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Shared geothermal energy projects in Montreal: the importance of pre-existing collective action spaces

Abstract

Interest and support for decentralized, shared, community-managed, renewable energy systems has been growing in different countries. In Montreal, local energy projects have emerged despite the fact that the Quebec energy portrait is largely dominated by hydroelectric power and offers a particular context for energy projects, especially when it comes to decentralized renewable energy. Through a series of interviews with initiators of shared geothermal projects, we study one factor for their emergence which is still understudied in the literature - the pre-existing collective action spaces contributing to the development of novel energy initiatives. We begin by presenting the Quebec context for energy provision and the limitations of local authorities. We then follow with a discussion of energy community and the role of existing collective action spaces. Two initiatives are finally presented and compared to better understand their trajectories in relation to the type of collective action spaces on which they were built. Our results show that, while pre-existing structures and spaces of collective action have helped with the emergence of these initiatives, they have also affected their trajectories and the challenges they face.

1. Introduction

Interest and support for decentralized, shared, community-managed, renewable energy systems has been growing in different countries. This chapter presents two projects of shared geothermal energy systems in Quebec, Canada, where hydroelectricity dominates. Despite the fact that this setting is not favourable to the development of this type of energy plan, local projects in Montreal have emerged nevertheless. In this chapter, we study one factor for their emergence which is still understudied in the literature - the pre-existing collective action spaces contributing to the development of novel energy initiatives. As we will see, while pre-existing structures and spaces of collective action have helped with the emergence of these initiatives, they have also affected their trajectories and the challenges they face.

We begin by presenting the Quebec context for energy provision and the limitations of local authorities. We then follow with a discussion of energy community and the role of existing collective action spaces. Two initiatives are then presented and compared to better understand their trajectories in relation to the type of collective action spaces on which they were built.

2. The Context of Decentralized Renewable Energy in Quebec Cities

The Quebec provincial energy landscape offers a particular context for energy projects, especially when it comes to decentralized renewable energy. The Quebec energy portrait is largely dominated by hydroelectric power. This context forms the structure for the socio-technical imaginaries and expectations regarding energy. According to 2018 data, hydroelectricity is responsible for 95% of Quebec's total electrical production, followed by wind, oil, natural gas and solar energy. Quebec’s electrical production also represents a third of all electricity produced in Canada (Canada Energy Regulator 2021). In terms of energy consumption, the use of electricity for air conditioning and heating represents 54% of household energy consumption and 66% of households use hydroelectricity for heating and cooling their buildings (Hydro-Québec 2021; Statistics Canada 2015). Moreover, Quebec consumes the most electricity per capita in Canada (Canada Energy Regulator 2021).

Hydroelectricity means that, in Quebec, renewable energy dominates the energy portfolio. It is also associated with Quebec heritage and the nationalist movement of the 1970s, when the

building of large dams was associated with the development and modernization of Quebec. Previously, in the 1940s and 1950s, electrification was provided through local electrical distribution co-ops which were later incorporated into a centralized state agency under the name Hydro-Quebec (MacArthur 2017; Savard 2014). Since its creation in 1944, Hydro-Quebec has been responsible for the majority of the production, transmission, and distribution of electricity in the province. Although large and small dams have been contested in Quebec (on behalf of indigenous rights and natural habitat protection), they retain a halo of strong ecological performance ensuring a privileged position for Quebecers in terms of low-carbon energy production (Desbiens 2004; Savard 2014). The attractiveness of developing other renewable energy is therefore lower, which is also related to the inherent costs of other sources when compared to hydro-electricity or gas (MacArthur 2017).

Geothermal energy, which is used in the shared community projects presented in this chapter, is a marginal source of energy in Quebec and Canada. It is used for the production of heat and air conditioning from heat pumps or hot water sources, but not for the production of electricity (Raymond et al. 2015). According to the 2010 Canadian GeoExchange Coalition (CGC) report, the geothermal market in Canada, all variations combined, experienced a significant increase between 2005 and 2008 and then declined in 2010 (Canadian GeoExchange Coalition 2010). These variations can be explained by fluctuation in the price of oil and gas, the financial crisis of 2008 and the implementation and loss of several financial assistance programs (Raymond et al. 2015). The latest data on the number of installations of geothermal entities dates from 2013.

The Canadian government offers few measures that allow local communities to take ownership of energy issues and develop their own renewable energy projects (Van Neste, Lessard, and Madénian 2019). In fact, in Canada, there is very little of this type of development, particularly in urban areas (MacArthur 2017; Rezaie and Rosen 2012). Decentralized energy projects are, to a large extent, mostly carried out in remote areas or outside densely populated areas, where the hydroelectric or gas grid cannot be connected. In Quebec and British Columbia, the dominance of hydroelectricity in the provincial energy portfolio does not encourage the development of micro-alternatives. In Ontario, however, local renewable energy sources are seen as part of the solution for reducing provincial reliance on coal. MacArthur (2017) counted that of the 200 energy generating co-operatives developed from 1990 to 2016 in Canada, the vast majority were located in Ontario. Energy community projects are mainly developed and managed by

municipalities and co-operatives, then to a lesser extent by community associations, while partnerships with private actors are poorly developed (Hoicka and MacArthur 2018).

Cities are increasingly involved in low-carbon transitions, especially in Europe, thanks to local energy developments and urban planning policies (Blanchard 2017). The Energy community Plan is a municipal tool that is increasingly being implemented in Canada. Tozer (2013) found that cities in Canada face several challenges in implementing their plans, particularly in terms of their capacities, funding, and legislation. The allocation of municipal power in Canada comes from provincial governments, which creates disparities in the power and competencies of municipalities (Tozer 2013).

While the province of Quebec was not part of Tozer's study, the situation seems similar. Cities have very little power over energy matters (Van Neste, Lessard and Madenian 2019). For example, on the legislative level, cities in Quebec are subject to the *Loi sur les compétences municipales* (C-47.1) which allows energy production only by means of a wind farm or a hydroelectric power station. This legal framework and Hydro-Quebec's monopoly provide an unfavourable context for cities to innovate in energy matters. Nevertheless, the City of Montreal created an Office for ecological transition and resilience in 2018 and announced many ambitious policies, such as reaching carbo-neutrality for buildings by 2050. Grassroots organizations speak of energy innovation and energy efficiency, with a broader vision of social change.

3. Energy community: Varying Meanings and Motivation

In recent years, several contributions to 'energy community' have been made, especially in Europe (Bauwens 2016; Boon and Dieperink 2014; Capellán-Pérez, Campos-Celador, and Terés-Zubiaga 2018; Dóci and Vasileiadou 2015; Smith, Hargreaves, et al. 2016; Walker and Devine-Wright 2008). Scholars have shown the polysemy of the term, the different meanings, and motivations from actors as well as the policy incentives. Walker and Devine-Wright (2008) proposed a definition and typologies for the types of functions and owners of energy community projects. The term energy community is rather broad and encompasses several types of energy development. An ideal-typical energy community project would be led and managed by a group of locals with profits distributed among the local community. Energy community projects have

also been analyzed as grassroots innovations (Seyfang et al. 2014; Smith, Hargreaves, et al. 2016).

The literature on the motivations surrounding energy communities is quite varied. Dóci and Vasileiadou (2015) looked at the motivations of individuals when participating in renewable energy communities from a socio-psychological approach. The authors concluded that there are three categories of motivation which are primarily related to a gain, i.e., cost reduction, and to normative considerations, such as climate change. Then to a lesser extent, joining a community and having fun are also part of the hedonic motivations. The researchers also noted that trust appears to be an integral part of strong and established energy communities. On the other hand, other academics have also tried to categorize the motivations and objectives of energy community as economic, environmental, social, political, and infrastructural (Seyfang, Park, and Smith 2013; Becker and Kunze 2014; Bauwens 2016). Bauwens (2016) found that the motivations behind integrating energy communities are not similar between individuals, and that communities should not be viewed as homogeneous groups. He noticed that heterogenous motivations depend on institutional factors, spatial patterns, and the diffusion of institutional innovation. Bauwens concludes that these differences affect the level of individual engagement in energy community. Hicks and Ison (2018) offer conceptual tools to better define the term “community renewable energy” (CRE) based on the “why” and “how” of CREs. They analyzed 25 communities based on their development process and motivations. Motivations varied within the context of energy community. Hicks and Ison (2018) uses the example of Australia and Denmark to show that where addressing climate change is a strong motivation in the former country and an anti-nuclear sentiment is more significant in the latter (Hicks and Ison 2018).

However, very little literature on decentralized energy communities in Quebec has been produced, especially in an urban context. As we explained, motivations for developing alternatives is not obvious in the context of existing cheap and renewable hydroelectric power, especially in the urban context where the hydroelectric and gas network is strongly integrated into the urban fabric. Municipalities and local actors have shown little involvement as energy has been a provincial affair for decades. Yet, shared geothermal infrastructure projects have gained visibility in the media over the past decade. A previously conducted media analysis showed *growing expectations* on its potential contribution to the energy transition, especially through collective or institutional projects (Van Neste and Proulx). Likewise, different types of “community” geothermal energy infrastructures are mentioned in discussions of neighbourhood

redevelopment, affordable housing supply, and new urban developments. It also seems to be carving out a path for itself in local citizen initiatives. Why are these projects being developed?

In the literature on energy community, emphasis has been put on the relationship between decentralized energy alternatives and the broader regime of public policy around energy (Seyfang et al. 2014; Smith, Fressoli, et al. 2016; Hoicka and MacArthur 2018; Wokuri 2019; Dóci, Vasileiadou, and Petersen 2015). In this work, community support (e.g., the funding of pilot projects) and constraints to energy community projects by the State are assessed to better understand their trajectories. This can be understood within a framework of socio-technical transitions in which models of energy community are considered a niche which must be nurtured to progressively change the dominant regime. Other contributions have also started to look at the relationship between energy innovations and the urban context - in terms of the regulation of urban development (Blanchard 2017), and the materiality of new assemblages between energy flows and the urban fabric (Debizet et al. 2016), with the objective of a greater local autonomy and a circular metabolism (Lopez 2019; Coutard and Rutherford 2015).

While these initiatives have already been discussed in terms of their democratic virtue (speaking of energy democracy), what has been less studied is the *pre-existing collective action spaces* which help us to understand the emergence, as well as the constraints (and hence trajectory) of energy community projects. Gregg et al. (2020) recently opened up this avenue of research in making explicit links between social innovations and theories of collective action in social movement literature. In particular, they rely on Tilly's mobilization model which shows that mobilization is a function of the alignment of interests and motivations of participants, access to resources and organizations, as well as opportunities and threats from the external context. Put into other words, pre-existing relational structures count, including formal, and informal networks tied to grassroots organizations as well as the heritage of previous mobilizations (student associations, neighbourhood groups, churches, etc.). Gregg et al. do not speak, however, of the cultural aspect in social movement studies which revisited this thesis. Scholars emphasized that existing collective action spaces are not necessarily enabling. They often need to be reappropriated and transformed. Even if they provide the support and opportunities to mobilize, some elements of pre-existing collective action spaces may be acting as obstacles to change (Polletta 2008; McAdam 2003).

In this chapter pre-existing collective action spaces will be the core of our study of energy community projects in Montreal. Our main objective is to show how, in both cases, these act as enablers and constraints which lead to appropriation, and which trigger specific challenges tied to the social, political, and material characteristics of these spaces where initiatives emerge. The core of the study is based on documentary analysis and a series of 12 semi-structured interviews with initiators and facilitators of shared geothermal energy projects in five urban housing complexes in Montreal. The emphasis here is on the experience of projects' initiators since the objective is to understand the emergence of projects in relation to existing structures of collective action, which they had to draw upon. We also focus on two of the five projects, both carried out in the Rosemont – La Petite-Patrie borough. This borough is an interesting territory since it is the only one in the city of Montreal to have adopted an ecological transition plan. The questions in the interview guide focused on the project and its beginnings, governance and actors involved as well as diffusion of the project and expectations for the future.

This chapter describes how each of the two pre-existing collective action spaces enabled the creation of a shared geothermal infrastructure project. Both of these pre-existing spaces will be detailed, followed by a description of the appropriation of these spaces used for the geothermal project. A brief review of each of the projects illustrates the issues facing these collective projects, but also, in some cases, how these communities were able to overcome challenges and find benefit. The Celsius project is a citizen-driven initiative that started with the development of a green alley. The second project, Le Coteau Vert, is the result of a new green concept in housing co-operatives, which came from the local community.

4. The Celsius project: Grassroots Initiative as Part of a Socio-ecological Transition

The first case presented describes how a local alley greening initiative served as a pre-existing space for collective action and as host for a collective geothermal infrastructure project.

4.1 Pre-existing Collective Action Space: The Green Back Alley Initiative

The Celsius project is the result of a citizen initiative to set up a shared geothermal infrastructure in a shared back alley. It builds on a previous "green alley" (*ruelle verte*) project in

which the residents had been involved. In Montreal, alleys can be found in many older neighbourhoods, located behind duplex and triplex apartment buildings (Regroupement des écoquartiers 2018), at the edge of private housing lots and public spaces (the alley itself). In Montreal, these back alleys have been physical spaces of resident participation for decades after the abandonment of their original function for the provision of light industrial activity. Several initiatives have been put implemented, especially in terms of urban greening and the calming of car traffic. Social activities are also at play here with the creation of formal and informal committees between neighbours and with help from the City. In back alleys, residents develop collective projects as an extension of their homes and they learn to manage simple common infrastructure materials such as benches, greenery, traffic control and the sharing of a space for everyday life.

The idea for the geothermal project emerged from two neighbours who had just finished greening their alley. Enthusiastic about the possibilities offered by this common space, as well as by the power of citizens who can collectively lead a project, the two citizens began their first steps. The alley's ability to facilitate sharing between neighbours is therefore both a collective social action space where the idea of Celsius emerged, but also the material space imagined for the installation of the geothermal infrastructure. This is how one of the neighbour described the creation of the project :

> We were just done with our green alley project. We were on a high and had so many ideas for projects, each one crazier than the next. While discussing with one of my neighbours, we thought that the alley might be a good place for vertical [geothermal] wells. [...] It's a good place to pool the infrastructure and make it accessible for the people of the alley. (translation, interview with initiator of Celsius project 2021)

Both neighbours are engineers, with one of the two working in the development of renewable energy, so the two neighbours already knew how geothermal energy works. They came up with the idea of installing a heating network that could be powered by geothermal energy and possibly, later, other urban heat sources such as sewers and neighbouring businesses. Materially, they imagined that the space in the alley permitted for vertical geothermal wells more easily than private gardens. Vertical wells require less urban space than the horizontal wells used in low-density environments.

The project was created on the pre-existing green alley collective action space, but the residents went broader than their own alley. The neighbours decided to carry out a feasibility study which resulted in the selection of three green alleys in the borough. Through a call for interest sent to the various green alley committees in the neighborhood, the selection was made by the initiators according to five criteria: 1) technical and economic feasibility; 2) reduction of greenhouse gases, in particular by replacing systems running on fossil fuels; 3) the willingness and involvement of citizens to set up such a project; 4) the acceptability of citizens with regard to the installation of such a system in their alleyways and; 5) the location of the alley in the Rosemont - La Petite-Patrie borough (Solon 2018). The three alleys selected for the Celsius project were already organized as green alleys, with a citizens' committee coordinating greening and maintenance activities. These citizens already had certain preoccupations, particularly about greening and the environment. Despite the fact that the idea came from two neighbours of the same green alley, their own alley was not chosen for a shared geothermal infrastructure. Other alleys were more motivated and showed greater civic engagement and it is these more active committees that have taken the ball for the concrete implementation of the project.

4.2 Appropriation and Modulation of the Collective Action Space

After choosing the more active and favorable lane committee, there were other steps to organize the mobilization of participants around the shared geothermal energy project; in itself, the green alley committees were not enough. Through the development of the geothermal project, the neighbours went through three additionary steps of appropriation and modulation of their collective action space: 1) the creation of the Solon citizen group, a citizen association that carries the project and came to develop other grassroot projects for the ecological transition in the borough 2) the creation of the Celsius solidarity co-operative, which legally regroups the users of the shared energy, and 3) adjustments and modifications made to the project, and following problems with the materialization of the infrastructure in the alley.

From their initial mobilization phase in green alley committees, the neighbours in the Celsius project quickly formed Solon. Solon is a citizen action group, composed of 33 members involved in the governance of the organization and more than 1000 citizens participating in the projects, that works to improve the residents' living environments and act in the socio-ecological transition of Montreal (Solon 2020). Solon goes further than back alley committees, particularly

in terms of territorial reach and the search for partners. The group reached out for partners and funding (with funding obtained from foundations, the City of Montreal, and the Federation of municipalities, among others). Solon helps citizens who wish to implement citizen projects that are in line with their mission. They offer financing, support as well as material resources. Working with university researchers and NGOs, Solon developed its own theories of transformation, valuing citizen appropriation of city and public spaces, with a focus on the use of space rather than its segmentation by property (Audet, Segers, and Manon 2019). At the heart of this approach, there is an emphasis on mutualization: the pooling of resources, infrastructure, and knowledge (Solon 2020, interviews).

While the green alley committees and Solon provided a vehicle to mobilize residents and build on existing informal networks, neither provided for a formal or legal structure to actually share an energy infrastructure as well as its products, risks, and benefits.

> We are joined together, but not just to get together and talk, we are here to act. Creating a co-operative provided us with a legal vehicle. Now we are going to be able to finance projects and make acquisitions for the co-operative. We can operate, develop and expand by working within an ecosystem of partners. (translation, Interview with initiator of the Celsius project 2021)

The last step was thus to create Celsius, a solidarity co-operative. What distinguishes the solidarity co-operative from other types of co-operatives is the diversity of its members. They can be users, producers, workers, and even supporting members aiming for the success of the co-operative and the achievement of a common goal (Ministère de l'économie et de l'innovation 2021).

The Celsius Co-op was created in April 2019 and has around twenty members: it has four supporting members, and all the others are user members. Currently, being a user co-operative, the members live nearby in the same neighborhood. This structure allows for the accommodation of new user members when others decide to integrate the geothermal infrastructure locally. The primary goal of the cooperative is to manage the project; the showcase project first and then the pilot project. The cooperative therefore takes care of managing subscriptions, invoicing and maintenance of equipment. The interviews noted that the co-operative structure of Celsius is an important element that defines the collective value of the project, but also participates in the development of the project itself. Beyond the simple fact that

the infrastructure is shared, it is the co-operative structure itself as well as the legal entity that forms the backbone of the project. Likewise, according to its initiators, the co-operative model made it possible to move the project forward and provide visibility and credibility in the search for new partners and donors.

Another element that seems to have played a role in the accomplishment and development of the project is the fact that the co-operative structure offers a flexible framework for the development of geothermal infrastructure as well as a mode for the further development of the co-operative. The infrastructure can be shared in different ways: it can be installed on private or public land and it can be shared between two or more individuals. Additionally, the operating rules for sharing the costs and fees can be defined according to the model chosen by the members of the co-op and above all, the different components of the infrastructure can also be shared in a segmented manner.

> ”Over five years of learning ... what we learned over time is that the co-operative tool allows flexibility on what is being pooled, when we talk about common geothermal energy or collective geothermal energy. As part of the showcase project that we are working on now, in the process of digging, the infrastructure shared are the wells, the heat pumps are not. They could be, depending on each situation. The wells are on private land. They could be on collective ground but that would mean yet another configuration. So, depending on the project configuration, the co-operative structure offers us the flexibility to adapt, to adapt it how you want. There is no simple answer to the question regarding collective geothermal energy. Because the wells are common property when in the alley. It depends on the case. For me, the basic vehicle is the co-operative itself. In the sense that the co-operative is designed to facilitate everyone's access to geothermal energy by pooling our efforts.” (translation, interview with initiator of Celsius project 2021)

The concept of flexibility was not a primary motivation in the creation of the solidarity co-operative. It was after encountering a problem that the initiators realized the advantage of this mode of development and the flexibility offered by this structure.

Indeed, interviews carried out with the project’s initiators confirmed that the initial plan was largely modified. The Celsius project was originally developed as a multi-energy heat network supplying the entire alley and built in the alleyway itself. But geothermal energy on a smaller

scale was later the focus. No longer was it the complete alley connected to the infrastructure, but rather small sets of a few homes:

> “At the very beginning, the idea was to create a multi-energy powered network but that idea was abandonned fairly quickly. We decided to open the door to the idea of a network, but for the time being we would need to be satisfied with geothermal energy. From there, we decided that it would be a geothermal network for the entire alley. Then, at some point in the project, when we were doing a complete simulation and the work with all the lawyers, engineers, etc., somehow, I don't know if it was in 2018-2019, but it became micro-networks for heating instead. Kind of like clusters. Um, which at this point became more like the idea of a housing core of like 2-3-4-5-6 participants… whatever, but the reason, for the cluster was that it was simpler… and it could still be dug in the alley!” (translation, interview with initiator of Celsius project 2021)

Drilling of the Celsius showcase project in Rosemont - La Petite-Patrie (photo credit: Gérard Lombard 2021)

In spring 2021, the project materialized as part of the built environment and a showcase project – called the Projet vitrine – was developed on private land instead of being in the alley. The showcase supplied a total of 7 housing units, also selected via a call for candidates from the three preselected alleys, chosen on the basis of technical, social and environmental criteria:

> "Today, what we are implementing for the showcase project is still the notion of a cluster, but for legal and tactical reasons, we are digging it on private land. It isn't being done in an alley, at least not for the showcase project. Is it still a heating network? Well, we're still calling it a micro-heating network, but for now, let's think of it as collective geothermal energy." (translation, interview with initiator of Celsius project 2021)

4.3 Constraints and benefits of the green alley for Celsius

We discussed how the green alley is both a social and material space at the core of the shared geothermal Celsius project. The effect it has on the project, however, is not neutral. What are the advantages and challenges raised by this collective action space, and how did it affect the trajectory of the project? Two dimensions are important.

First, the social and material space of the alley did offer constraints, in terms of the differentiated interest and motivation of residents in alleys, as well as the public ownership of the alley. The project was confronted with the fact that the alley is property of the City. Thus, the drilling and installation of geothermal wells was subject to authorization from the City and required a permit. The problem with this permit is that it can be revoked by the City at any time. Since the geothermal infrastructure was to be installed over the long term, this revocability was a fairly significant constraint on the project. The project leaders, looking to begin the project in earnest, decided to proceed with the development of a showcase project where the drilling could be carried out on private land. In April 2021, the members of the project still do not know whether the project will ever come to fruition in the alley as initially planned.

Second, an important aspect for Celsius regarding the collective aspect of the project is that the alley makes geothermal energy accessible to all. If this initially came with a vision of geothermal

energy for all resident of the green alleys, it was facilitated by the structure of the solidarity co-operative they chose for pooling their infrastructure. Their mode of development allows tenants and residents, who do not necessarily have the financial or technical resources, to benefit from this infrastructure. For Celsius, this a solution for Quebec's socio-ecological transition:

> “The idea of the co-operative model was also to allow anyone to become a co-operator, even if they don't have the initial financial capacity—one of the largest challenges posed by geothermal energy. So, by democratizing the solution it also means democratizing decision-making processes, investment, local returns, etc., etc. I could make you a whole list, but recently, we realized it also means democratizing the capacity of scaling [making geothermal energy much more widely available on the island of Montreal] which is part and parcel of this model. We get the feeling that if you have actors, like Solon, Co-op Carbone, Co-op Celsius and so on, well you are also creating a structure that is able to scale geothermal energy more easily than by going it piecemeal.” (translation, interview with initiator of Celsius project 2021)

5. Ecological Community Housing With a Local Desire for Geothermal Energy

The second case presented here is a shared geothermal project in a housing co-operative. The housing co-operative model, and its process of development, provided the collective action space that facilitated the emergence of the geothermal project. We begin by describing the place of housing co-operatives in Quebec and how the project has developed over the years. Then, we will describe the process of the project’s reappropriation which made it possible to implement the geothermal installation in Co-op Le Coteau Vert, and the challenges it has faced since the housing co-operative is inhabited (in 2010).

5.1 Social Housing Co-operatives as Collective Spaces of Action

The movement of housing cooperatives in Quebec gained momentum during the 1970s, fuelled by subsidy programs and born out of a strong desire from residents and social economy organizations to improve affordable housing rental supply (Bouchard 2009). Since housing co-operatives are not publicly owned, they are founded as an initiative of citizen groups or local organizations. They are assisted by GRTs (group of technical resources), that act as facilitators

with the government (Bouchard and Hudon 2008) and are mandated to provide support for community and citizen groups in the development of social and affordable housing. The Quebec co-operative housing model makes all residents co-op members. As members, they have shared responsibility and a structure to decide and manage their collective ownership of the coop building and related infrastructure. Members they also have to personally engaged in renovations and maintenance.

The *Le Coteau vert* housing co-operative and the adjacent *Un toit pour tous* community housing project are the result of a long process of claiming a site (also in the Rosemont - La Petite-Patrie borough) located near the orange line of Montreal's subway system. The land was previously occupied by a municipal garage. After searching for a site for a co-operative for several years, the La Petite-Patrie Housing Committee made a request for the site. At the time, there was a significant lack of social housing in the borough. Until the early 2000s, the main objective of the project was to build new housing for low-income individuals and families. A collaborative consultation process was set up and it was through a consultation table that representatives of the city, the technical resource group Bâtir son quartier, the architectural firm Oeuf, Énergir (at the time Gaz Métropolitain), citizens and various community groups came together to set up a community housing project.

Interior courtyard of Co-op Le Coteau vert (photo credit: Myriam Proulx 2021)

Supported financially by federal, provincial, and municipal levels of government, the project came to fruition in 2006 and two years later, construction of the new buildings began in the existing built environment. Eight new buildings were built around an interior courtyard to create the Le Coteau Vert family housing co-operative which has 95 units and community housing for small households with 60 units in the Un toit pour tous project (Pearl and Wentz 2014).

5.2 Reappropriation of Collective Spaces of Action in the Creation of a Green Co-operative

During the 2000s, a new group of citizens with strong environmental values joined the table and led discussions regarding the creation of an ecologically minded co-operative (Le coteau vert

2016). The local community already had intended to create a “green project”, but this citizen group, called *Logis vert* at the time, pushed to install geothermal energy and find the necessary subsidies to make it happen. The members of Logis Vert were therefore included in the project by the founding members, i.e., representatives of the La Petite-Patrie housing committee.

> “There were several people in the group who were very motivated by environmental aspects. So, we said we’ll continue to seek funding for environmental improvements. Then, I don't really know how or why, but back then it was like, ‘the thing’... you know, there were a number of little environmental things, but one big idea was that we wanted a geothermal system. So, we spent several years looking for funding for geothermal energy and a few other things.” (translation, interview with initiator of Co-op Le Coteau vert 2021)

The architectural firm l'Oeuf, who created the project, had participated in the Benny Farm project (also in Montreal) a few years earlier. Benny Farm is a large community housing redevelopment project which had also integrated geothermal energy. This previous project had contributed to promote geothermal energy as a concrete way to include environmental components in a housing project via a co-operative model. At that time, the integration of green components seemed to be the logical next steps in the development of social housing. In fact, some researchers were interested in the development of renewable energy and energy efficiency in social and community housing in Canada, Australia, and the United Kingdom (Reeves, Taylor, and Fleming 2010; Urmee, Thoo, and Killick 2012; McCabe, Pojani, and van Groenou 2018; Tardy and Lee 2019). According to an interview with the GRT, the project fit nicely into the organization's sustainable development objectives.

> “Just so you know, we were open... we wanted to be part of sustainable development, and yes, we can we do a bit more in terms of energy savings, in terms of choice of materials... and ensure that our impact, our ecological footprint... at the community housing level, does what can to improve ourselves overall. You know, to have a smaller environmental footprint.” (translation, interview with member of GRT Bâtir son quartier 2021)

Unlike in the Celsius project, their co-operative structure was already present and supported by a development project. Housing co-ops offer shared costs and responsibilities, shared equipment, and maintenance responsibility that is shared and managed by the co-op's financial fund. Thus, geothermal infrastructure was already financially accounted for.

5.3 Geothermal Infrastructure in Community Housing Projects

The two main issues in the implementation of geothermal infrastructure in the housing co-operative relate to cost and the complexity of technological maintenance. Costs can be high for social and low-income housing. In the case of the Le coteau vert co-operative, several technical problems arose from the geothermal system; problems with commissioning equipment, disappointment with the efficiency of the system to temper the air in the accommodation, and complications with the design of the system linked to problems with condensation.

While the co-operative housing model facilitated the sharing of costs and maintenance decisions, because of the pre-existing shared housing structure and level of member engagement, issues still came up when it came to the integration of energy into shared infrastructure. A particular dynamic was created because the costs are collective and are managed by the co-operative while the economic gains associated with geothermal heating were individual. A geothermal system can greatly reduce heating costs in winter, but these costs come at the expense of resident tenants and not the co-operative. Heating and electrical bills are traditionally paid by the individual, even in housing co-operatives. The cost of geothermal infrastructure and maintenance is included in the co-operative budget as a part of overall maintenance, however. The costs required by the geothermal infrastructure therefore conflict with the budget available for other repairs or they may even necessitate an increase in rent for residents.

> Until recently Le coteau vert had a fairly comfortable economic situation. But we had major problems with water infiltration [...] we started opening the walls two years ago and discovered they were all rotten. So, we spent a lot of money... We had a lot of money put aside, and then we spent half of it getting the walls fixed. And there are still other things to repair[...] So we said OK, we're still spending a lot of money to maintain this system, but that means that we have heating, which looks to us like it would be free. Except, that what happens is that this financial burden is being carried by the co-op, it fits into the co-op's budget instead of being paid by the residents, the resident tenants. So... we had a lot of talk about rent increases recently just to pay for the water infiltration, and now there's a lot of talk about when we compare how much we pay in rent compared to what should be paid for a place without utilities. Because we don't all have the same heating,

> you can’t compare them (translation, interview with initiator of Co-op Le Coteau vert 2021).

In addition to the issue of maintenance cost, there is also the fact that co-operatives are not used to adjusting rent as a function of differentiated heating costs, complicating the discussion about collective investment and rent increases. Not all apartments have the same heating costs depending on their location in the complex. They have not yet found a model to deal with the sharing of costs and the adjustment of rents, for the monetary savings related to the geothermal infrastructure to be fairly redistributed across the co-operative members.

The second issue that came up is related to technical issues. Putting a complex and innovative system in the hands of a community that lacks the knowledge to understand how the system works creates a gap between technology and residents. According to our interviews, we frequently heard that residents had high expectations regarding the air conditioning potential of homes. They did not fully understand that the system works by tempering the air instead of cooling it, meaning residents of the co-op were disappointed with the geothermal system.

Likewise, the system is only working today because one highly dedicated resident who decided to take responsibility for the care of the geothermal system, understanding its problems, making minor repairs, researching infrastructure improvement, etc. Despite the fact that the system is owned by the co-operative, one of the learnings of the project is that it remains essential that individuals also act as a technical advisors on the technology used in the housing co-operative:

> There is a set of green measures that have been implemented, so in that sense the project is a success. I wouldn’t say geothermal energy was a failure, but it’s not a total success either. In the sense that uh... there is still room for improvement to optimize the system…. My feeling is, if it works the way it works today, it is only thanks to a somewhat exceptional investment made by the members of the co-operative, especially [name of one resident of the co-op]. (Free translation, interview with member of GRT Bâtir son quartier 2021)

Despite these rather negative aspects of technology, the majority of residents are satisfied and proud to be part of this green co-operative, according to our interviews with initiators of the project. There is still a consensus in the co-operative regarding geothermal infrastructure. Yet, according to their own documents and our interviews, the architects and community housing

developers that worked on this project, as well as similar ones developed during the same period in Montreal, concluded that geothermal energy is too complicated for co-operative housing technically speaking (Pearl and Wentz 2014). It is also complicated by low support from the government regarding the implementation of this type of infrastructure in social and co-operative housing, with only ad hoc subsidies being available.

6. Conclusion

This chapter presented two co-operative geothermal projects in Montreal and the collective action spaces from which they materialized. The emergence of these projects cannot be credited to particular incentives by the State. As we have shown, Quebec's dominant centralized hydroelectric energy system and the limited engagement of local actors in energy affairs is not favourable to decentralized energy development, especially in urban settings. However, citizen-led projects have emerged. We have explored other factors which helped to understand the particularities of their emergence and trajectory.

In both cases, the pre-existing collective spaces played an important role in their development. These spaces paved the way for motivated citizens and residents to come together and establish their own project. Both projects favoured a co-operative model and joint management. While the housing co-operative already used this model, the citizen initiative project opted for a more flexible solidarity co-operative model. In the case of the Le Coteau vert co-operative, the expectations regarding the development of geothermal energy and other green measures were created by the emergence of a greener community housing development method. In the other case, the alley helped bring citizens together to consider the creation of a new collective project around a favourable material site for the pooling of geothermal wells.

While both projects sprang from a citizen initiative, each took a different path related to the level of structure for their collective action spaces, as well as their material territorialization within the city. The housing co-operative is de facto more institutionalized, because of the pre-existing regulations and the structure of the housing co-operatives, as well as the technical and development required for the new housing complex. The Celsius project, despite grants from government and community funds, has remained in citizen hands from the very beginning. Additionally, the challenges of materializing the infrastructure are quite different. One fits into an

existing and narrow built environment (back alleys and private gardens), while the housing co-op is a redevelopment project, offering greater flexibility in design and adaptation.

Both projects faced significant technical and material challenges related to the properties of the land. These challenges demanded extraordinary flexibility and commitment over time and these challenges still remain. However, while neither project appears to be an outstanding success technically or environmentally speaking (in terms of high ecological gain), the residents involved still consider the community component of the project to have made a strong contribution. For the housing co-operative, the project is a source of pride and shows their ecological commitment. While architects do not recommend it for future housing developments, for the members of the co-operative, it has enhanced their collective project, but it nevertheless depends on the involvement of skilled members. For Celsius, the initiators have come to see their project as an experimental site for the pooling of shared infrastructure, resources, and knowledge which is part of their broader agenda to enact concrete transition pathways in existing urban built environments. In these green alleys, the current geothermal infrastructure, its scale, and its location changed several times because of issues related to property permit revocability and technical difficulties. However, these adjustments are now interpreted by the actors as part of a transformative pathway. They present their co-operative as a flexible energy community model that can be changed to suit context and constraints, even though the geothermal wells were finally located on private property instead of public or shared property. In both projects, it seems that the involvement of the local community in all stages of the project enabled it to adapt to the challenges faced and yet still maintain their motivation.

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