

THE IMPLEMENTATION OF SUSTAINABLE NEW BUSINESS MODELS FOR ENERGY PROVIDERS, A CASE STUDY OF ENGIE'S DISTRICT HEATING AND COOLING SYSTEMS

Johanna AYRAULT, ENGIE Lab Environment & Society and CGS (MINES Paristech), +33604450413, johanna.ayrault@engie.com
Franck AGGERI, CGS (MINES Paristech), +33678540367, franck.aggeri@mines-paristech.fr
Anne PRIEUR-VERNAT, ENGIE Lab Environment & Society, +33761409614, anne.prieur-vernats@engie.com
Élodie LE CADRE, ENGIE Research, +33763458448, elodie.lecadre@engie.com

Overview

A district heating and cooling system (DHCS) comprises the heating or cooling production units and the distribution network going to the Energy Transfer Station situated in a building. In this communication, we focus on public-owned DHCS that are operated by a private energy operator. During the last decade, energy operators have seen a shift in their clients demand. Environmental and social concerns are integrated to the design of the networks. Many local authorities are committed into carbon neutrality goals and are trying to build roadmaps for a local sustainable transition. Public infrastructures are becoming an important part of these transitions. The UN environment program points out the key leverage that DHCS can be for a sustainable transition. At the EU level, they are becoming integrated to the energy strategies. Thus, energy operators' role is changing, as they have the expertise to support this transition and to help design more sustainable utilities.

Historically, public utilities have been considered with a techno-economic approach, focused on the price and the technical performance. For the sustainable transition, technical answers have been put forward, like 4th and 5th generation DHCS. They allow to integrate more renewable and recovery heat sources, and have a better overall efficiency. However, these systems are also very different from the historical ones: they require a strong local anchorage as they build upon local resources for the heat source and, as they multiply and decentralize the heat source, they demand the integration of a great variety of stakeholders. Thus, usual ways of doing business are no longer relevant, and the historical frame of DHCS is moving.

To be part of this dynamic, ENGIE has given itself a purpose in 2020. It is "to act to accelerate the transition towards a carbon-neutral economy, through reduced energy consumption and more environmentally-friendly solutions. The purpose brings together the company, its employees, its clients and its shareholders, and reconciles economic performance with a positive impact on people and the planet. ENGIE's actions are assessed in their entirety and over time". Well-adapted to the changing demand, this purpose highlights ENGIE's expertise in the energy sector and adds a new dimension to the classical techno-economic approach: the positive impact on people and the planet. At the level of DHCS, this new purpose is aligned with the public authority wish for a sustainable transition, with the promise of low-carbon solutions for their heating and cooling delivery.

To study the ongoing transition in the DHCS sector, the business model seems to be an adapted tool. One recurrent definition of business model is the one of Osterwalder and Pigneur, assessing that it is "a conceptual tool to help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication and innovation" (Osterwalder and Pigneur, 2005 in Bocken and al., 2013). A common point to many definitions is the central place of the valuation process: value proposition, capture and delivery. For ENGIE, we can see that the value proposition is shifting towards a more systemic value comprising social and environmental concerns. Consequently, the whole valuation process will need to adapt. Literature on business models also tries to give analysis frameworks, which point out the pillars of a business model. One framework of interest is the RCOV framework (Demil and Lecocq, 2010), presenting business model as a dynamic process between three pillars: value proposition, resources and competences, internal and external organization. This framework can be applied to study ENGIE business model concerning DHCS. However, if a lot of studies devise canevases to assess the innovative aspects of a business model, or the features that can help innovation in a business model, few get interested in their operational implementation. To fill this gap, we use the literature on management tools to understand how new sustainable business models are implemented down to the operational level, and can change the operators practices. One interesting tool is the contract, as it embodies and formalizes part of the business model. We study it through Berry's theory on the performativity of management tools (Berry, 1983).

Building on these literatures, we propose an analysis framework to understand how ENGIE can align its operational business model with its strategy. We base our study on various DHCS cases and informal interviews within ENGIE. With this material, we challenge the three pillars of our analysis framework, with a particular interest in the tension between the strategy in principle and what happens in practice. It allows us to point out various critical points in the design of business models for sustainable DHCS.

Methods

The methods is primarily based on the literature review. We use three streams of literature to frame our problematic. The first one is the business models. Business models is a concept coming from managers and has gained momentum in the academic field in the mid-1990. It has developed mostly on the strategic field, alongside e-business, trying to understand how these new businesses were working. Due to its empirical anchorage and abundant development, the literature is not uniformized: it does not have a common language or shared and accurate terminology (Zott et al., 2011). Multiple definitions of what is a business model can be found in the literature, but also at an empirical level. A common point to the various definitions is the central place given to the valuation process. This process has three steps: value proposition, creation and capture (Teece, 2010 ; Zott et al., 2011 ; Bocken et al., 2013 ; Hamelink and Opendenakker, 2019). The value proposition corresponds to the strategic intent of the company, the value creation to the means and resources used to deliver the value and the value capture is about the ways to integrate the value and calculate it. More than definitions, multiple canvases to help create or analyze business models co-exist. The one of Osterwalder and Pigneur (2010) is widely used. It proposes nine blocks to analyze an existing business model or to brainstorm on a new one: key partnerships, key resources, key activities, customer value, customer segment, customer channel, customer relationship, cost structure and income structure. However, this extended framework does not seem to be relevant when studying a business model from an innovative sustainable activity point of view. The customers, partnerships and resources are still to be built and boundaries between the various blocks are blurred. Moreover, the value proposition comprises multiple values, making the use of the canvas unpractical. We have thus chosen to use the RCOV framework. This framework only comprises three pillars, and is by design well-adapted for dynamic business models. It presents the business model as a dynamic process between the value proposition, the resources and competences, and the internal and external organization.

Our second stream of literature is related to the object studied. Indeed, in this communication we do not use business models to study a company, or part of a company, but to study an activity linked with a public infrastructure. Literature on DHCS can be replaced in the more general frame of public utilities. However, one peculiarity of DHCS compared to other utilities like electricity network, is that there is little literature on the non-technical aspects and the sociotechnical network. The literature is prolific on innovative technical solutions, like storage, intelligent-networks, etc. (Shaffer et al., 2018). In the road for sustainability, non-technical aspects like business models are crucial, as they enable the good implementation and development of innovative solutions (Lygnerud, 2018).

To be able to link both literatures, and gain access to the practices forming the operational business model, we are using a third body of literature: management tools. They allow to better understand the translation between the intent and the field. We use a performative approach to management tools (Berry, 1983; Aggeri, 2017), as they make real a value proposition, frame the possible by choosing some conventions and act on operators practices. We argue that they have a role in operationalizing a strategic business model. One interesting tool is the contractual process, as it embodies and formalizes part of the business model (Decouzon et al. 2015). The contractual process goes from the design of the request for proposals to the signature of the contract. It is composed of various conventions and calculation choices, supported by calculation devices (Miller and Power, 2013).

To gain empirical material, we have used qualitative methods. We have conducted multiple semi-directive interviews to better understand the heat market context in France, but also ENGIE's strategy. The French market study was done through five interviews with representative of the French government, private operators and local authorities. It was completed by grey literature and conferences. This study allowed us to better understand the sustainable heat strategy in France and the related business models. During the interviews within ENGIE, we were confronted to various DHCS projects, which allowed us to gain first knowledge on the systems characteristics but also on the contractual process leading to DHCS. We have then studied in depth two French district heating: Dunkirk, based on recovery heat from a steel industry, and Besancon, a biomass-based district heating. The studies were done through respectively ten and nine semi-directive interviews, with various stakeholders revolving around the network (e.g. public authority owning the network, private operator, suppliers, supporting public organizations). These case studies (Yin, 2018) gave us a comprehensive understanding of the network's history, its dynamic and the issues at stake concerning governance and business models. They were chosen because they were both French pioneer in the integration of renewable and recovery heat.

In Dunkirk, the choice of recovery heat was made from the beginning, in 1986. After the oil crisis, the public authority wanted to ensure affordable heat that was not dependent on fossil-fuel prices variations. A partnership was made with Arcelor-Mittal, a nearby steel industry. This partnership gave root to the industrial ecology dynamic in the

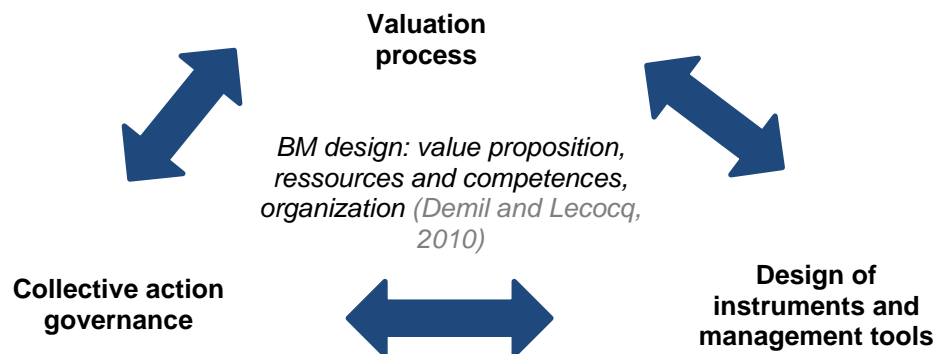
territory. The district heating allows the integration of industrials to the public service, enhancing their resiliency to crisis.

Besancon is an old district heating, dating back to 1968. In 2006 it was one of the first French district heating to set up large biomass boilers for heat production. This path towards sustainability through biomass was confirmed in 2013, with the setting up of two other biomass boilers. This choice is supported by the abundance of the wood resource in the region, and gather many stakeholders around the network.

All this material gave us ground for our analysis framework, by pointing out the critical points encountered when designing a transition towards sustainable DHCS. It also highlighted the central role of the contractual process, as it crystallizes the stakeholders collaborations and objectives.

Results

The first result is the structuration of an analysis framework adapted to DHCS sustainable transition. This framework is composed of three dimensions, which appear crucial when designing a sustainable business model for DHCS. The framework is adapted to the study of a project or an activity, as it shifts the focal point from a specific company to a project. Therefore, it is more systemic and inclusive, considering *a priori* all the stakeholders on an equal foot. The first dimension, derived directly from literature in business models, is the valuation process. Indeed, in the case of sustainable DHCS, the value proposition is changing towards a more systemic one comprising social and environmental aspects. This shift causes a reconfiguration of the whole valuation process. The second dimension is the collective action governance. Sustainable DHCS, with the integration of multiple heat resources requires the commitment of all the associated stakeholders and the adequate governance of this new network. Finally, proper calculation and monitoring tools for the new values need to be designed, just as management tools to support and govern new organization of collective action, locally anchored and based on local resources. Thus, the third dimension relates to the design of instruments (e.g. calculation or management tools).



Our next results concern the components of these three dimensions. Several critical points emerged from our research, each one related to one of the dimension.

The *valuation process* is a concept widely used in the literature stream of business models. It is usually understood as the process enabling a company to capture financial value. Here, the focus changes from the company to the activity, and multiple values can be included. It comprises four components. The first one, is the value proposition. It is core to every definition of a business model and is one of the three fundamental pillars described by Demil and Lecocq (2010). This value proposition is the formalization of the strategic intent: what is to be delivered through the project? In the case of sustainable DHCS, the value is systemic, as the DHCS is supposed to be part of a transition plan. Shifting from the historical technico-economic performance, the value proposition includes social, societal and environmental values to be created for various stakeholders (e.g. the local authority, private operator, suppliers, local companies, heat consumers and local citizens). For instance in Dunkirk there was a will from the public authority to become autonomous from fossil fuels and use local resources for heat delivery. In some other ENGIE's projects, there was a wish that the DHCS will enhance the city's attractivity, and this intangible value was part of the project's objectives and thus part of the value proposition. The value proposition frames the future the DHCS will help achieve, and is thus necessary to ensure the commitment of all stakeholders. The second step of this valuation process is the value creation. It is about the means (material or not) that will be necessary to deliver the value proposition. In the case of a DHCS, it is about the technical system that will be chosen to deliver the value and

the competences and expertise needed to operate the system in order to deliver such value. In Dunkirk, the choice was made to use waste heat from industrials as a resource for the DHCS. This local resource was decoupled from fossil fuels, and enabled to create a local dynamic integrating industrials. This choice of course led to many reconfigurations when it comes to competences: how to create a partnership for heat delivery? What technical system to implement for heat recovery? The choices made for value creation are crucial to design a sustainable system: they are built from local resources, far from the historical plug-in of universal technical solutions such as gas boilers. These choices are also the backbone for the collective action governance, as the system chosen demands a specific stakeholder network. The third component is the value capture. This part questions the devices to integrate the value created. Here again, the value taken into account is not only financial, but usually part of it is monetized. A way for doing that is to set up outcome-based payment, where the outcomes are related to the value proposition. For instance in Besancon, part of the payment made by the public authority to the private operator depends on the achievement of some additional tasks related to non-technical and non-financial performances, like presentations in local schools to raise citizens awareness. In one of the latest request for proposals won by ENGIE, part of the NPV (Net Present Value) depended on environmental and aesthetical commitments, with objectives that will be followed during the whole contract duration. The value capture is one device that allows to structure the partnership between the various stakeholders. One key role of a business model for sustainable systems is to link the value creation to the value capture, so that all stakeholders are part of both processes and one actor does not take advantage of its position to get most of the gains. The final component of the valuation process, which is not always described in business model literature but is emphasized in sustainable concerns is the value sharing. This part is strongly related to the value capture, but with a focus in the distribution of value between the various stakeholders. It can be for financial value but also for more intangible objectives that were supposed to be reached. For the latter, value sharing questions and verifies the effective consequences of the objectives. Another aspect taken into account in this component of value sharing is the use made of the value for the project. An importance can be given to reinvestment within the project for continual improvement, so that the value is not capitalized for benefits at the expense of the project development. In Besancon, the benefits to be made by the private operator could not exceed a certain amount, so that all the surplus was reinvested in the project.

The *collective action governance* is partly based on the principles presented so far, but with the question of the integration of the stakeholders in the making of these principles. One first component relates to the importance of co-construction. In the DHCS projects, the local anchorage is paramount. But committing various local stakeholders to a project requires that they share a common value proposition that makes sense and where they can see their potential interest. Thus, stakeholders need to be integrated early in the design process, to make sure the project is adapted to the interest of everyone of them and to involve them from the beginning. It will also help build the stakeholder network and create good relationships. In one of ENGIE's projects, the request for proposals was designed by the public authority after a long maturation time where they conducted multiple interviews with various stakeholders. This focus on dialogue from the beginning of the process led way to informal relationship that supported the project development. On the contrary, in Besancon the decisions for the public-private partnership are mostly made by the public authority, so that the operator does not feel involved, impacting the quality of the relationship and thus the quality of service. The second component is about reorganization. Indeed, the system chosen for the value creation is related to a specific stakeholder network that needs to be created and structured. The role of the public authority is paramount in the identification and involvement of the more relevant stakeholders. For the involvement, a clear understanding of their resources, competences and interest can help situate them in the sociotechnical network and define which type of actor they are (Brulot et al., 2014). In Besancon, the whole wood industry was reorganized due to the introduction of wood-biomass as a new outlet. The structuration of such sector demands a careful understanding of the situation but also of the impact the chosen value creation solution will have on the situation. This knowledge, or the resources to access the knowledge are usually born by the public authority, but the private operator, as it has access to many financial and non-financial resources, can become a partner in this structuration. In this perspective, public-private partnership reconfiguration is another pillar of the governance process. It is moving away from the historical delegations. Indeed, the integration of new stakeholders threatens and makes irrelevant the two-actor relationship. New collaborations based on co-construction are pushed forward, with a mutualization of the resources from various stakeholders. In the French public market framework, the private company advising a public authority during the design of the request for proposals cannot be a contestant and answer to the request, as the competition would be unfair. Thus, there is little incentive in the actual frame for early collaboration and involvement of stakeholders. ENGIE is trying to position itself as a strategic partner for urban transitions, helping in the design and the implementation of roadmaps. Innovative partnerships are being pushed forward where the object of the request for proposal is no longer the operation of a DHCS but the decarbonation of heat delivery, giving more space for innovation and co-construction. The last component of the collective action governance is the integration to local strategies. Once the stakeholder network is designed, and the place of public and private partners defined, there is a need to ensure that the sociotechnical network is aligned with the local objectives of other policies. For instance, in Besancon the DHCS was thought together with the refurbishment policy and the social objective of affordable heat delivery targeted specific neighbourhoods within the refurbished area.

The importance of *instruments* has already been highlighted in the presentation of the first two dimensions but this part will develop some actions allowed by these instruments. The first one is the framing of the value

proposition. Once the global idea is co-constructed, there is a need to qualify and quantify it, so that it can be assessed during the lifetime of the concession. To do so, convention choices are needed, to adopt the right indicator for value framing. One classical convention is the used of CO₂eq and translation tables to assess greenhouse gases emissions. These choices can be highly controversial, like for the impact of human activity on biodiversity. These choices will then be used in the request for proposal, as indicators to specify the value proposition. In the sociotechnical system used to deliver this proposition, various stakeholders are integrated. Instruments also have a role of contractualization of partnerships. This step is crucial for the formalization of the stakeholders network, giving guarantees to the partners. In the contractualization, four aspects are paramount: the risks, responsibilities, benefits and investments. Indeed, a careful balance between the stakeholders in those aspects will ensure the network stability and coherence (Lygnerud et al., 2019). This was particularly true in Dunkirk, for the integration of a steel industrial, Arcelor-Mittal, within the network. Arcelor-Mittal's core activity was not heat delivery. Thus, all its activity was designed to limit risks on its industrial process, at the expense of the stability of heat delivery. The industrial did not want to commit and give insurances for heat delivery, creating a huge risk for the heat operator who was supposed to react in case Arcelor-Mittal could no longer deliver heat. Moreover, most of the investments were born by the private operator, except those within the legal perimeter of Arcelor, as the latter was less dependent on the heat network than the opposite. Finally, the benefits were mostly on the network part, as it allowed to limit costs from heat production, explaining partly why Arcelor-Mittal did not wish to be involved more. To help balance the partnership, the public authority acted as a mediator and was the one giving insurances to the network operator for heat delivery. The informal trust network was also paramount for the success and resilience of the district heating. Contracts formalizing the partnerships can thus help integrate different stakeholders and structure the responsibilities of each. Once the network is formalized and the district heating in operation, the values taken at the beginning of the delegation needs to be assessed. Here the instruments play a role in defining the objectives: giving thresholds to the indicators and methods to monitor their evolution during the delegation lifetime. The thresholds can be defined by national or international laws, or be devised at a local level. In Dunkirk and Besancon, the thresholds are aligned with national objectives. However in other of ENGIE's projects, the objectives are so ambitious that they require different thresholds. The calculation method is also a convention choice that can be highly controversial. For instance in Life Cycle Assessment, a method assessing the environmental performance, depending on the emission factors chosen, and the perimeter of the study, the results can be completely different. Finally, the instruments can also have a part in the formalization of the value sharing. Indeed, to ensure that benefits are shared between all the stakeholders, all partnerships can be formalized in contracts. In Besancon, the long-term public-private partnership was replicated in a cascade of contracts, between the network operator and the purchase center, between the purchase center and the wood cooperatives and between the wood cooperatives and the wood workers. This cascade reproduces the long-term contract at every scale, giving more forecasting to some seasonal independent workers. In the wood industry, wood workers usually have precarious employment with little security and stability due to the huge investments needed. Thanks to the contractual instruments, the sector can be more resilient and get structured more easily.

Obviously, the three dimensions, and thus their components are interrelated but were presented in a linear way for the first approach. *Table 1* gives a summary of the three dimensions. The table can be read in line, for a linear vision of each three dimension, or in column to better see the interlinking between the three dimensions.

Table 1 Summary of the analysis framework

Valuation process	Value proposition <i>Systemic value encompassing more than technico-economical performance.</i>	Value creation <i>Use of innovative solutions, with a high share of recovery and renewable local resources.</i>	Value capture <i>Outcome-based payments.</i>	Value sharing <i>Use of the benefits for continual improvement.</i>
Collective action governance	Co-construction <i>Early involvement of stakeholders to co-design values.</i>	Reorganization <i>New stakeholder network to be designed and structured.</i>	Reconfiguration of the Public-Private Partnership <i>Innovative partnerships and collaborations.</i>	Integration to local strategies <i>Alignment between local policies.</i>
Instruments	Framing the value proposition <i>Make convention choices to frame the demand in the</i>	Contractualizing the partnerships <i>Design of the sharing of risks, responsibilities,</i>	Defining the objectives <i>Agree on tools for value monitoring and thresholds to be reached.</i>	Formalizing the value sharing <i>Use multiple contracts or a cascade of contracts.</i>

	<i>request for proposals.</i>	<i>benefits and investments.</i>		
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The different components put forward are critical points for the design of a sustainable DHCS. In practice, they can be enablers, when the strategy is aligned with the operational business model, or they can be barriers when there are gaps between the strategy and the practices. These various components also link the pillars of the RCOV framework with the three dimensions of our analysis framework, as they highlight the changes in the value proposition, the needed reorganizations, and the new resources and competences required.

Conclusions

Due to the moving context and the ambitious objectives of their clients, private operators need to reconfigure their role in sustainable heat delivery. To do so they design innovative DHCS, that are 1) based on a high share of renewable and recovery heat and heat storage, and 2) using smart-monitoring to ensure an optimized efficiency. However, these systems demand a approach different from the technico-economic one: they integrate systemic values (e.g. environmental, technical, social, financial) and gather around many different local stakeholders. To adapt, ENGIE has launched a new strategy aiming at helping a carbon-neutral transition for its client. To deliver this proposition, its business model for DHCS needs to change. In this communication we build upon the RCOV framework for business model analysis. As the value proposition is changing, so are the organization and the competences needed. We use this model to highlight various critical points when designing a business model for sustainable DHCS, and thus for ENGIE to align its operational business model and its strategy.

Our contribution takes the form of an analysis framework of three dimensions. The first one is the valuation process, reconfigured due to the new concerns of clients and the more systemic value that needs to be delivered by DHCS. The second dimension concerns collective action governance: as the stakeholder network is changing and gaining in complexity, the governance needs to adapt so that the value can be delivered. The third dimension comprises the instruments needed to lead this transition: conventions choices need to be made to frame the value taken into account, management tools have to be devised to support co-construction of these values and the proper governance of the stakeholder network. These three dimensions can then be subdivided into interlinked components, that derive from an analysis of the tension between the operational business model and the strategic intent. They are operational pieces to be carefully thought when designing a sustainable DHCS and the related business model. These components also allow to link back the analysis framework with the RCOV framework. This analysis framework is thus a contribution to both literature on business models and literature on DHCS and their sustainable transition.

The framework was built based on a literature review and empirical material, but it now needs to be challenged. This challenge is twofold: 1) a confrontation with other existing frameworks in the literature, like the one existing for specific business models such as product-service systems, 2) a operational use on existing project, to gain insights on its relevance and develop more the different components.

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