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► **To cite this version:**

Johanna Ayrault, Franck Aggeri. The use of sustainable district heating to foster local ecological transitionan industrial ecology approach. 37th EGOS colloquium, Jul 2021, online, Netherlands. hal-03388507

**HAL Id: hal-03388507**

**<https://minesparis-psl.hal.science/hal-03388507>**

Submitted on 20 Oct 2021

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## **The use of sustainable district heating to foster local ecological transition – an industrial ecology approach**

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### **Abstract**

Sustainable District Heating (SDH) are both local public infrastructures of sustainable heat production and distribution and a specific collective organization supporting this infrastructure designed for an ecological transition at a local level. This ecological transition is the last evolution of urban transitions reconfiguring the place of public authority and PPP (public-private partnerships). Designing a SDH is not only a technical matter, it is a social and organizational process by which a network of stakeholders is involved and structured within a governance framework. The building of stakeholder networks, based on governance mechanisms, and aimed at building sustainability-driven interdependent systems of resources, are precisely the core of industrial ecology. Our research question is the following: to what extent SDH, considered as a specific form of industrial ecology, may contribute to an ecological transition at the local level? In this communication, we first characterize the local sustainable transition in which district heating are embedded in, then build on two pillars of industrial ecology - the design of a shared imaginary and the governance of the stakeholder network. We highlight the importance of contracts in the governance of such settings and finally, point out some gaps between sustainable imaginaries in Europe. We illustrate this dynamic through two district heating case studies in France. We use these two case studies to propose a comprehensive understanding of SDH design and governance and to build a new conceptualization of the key role of contracts in the collective governance process.

Keywords: ecological transition – industrial ecology – district heating

## 1. Introduction

District heating refers to a heat production unit and its distribution network. It comprises a great variety of technologies and network typologies. In this communication we focus on district heating as a public infrastructure, owned by a public body and operated by a private company on behalf of this public body. This private company is chosen through a request for proposals and the delegation contract can last for decades, during which the private company will manage the production facilities and the heat transport towards Energy Transfer Stations that feed the buildings and final clients. District heating systems have undergone a first evolution in the 2000s, with the raise of environmental concerns.

The answer for this concern was initially found in technological solutions, with the implementation of “greener” sources for heat production (geothermal or solar energy, waste heat, etc.). The actual definition for “sustainable district heating” in France is a district heating with more than 50 % of renewable and recovery sources in their energy mix (SNCU, 2020). In international energy studies, district heating is beginning to be seen as an essential building block of the ecological transition (UNEP, 2020) and more and more local clients (cities, universities, etc.) have adopted strong environmental strategies with ambitious targets, like being carbon neutral. But the solutions studied focus on the technical aspects of this transition: new green and local sources, low-temperature district heating, thermal storage, etc. (Shaffer et al., 2018 ; Schmidt, 2018). This technical approach encountered some limitations and difficulties to lower at the expected pace the share of fossil fuels (Lygnerud, 2018 ; Lygnerud et al., 2019).

However, different voices have expressed the idea that an ecological and circular transition requires more than technical solutions, but also some studies of the supporting stakeholders network and its governance (Loorbach, 2010), in particular a reconfiguration of the public authority commitment to public utilities (Marvin and Graham, 1999).

In this perspective, we propose to draw upon the industrial ecology framework (Erkman, 2004; Neves et al., 2020) to rethink sustainable district heating facing the ecological transition. Industrial ecology is based on synergies and collaborations within an area between various stakeholders (Erkman, 2004; Beaurain and Brulot, 2011; Brulot et al., 2014), going further than studying flow exchanges. Four pillars are put

forward by Brullot (2009) to analyze the maturity of industrial ecology: trust between stakeholders, shared imaginary comprising rules and coming from a collaborative process, governance and density of relationships between stakeholders. In this communication we focus on the shared imaginary and the governance to shed light on the local and systemic aspects of a sustainable district heating.

The research question that we want to address in the communication is thus the following: to what extent sustainable district heating, considered as a specific form of industrial ecology, may contribute to an ecological transition at the local level?

We base our study on two French district heating networks. They were pioneers in a technical-driven approach of district heating transition, with the early implementation of a great share of renewable and recovery sources in their energy mix. We study these historical examples, understanding the dynamic of their evolution and its local impact drawing on the two pillars mentioned above. The two district heating had a similar objective of having a decarbonized heat for their territory and used a similar systemic and local approach. In both cases, they used contracts as a tool to formalize the network governance. We will analyze its importance for the success of an ecological transition.

## **2. Methodology**

### 2.1. Literature review

Literature on sustainable district heating mainly tackles technologies and modelling. An important body of literature is the use of storage and low-temperature district heating, as two means to optimize the network efficiency and the integration of more renewable and recovery sources (Shaffer et al., 2018 ; Schmidt, 2018). Some articles tackle the conditions for the implementation of these technologies, with a focus on contracts or policy (Lygnerud 2018 ; Lygnerud et al., 2019). Indeed, the new generation of district heating differs with the former ones as it is less centralized and builds more on the local resources for its energy mix. The integration of such resources obviously questions the technologies but also the policy framework which may promote or hinder the use of such heat. However, using local renewable resources also means that the main contractor has to collaborate with local actors that are not substitutable for one

another. When looking at the global system, the sustainable district has an impact on a broader territory: from the forest worker to the prosumer, not forgetting all the public entities committed to the local development and transition. All in all, sustainable district heating appears as a adapted tool to support local urban sustainable transition.

Sustainable transition corresponds to an emerging body of literature (Köhler et al., 2019) which gained momentum around 2005. Sustainable transitions can be defined as “Long-term, multidimensional and fundamental transformation processes through which established socio-technical systems shift to more sustainable mode of production and consumption” (Markard et al., 2012). This literature studies the tools for such a transition (Loorbach, 2010) and the needed non-technical reconfiguration at a policy level (Jacobsson and Jonhson, 2000). It presents a strong interest in the energy transition but mainly at national levels. District heating system present a more local anchorage and can be linked with another stream of literature: urban utility transitions, which points out the social and organizational aspects of such transitions. Marvin and Graham (1999) study the flickering commitment of public authorities in their utilities, depending in the various global dynamics like centralization or privatization. The more recent transition is characterized by a renewal of the public authority interest in its utilities, which can be linked to a will to use them as sustainable transition vectors. Collier (2011) also shows that the transition of infrastructures and utilities are backbone of global social transitions: through the choices made for the operation and framing of utilities, a vision of society and collective action is created. However, this literature does not analyses in depth the critical points for the integration of public utilities – like district heating – in local sustainable transition.

To fill this gap, we propose to draw upon literature on industrial ecology (Erkman 2004; Neves et al., 2020) which promotes an approach closer to the one of ecological ecosystems to minimize human activities impact, with complementarities and interdependences: waste for certain stakeholders are resources for others. In fact, district heating is often at the heart of industrial ecology systems, as waste heat is a classical way to exchange between industrials. Industrial ecology requires a collective design and governance mechanisms to ensure to minimize environmental impacts and a correct sharing of value. To analyze the maturity of industrial ecology, four pillars are put forward by Brulot (2009): trust between stakeholders, shared imaginary comprising rules and coming from a collaborative process, governance and density of

relationships between stakeholders. Literature on industrial ecology formalizes governance strategies (Brullot et al., 2014; Bahers et al., 2020). Such collaboration may then be used for local development (Beurain and Brullot, 2011; Cerceau et al., 2018), a clear objective of district heating ecological transition. In this communication we focus on two pillars of industrial ecology, which are strongly linked with critical points of the sustainable transition: the construction of a shared imaginary and the governance (Kemp et al. 2009), analyzing how they were implemented in our two case studies and in which way they support the path towards sustainable district heating.

We argue that contracts act as mediating instruments (Miller and Power, 2013) as they formalizes the links – e.g. mutual commitments, risk and investment sharing, criteria and objectives - between various stakeholders (Decouzon et al., 2015).

## 2.2. Field work

Our field work is based on two case studies (Yin, 2018): Dunkirk and Besancon. We conducted a longitudinal qualitative study with the main stakeholders to explore “the contexts, content, and process of change together with their interconnections through time” (Pettigrew, 1990). Both case studies are historical and innovative sustainable district heating, at least on technical issues, which allow to have some insights about their evolution. The study aims at analyzing the dynamic of the first environmental transition of district heating systems. This study was done through semi-directive interviews (10 for Dunkirk and 9 for Besancon) and a was analyzed through the two pillars of industrial ecology mentioned earlier: construction of a shared imaginary and governance of the stakeholders network. A strong emphasis was also put on the contracts, as a mediating instrument used to formalize these pillars.

Dunkirk and Besancon where pioneers in the implementation of renewable and recovery sources to their energy mix.

Dunkirk chose to set up waste heat recovery from a nearby large steel facility (today called Arcelor-Mittal) in 1986. The local public authority was trying to get rid of fossil fuels and their price variations, to ensure affordable heat supply in Dunkirk. Arcelor was producing great amounts of heat that were lost, and had a reputation of polluter. Its commitment to the district heating network gave roots to industrial ecology within

the territory, with the ambition of becoming more resilient to crisis (e.g. environmental threats, international competition, etc.). The district heating is locally well integrated, with a systemic approach mobilizing various stakeholders. Indeed, in Dunkirk the district heating owner is the Urban Community of Dunkirk, who delegates the management of the network to a private operator (here Dalkia). For the heat supply, the industrial Arcelor-Mittal is committed, along with other industrials and the waste incinerator. The heat is then distributed to the users, who can be individual, social housing managers, public institutions, etc. However the district heating has faced financial problems and industrial heat is still an uncertain resource.

Besancon is an old district heating, dating from 1968. It was one of the first French district heating to set up large scale biomass boilers in 2006. The choice of biomass is strongly linked to the local resources and has strengthened local employment in the forest industry. Indeed, its wood-energy is made from waste from the forest sector, or cleaning in the forests. Here again, various stakeholders are committed, like the public client (the metropolis of Besancon), the private company (ENGIE), the wood industry stakeholders (wood suppliers, wood workers, forest owners, etc.), the waste incinerator and the diverse final clients. Nonetheless, the district heating has not developed during the last decade due to a lack of commitment of some important stakeholders.

These two fields are utterly interesting because they represent two very different network typologies with the same will of integrating local renewable and recovery energy for heat production. Other international projects are included in the communication to embody some particular aspects of interest: Ottawa, with an ambitious contractual process to frame the district heating transition, and Helsinki which launched the first energy challenge, a call for ideas to imagine the future of its district heating system.

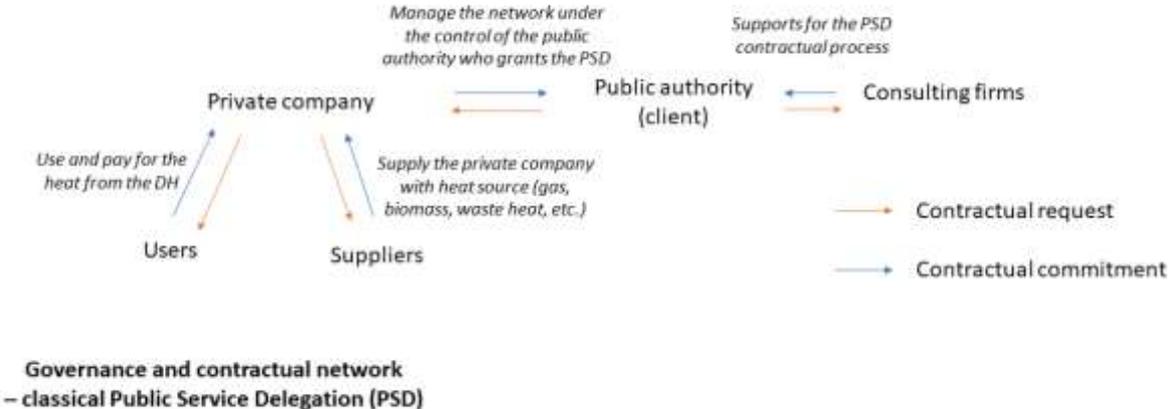
### **3. Results**

#### **3.1. Characteristics of the local ecological transition**

The ecological transition of district heating is part of an urban transition redefining the role of the public authority (Marvin et al., 1999). Indeed, district heating are mainly implemented in densely populated areas due to technical features. Their transition is thus part of a more global “urban sustainable transition”, in which the cities commit to neutrality objectives. However, these new goals also demand a reconfiguration of the

historical commitment of public authorities in their infrastructure and utilities. In France, like in the UK for instance, public utilities network were historically designed as the national level. Centralized network of gas or electricity are consequences of this national strategy.

In France, urban utilities networks are owned by the public authority, but their operation and maintenance has historically been delegated to national monopolies. There have been a lack of interest and awareness from the local authority for their place in the development of such network. Thus, it has never been integrated to the local urban plans, and historical Public-Private Partnerships were almost automatically renewed, with little specifications or follow-up. The most common contract is the concession. Here, all the risks and investments are borne by the private company. Each contract defines the concession duration (usually about 20 to 30 years) and also states the evaluation criteria for the performance (mainly financial and technical). The public authority is only involved as a controller while the private company has a great deal of autonomy on its management of the district heating. The commitment of the public authority in the district heating is highly variable and often hindered by the lack of awareness and technical competences.



Lately, decentralization laws have been passed in France to empower local authorities, in particular the law MAPAM (2012) and NOTRe (2014). Among other responsibilities, local authority now need to integrate heating networks into their urban plans and sustainable transition strategy. Indeed, the crucial importance of the local level in such transition is starting to be better understood, all the more as the sustainable resources are local. For instance, waste heat, geothermal sources, local biomass or wood wastes can be inputs for a district heating. The use of waste heat from the industrial Arcelor-Mittal in Dunkirk, or the integration of biomass boiler using local wood in Besancon are

two examples of such integration. Taking advantage of this empowerment, local authorities have started to design ambitious transition plans, using public authorities as sustainability vectors. More than the use of renewable resources, they add local concerns (e.g. fighting fuel poverty, fostering local employment, reducing local pollution) as specifications framing the utilities' performance. These concerns can be seen as the translation of the Sustainable Development Goals at a local level, and may vary from one local context to the other. They are often stated in the urban transition plans, as key issues to be tackled. For instance in Dunkirk, the district heating fostered the creation of an industrial ecology dynamic, having a positive impact on the integration of industries in the territory, and participating in the resilience of the area. Moreover, the use of recovery heat from Arcelor reduced the local emission of smokes and the air pollution. In Besancon, the use of biomass secured local workers and supported the wood area. The affordability of the heat was also a local concern and remained at the heart of the delegation renewal.

Two main characteristics of the local sustainable transition can be identified: 1) the integration of local concerns into the utilities performances and 2) the valorization of local resources. All in all, the actual local sustainable transition is strongly linked to circular economy, especially industrial ecology considering the scale of the circular loops. Therefore, local authorities need to commit again in the governance of their public utilities to succeed in the reaching of the ambitious sustainable objectives. This re-involvement implies the need for new competences to be able to discuss with historically powerful and skilled private operators. The use of other types of project society allowing a stronger commitment of the public authority and limiting its risks is gaining momentum like SEMOP and SAS EnR where the public authority has shares and plays a part in the network management. To understand how new partnerships allowing more local positive externalities may be built, the industrial ecology is an interesting framework to consider.

### 3.2. The needed reconfigurations for such a transition

The two characteristics of the sustainable transition can now be viewed in the framing of the value proposition of district heating. Indeed, more than just delivering heat at a competitive price, district heating are now actors of the urban transition and must deliver environmental and social performances. Innovative and decentralized technical solutions are put forward as they allow a better integration in the local context. They

are based upon the use of various local renewable resources and storage and are supposed to deliver the expected “sustainable” performance. However, their design entails new ways of designing and operating the district heating systems: the value proposition is different and needs to be framed and backed-up by calculation conventions and tools and the integration of new stakeholders (e.g. for heat production) causes the reconfiguration of the collective action. These two aspects are strongly related to two pillars of the industrial ecology process 1) the design of a shared imaginary and 2) the governance of the stakeholder network. They then find a formalization in the contractual process, the third reconfiguration developed in this communication.

### 3.2.1. Co-construction of a shared imaginary for the value proposition

One first striking point is the necessary construction of a shared imaginary. This shared imaginary represents the expected benefits of the district heating and, like in industrial ecology, is key to mobilize a broader set of stakeholders and make them collaborate for a common purpose. This imaginary is based on the expected benefits by all the stakeholders, and is used to frame the value proposition of the network. Historically, this value proposition relies on technical and economic performances. However, in the context of a sustainable transition, the value proposition encompasses new values related to the characteristic of the transition: 1) the integration of local concerns into the utilities performances and 2) the valorization of local resources. These values can be explicit, monitored by indicators integrated to the request for proposals with the operator being responsible for their achievement, or implicit such as positive externalities on the attractiveness of the neighborhood connected to the network.

In both case studies, the shift for a more global value creating a shared imaginary around the network has occurred. In Dunkirk the driver was the creation of stronger interrelations and complementarities between local stakeholders, and in Besancon the use of a local resource (wood) supporting local industry. However, in both cases, this vision did not have the same importance for all stakeholders, which weakened the district heating project. In Dunkirk, even if Arcelor-Mittal was committed to supply the network with heat, it did not want to share a long-term contract with the other stakeholders, stating clearly that the industrial process was always coming first and that it could not take risks and responsibilities to ensure heat supply. This threat was

counterbalanced by the informal network of interpersonal confidence and long history of industrial collaboration with public authority. In Besancon, the representatives were not fully committed to the network. Even if most stakeholders shared a common vision for the district heating and were aware of its benefits for the territory (affordable heat for social housing, integration of the wood industry to heat supply, local jobs, etc.) the lack of interest from the representatives severely hindered the network development during the last decade.

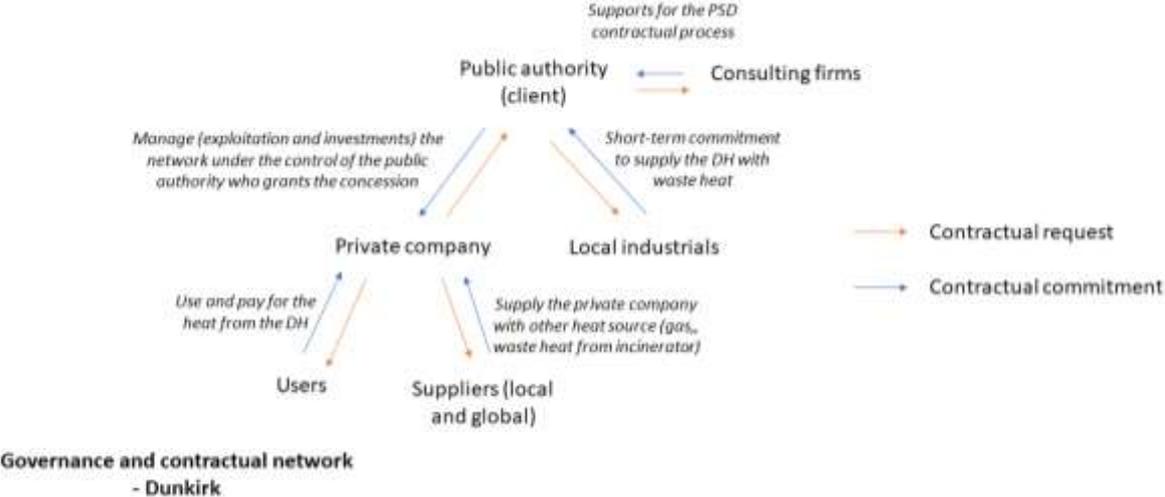
The commitment of all stakeholders to a common vision and value proposition is necessary for the integration and development of the district heating network. It is supported by an informal network of collaboration and confidence, and by the use of co-construction whenever it is possible.

### 3.2.2. New collective action governance led by the public authority

The sustainable transition shared imaginary is mainly based on collaboration and co-construction (Itten et al., 2021), which is translated at the scale of district heating projects. It demands the integration of new and shared values into the framing of the request for proposal. To frame and deliver these values, different stakeholders are integrated to the process, which causes a reconfiguration of the stakeholder network. This reconfiguration entails a new vision of the collective action, and thus a new governance. Indeed, with decentralized solution, new heat producers and owners can be integrated to the network. Moreover, in order to cover the huge investments demanded by innovative renewable solutions, new financial partners can be part of the project. And finally, as the sustainable heat transition claim its local anchorage, crowdfunding is becoming common practice as it allows to commit citizens in the district heating. As for industrial ecology systems, all these stakeholders are interrelated in a complex network, their commitment depending on the level of benefits, risks, responsibilities and investments they see in the district heating.

In public networks operated by private operators, the public authority has a predominant role in the collective action governance. They are first needed to help frame the appropriate value proposition and related imaginary, by identifying the relevant stakeholders and understanding their interest in the network. Once the place of each stakeholder in the network is clearer, they are key to ensure the risks, responsibilities, investments and benefits are correctly shared between all

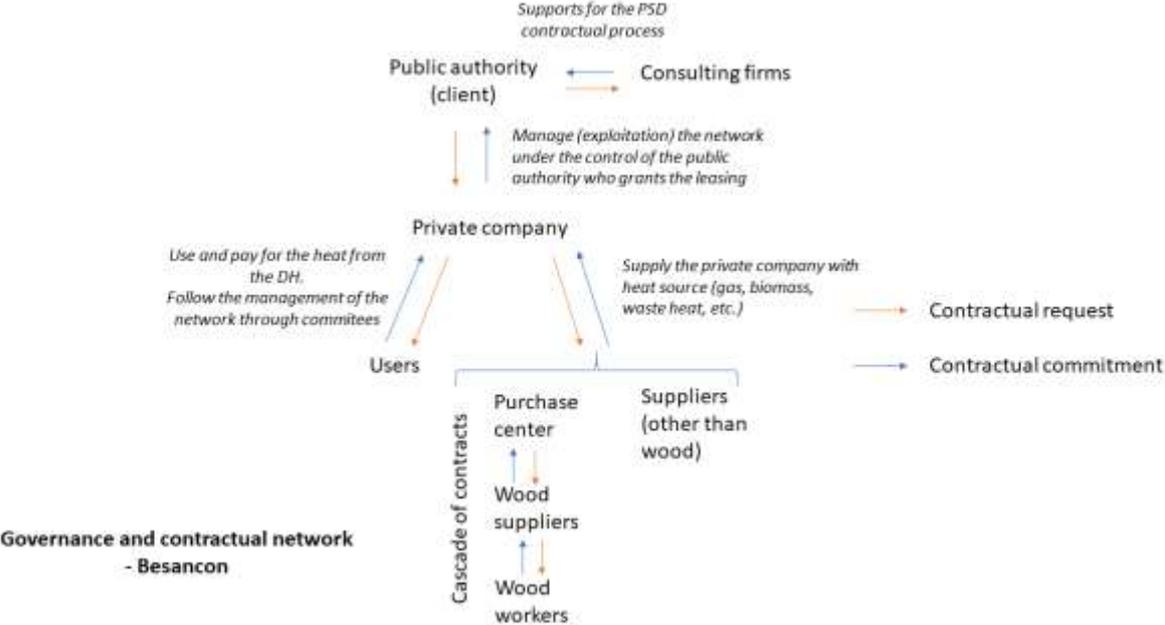
stakeholders, creating an ethical ecosystem. They act as facilitator between the various stakeholders. In Dunkirk for example, the public authority has an important role as the industrial Arcelor-Mittal has recently chosen to set up its supply contract with the public authority instead of the private operator in charge of the district heating. They are key in maintaining the trust-nexus and integrating new stakeholders into the ecosystem.



### 3.2.3. The role of the contractual process as a management tool

The final reconfiguration is about the contractual process. The contractual process embodies the whole process from the design of the request for proposals to the writing of the contract. The classical concession presented before is no longer relevant for the implementation of sustainable district heating. It does not take into account the systemic value demanded by the shared imaginary, and does not give a place to all the stakeholders needed to design the process and deliver the value. To make sure the sharing of the value complies with the principle of circular economy, one way that does not question the classical frame is to use a cascade of contracts. It means to multiply and reproduce the long-term contracts over the different stakeholders, to secure their future and help structure the processes. For instance in Besancon the long-term contract between the public authority and the private company operating the network was reproduced through the wood sector. Indeed, the purchase center, which is also part of the group owning the operating company, proposed long-term contract with part of its wood suppliers. This long-term contract was then used to secure some forest workers and help them forecast the coming demand. All in all, it helped the local

economy by insuring seasonal workers, structuring the local wood biomass process thanks to long-term contracts and anchoring the district heating in the local ecosystem.



However, the public market frame sometimes hinders collaboration and co-construction, by preventing discussions between the various stakeholders once the request for proposal is launched. To foster this co-construction, the design of the request for proposal is paramount. In Ottawa, the Canadian government made interviews all over the world to better understand the current state of the heat market and design properly the request. Moreover, it included a long phase of dialogue between the government and the various contestants to frame correctly the value proposition. Another way of innovating in the design of the request for proposal was imagined by the city of Helsinki. It has launched a request for ideas – Helsinki Energy Challenge - on his district heating, to get innovative propositions on the possible future of its network, particularly local production systems. The ideas can then be used to better frame the request for proposal.

### 3.3. A gap between the local transition and the global one

The local transition has very specific characteristics: 1) the integration of local concerns into the utilities performances and 2) the valorization of local resources. To give life to this transition through district heating projects, instruments have been designed. This dynamic is done within a more global transition, the “sustainable transition”. Indeed, at European and local levels, strategies are being developed to reach carbon neutrality

goals, strategies in which heat decarbonation and sustainable district heating are embedded. However, the problematization of the transition at these two scales is very different, with different views of the two pillars mentioned so far.

Concerning the imaginary, the local transition is focused on circular aspects, with a systemic approach allowing local anchorage and local benefits (Farné Fratini et al., 2019). At a European and national level, the problematization and framing is much more technical, with a strong focus on carbon. The aim of sustainable district heating is to allow urban decarbonation, and the achievement of neutrality goals in the short to mid-term. The instruments and programs designed are focused on this aspect and does not necessarily align with local concerns. This makes it difficult for them to foster sustainable district heating development and the implementation of disruptive systems. For instance, to incentivize the decarbonation of district heating, a French threshold of 50 % recovery and renewable energy was implemented. The compliance to this threshold is, among other, needed to get national funds and be competitive with gas. However, it did not encourage the setting up of innovative district heating, but only the shift from coal and fuel to biomass or waste recovery heat. This shift does not change the configuration of the network but only the production means and the boiler type. The systematic comparison to individual gas, which price is frozen in France, makes it difficult for innovative district heating to be competitive: geothermal energy demands huge investments and struggles to develop. This focus on the decarbonation and the convention used also makes invisible other values that are locally important, like fuel poverty. This aspect is tackled by some other strategies, with the “just transition” rhetoric but struggles to get linked to the incentive for sustainable district heating development.

Another invisibility concerns the governance and integration of multiple stakeholders. If local strategies have a focus on local anchorage, the attractivity of the territory and the development of new skills, these aspects are invisible in national and European strategies. Indeed, the strong focus on carbon makes the stakeholders invisible: all is about calculation of carbon emission, reduction of the emission, allocation of the emissions without links to the human side, except for the expertise (Jasanoff, 2010). A striking example is biomass: at a European level, the discussions are on the sustainability of biomass and the calculation of substitution indexes. At a local level, concerns are much more operational: how to structure the biomass industry and secure workers?

If national and European circular strategies exist, they are not linked to the energy transition ones at the local level. These strategies seem very far away for the stakeholders, and the instruments designed are not always known and used. Moreover, the relation between district heating and industrial ecology is not obvious. If in Dunkirk, the two are strongly linked, it is not the case in the majority of the French district heating, and the tools designed to support industrial ecology are not exported for a better integration of district heating in the local context.

#### **4. Conclusion and discussion**

This communication, based on two French case studies, gives a comprehensive understanding of the innovative aspects of sustainable district heating which has become a pillar for the ecological transition at a local scale.

Our empirical contribution is twofold. First, we point out the critical aspects of the local sustainable heat transition: 1) the integration of local concerns into the utilities performances and 2) the valorization of local resources. These characteristics allow to link this transition, which is for now considered mainly on a technico-economic level, with work on industrial ecology (Beaurain and Brulot, 2011; Cerceau et al., 2018). Secondly, we have analyzed the challenges and conditions for the emergence of sustainable district heating. As they rely as much as possible on local sustainable sources (geothermal energy, solar, wood, industrial waste heat etc.), they entail the creation of a new network of stakeholders, strongly interlinked. The study of such networks with interdependencies between stakeholders assembled around a common purpose and associated to a collective and shared value proposition (Beaurain and Brulot, 2011 ; Brulot et al., 2014) is at the heart of industrial ecology. In this communication we focus on two pillars of the industrial ecology: 1) construction of a shared imaginary and 2) collective action governance (Brulot, 2009). The creation of a new value proposition and the commitment of all stakeholders to this proposition depends on the creation of a shared imaginary. To implement the collective value proposition, this network of stakeholders have to redefine the governance principles and the organizations surrounding the district heating (e.g. risk, value investment and opportunities sharing) (Brulot et al., 2014; Bahers et al. 2020).

Our theoretical contribution is twofold. First, we stress the key role of contracts in the governance process. They act as mediating instruments (Miller and Power, 2013) formalizing and making coherent the relationships between stakeholders. All the aspects mentioned above are formalized in a stream of contracts (Decouzon et al. 2015), insuring a fair sharing and anchoring the governance principles for the main contract duration. Secondly, we point out the existence of gaps between the imaginaries of the sustainable transition at the local, national and European scale. Related to these imaginaries are corresponding instruments which may make invisible some aspects of the transition. Indeed, at the European scale the sustainable transition is focused in decarbonation (Jasanoff, 2010), supported by calculation norms which give little space to collective action and its stakeholders. On the contrary, at a local scale sustainable transition is much more related to circular economy principles with the integration of local concerns and resources (Farné Fratini et al., 2019).

In the two case studied, parts of this global dynamic could be observed but the collective intelligence was limited. The major part of the efforts were put on the technological solutions for the integration of more renewable and recovery sources. Other district heating are going further on the creation of a shared and locally anchored imaginary to frame the value proposition, like in Ottawa and Helsinki.

However, we have considered the contract as central in the industrial ecology dynamic, but not all externalities and partnerships can be integrating into the main contract from the beginning. Further research shall be conducted on the limits of the contracts the dynamic between contractual and non-contractual aspects, for instance integrating temporal aspects and learning processes.

Moreover, the vision taken here of sustainable district heating is partial, as it is centered on two pillars of industrial ecology. A more global vision, like a one based on the different aspects of the business model, could also be relevant to further investigate the value creation and capture, but also the needed competences supporting this value.

Finally, gaps between the different imaginary of the sustainable transition need to be elaborated. We have focused here on the different imaginaries at various levels and the invisibilities coming from the focus taken for the value proposition. Other gaps, like temporality of transitions could be integrated to the analysis. We argue that instruments

are a way to study and help fill these gaps, as they bear the memory of the convention choices that were made, and can be tools for co-construction and connection between different value propositions.

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