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Industrial Ecology as a Lever for Greening Industrial Territories. The case of Dunkirk (France)

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Introduction

In this presentation, we will analyze the link between **circular economy** and **decarbonization** to **territorial development**, applying it to the case of industrial and port regions.

Using the concepts of territorial and industrial economics: specific resources, proximity dynamics and agglomeration effects, innovative milieu and innovation ecosystem, we seek to explain **how the circular economy (and in particular industrial ecology) and today decarbonization can be a source of innovation and diversification and transition of industrial territories towards a more sustainable development**.

We also study the **lock-in factors** which can hinder the transition (using the Multi-level Perspective, Geels, 2019) This analytical framework is applied through different studies (Gallaud, Laperche, 2016; Kasmi et al., 2017; Kasmi, 2018, 2021, Veyssiere et al., 2021, Andriamanantena et al., 2022, Boutillier et al., 2024, Kasmi et al., 2024) to the case of industrial regions, in particular in the case of Dunkirk (North of France).

Projects : CDC (2016-2018) IMPPEC (2020-2023) ; TIGA (2018-2026) ; IRETRA ANR (2023-2026) ;

Content

1- THE CIRCULAR ECONOMY AND DECARBONIZATION: LEVERS FOR TERRITORIAL DEVELOPMENT

2- THE CASE OF PORT AND INDUSTRIAL REGIONS - EXAMPLE OF DUNKIRK (North of France)

3- STAKES –THE NEED FOR A SYSTEMIC APPROACH TO TERRITORIAL DEVELOPMENT AND INNOVATION

1-THE CIRCULAR ECONOMY AND DECARBONIZATION: LEVERS FOR TERRITORIAL DEVELOPMENT ?

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Definitions

- From the linear model of resource consumption existing from the beginning of industrialization

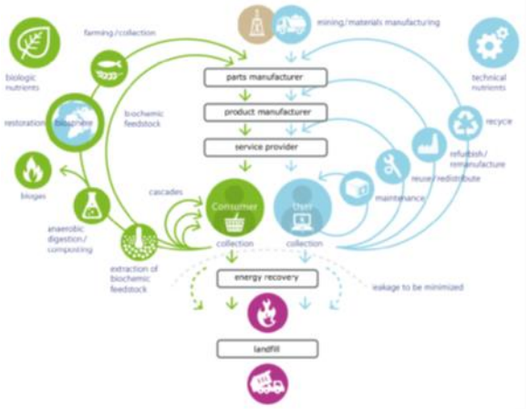
(industrial revolutions)


Extracting


Producing


Discarding

- To the circular model, aiming at increasing the efficiency of resource use and reducing the impact on the environment while enhancing the well-being of individuals



Mac Athur Foundation

Ademe

Figure 1.2. *A type 1 ecosystem [ALB 92]*

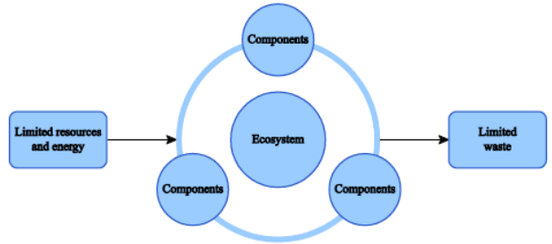


Figure 1.3. *A type II ecosystem [ALB 92]*

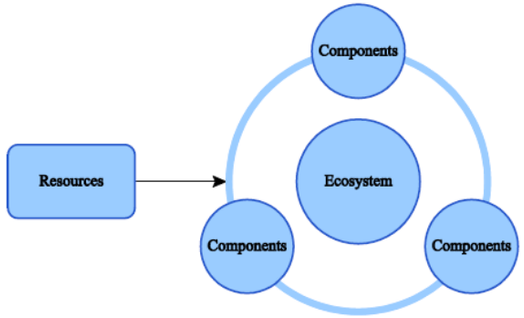


Figure 1.4. *A type III ecosystem [ALB 92]*

Allenby, 1992

When dealing with the CE, territorial development has long been under underestimated, whether postulated

- Plural economic discourses associated to the CE (Calisto Friant et al., 2020)
- In CE policies of EU Member States, the economic impact of the CE is of course underlined, but the link with territorial development hardly appears (Pinyol Alberich, 2022)
- The French definition of the CE(Ademe) does not make a strong reference to territorial development (Niang et al., 2020)
- Indicators for the Circular economy are mainly at the level of Firms (micro), or at the National level (macro) (Andriamanantena et al., 2022)
- Works on industrial ecology mainly put forward the regional impacts, but without explaining the mechanisms by which regional developement could occur (Kasmi, 2018)

ROLE OF CE /INDUSTRIAL ECOLOGY FOR TERRITORIAL DEVELOPMENT

- A set of economic, environmental and social positive impacts (Dunn & Steineman, 1998; Gibbs, Deutz, & Proctor 2005, Kohronen et al.2018). :
- Reduction of the cost of inputs,
- Reduction of the cost of waste disposal,
- Economic valuation of wastes,
- Diversification of the economic basis,
- Job creation ; new companies,
- Reduction of emissions & environmental aspects

A list of impacts but no systematic analysis

A « win - win - win » strategy for sustainable development

The CE as a lever of the Territorial development process: hypothesis/ concepts

Circular economy project at a territorial level:

Proximity (Geographical, institutional, cognitive, organizational, social) / Institutional factors (regulation, governance)

Resources creation & valorization / Innovations ***(technological, organizational, commercial)***

Reinforcement of the competitive advantage (through Specialization or diversification; through attractiveness of new activities wich will ensue in new companies, jobs, innovations)

Intellectual Model built on the association of some contributions of Regional science (French school of proximity, Gremi) / Industrial and Innovation economics (innovation ecosystems)/ Economic geography (evolutionary economic geography)

Systemic approach to territorial development: various stakeholders bound together around a common goal, without underestimating tensions and conflicts/ Interactive process

Territorial development ensues from a specific dynamics between proximity/ Institutional factors and ressources creation/ valorization (Veyssiere et al. 2021)

Leads to the creation of Innovative milieu/ Innovation ecosystems: agglomeration effects / Specialization and variety (related variety ; non related variety)

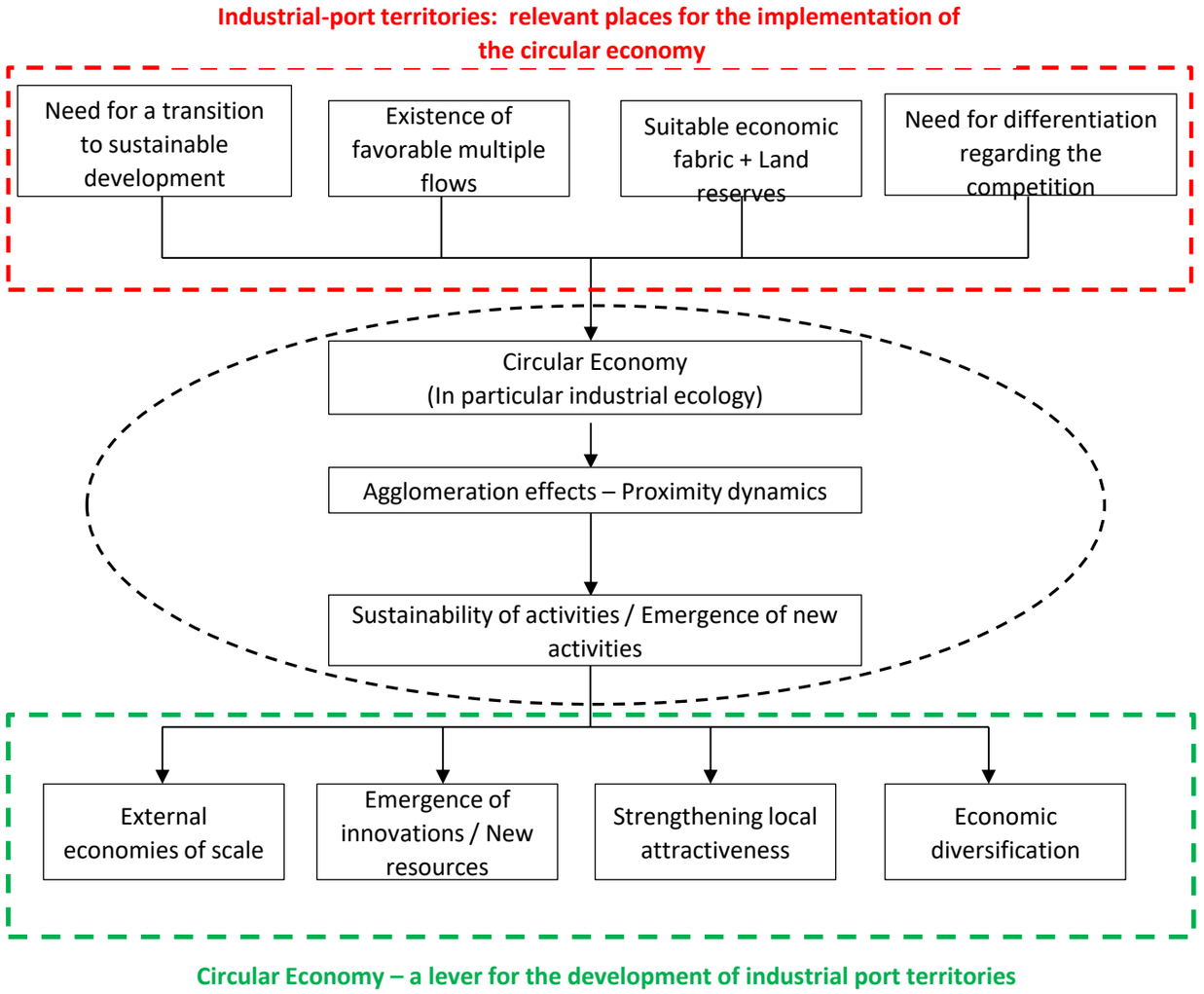
Industrial port areas are particularly suitable for developing circular economy projects (and in particular industrial ecology)

- They bring together large industrial companies and a network of subcontractors, which often have commercial relations - possibility for developing other types of relations, in particular for waste management

- They are places where material and energy flows are concentrated - possibility of pooling, establishing relationships, possibly creating recycling channels

- They are highly polluted areas - this makes it necessary to transform them towards a more sustainable mode of operation Strong international competition

- These aspects make differentiation necessary



IMPPEC, 2022

Decarbonization

- Decarbonization becomes more and more popular and covers very different realities.

- According to the French Ministry of the Economy, decarbonization is defined as **all the measures and techniques used to limit the carbon footprint of a company or region**.

- Four major breakthrough technologies can be identified: low-carbon hydrogen, biomass, electrification of processes through the production of decarbonized electricity (from renewable energies and nuclear energy) and carbon capture, storage and reuse.

- In addition other processes are also being implemented to improve the energy efficiency and sobriety of existing industrial equipments, making it possible to save energy for a wide variety of activities that are not directly productive (lighting and heating systems, operating models, etc.)

Impacts on territorial Development / Links with the Circular economy project

2- THE CASE OF DUNKIRK (North, France)

Video https://dunkerquelenergiecreative.fr/en/dunkirk-creative-energy/

- Third French Port

- Sixth in the Northern Range (2019).

- France's leading port for importing ores and coal, and for importing fruits in containers.

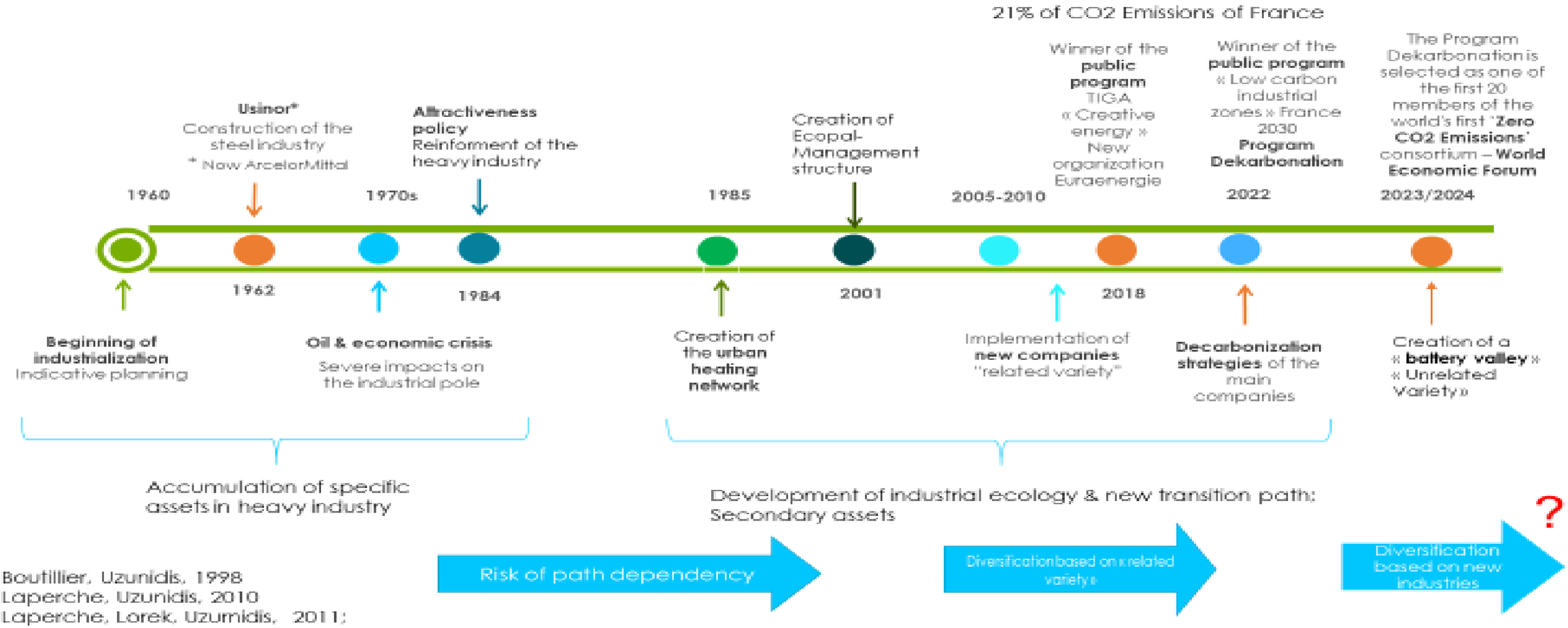
- France's leading rail freight port and second port for trade with Great Britain.

- Leading river port in the HDF region.

- 46 million tonnes (MT) in 2024

- 21 % of CO2 industrial emissions in France

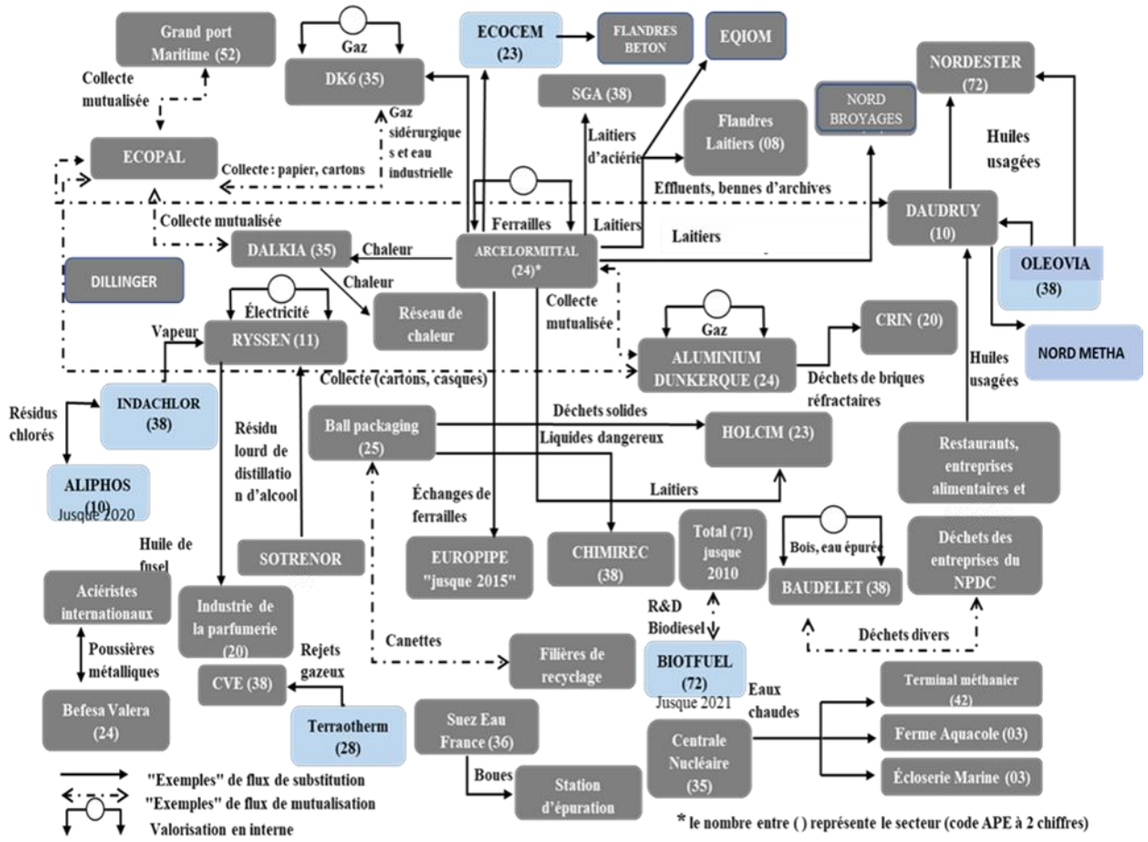
The case of Dunkirk (North of France) : An industrial trajectory



Boutillier, Uzunidis, 1998
Laperche, Uzunidis, 2010
Laperche, Lorek, Uzumidis, 2011;
Kasmi, 2018; Boutillier, Laperche, Le, 2024

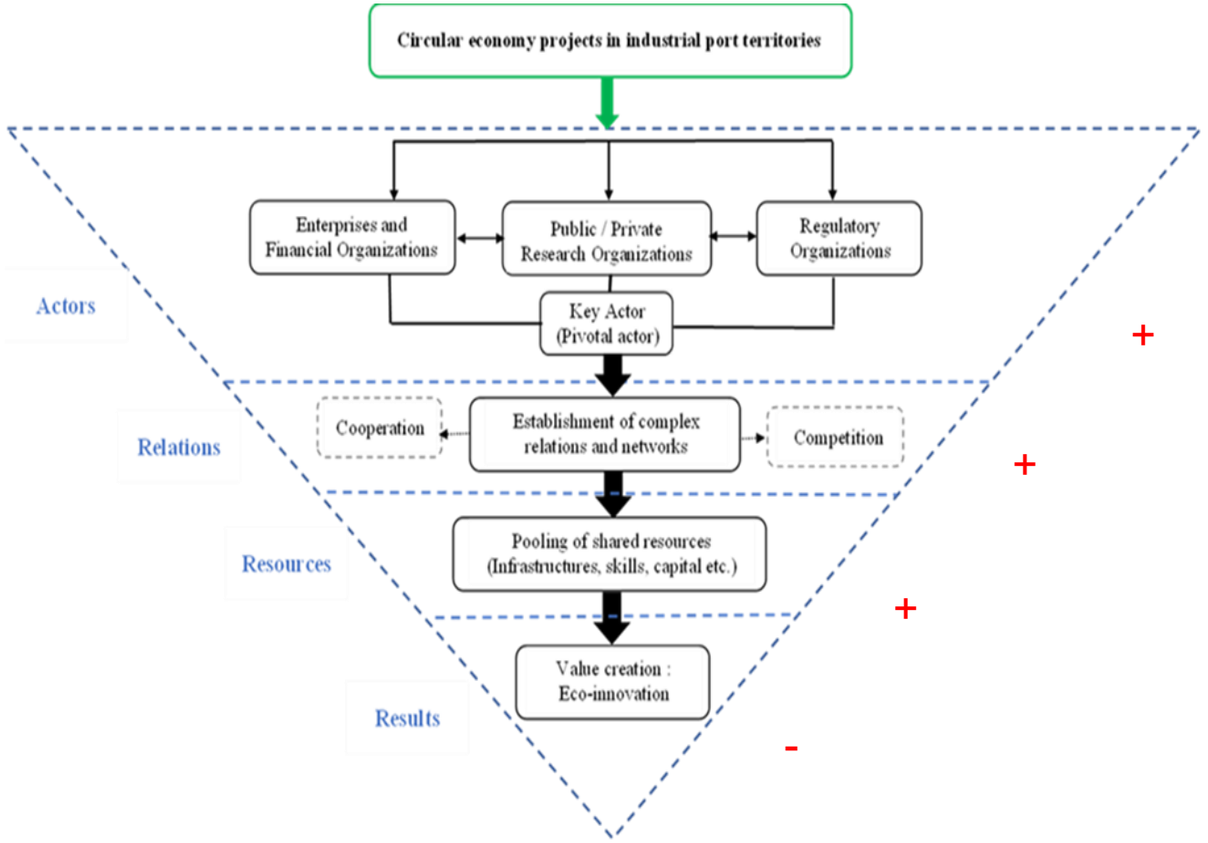
Circular economy and the creation of an industrial symbiosis: What impacts at the territorial level?

Dunkirk: pioneer city in Industrial Ecology (France)



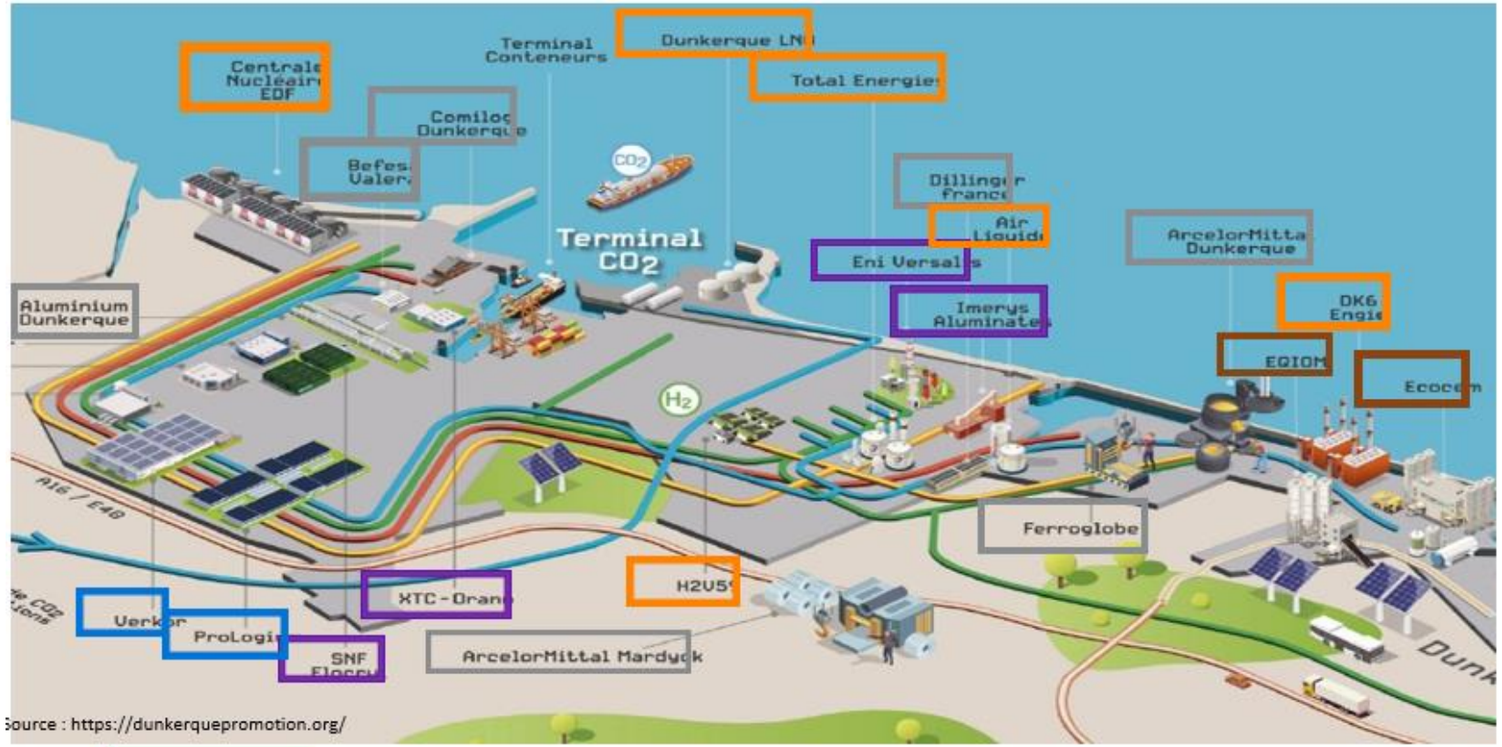
Kasmi, 2018, 2020, Boutillier et al., 2024

An imperfect « Circular ecosystem of innovation »



Andriamanantena et al., 2022

GIGAFACTORIES – An ecosystem around the production and recycling of Batteries (diversification / non related variety)



Agro-alimentaire
Lesieur
Coca-Cola
Sidérurgie et métallurgie
Énergie
Chimie
Construction
Batteries

Two gigafactories to produce electric batteries for the automotive industry, Verkor of France and ProLogium of Taiwan (*still in project*).

Chinese company XTC New Energy and French company Orano have signed an agreement to produce cathode materials for electric batteries.

Two battery recycling units operated by the Eramet and Suez consortium were foreseen but the projects are now cancelled.

Many other projects of implementation of new companies various sectors (wind-turbine platform, hydrogen)

Decarbonization : Many projects / Public support – towards a new trajectory

Dunkirk, along with Fos-sur-Mer, is a winner of the ‘Low Carbon Industrial Zones’ call for projects, launched as part of the France 2030 Plan.

The Dunkirk project, DKARBONATION , is to receive a total of €13.6 million in state aid to carry out engineering and feasibility studies, focusing mainly on Dunkirk's flagship activity, the steel industry. Three types of activity will be developed: increasing steel recycling; producing ‘green’ steel using hydrogen; and capturing and storing CO2.

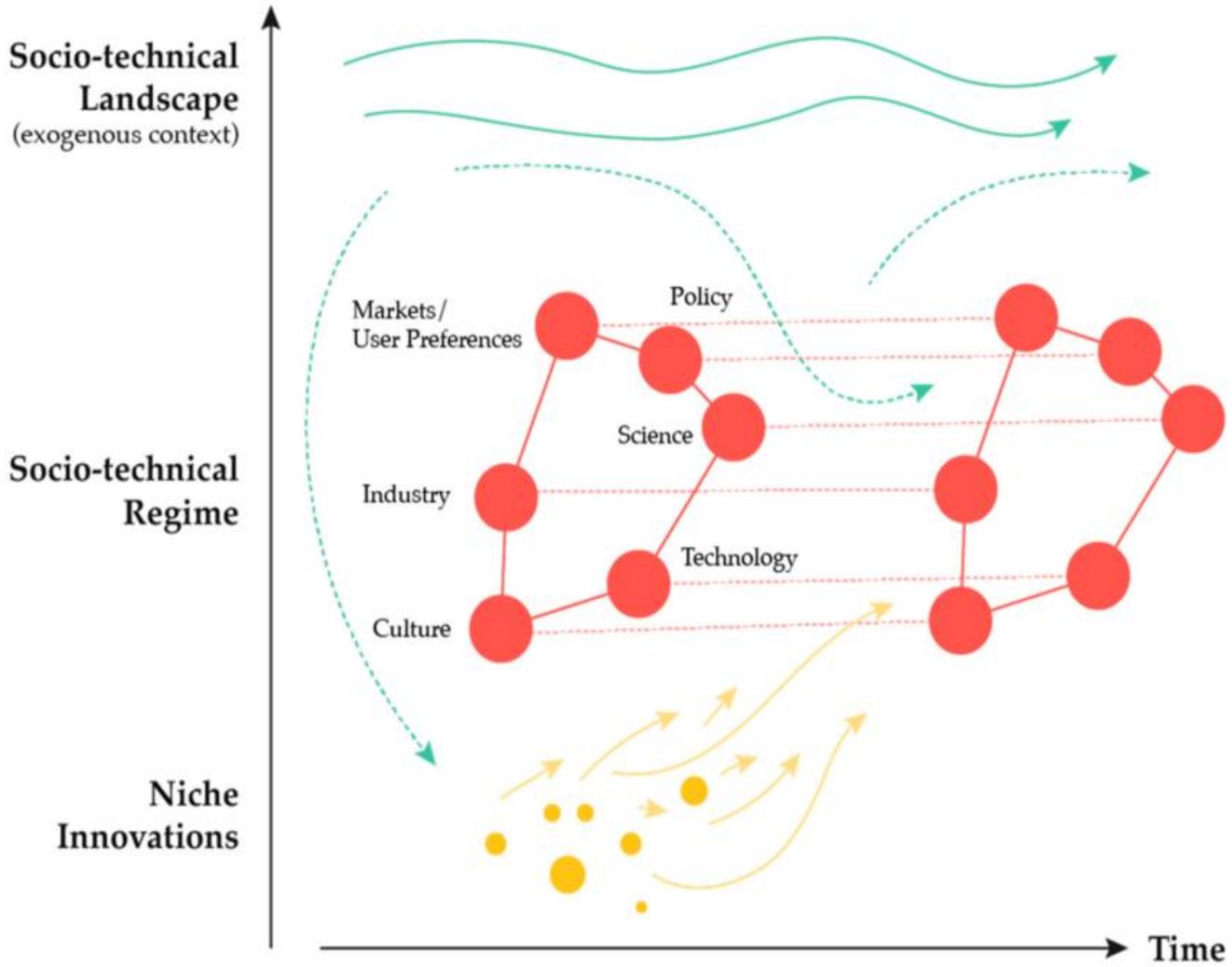
- Collective projects (see next page)
- Individual industrial projects (ArcelorMittal being the most emblematic, which is gradually replacing its blast furnaces with electric furnaces and developing CO2 capture ; but techniques that are still at the experimental stage : many other projects in companies like Aluminium DK, Lesieur, Daudruy)
- Production of Energy (2 EPR, Hydrogen, wind energy)

Collective projects – Decarbonization – Reality or Speculation ?

Name of the project	description
D'Artagnan	Air Liquide / LNG - building of a pipeline network to transport the CO2 captured in several plants near Dunkirk, and a CO2 terminal at the port of Dunkirk to receive and prepare **the CO2 for shipment to sequestration sites in the North Sea**, for a total investment of €220 million. *Postponed*
3D (pour DMXTM Demonstration in Dunkirk) et DRI	A consortium of 11 European companies, including ArcelorMittal, Axens, IFP Energies nouvelles (IFPEN) and Total, has launched this project to demonstrate DMX**, an innovative process for capturing CO2 from industrial sources**. The project is part of a wider study into the development of the future European CO2 capture and storage hub at Dunkirk-North Sea. The project has a budget of €19.3 million over 4 years, including €14.8 million in subsidies from the European Union. *Demonstration Project / Economic and technical Lock-in factors*
REUZE	ENGIE and Infinium (a company specialising in ultra-low-carbon fuel technologies) have signed a partnership agreement to produce **synthetic fuels by recovering the CO2 emitted by ArcelorMittal in Dunkirk**. The aim is to capture around 300,000 tonnes of CO2. Combined **with green hydrogen** produced by a 400 MW electrolyser installed by ENGIE, the company will be able to produce fuel for sectors that are difficult to decarbonise (e.g. air and sea transport). The investment amounts to more than €500 million. It is supported by the Hauts-de-France Region, the Communauté Urbaine de Dunkerque and the Grand Port Maritime de Dunkerque. *Postponed/ Abandoned?*
K6	Air Liquide and EQIOM have joined forces in the K6 project to transform the EQIOM plant in Lumbres into one of the first **carbon-neutral cement plants in Europe**, capturing 8 million tonnes of CO2 over the first 10 years of operation. The project has been selected for funding by the European Commission under the 2021 edition of its Innovation Fund (€150 million), in addition to additional public funding. *Postponed/ depending on other projects (D'Artagnan…)*
Fatal Heat Superhighway	*Connecting industrialists and logistics providers in the industrial-port area, planned for 2025, but Postponed* *Potentially spanning 30 km, it will collect, transport, transform and use waste heat, avoiding the emission of 60 kT of CO2 per year.*

3 - Stakes: Barriers, difficulties. The need for systemic approaches

Multi-level Perpective (Geels, 2019) applied to territories



Climate change ; shared vision (at the european level of the need for transition toward sustainability : carbon neutrality objectives)

Industrial fabric at the local level: heavy industry, path dependency

Transition toward carbon-free re-industrialisation

Industrial symbiosis, individual and collective industrial decarbonization Projects

Enabling and Lock in factors for transition (case of Dunkirk)

Impacts Types of factors (MLP)	Enabling	Lock-in
Techno-economic	* Territorial sepcialization: heavy industry * Fossil-based industrial fabric * Financial support from European and national programs (Zibac) ***Need for change***	* New Technologies (hydrogen, carbon capture etc.) are not mature * Costs of investment * Lack of R&D and Innovation *Nature of the industrial fabric: absence of decision centers ***Uncertainties, structural weaknesses***
Social and Cognitive	* High unemployment rate * Industrial identity ***Location attractiveness factors***	*Lack of competences, *Weak relationship between university and research, *Absence of entrepreneurs and of an entrepreneuship culture ***Systemic weaknesses***
Institutional factors	*Policies in favor of sustainable innovation *Toward a collective management of resources (co-products, wastes) *Shared vision of the territory « territory as a common » ***Building of a Collective approach***	*too optimistic vision (marketing vision); “headlong rush”: Investments, public debt ***Self-fulfilling prophecy (Risks)***

Is Circular Economy and decarbonisation a lever for territorial development (in industrial regions) ?

2 possible views based on the case of Dunkirk

- A positive view: **An innovative ecosystem in construction** – **Ongoing process of transition** CE : a source of organizational innovations at the level of the territory. Identification and pooling of existing resources collectively managed by the actors –

- A more negative picture: **An area of Application/Experimentation** – fragility remains (path dependency); speculative vision

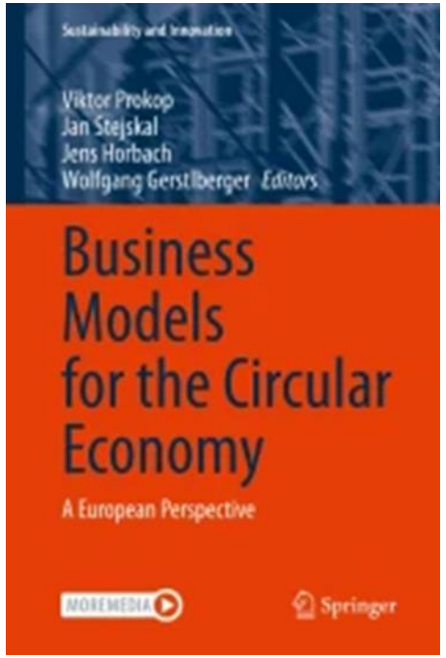
Open questions

- Are the limits put forward in the case of Dunkirk specific to this territory?
- Need for comparisons –; other ports: Fos Marseille / Haropa / North Range
- Are the limits due to the temporality of the territorial development process? TDP is not a linear process
- Territorial trajectories are characterized by setback and advances. With some actors moving faster than others

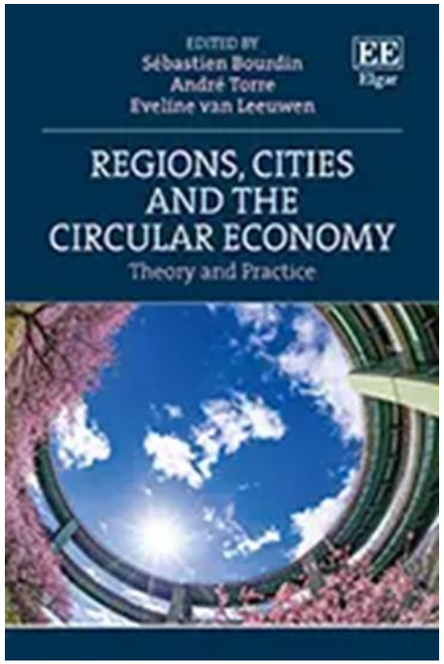
What do we learn about the analysis of case study?

- Importance to go into details, not only relying on public discourse (territorial marketing) or of companies (marketing strategies)
- Adopting a systemic approach of teritorial developement, innovation, transition
- Need for indicators: relying on common indicators, developing ad-hoc indicators; not only economic but also environmental and social indicators.

References



Andriamanantena, Laperche, Boutillier, 2022



Kasmi, Veyssiere, Laperche, 2024

Boutillier, Laperche, Le, 2024

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Thanks for your attention

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