021 the Dunkirk local authorities hosted the third edition of the "European meeting Industry and territory"[4] organized by a local cluster of industrial companies. According to the organizers, this event was born from the observation that the answers to the fight against climate change, the preservation of the environment and the maintenance of an efficient industrial fabric that provides jobs can only be found within the framework of a multi-stakeholder dialogue at the local level. These meetings enable local stakeholders to define a roadmap for decarbonation of this industrial territory. Two targets were defined:

- A reduction of 30% of CO_2 emission in 2030 compared to 2019 and -46% compared to 1990.
- A carbon neutrality in 2050.

In order to reach these mitigation targets the local authorities of Dunkirk defined an investment plan that will enable stakeholders to innovate on decarbonation issues as well as build relevant infrastructure needed to share waste heat, CO_2, or other byproduct in the industrial area perimeter. Figure 2 shows the decarbonation infrastructure of Dunkirk. The map underlines the fact that the ecosystem of Dunkirk already includes carbon capture and utilization programs (CCU) in a decarbonation perspective, a context in which the C2FUEL project fits perfectly.

[3] https://rev3.fr/comprendre/ reviewed the 1st December 2021.
[4] https://www.rencontresco2-industries-territoires.com/ reviewed the 1st December 2021.

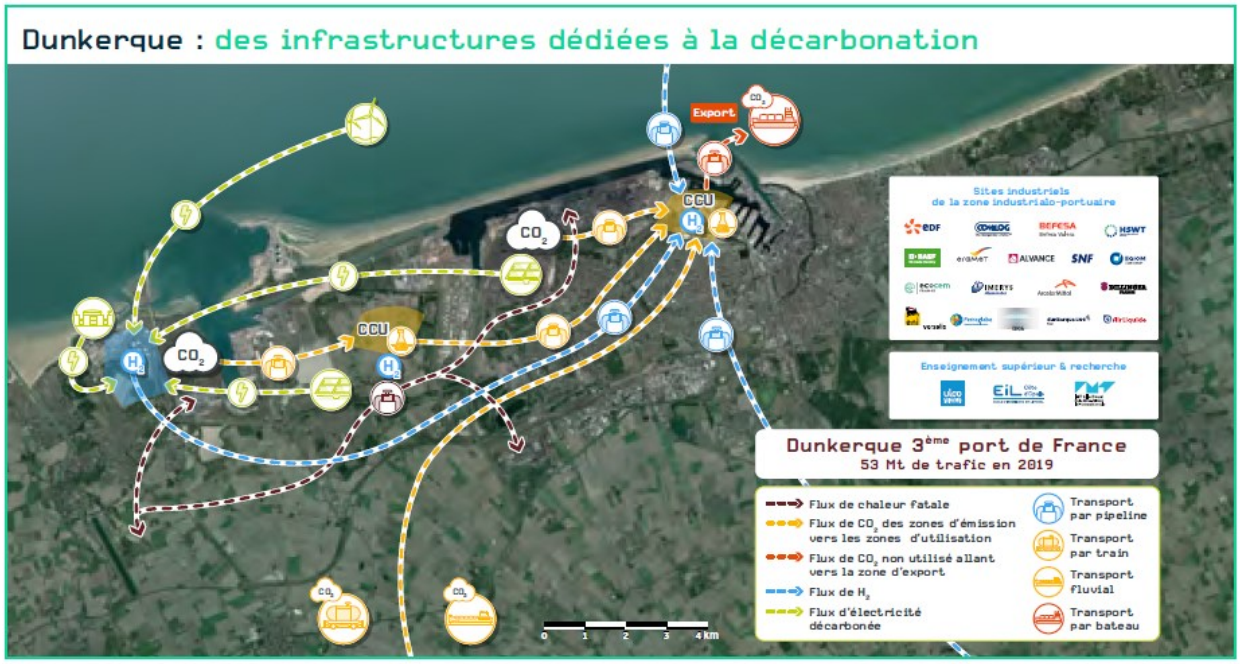

Figure 2: Decarbonation infrastructure- Dunkirk Decarbonation roadmap

The European Hydrogen Backbone

The European Hydrogen Backbone is an infrastructure project steered by 11 European companies of gas network management (see Figure 3). The main objective is to build a 39 000 kms of hydrogen network and two thirds of the network is based on the repurposing of existing natural gas pipelines. The goal of this network is to support the energy transition in connecting 21 countries. As showed on the map below, Dunkirk harbor belongs to the core of the European Hydrogen Backbone.

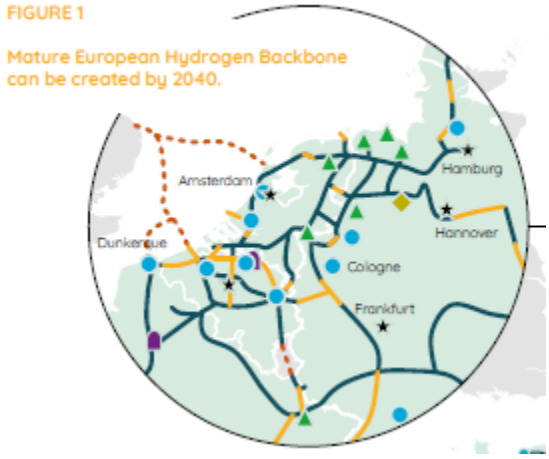

Figure 3: Part of the European Hydrogen backbone

According to this short description of the documents mentioned by the stakeholders we met, we understand that the territory of Dunkirk has a strong ambition and a key position regarding hydrogen and the decarbonation strategy for industrial sector. This is in strong alignment with the C2FUEL project.

4 First results

The following paragraphs summarize the first results of the first part of our interviews survey as well as the short documentary survey we managed. The following paragraphs is largely based on data collected through interviews.

4.1 An industrial territory considering ecological transition as a motivating challenge

The first thing mentioned by our interviewees is that Dunkirk has a long history with industry and two or three decades before industry was the main sector of employment in the area. This industrial past left a mark on territorial structure and landscape but also on people living nearby the industry. Indeed, air pollution causes specific diseases and cancers, a situation which is accepted by population thanks to the employment provided.

Although industrial sites are still in operation in Dunkirk, they do not employ a population as large as in the past. In addition, the raise of environmental consciousness among population as well as the energy transition bring a new vision on industry on the territory.

As mentioned in the decarbonation roadmap as well as by the stakeholders from **Eura-énergie**, the energy transition is not seen on the territory as a burden but rather as a challenge that has to be overcome through innovation as, for instance, the implementation of innovative carbon capture process or hydrogen process tested on the Arcelor Mittal site or innovative model as Industrial ecology. In addition, according to the interviewees from **Eura-énergie**, local authorities were involved in energetic issues since the 1980 with a dedicated department in the municipality. Currently as mentioned in the decarbonation roadmap, the goal of the local authorities is to demonstrate the feasibility to convert a large CO_2 emitting territory in a carbon neutral territory.

4.2 A quality of life as a priority for the stakeholders of the territory

The second main theme mentioned by the stakeholders we met is mainly related to the need to preserve the quality of life of inhabitants of the urban areas especially regarding air pollution. As stressed by stakeholders from the environmental NGOs, Dunkirk industrial area gathers a lot of high risks industrial sites, therefore the implementation of another industrial project as C2FUEL should not be realized without analysis of the potential additional risks that may be caused by this new production process. As they mentioned, they still remain in an alertness attitude regarding all new industrial projects. Their main goal is to prevent the raising of new pollution, as well as a degradation of quality of life for local population.

4.3 A lack of knowledge regarding the C2FUEL project but no opposition.

In all the interview we managed, the stakeholders have a low level of knowledge of the C2FUEL project. Those who know the most come from the spatial planning office and the local authorities or local association promoting industrial ecology. However, they only heard about the concept but do not really know more. This raised a lot of questions related to the hydrogen production sources, as well as the quantity of CO_2 needed to produce DME and Formic Acid. In addition, the industrial ecology association is really willing to know more about the project in order to identify new potential industrial symbiosis.

4.4 Synthesis of the results

In the strategic documents as well as through the interviews of stakeholders, we identified three complementary low carbon transition narratives. Figure 4 summarizes the main information regarding these scenarios. On the left part are placed the scenarios,

- Two specific scenarios:
    - one European scenario focusing on gas infrastructure: **European Hydrogen backbone** (in orange)
    - one local decarbonation scenario at city scale: **Dunkirk Decarbonation roadmap** (in blue)
- And one global scenario based on the third industrial revolution concept: **Rev3** (in green).

These narratives utilize different supporting technologies and methods, which are listed in the right part. All these strategies aim the same goal: create a low carbon industrial territory, an objective very promising for the integration of the C2FUEL project.

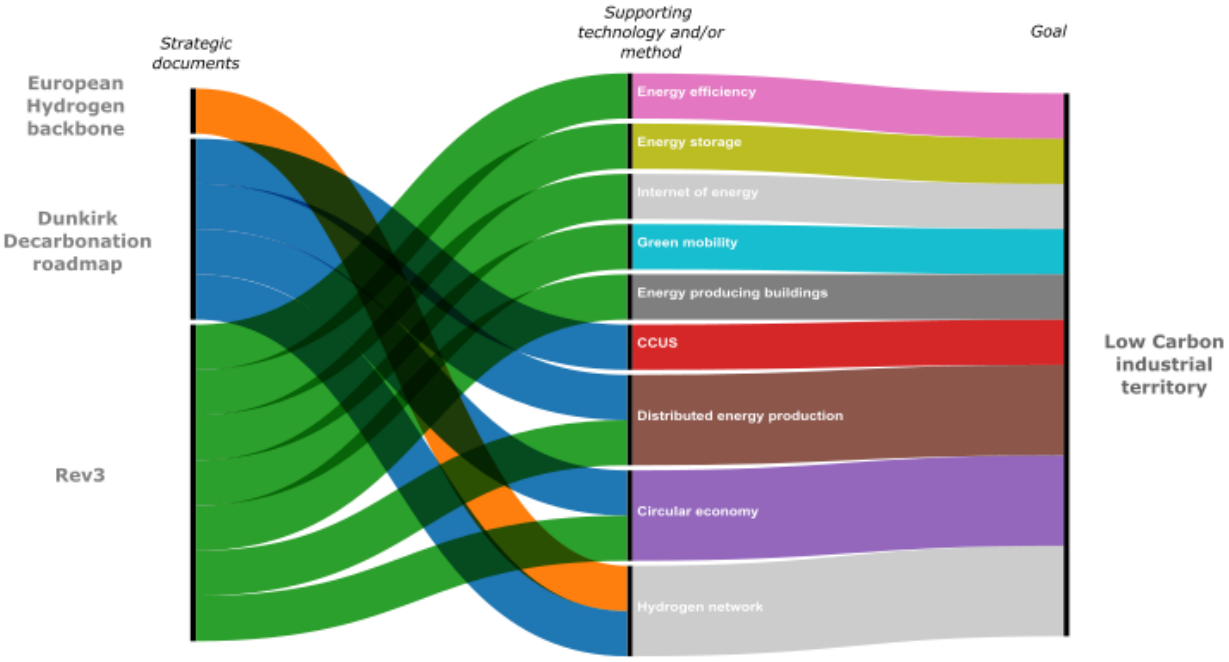

Figure 4: Synthesis of various narratives identified in the territory

5 Conclusion and next steps

According to this context, the C2FUEL technological process fits perfectly with the ambition of decarbonation voiced by local stakeholders of the territory. If developed at an industrial scale, technologies developed in the C2FUEL project could largely contribute both to the decarbonation of the Rev3 and local decarbonation narratives through energy storage and the production of synthetic fuels, that enables low carbon mobility.

The next steps of the social acceptance survey will consist in deepening our analysis of data collected through interviews and desk research as well as identifying other stakeholders to interview especially users of DME and Formic Acid.

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