COMMUNOSERRE

Issues facing urban community greenhouses in disadvantaged neighborhoods

A toolkit for practioners and decision-makers

2023

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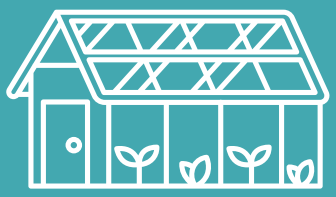
Bibliographical references for each section of the toolkit can be consulted at: www.communoserre.info.

The cover photo, captured by Nathan McClintock, was taken at the Emily-de-Witt greenhouse.

TABLE OF CONTENT

I. Introduction



About the project

This multidisciplinary research project was conducted by some fifteen professors and students from the Centre Urbanisation Culture Société (UCS) and the Centre Eau Terre Environnement (ETE) of the Institut national de la recherche scientifique (INRS), the École des technologies supérieures (ÉTS), and the Laboratoire sur l'agriculture urbaine (AU/LAB) with funding from INRS.

The objectives of the research project were to examine the technical, socio-economic and political challenges associated with urban community greenhouses' integration, particularly in Montreal's disadvantaged neighborhoods.

More specifically, the research team examined the potential of **geothermal technologies**, **water management strategies** and various greenhouse designs to improve their **energy efficiency performance** in Quebec's harsh climate. **A greenhouse gas emissions calculator** was developed to inform decision-making on how to reduce the ecological footprint of urban community greenhouses with technologies adapted to community groups and urban realities.

The team also analyzed the socioeconomic and political issues arising from the **motivations** driving community greenhouse projects, as well as the **partnerships** and **financing** required to make them a reality. **Inclusive** measures deployed by project leaders are also identified to reach a diversity of Montrealers, particularly the most vulnerable, and address the risks of **eco-gentrification** associated with greenhouses.

This toolkit explores the sociopolitical issues at stake and proposes technical recommendations to consider when planning an urban community greenhouse.

ÉTS Le génie pour l'industrie

INRS Institut national de la recherche scientifique

laboratoire agriculture urbaine

Credit: Sophie Van Neste

The multidisciplinary CommunoSerre research project was directed by INRS professors Nathan McClintock and Jasmin Raymond.

Social issues related to community greenhouses in Montreal were analyzed by students Florence Barnabé, Caroline Flory-Célini, Sophie Lavoie and Sugir Selliah, with contributions from Jackson Dos Santos Brito, under the supervision of professors Nathan McClintock and Sophie Van Neste of INRS-UCS. The focus groups were conducted by these students. Chantal Gailloux (Ph.D) participated in the analysis of the results and led the writing of these sections.

Greenhouse energy efficiency was examined by student Arnaud Beaulac under the supervision of ÉTS professors Danielle Monfet and Didier Haillot.

The potential of geothermal energy was analyzed by students Florian Maranghi and Xavier Léveillée-Dallaire under the supervision of Professor Jasmin Raymond at INRS-ETE.

The analysis of water management in urban greenhouses was carried out by student Emma Mamifarananahary, with the contribution of Brenda Garcia Gonzalez, under the supervision of Professor Geneviève Bordeleau at INRS-ETE.

Professor Louis-César Pasquier at INRS-ETE developed, with postdoctoral fellow Hélène Clavelier, a greenhouse gas calculator for urban community greenhouses.

This report was coordinated by Chantal Gailloux.

Our thanks to Florence Labrèche of AU/LAB and Natachat Danis of Éco Gaïa for proofreading.

Highlights

Varied motivations in urban community greenhouses

The community greenhouse project leaders we met consider that the main interest of greenhouses lies in their potential to create social links, rather than in their productive capacity to feed the population and counter food insecurity. The productive and agro-educational missions are often in tension in greenhouses as in other urban agriculture projects. Some community greenhouses aim to support local agri-food production in order to combat food insecurity and develop a local, ecological agri-food network. The ecological dimension of greenhouses seems to be taken for granted by project leaders and was not discussed in depth in the interviews.

Many greenhouses are located in non-profits or educational settings. Used for teaching or psychosocial intervention, urban community greenhouses are important places of education and empowerment. Greenhouses make their users proud and can help forge social diversity. Mobilizing, greenhouse projects bring together a large number of players to secure access to land and funding while addressing issues of participation and inclusion.

Greenhouses run by community groups serve as a pretext for psychosocial intervention to reach marginalized populations. The project leaders want to make the food, activities and services provided in the greenhouses more accessible.

Underprivileged Montrealers don't always know that greenhouse-grown food is for them, which points to a lack of communication and a greater difficulty in reaching the most vulnerable populations. Some vulnerable citizens note that products from urban agriculture sold at farmers' markets are still too expensive.

Reclaiming space through a greenhouse project is sometimes accompanied by a process of collective reflection to imagine and embody a more ecological and inclusive future.

The visibility and attractiveness offered by greenhouses make them urban development tools that can contribute to the gentrification of neighborhoods. Green infrastructures like greenhouses are sometimes gas pedals, sometimes indicators of gentrification.

Highlights

Partnerships and financing

Partnerships can facilitate access to funding. Partnerships can bring visibility and legitimacy to the project or organization, but they can be cumbersome and difficult to maneuver when the various objectives of different organizations collide when defining projects.

Funding is not always adapted to the mission of community greenhouses, especially when they are used for psychosocial intervention or have a social economy mission.

When planning a greenhouse, some community groups feel that municipal, provincial, or federal officials or elected representatives are out of touch with their financial reality, which is fragile and constantly being renewed.

Through partnerships, community groups offer a continuum of services in greenhouses.

Water management

Water-retaining products, such as natural-fiber-based soils, seaweed-based fertilizers, or polyacrylic acid gels, should be considered to save water in community greenhouses. Drip irrigation and the use of capillary mat irrigation are other water-saving strategies.

Rainwater harvesting, from a roof with gutter connected to a barrel with tap, should be done from a space twice the size of the greenhouse.

Sub-irrigation with a flooding table is an option for managing or recovering leaching water.

Despite their focus on social interaction, community greenhouses are sensitive places, easily disrupted by insect infestations, such as aphids or mold due to excessive humidity. Greenhouses may therefore require additional knowledge of integrated pest management or technical know-how to select equipment that maintains optimal conditions in the greenhouse.

Calculating GHGs

A calculator of direct and indirect GHG emissions produced by the construction and maintenance of urban community greenhouses has been developed and is available online.

Highlights

Energy efficiency: Siding, heating, and lighting

When it comes to heating greenhouses in Montreal, energy-efficient and low-energy options such as insulated, in-ground, or cold greenhouses are preferred for community groups.

The cold greenhouse (i.e. without heating or artificial lighting) extends the lettuce growing season by one to two months. The double polyethylene greenhouse offers the longest growing season, from early March to late October. Although this covering allows less solar radiation to pass through, it is sufficient for lettuce growth. Of the other coverings studied, polycarbonate is the most insulating, while horticultural glass transmits the most light (although the light threshold is not sufficient in December).

Greenhouse annual heating costs can be reduced by up to 50% with a wide range of solutions, taking advantage of the thermal stability of the soil, partially insulating the greenhouse envelope, or reducing its temperature. Horizontal geothermal heat exchangers can also be installed under the greenhouse to cover a minimum of 25% of heating and cooling loads.

It's unrealistic to cover 100% of heating and cooling loads with geothermal energy, in an urban greenhouse context in Montreal's climate, where available space is often limited. Horizontal geothermal heat exchangers covering one and a half times the surface area of the greenhouse can provide around 30% of heating and cooling loads.

The annual energy consumption of a small 250m^2 double polyethylene greenhouse is 150 kilowatt-hours per square meter (kWh-m^2) when the interior temperature of the greenhouse is maintained at 6˚C, 310 kWh-m^2 for 12˚C, and 530 kWh-m^2 for 18˚C. Annual electricity costs are approximately $3,800, $7,600 and $13,000 respectively.

In a double polyethylene greenhouse maintained at 18˚C year-round, the addition of artificial lighting makes gives the minimum amount of daily light required for the growth of several plants. The annual electricity cost of lighting in a small greenhouse is estimated at around $1,000 with high-pressure sodium lamps and $500 with light-emitting diodes.

The greenhouse configuration with an insulated north-facing wall is one of the most cost-effective, delivering energy savings of around 25%. The solution of a greenhouse buried at a depth of 2m, without additional insulation, also seems advantageous, with energy savings of around 35%. Adding thermal insulation to an already buried greenhouse is counterproductive and does not significantly improve energy performance, while the important costs of excavation and thermal insulation add up. The Canadian well is effective only for cold greenhouses maintained at 10˚C and can reduce heating consumption by 12% to 21%. A geothermal heat pump can provide between 20% and 27% of the needs of a greenhouse heated to between 18 and 20˚C year-round, with a limited-area horizontal geothermal exchanger placed in the ground beneath the greenhouse to make it affordable.

Emily-de-Witt greenhouse, Credit: N.McClintock

Introduction and context

Historically, in times of crisis, city dwellers turn to urban agriculture to supplement their diets. Faced with food supply challenges caused by the COVID-19 pandemic, the war in Ukraine and more frequent extreme weather events due to climate change, greenhouses have emerged as an interesting avenue for producing fresh, local food available year-round.

As elsewhere in the world, greenhouse production in Canada has grown in popularity, climbing 24% between 2015 and 2020 to reach 1,809 hectares in 2020. The Quebec government has invested $91 million to double the province's greenhouse production between 2020 and 2025, offering subsidies, loans and preferential electricity rates at 40% of the market price. What role can community greenhouses play in cities, more specifically in Montreal's disadvantaged neighborhoods?

Greenhouses are infrastructures that make it possible to extend the horticultural production season in hot or cold weather, even in an urban context. In Montreal (Tiohtià:ke), urban agriculture is seen by residents and decision-makers as a means to improve access to fresh, local food. The most optimistic even see urban greenhouses as a step towards urban food self-sufficiency: "We think it's the future to have almost self-sufficient cities. We're dreaming of cities filled with rooftop greenhouses," says a spokesperson for Lufa Farms, the Montreal-based company that launched the world's largest rooftop greenhouse in 2020, with a surface area of 15,000 m².

The promise of this urban agriculture of the future, for fresh, local produce with a minimal carbon footprint, nonetheless comes with its share of challenges. Zoning, permits, and other regulatory hurdles are among the barriers to the expansion of community-based urban agriculture. For example, rooftop greenhouses are subject to the National Building Code, entailing additional costs such as fire sprinklers. Sometimes technologically sophisticated, greenhouses can be expensive[1] and are not necessarily energy-efficient in a city with harsh winters like Montreal. **Although many community greenhouse projects aim to feed the population and counter food insecurity, the project owners we met during this research project consider that the main interest of greenhouses lies in their potential to create**

social links.

In addition to the economic, technical and regulatory challenges of setting up new urban greenhouses, there are other social challenges linked to green gentrification. Indeed, investment in green infrastructure, such as gardens, parks, or green alleys, can help make neighborhoods in transition more attractive. Beyond the positive impacts of a greener neighborhood on the quality of life of its citizens, some residents are skeptical about investments in green infrastructure and perceive them as harbingers of gentrification, or even eviction. These residents fear that these investments will result in the displacement of the most disenfranchised, while new, more affluent residents could be attracted, contributing to rising rents.

Montreal is no exception and has seen **socioeconomic disparity** grow in the 21st century, notably through income disparity and gentrification of central neighborhoods. In a study on the evolution of the sociospatial distribution of wealth in Montreal between 1980 and 2015, Leloup and Rose (2018) note a shift in the low-income population. Initially located in the center and east of the city in 1980, this population has moved to the periphery in the neighborhoods of Montréal-Nord, Saint-Michel, Saint-Léonard and Cartierville. Socioeconomic segregation by neighborhood is thus observable, with a concentration of wealth in the central boroughs of Plateau-Mont-Royal, Mile-End, Rosemont, Hochelaga-Maisonneuve and the South-West, which are now gentrified. This socio-spatial disparity reflects the ability of vulnerable households to meet their primary needs, such as food.

In Montreal, 234,500 people, or 13.6% of the population, were food insecure in 2015 (PRSP 2020), while 13.1% of households were affected in the province in 2021 (Tarasuk et al. 2022). These are mainly people living below the low-income threshold, tenants and immigrants. Beyond physical access to food stores, it is economic access that limits Montrealers' food security, creating "food mirages." Contrary to the popular discourse on food deserts, food security in Montreal has more to do with poverty and food prices than with proximity to shops.

Some residents of Saint-Michel and Centre-Sud, among others, face food insecurity. For example, in Saint-Michel, nearly 15% of households were food insecure in 2011, and 42.7% of Grade 6 students said they didn't eat breakfast every day in 2017. The majority of the neighborhood's 115 food outlets were convenience stores offering little diversity, processed foods of average quality. Centre-Sud offers a similar picture: 73 of the neighborhood's food outlets were convenience stores, while 39% of the neighborhood's residents lived below the low-income cut-off in 2016.

The COVID-19 pandemic has exacerbated inequalities in access to food, causing food price inflation due to shortages and supply difficulties. It has also exacerbated financial stress on citizens faced with job losses, reduced working hours, or rising rents. Since the start of the pandemic in 2020, Moisson Montréal has seen an increase of 40% of requests for food aid at the city's food banks,

putting increased pressure on the network of community organizations committed to food security in Montreal. Moisson Montréal also notes that the profile of beneficiaries seems to be changing, with more students, but also workers, families and seniors, offering a non-stereotyped face of precariousness.

Several community groups involved in urban agriculture and the fight against food insecurity have chosen to set up greenhouses in their neighborhoods. These greenhouses come in a variety of forms, from low-tech structures for growing seedlings in the spring to larger, state-of-the-art four-season greenhouses featuring temperature control, misting, drip irrigation with fertilizer injection, automatic shading, high-pressure sodium lighting, biological pest control, CO_2 injection and an integrated database system.

The various forms taken by community greenhouses need to be adapted to the diversity of project motivations, while the educational and productive dimensions are in tension and call for compromise. **In view of budgetary and space constraints, we have found that community groups developing greenhouse projects benefit from favoring low-energy and low-technology scenarios that will be easy to implement and maintain.**

The aim of this toolkit is to present cross-disciplinary recommendations for the harmonious, environmentally-friendly integration of community greenhouses into urban environments, particularly in Montreal's disadvantaged neighborhoods. In the following pages, based on interviews with fourteen community greenhouse project leaders and four focus groups conducted in Centre-Sud and Saint-Michel, we explore issues related to the importance of networks in carrying out a community greenhouse project, particularly with regard to financing. The various motivations for community greenhouse projects are analyzed, as are concerns about eco-gentrification. Proposals for inclusion measures in community greenhouses are listed. On the technical side, recommendations are also made for improving energy efficiency and water management in urban community greenhouses, based on simulations. Geothermal potential for heating greenhouses is explored, and a greenhouse gas emissions calculator is offered on the CommunoSerre website. All of this is illustrated and exemplified by case studies of greenhouse projects and neighborhoods. Consult the bibliographies and methodologies at www.communoserre.info.

[1] According to Agriculture and Agri-Food Canada (2022), in 2020, average greenhouse operating expenses reached $\$110.7/m^2$. This increase of almost 23% over the 10-year average is mainly attributed to electricity costs (+10.2%), salary expenses (+7.5%) and technological costs because operators are looking to "equip themselves with advanced technologies to improve production efficiency, reduce inputs and labor costs, and increase product quality." Guimont et al. (2020) report investments of $\$99/m^2$ for unheated greenhouses and $\$120$ to $\$125/m^2$ for heated greenhouses, while Sequin (2021) puts them at $\$226$ to $\$280/m^2$ for a greenhouse in an agricultural zone, $\$478$ to $\$608/m^2$ for an urban greenhouse, or $\$866$ to $\$1,054/m^2$ for an urban rooftop greenhouse (in Gaudreau et al. 2023: 22). These figures do not take into account annual operating costs, which for a community greenhouse may depend on volunteer labor, donations, grants or sales.

II. Motivations and functions of community greenhouses

What are urban community greenhouses for?

The groups operating community greenhouses in Montreal have diverse motivations, visions and functions. Multifunctional, greenhouses are part of a wide range of activities carried out by community organizations, and they are an important lever for improving the living conditions of Montrealers. Community greenhouses enable the reappropriation and improvement of urban space, cohabitation, empowerment, education and the fight against school dropout. These greenhouses inspire citizens and decision-makers alike: it's their potential for education, involvement, connection to plants and the promotion of a local utopia that counts. Citizen-based urban agriculture, of which community greenhouses are a part, led by women, immigrants, students and community organizations, is well established in Montreal, even if many feel that, with current public funding, "it's economic urban agriculture that's got the wind in its sails".

However, the motivations behind community greenhouse projects are often contradictory, while the educational mission often makes the crops less productive.

Community greenhouses are part of a network of public and private organizations mobilized to offer a **wide range of activities and services**. The greenhouse infrastructure supports other projects more directly related to food security, for example, by providing seedlings produced in the greenhouse. Although some greenhouses produce limited quantities [2], their contribution is above all qualitative, producing quality vegetables and seedlings while helping to create social links.

Greenhouse in a tempo car shelter, by AU/LAB, Credit:N.McClintock

Strategies to combat **food insecurity** have changed in recent years. In an effort to move beyond emergency repairs with a mediocre-quality supply nearing its expiration date, community organizations fighting for food security are developing urban agriculture initiatives, such as greenhouses, to engage in food production and processing in order to offer fresh, decent food to citizens in need. However, some residents noted during the focus groups that products from urban agriculture sold at farmers' markets were still too expensive for them. The most needy in the focus groups also noted that they didn't always know that greenhouse-grown food was available to them, indicating a lack of communication and a greater difficulty in reaching them. According to these citizens, the greenhouses seem to play little part in their neighborhood's food security.

Greenhouse projects mobilize a large number of players into partnerships to secure access to land and financing. The visibility and attractiveness they generate make them urban development tools that can contribute to the gentrification of neighborhoods. Despite their intentions to be inclusive, greenhouses can be disconnected from the marginalized populations they aim to serve, even though several projects have put in place measures to promote

inclusion and participation. Although a diversity of organizations is sometimes involved in community greenhouse projects in Montreal, the staff is predominantly white, and barriers to inclusion remain (see p.26).

Empowerment and education

Many greenhouses focus primarily on education and psychosocial intervention, such as **L'Ancre des Jeunes greenhouse** in Verdun, the **Rivard-Paquette greenhouse** at École Jean Grou in Rivière-des-Prairies or the **Jardins des Patriotes greenhouse** at École Louis-Joseph-Papineau in Saint-Michel (p.14). Urban community greenhouses are therefore important places for education and empowerment.

For example, the greenhouse run by the non-profit organization **L'Ancre des Jeunes** in Verdun aims to combat school dropout by involving young people with learning difficulties in its activities. The program is based on an individualized approach in which the workers work with one or two young people at a time, rather than in a group, in a caring approach centered on the needs of the young people. The program is both educational, by growing vegetables, and playful, to enable discovery, exploration, empowerment, and not just professionalization. This experiential intervention aims to develop a sense of belonging among young people, motivating them while learning in an informal setting through a variety of activities. For example, they work with elementary schools on beautification projects involving flowers and produce vegetables for local restaurants.

Since 2004, the **Rivard-Paquette greenhouse** at École secondaire Jean Grou in Rivière-des-Prairies has been welcoming students with learning difficulties to help them achieve success. "I try to jealously guard the project for those who have difficulty," says one teacher, admitting that the greenhouse nevertheless remains open to science classes. "We're casting a wide net in terms of objectives," says the teacher. "We want to develop food awareness among our students and their parents, who are in that disadvantaged pocket, but also there's the other, more theoretical, technical aspect, I'd say, linked to the science curriculum." She recounts the delight of local residents who buy their vegetables at the market run by the youngsters, who have also grown the produce sold:

> *When they see young people having trouble adding up 50 cents twice, they understand who they're dealing with. They're very patient in most cases, and then they'll wait until the student is able to prepare his bill and help him take it all to his car. (...) It's a project that really motivates the students.*

Since then, this project has inspired and helped launch several other greenhouses in schools, even if the funding challenges associated with maintenance remain.

Rivard-Paquette greenhouse. Credit: Mario Desroches, CSSPI

Other greenhouses enable empowerment through shared infrastructure. Such is the case of the **Grand Potager** in Verdun, which makes use of a former municipal greenhouse for citizen urban agriculture projects. It's "the whole community that benefits from urban agriculture activities", by allowing the greenhouse's resources to be rented and shared, and by facilitating networking between citizens so that local, ecological, socially-responsible and culturally-appropriate agri-food projects can emerge.

Appropriating and improving space

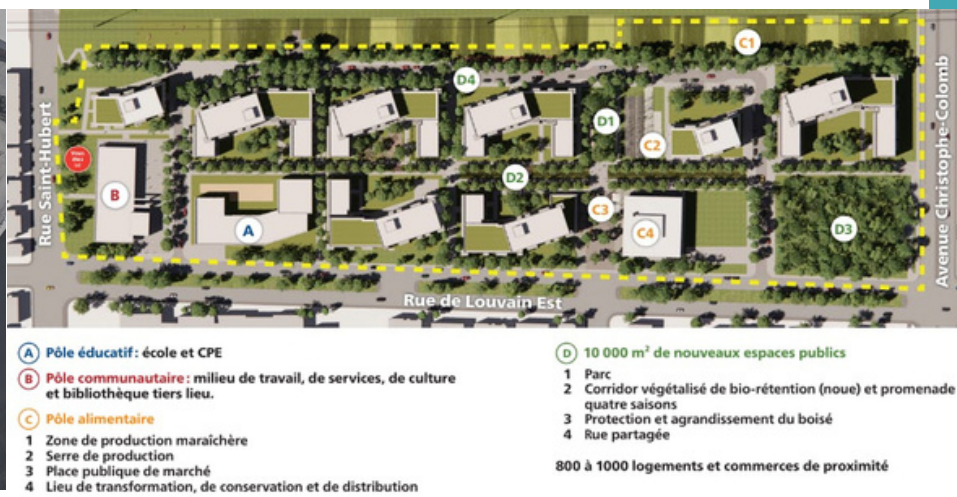
Urban community greenhouses are part of a process to reclaim post-industrial urban space marked by abandonment, or public spaces marked by social problems such as homelessness. This reappropriation of space is sometimes accompanied by a process of collective reflection to imagine and embody a more ecological and inclusive future. Helping to make the neighborhood more attractive, greenhouse project developers may also be called upon to take a stand on local gentrification issues (p.28). Examples include the collective effort to transform Canada Malting's former grain silos into social housing in Saint-Henri, the transformation of 8-hectare municipal site into an eco-neighborhood at Louvain Est in Ahuntsic, and the popular struggles leading to the appropriation of Bâtiment 7 in Pointe-Saint-Charles, all accompanied by greenhouse projects.

A local and ecological local and ecological to reduce food insecurity

Some community greenhouses aim to support local agri-food production in order to develop a local and ecological agri-food network. According to these project leaders, the mission of the greenhouse is to fight food insecurity by offering fresh, healthy and dignified food to people receiving food aid.

Such is the case for Notre Quartier Nourricier in Centre-Sud with the **Emily-de-Witt greenhouse**, which donates 15% of its production to the food bank and local organizations, while another part is sold to the Marché solidaire Frontenac (p.22). The same is true of the Senneville peri-urban farm, which houses a greenhouse that supplies **Santropol Roulant**'s meals-on-wheels program (p.18), and the **B7's Fermette greenhouse** (p.16), which connects to hyperlocal food stores. Although this production is based on a short circuit to offer healthy food, with a minimum

Overview of the À Nous la Malting project
Credit: Monument Architecture



Overall plan of the Louvain Est eco-district
Credit: Fahey, Ville de Montréal and the Louvain Est shared project office

of inputs while reusing waste, the ecological dimension of greenhouses seems to be taken for granted by the project leaders interviewed and was not discussed in depth in the interviews conducted by CommunoSerre.

Local agri-food production for solidarity markets and convenience stores is therefore part of a desire to go beyond emergency charity food aid, where products that have expired, or are about to, are offered. One speaker explains:

> *There's also a transformation of food security that [no longer] wants to do charity, [but] wants to respect the dignity of the people who go to get these products (...) [It's a] refusal to offer food like churches used to. They don't want that anymore. So they really see urban agriculture as a way of involving, educating and giving decision-making power back to vulnerable people. To offer quality products that are much better than bean cans.*

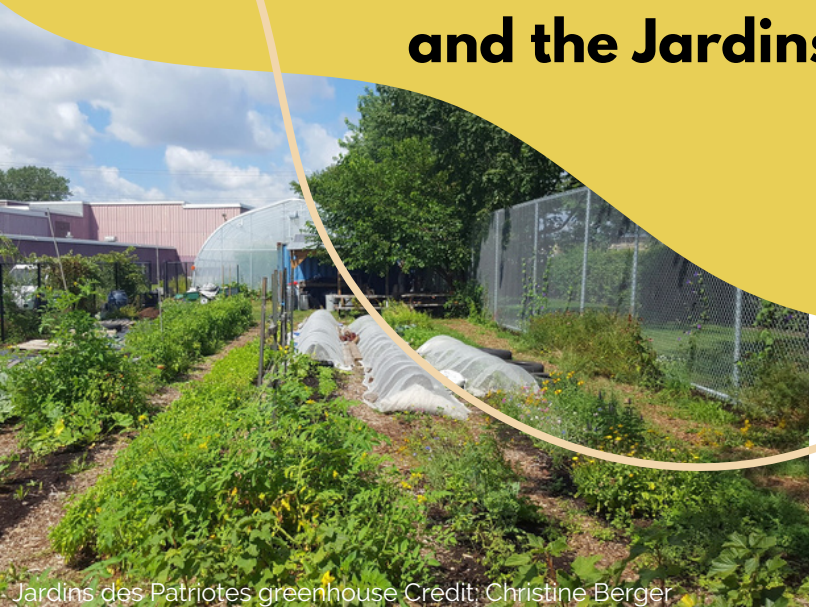
In one focus group, an underprivileged citizen stated that the foodstuffs he received were sometimes almost expired, so he couldn't always eat them with confidence. The focus groups also highlighted that the most disadvantaged citizens are often very much focused on individual strategies for obtaining cheap food by visiting organizations and businesses.

Grand Potager. Credit: Grand Potager

Even though some participants said that their civic involvement enables them to obtain fresh, free food, greenhouses were of little importance in the eating habits of the underprivileged participants consulted during the focus groups. In an emergency, these underprivileged citizens were more interested in coping strategies that involve self-organization in the face of food banks, soup kitchens preparing low-cost meals, and big-box grocery stores offering attractive discounts on meat or bread. These participants presented their strategies with a certain pride and showed a keen interest in the strategies of other citizens.

[2] According to Avard (2014), Lamalice et al. (2018) and Piché et al. (2020), all listed in Gaudreau et al. (2023: 16), non-commercial greenhouses can have yields oscillating around 2 to 4kg/m^2, whereas it is 7 to 10kg/m^2 in a commercial context (Guimont et al. 2020).

Focus on Saint-Michel and the Jardins des Patriotes



Jardins des Patriotes greenhouse Credit: Christine Berger

Saint-Michel is a borough in north-central Montreal, located in the eastern part of the Villeray-Saint-Michel-Parc-Extension district. With over 56,000 residents in 2020, the neighborhood is young, family-oriented and multicultural. One of the most densely populated neighborhoods, Saint-Michel is disadvantaged, with nearly 15% of households facing food insecurity. "Saint-Michel is starting to change," according to Pape Dione, director of the PARI Saint-Michel organization, which co-manages the Jardins des Patriotes greenhouse with École secondaire Louis-Joseph-Papineau. "We have something other than street gangs to present," he says, pointing out that violence is decreasing.

However, a sense of gloom about food issues and the intensity of socioeconomic challenges was palpable at the focus groups held in Saint-Michel. Limited access to healthy, physically and financially accessible and culturally acceptable food was identified as a major issue in the neighborhood by the citizens interviewed. One young person said that "during the pandemic, the fridge was emptier", while a woman of Haitian origin suggested that food problems are getting worse for everyone, and "even those who work are having a hard time". "Everything has gone up," said one of the youngest participants in the focus group, accurately describing the rising prices of certain foodstuffs. Food security is nevertheless intertwined with other socio-economic challenges, linked to housing, educational achievement and social exclusion, particularly associated with recent immigration. Besides inflation, focus group participants were also concerned about the safety of public spaces, the disparity of services and green infrastructure between neighborhoods, such as bike paths or flower boxes, and were inhabited by a sense of powerlessness when it came to their aspirations for the neighborhood. "It's up to us, in Saint-Michel. If we change [our habits], Saint-Michel will change too," said one optimistic participant. The young people deplored the lack of safe spaces for them to do homework or to meet.

Jardins des Patriotes Greenhouse at École secondaire Louis-Joseph-Papineau

> *I wanted to make the transition to local agriculture produced by young people, by combining pedagogical, social and environmental objectives that were in line with the concerns of neighborhood organizations.*

Inspired by her participation in the Urban Agriculture Summer School and wanting to help feed the neighborhood population, teacher Karine Lévesque started a 165 m^2 (1,800 ft^2) three-season greenhouse in the high school courtyard in 2018. "Young people feel useful to their community and develop a strong sense of belonging and pride in it," says the instigator, who published De l'école au jardin (From school to garden) with Écosociété publishing house.

> *I wondered how I could integrate an urban farm into my high school courses. Imagining an apocalyptic scenario, my students quickly came to the conclusion that they needed to feed the city. But how? By starting to grow our own food. Starting with what? By planting seeds... that they would grow themselves! Yes, but in winter, since nothing grows outside, they came up with the idea of a greenhouse! And how do you do that? By making plans, building it together, and so on.*

The greenhouse serves a number of purposes and is used year-round by a variety of audiences. Primarily aimed at teenagers during the school year and day campers in the summer, the greenhouse welcomes over 800 young people a year. The greenhouse is used to teach the basics of cultivation and weeding, as well as for job-readiness training and the "Environnement et Agriculture urbaine" program set up by the Centre de services scolaires de Montréal. Greenhouse crops are distributed through a partnership with local community organizations. For instance, these crops are sold at the solidarity market set up in the Saint-Michel metro station, as well as at the mini-market held in front of the school on Thursdays. Unsold produce is then processed in the collective kitchens of Mon resto Saint-Michel and returned to the market as canned goods. Surpluses are added to Moisson Montréal's boxes. Lévesque explains:

> *Some people stop to talk to us and say, "I've lived in this neighborhood for thirty years, and I think it's great to see what you're doing in terms of social development." At the market, people ask to buy our products.*

The greenhouse is part of a variety of urban agriculture projects at École Louis-Joseph-Papineau, where a collective garden, fruit bushes, a mushroom farm, vines, a maple grove and an orchard have been planted since 2016. A new four-season greenhouse, winner of the City of Montreal's first participatory budget in 2021 with a sum of $765,000, will be inaugurated in 2023.

Marché solidaire St-Michel in a container. Credit: Karine Lévesque


Jardins des Patriotes greenhouse. Credit: Christine Berger

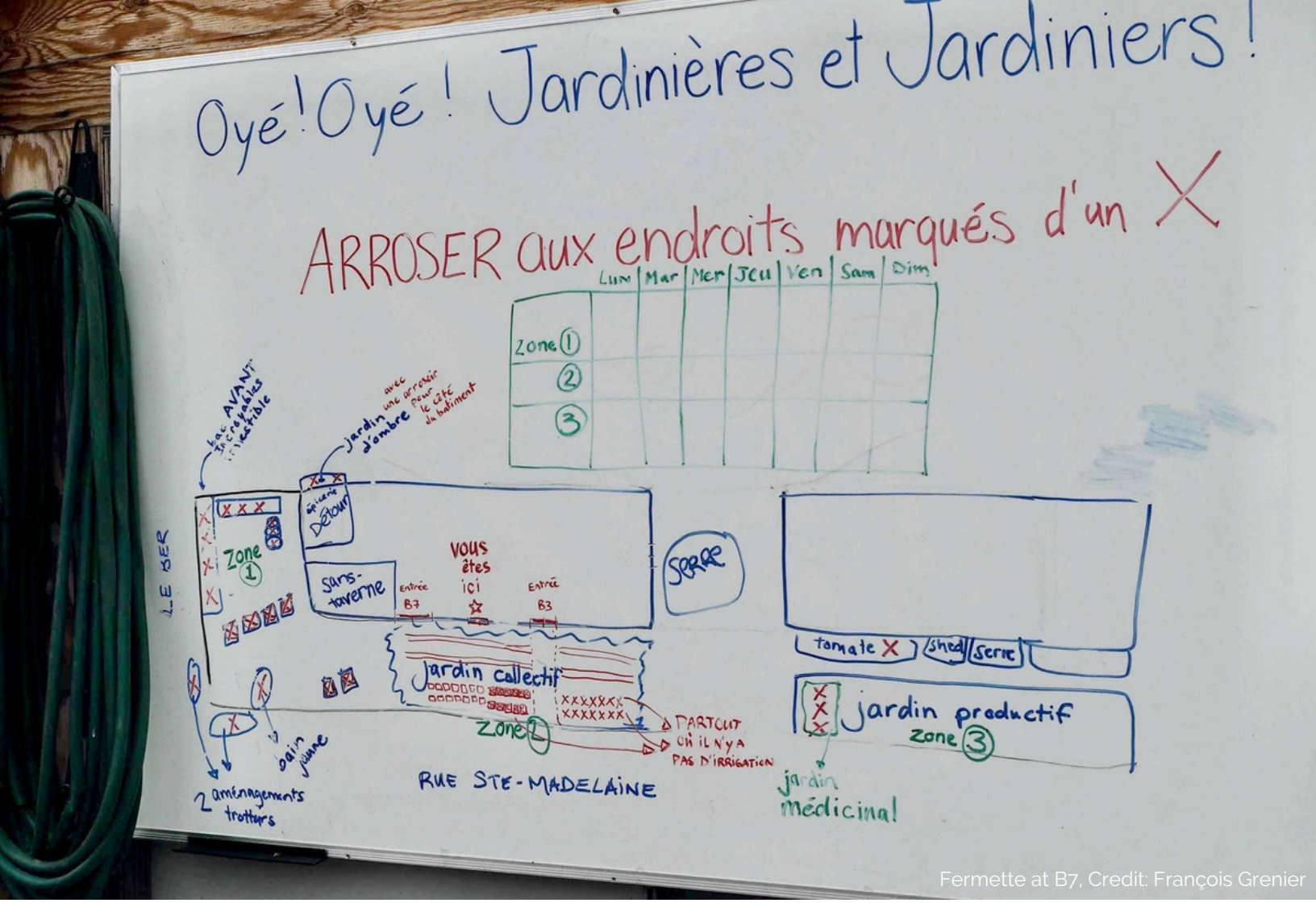
Focus on
Bâtiment 7
Reclaiming post-industrial urban space to create an inclusive environment focused on popular education and agri-food production

In Pointe-Saint-Charles, Bâtiment 7 is the result of a decade-long citizens' struggle to acquire the former Canadian National Railways building and land. The Fermette du B7's three-season greenhouse, which produces seedlings for the collective gardens of the Club populaire de consommateurs de Pointe-Saint-Charles and for B7's urban agriculture projects, is one of the food hub projects developed around a small building adjacent to B7, the Oil Store. The food hub projects, which include a greenhouse, a chicken coop, beehives, soil and container gardens, fruit trees,and a processing space in containers, are connected to the food uses at the front of Building 7 - i.e. the café-bar, brasserie and grocery store - to create a **hyperlocal agri-food network**.

Recognizing that trade-offs between production and education are often necessary in urban agriculture projects, the Fermette du B7 projects attempt to reconcile the two vocations. While lot 5, located near the Oil Store, will be dedicated to production, and a second greenhouse is planned to increase production capacity, the education and awareness-raising dimension remains transversal to the Fermette's activities:

> *All our activities are really part of a **popular education** perspective. So the aim is to share our knowledge between all the gardeners, between myself and the gardeners, and for everyone to learn how to grow vegetables... It's really empowerment, how you take all these networks and work for the community and for yourself.*

B7 Fermette's greenhouse, Credit: François Grenier



Fermette at B7, Credit: François Grenier

Acknowledging that urban agriculture personnel in Montreal are often white, Building 7 addresses inclusion through a strong commitment and specific measures. For example, the greenhouse and gardens are animated in such a way as to encourage participation by all, but especially by those who are more vulnerable, less at ease or have no gardening knowledge. According to the animators-horticulturists, to be inclusive, it is important to prioritize people who need more support, investing more energy in reaching them than perhaps necessary for more affluent or educated people.

Specific mechanisms, notably for hiring, will also be introduced in the near future to encourage greater diversity in the organization's workforce. Building 7 has now achieved parity, with four racialized employees out of seven or eight, depending on the season. B7 will also be hiring a diversity and inclusion coordinator, since despite the democratic structure and decision-making processes, some believe there is still room for improvement to limit barriers to the participation of racialized people in the organization and its programs.

Focus on
Santropol Roulant
Committed to inclusion and agro-education

Santropol Roulant is a community food center that uses food to strengthen social inclusion between generations. Since 1995, Santropol Roulant has been providing Meals-on-Wheels with low-cost, home-delivered meals to people with reduced autonomy in Montreal's central neighborhoods, including Centre-Sud, Mile-End, Centre-Ouest, Côte-des-Neiges and Notre-Dame-de-Grâce. While 80% of Meals-on-Wheels customers are seniors, the volunteers are young adults who cook, prepare and deliver the 100 daily meals, forging intergenerational links.

Santropol Roulant operates two greenhouses: one on the West Island in Senneville to produce seedlings for the one-hectare farm and a smaller rooftop greenhouse at the Roy Street location on the Plateau, which now serves primarily as a meeting point. The vegetables, first sown in the greenhouse, then grown in the ground, are certified organic. With the aim of embodying a "healthy, fair and sustainable food system", the peri-urban farm has been producing a variety of fresh vegetables since 2012 for the farm's weekly meals-on-wheels program and farmers' markets to "make organic produce accessible to all, regardless of socioeconomic status, level of mobility, or autonomy." However, in 2022, the Roulant chose to reduce on-farm production and discontinue the vegetable basket program to refocus on its agro-educational mission. As with many other urban agriculture projects, the productive and agro-educational missions are in tension.

Santropol Roulant is developing several demonstration gardens to raise awareness: the green roof of its Plateau location; the Roy terraces, a pedestrian, landscaped and edible development on Roy Street; and the Cité-des-Hospitalières garden, to offer guided historical tours of the former convent's agricultural spaces. The Roulant has also developed collaborations with local restaurants and schools.

Santropol Roulant's greenhouse in Senneville. Credits: Chris Henschen (left) and Howard Reitman (right)

Santropol Roulant is committed to ensuring the accessibility of its food and activities. For example, it works with the Montreal Native Friendship Centre to ensure that unused vegetables are delivered to needy Indigenous families, the equivalent of five to six bins a week. In addition, the organization is committed to universal accessibility by installing an elevator and ramp to the greenhouse on Roy Street, which was originally a production space, but these measures have reduced the greenhouse's dimensions by half. Translation of their communications material is equally important for the organization, as volunteers and beneficiaries are bilingual and even trilingual. External communications for mobilization are therefore always translated into French and English, and sometimes even into Spanish. On the organization's premises, the Roulant sometimes goes the extra mile, as evidenced by a multilingual poster featuring Iiyiyuu ayimuun (Cree) and Anishinaabemowin (Ojibwe).

Santropol Roulant's small greenhouse on the Plateau
Credit: Santropol Roulant

Focus on
Jardins Gamelin
Intervention and sharing space to make the homeless proud

Jardins Gamelin greenhouse, Credit: Marie-Pierre Savard

In the downtown area, the redevelopment of Place Publique Émilie-Gamelin into Jardins Gamelin since 2015 aims to facilitate the coexistence of students, workers, tourists and itinerants through cultural and community programming, including free urban agriculture workshops as well as a restaurant and bar service housed in containers. Hired by the Quartier des Spectacles to manage the green spaces and provide social animation for the public square, Sentier Urbain has been present in the neighborhood for nearly 30 years and has gained recognition for its involvement of marginalized populations through a mission to mobilize, educate and democratize urban agriculture. Seen as an awareness-raising and intervention tool, the greenhouse is one of seven gardens on the site. A variety of vegetable plants are grown here, an aquaponics system is operated where fish and vegetable plants live in symbiosis, and a composting system is operated using black soldier flies.

Les Jardins Gamelin are the result of a collaboration between Sentier Urbain, which is the project owner, the Ville-Marie borough, the Quartier des Spectacles, the urban design non-profit organization Pépinière & Co. and the intervention non-profit organization Présence Compassion. The Centre intégré universitaire de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal and the Service de police de la Ville de Montréal were involved in the preliminary phases of the project. Sentier Urbain's aim was to foster social cohesion through a project that would bring people together and be inclusive, and it was essential to their involvement that the partners were all in a position "not to exclude marginalized customers."

> *Every space we mobilized for the garden circuit was an area with a major social problem, and the residents realized that the people who were perceived as the problem could be part of the solution.*

The Jardins Gamelin aim to promote the inclusion and participation of marginalized people, such as the homeless. Through a pre-employability program aimed at personal mobilization and social affiliation, workers structure work periods focused on plant maintenance, harvesting and processing. They also stimulate exchanges between participants, with employees, but also with workers and passers-by, to create pride among participants while promoting cohabitation and diversity among users of the public space.

Marginalized people are encouraged to get involved in the gardens and greenhouse by being paid with gift cards to make grocery or drugstore purchases in exchange for hours of involvement. This work has a double benefit: not only are they more valued by passers-by, but the participants are proud, even protective, of the green spaces they cultivate. The facilitator explains that participants develop a sense of belonging and invite others to respect the space in which they have invested, saying: "Hey, I worked for that! The facilitator recounts that participants even value the site among their peers, warning other itinerants to self-regulate: "Hey, don't do that! We like plants, and we watered them yesterday". According to the facilitator, this is "a fine example of integration and mobilization". Through their involvement, the itinerants become ambassadors for the greening projects, the work invested and the plants they care for.

Jardins Gamelin greenhouse. Credit: Marie-Pierre Savard

Jardins Gamelin greenhouse. Credit: Marie-Pierre Savard

Passers-by view participants more positively because of their involvement in the space. Rather than being judged for looking tipsy, they get "recognition from the man in the street."

> *If you're weeding, picking up, oh well, you're going to be called: Wow, that's really nice what you're doing! Thank you so much!' That's what gets them, the way people look at them is completely different. And that's really one of the major benefits for me in these interventions. And for them, of course.*

This recognition is one of the most beneficial aspects of the project for the homeless, according to the workers.

Focus on Centre-Sud and Emily-de-Witt greenhouse

Centre-Sud is a working-class neighborhood in transition, historically affected by issues of poverty and homelessness. The neighborhood has been the scene of major urban renovations that continue to impact its social and economic geography today.

The "Faubourg à m'lasse" was an economic hub in Montreal until the end of the 19th century. In the 20th century, the district declined and became devitalized. A series of demolition and construction projects began in the 1950s to change the face of this working-class neighborhood. The Maison Radio-Canada, the Jacques-Cartier Bridge, certain UQAM pavilions, and the buildings of the Ministère de l'Éducation and the Sûreté du Québec are just a few examples of the many institutions that moved into Centre-Sud to alleviate poverty and assert the citizenship of French-speaking Quebecers in the face of a downtown dominated by the English-speaking economic elite. Despite these urban renovations, Centre-Sud remains a neighborhood with a high proportion of single person households, "single-parent families, significant under-education, one of the highest unemployment rates in Montreal, and numerous social problems (drug addiction, homelessness, street prostitution, mental health, crime)." Nonetheless, the district has become an area rich in community experimentation, where the issue of food security is a priority.

The more vulnerable citizens interviewed during the focus groups conducted by CommunoSerre in Centre-Sud also revealed an interest in emergency food services and tips for saving on the grocery basket, while the more educated citizens wanted to experiment to embody a more inclusive and sustainable future.

"This was one of the highest-priced grocery baskets in Montreal," says François Bergeron, director of the Corporation de développement communautaire (CDC) de Centre-Sud, while 34% of its 36,000 residents are low-income.

A dozen food security organizations work in the neighborhood, and several have been united since 2016 in a collective called Notre Quartier Nourricier (NQN). "Everyone was working on their own. Eventually, we realized that the needs were too great not to collaborate," explains the CDC director in L'Actualité. "It's based on the conviction that no single organization can solve an issue as complex as poverty," recounts Myriam Bérubé, Director of Experimental Projects and Learning at Centraide of Greater Montreal, in La Presse. NQN is the fruit of a long-term effort based on mobilization, consultation, collective action and the commitment of various players, such as the Ville-Marie borough and various community organizations. Private companies JTI Macdonald and Gaz Métro, which have been present in the neighborhood since 1876 and 1873 respectively, support the group's food security initiatives.

Our Quartier Nourricier aims to developing a local, solidarity-based and sustainable food system. Aiming for a healthy, affordable food supply for all Centre-Sud residents, and more particularly for those in precarious situations, NQN is committed to solidarity-based food distribution, local agri-food processing and

education. This mission revolves around three infrastructures: a market, a collective kitchen and a community greenhouse.

The **Emily-de-Witt four-season greenhouse** is the result of long-term community consultation. Concerted action on food security issues in the neighborhood dates back to 1990, notably with the Table de concertation et d'intervention pour une garantie alimentaire (CIGAL) and the Table de développement social Centre-Sud, with organizations such as the Carrefour alimentaire Centre-Sud, the CDC, the Société écocitoyenne de Montréal, which oversees the Ville-Marie eco-quartier, and Sentier Urbain. "It's really a need that had been identified by the community. Funding came in for a food security structuring project for territories undergoing integrated urban revitalization (RUI), with community consultation and with the acceptance of the funder," explains a Emily-de-Witt greenhouse project leader, admitting that it nevertheless took three drafts of the project before the greenhouse was accepted.

Emily-de-Witt greenhouse sits in Parc Walter-Stewart, behind the tobacco products factory, JTI-Macdonald, based at the corner of Ontario and Iberville streets. A project born in 2013 and opened in 2017, the 115 m^2 (1200 ft^2) greenhouse is an animation, production and distribution space managed by Sentier Urbain since 2023. The greenhouse hosts school and community groups, as well as including a social reintegration workbench and a seeds library open to all. The greenhouse also produces 10,000 seedlings in the spring, which are sold to the public at the Urban Agriculture Fair in May and donated to local community gardens, supporting other local food security initiatives.

The greenhouse's activities are divided into three production periods: seedling production from February to May, market garden production in the greenhouse from May to September, and winter greenery production from September to May. In summer, 400 kilograms of eggplants, cucumbers, beans, tomatoes and peppers are grown in the greenhouse. Nearly 15% of this production is donated to the local food bank, while the rest is sold at the Marché solidaire Frontenac next to the metro station.

With a triple vocation of animation, production and distribution, the greenhouse has to make compromises: although the greenhouse is financially self-sufficient, production and profitability ambitions are subject to the greenhouse's social and educational mission. "We're reducing our profitability, but we're offering greater variety on the educational front," points out Maxime Comeau, urban agriculture project manager at NQN and Sentier Urbain. In addition to its educational mission, the greenhouse aims to strengthen social cohesion in the neighborhood, and its protagonists hope it will become "a rallying point for citizens".

> *You know, we had a great, great desire to share it, to have animations and all that. On the other hand, there were production constraints, the possibility of contamination and insects, so we needed to keep a pretty tight rein on that. So we had to be careful when sharing the greenhouse. We couldn't have two or three organizations running different related activities with different clienteles, with uncontrolled traffic. There were constraints at that level.*

Emily-de-Witt greenhouse, Credit: Sentier Urbain

So, although they are places for intervention and education, greenhouses are sensitive areas that are easily disrupted by insect infestations, such as aphids or mildew due to excessive humidity levels. Greenhouses may therefore require additional knowledge of integrated pest management or techniques for selecting equipment that maintains optimal conditions in the greenhouse, possibly automating certain operations, but also requiring special maintenance.

On the other hand, some organizations are experimenting with simplified greenhouse configurations, such as passive greenhouses built from carports. Supported by the Laboratoire d'agriculture urbaine (AU/LAB), Carrefour solidaire and the Laboratoire d'innovation civique et règlementaire (LICER), the Promenade des Saveurs is a pilot project in the form of an edible pedestrian street on rue Dufresne. While zoning in Montreal currently prohibits tempo shelters, the Promenade des Saveurs features carports without artificial heating in winter, to extend the harvest season into autumn and bring the sowing season forward to spring.

Émily-de-Witt greenhouse, Credit: Sentier Urbain

III. Social issues

Inclusion


Seedy Weekend in the greenhouse, Credit: Grand Potager

Community greenhouses are part of a drive to make **food, activities and services more accessible**.

Food accessibility

Greenhouses enable food to be produced and sold locally at competitive prices, as in the case of vegetables seeded in the greenhouse, then grown on the farm and transformed into meals by **Santropol Roulant**'s meals-on-wheels program, or vegetables grown at the Serre **Rivard-Paquette**, then sold by students. Surpluses are sometimes redistributed or valorized through processing, notably in collective kitchens. As for the **Grand Potager** greenhouse, which serves as an incubator for citizen urban agriculture projects by providing a shared infrastructure, it is mobilized to produce culturally adapted vegetables that are less available in grocery stores. For example, they produce herbs for the Vietnamese community, various varieties of parsley for Iranians or flower bulbs for the Chinese New Year.

> *Diversity found us, and that made us realize, once again, that the role of urban agriculture is to meet these needs. (...) Is urban agriculture really about producing small Lebanese cucumbers year-round on a rooftop? Or maybe it's more about making eggplants, okra, spices, herbs that people can't get at the grocery store [and that] they have to produce themselves.*

Accessibility of activities and services

Accessibility to activities and services is achieved in a variety of ways. Firstly, some stakeholders, such as those at B7, stress the need to give priority to vulnerable people, by doing more to reach them and meet their needs. To this end, some rare greenhouses offer universal access to people with reduced mobility, such as Santropol Roulant's rooftop greenhouse on the Plateau, which is accessible by elevator and ramp.

Secondly, in a bilingual or even allophone context, as in Montreal, the language of meetings and communications plays a major role in the inclusion of communities in activities, but the resources to ensure continuous translation are deficient. For this reason, some groups will choose to conduct their activities in the dominant language of the neighborhood, while others will mobilize their resources to make external communications for mobilization bilingual. Sporadically, multilingual posters will be created, as evidenced by the Cree and Ojibwe poster in the Roulant's entrance. Another organization admits the difficulties of being bilingual due to a lack of human and financial resources:

> *We'd like it to be more inclusive, [but] having bilingual meetings has been very difficult. We tried. (...) As far as visible minorities are concerned, there were a few, but they're mostly bilingual or French-speaking. But if they're English-speaking, you know, we're not doing a very good job of reaching out to them (...) And even members have suggested [that we translate our communications] into languages other than English, like Spanish or Arabic. The problem is time. We just don't have the time, unfortunately. We're in a hurry all the time.*

Thirdly, in some groups, specific measures for hiring and mentoring are being deployed to ensure that employees working in urban agriculture are more diverse.

Serre Rivard-Paquette, Credit: Éco de la Pointe-aux-Prairies

Fourthly, while urban agriculture in Montreal actively uses unceded Kanien'kehà:ka (or Mohawk) land, some groups want to be more inclusive and accessible to indigenous cultures. Rather than just planting the three sisters - corn, beans and squash - some groups, like the **Grand Potager**, are committed to issuing a land recognition prior to their events. Although they'd like to do more, they feel awkward and don't know where to start:

> *We started with the first step: we just drafted an indigenous land recognition to say before events or when we take a political stance. It's not much, but you know, it's really important to do so in urban agriculture. We use land that is not ours. (...) Yes, we'd like to develop more of a relationship, but I want to do it correctly.*

Fifthly, gardening is perceived differently in different cultures. For example, one practitioner notes that working the land can be associated with a lower social status in the Haitian community:

> *working the land is associated with being a peasant, so it's frowned upon. So the more you're in the sun, the blacker you are, which means you're not in a profession: you're out in the fields cultivating. Whereas in our culture, it's "the more money you have, the more time you have for gardening", and there's a clash between the two. That's where I think we need to get back on track and make our students understand that, well, no, you're not a farmer if you farm, on the contrary.*

However, some inclusion measures meet with resistance, especially when it comes to creating non-mixed spaces or measures to support specific populations. For example, when one organization wanted to create a safe discussion space exclusively for immigrant women, the idea was rejected for lack of consensus because some felt that a non-mixed committee would be contrary to the organization's mission of openness and accessibility. Elsewhere, the proposal to modulate the cost of services offered according to a transparent scale to reconcile accessibility and profitability has proven difficult to implement:

> *there are some who have free access to greenhouses, and then there are others who pay [more] for a greenhouse. Everyone knows why. Everyone knows how high, and then you understand the math. But right now, when I try to bring it in, it creates a lot of friction.*

In this way, inclusion measures are confronted with the belief that everyone should benefit from the same supports and be treated equally, rather than receiving equitable treatment allowing equal access to all. This universalist vision of equality fails to take into account the factors of discrimination and systemic disadvantage that an equity lens urges us to redress. From this perspective of equity, differential and intersectional inclusion policies according to contexts and populations are to be favored.

Gentrification

Green gentrification refers to investments in green infrastructure (parks, green alleys or greenhouses), which attract an influx of more affluent people, resulting in higher rents in neighborhoods in transition. Low-income residents are generally skeptical of these green infrastructure investments, seeing them as harbingers of displacement. However, a disparity in green infrastructure between neighborhoods can also cause discontent and affect living conditions. During focus groups in Saint-Michel, young people noted a disparity in the quality of sustainable infrastructure in their neighborhoods, such as green bins, bike paths and community fridges. These young people also pointed to a lack of places to study or gather.

Greenhouses and urban agriculture initiatives are sometimes mobilized in urban development projects for their attractiveness. For example, an advertisement for the **Esplanade Cartier** real estate project featured a rooftop greenhouse and numerous green spaces. Nonetheless, these partnerships between real estate developers and non-profit organizations help to create places of eco-responsible commitment.

The gentrification and exclusion that can ensue is often a concern for greenhouse project initiators. For example, in the downtown area, the promoters of the Sentier Urbain greenhouse project in the **Jardins Gamelin** admitted that they had agreed to collaborate with the borough when it became clear that the homeless frequenting Place Émilie-Gamelin would be included in the project, not driven out: "The borough's position was not to exclude the marginalized clientele, and that was a basic condition for us to be able to embark on the process," explains the founder. "There used to be a lot of police officers involved

Grand Potager greenhouse, Credit: Grand Potager

in repression," admits policewoman Vanessa Lepage, who then adds: "Today, we try to have a preventive presence, to explain life codes. We want to keep these people here, since we've brought the services here. The last thing we want is for them to leave the park." In this case, the Jardins Gamelin provided an opportunity to experiment and forge collaboration between various stakeholders to enable cohabitation in a safe public space.

At the rooftop greenhouse project in the works, heated by a data center on the floor below, in the former grain silos of **Canada Malting**, the aim is to prevent the greenhouse from benefiting the wealthy. In order to minimize the effects of gentrification, it is suggested that "to really benefit people who are vulnerable, who are marginalized by the effects of gentrification, decisions must absolutely be taken by the members of the collective, i.e. the members who work and live on the site."

Similarly, in Ahuntsic-Cartierville, the development of the Louvain Est eco-district, located on a vast 8-hectare municipal site, is the subject of major citizen mobilization and consultation. The community is proposing the construction of 800 to 1,000 affordable housing units in trust, to ensure long-term affordability, juxtaposed with a food hub that includes a 550m^2 (or 5920ft^2)

Grand Potager Seedy Weekend, Credit: Isabelle Jetté

four-season greenhouse. Nevertheless, despite this commitment to an inclusive living environment, one of the project's promoters points out that, because of past experience with low-cost housing in the area, the fear that "less affluent residents will come into the neighborhood" still seems to loom large among some of the neighborhood's residents.

Greenhouse projects therefore elicit a variety of reactions from residents who are not uniformly informed about their vocation: while some residents are unaware of the mission of the neighborhood greenhouse, not knowing that it is open to all, others suggest that it has given the neighborhood a new lease of life.

> *The city invests money directly into this with our taxes, and who uses it? (...) What's the result? If it goes to the food banks, there has to be a discussion with the citizens (...) Don't touch that stuff. But if it's for people to line their own pockets (...) well, I think it's abuse.*

The most vulnerable residents are worried about rising rents, while condos have recently been built and promises of social housing in the neighborhood have fallen through. They therefore welcome the greenhouse with a sense of injustice and inequity, and don't necessarily see how it can help them feed themselves. This situation reflects a lack of understanding of how greenhouses work, and even a lack of interest in community-based urban agriculture initiatives, making it more difficult to reach disadvantaged citizens.

Conversely, the more educated and affluent residents in the focus groups noted that, while gentrification of the neighborhood seems to be underway, the greenhouse is forging a social mix and has brought "a generalized movement to the neighborhood". For example, one citizen who was particularly well-informed about community initiatives in urban agriculture in the neighborhood said:

> *The fruit and vegetable market, in summer, next to the metro (...) is literally associated with the greenhouse. So they're going to sell us products that the greenhouse produces. Now, that's interesting! When there's zero or*

almost zero travel... And it's an organization that's not looking to make money. (...) But frankly, I think it's really given a big boost to young people and the neighborhood. This construction [of the greenhouse], it brought about a movement. It's not just the greenhouse, it's the movement it brought to the neighborhood from behind.

It therefore bears witness not only to the attractiveness and mobilization created by the greenhouse, but also to the social exchanges that take place during greenhouse activities, which are seen as a meeting place that fosters diversity and reinforces social cohesion in the neighborhood. The more affluent and educated participants in the focus groups see urban agriculture more generally as a tool to address the neighborhood's social problems of cohabitation, inclusion, road insecurity and citizen reappropriation of the city in a context of gentrification and widening income disparity.

> *It's already too late. I know that rents are going to explode. People on low incomes are being pushed out. In the community garden, you can feel it. It's not the same people as before.*

Here again, citizens seem to suggest that food security is a secondary dimension of urban agriculture initiatives such as greenhouses.

Emily-de-Witt greenhouse, Credit: Sentier Urbain

Network and financing


Jardins des Patriotes greenhouse. Credit:Christine Berger

Greenhouse projects mobilize, and organizations create partnerships to access funding to make it happen. Some will want to foster alliances with organizations that have been involved in their neighborhoods for a long time and have a higher profile, notably via the "tables de concertation" that bring together various organizations and seek to collaborate to offer services to youth, seniors, food security or mental health. Forming partnerships can therefore bring legitimacy to organizations and greenhouse projects.

However, these partnerships around a diversity of missions and projects can be cumbersome and difficult to maneuver as the diverse objectives of the various organizations collide. Friction arises when project goals and missions are defined. Each organization has its own rules of operation, its own priorities to follow, and tries to influence the project. Despite collaborations, these organizations remain autonomous and may compete with their partners for grants or to advance certain projects, sometimes without the full support of all partners or community members:

> *There were tensions. (...) [Those who were the only ones in contact with the financial backer] took off with the ball and started planning the greenhouse in total opacity. So, for a project that is based on the vision of the citizens, the vision of the local community, it created a lot of frustration and misunderstanding, especially as we were trying to plan in an open and participatory process.*

Over time, partnerships are built and changed according to the projects, resources and strengths of the organizations involved. Resistance can emerge when groups try to give more decision-making power to community groups and citizens, as these practices destabilize them. Such resistance also reveals personality dynamics. In addition, organizational differences may arise, as well as power plays between organizations, and even between decision-making levels on the political scene:

> *When I started reclaiming space for urban agriculture, it wasn't with public servants. They held us in shackles. They could stretch out processes that would normally take three months, a year, and even after a year, I needed to talk to the mayor so he would intervene and resolve the matter. And it didn't happen only once, but many times. Of course, I gained a reputation. (...) And when we gained recognition, then, I built bridges with public servants because I mostly work with them. And it became simple: there was respect, recognition, and openness. And those who showed no openness, well no problem, I appealed to politicians.*

What's more, while partnerships help build local mobilization, community groups face financial constraints when faced with greenhouse projects that are costly to build and maintain (see note, p.8). Some community groups find that discussions with government officials or elected representatives upstream of the greenhouse project, during the funding

Jardins des Patriotes greenhouse. Credit: Christine Berger

Emily-de-Witt greenhouse. Credit: N.McClintock

phase, arouse passions even though they are sometimes out of touch with the financial realities of the community milieu. Projects can get out of hand and go beyond the organization's ambitions with an expensive greenhouse project, costing over a million dollars to ideate, plan and build:

> *It was a project that had attracted money. It looked very glamorous. It was publicized in the media, long before the first screw or the first pane of glass was put in the greenhouse (...) There was pressure (...) [but] we came up with a really scaled-down version, in other words, we now have a greenhouse that's 200 square feet [or 20 m^2]. It's more like a solarium!*

Recurrent funding for psychosocial intervention in greenhouses remains a perpetual challenge, however, and affects the quality of services provided by community organizations:

> *For us, it's important that our clients continue to participate. However, if we don't have the funding, [we won't be able to] support them in the same way we do now. (...) At that point, it's clear that the intervention is less successful because we no longer have the young people with us five days a week, six months on the line with a whole learning process. (...) What funders want is quantity. We prefer to focus on the quality of support, but that comes at a cost. There's a cost to that.*

Intervention projects are often based on collaboration between organizations to offer a continuum of services in greenhouses. The organizations that join forces have complementary or more specialized aims. For example, at Jardins Gamelin, Sentier Urbain has developed partnerships with organizations that work with homeless or marginalized people, such as Présence Compassion and Spectre de rue, which provide intervention services, and Maison du Père, which offers a soup kitchen (using greenhouse harvests) and accommodation.

Services provided within the infrastructure of a community greenhouse remain fragile, however, as funding must be renewed each year:

> *I don't know what solution they're going to come up with for this project this year. (...) No one is questioning the relevance of the project. We've seen the impact on the community. (...) The real need is there, and it's not going to change. It's just a matter of seeing how we can make it last.*

"It's not enough," says one greenhouse project leader of the subsidies received, admitting that he had considered self-financing. The same is true of a greenhouse in an educational setting, which for a long time was financed by the school cafeteria in order to pay for the $70,000 a year needed

for maintenance by a horticulturist and for repairs, costs already reduced thanks to the involvement of volunteers. When the cafeteria was no longer run by the school, the greenhouse lost its funding and closed for a year, until media and political representations convinced the school board to fund the project. Elsewhere, the avenue of self-financing through greenhouse production of mescluns, salads and sprouts in winter sold to restaurants and delicatessens was considered to achieve profitability. In the end, the community group concluded that this project would derail their mission of accessibility by serving a more affluent clientele, and therefore preferred to prioritize mission over profitability. Indeed, some community greenhouse project initiators perceive that funders are concerned that greenhouses should become profitable through self-financing, which could threaten their mission of education and empowerment:

> *Decision-making was perhaps a little more complicated because we felt a certain pressure, since we had certain accounts to render. On the other hand, once the decision was made [that the greenhouse would not be exclusively productive for the sake of profitability], and that it was clear to everyone, things settled down well in the field.*

In addition to the tension between the mission of profitable horticultural production and the mission of education and intervention, funding is not always adapted to the greenhouse projects' goals, especially when they straddle the economic and social strands of social economy. Indeed, some note that economic urban agriculture is favored and funded more, a trend initiated with the Office de la consultation publique de Montréal's report on urban agriculture in 2012 and exacerbated since COVID-19:

> *When I apply for economic financing, I don't get it because I'm too social. When I apply for social financing, I don't get it because I'm too economic. So I realize that, even for financial backers, it's not at all clear what the social economy is. (...) The economy is easier to measure, quantify and value. I'm afraid that the social aspect, the transformational aspect, the resilience aspect of the food system is a bit evacuated, in the sense of saying the only thing we want from urban agriculture is to produce more vegetables.*

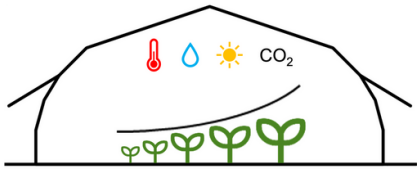
In short, networks are essential to the ideation, implementation and maintenance of community greenhouse projects. Creating both opportunities and difficulties, these collaborations give concrete expression to a mobilization around greenhouse projects, but can also give way to power plays and competition, notably for funding and by exerting pressure on the type of project or intervention to be offered.

IV. Technical challenges

Energy efficiency in greenhouses: It's all about the envelope

Community greenhouse projects in Montreal use a variety of technologies, from the most rudimentary, such as the carport, to the most complex, such as the double-walled heated greenhouse. Four types of envelope are commonly used in greenhouses: double polyethylene (PEd), single polyethylene (PEs), polycarbonate (PC) and horticultural glass (VH). While some greenhouses are heated, like the Emily-de-Witt greenhouse, others are cold and sometimes feature artificial lighting to compensate for low sunlight levels.

A dynamic thermal simulation tool for buildings was used to compare the impacts of: 1) different technological choices (such as envelope type and artificial lighting) and 2) heating temperature as a control strategy for the plant production space. The impacts of these choices are quantified by comparing the length of the plant growing season, the photosynthetically active radiation (PAR) available to the plants, and the energy consumption required to maintain the desired indoor conditions.



In the cold greenhouse, i.e. without heating or artificial lighting, simulations show an extension of the lettuce growing season by one to two months, compared with farming in the field (Figure 3). The double polyethylene (PEd) greenhouse provides the longest growing season, from early March to late October. Although this covering allows less solar radiation to pass through, the amount of PAR

Double polyethylene (PEd) greenhouse, active ventilation and gas heating. South Central, Montreal

Single polyethylene (PEs) greenhouse, unheated. South Central, Montreal

Polycarbonate (PC) greenhouse, active ventilation, storage system and unheated. Kuujjuaq, Nunavik

Horticultural glasshouse (PV), active ventilation, electric heating. Ahuntsic, Montreal

Figure 1. Various examples of greenhouses with and without heating and ventilation

inside is sufficient for lettuce growth (Figure 2). Of the other covers studied, polycarbonate (PC) is the most insulating, while horticultural glass (VH) transmits the maximum amount of RPA, enabling faster crop growth. For PC and VH coverings, the minimum daily RPA threshold for lettuce growth is reached every month except December.

The annual energy consumption of a small 250 m^2 double polyethylene (PEd) greenhouse is 150 kilowatt-hours per square meter (kWh/m^2) when the interior temperature of the greenhouse is maintained at 6°C, 310 kWh/m^2 at 12°C and 530 kWh/m^2 at 18°C (Figure 4).

While many plants need a minimum of 2˚C to survive, 6˚C allows year-round growth of lettuces, and 12˚C allows year-round growth of tomatoes. However, a temperature of 18˚C is associated with optimal growth for many vegetables. The annual electricity costs in Quebec for these temperatures are approximately $3,800, $7,600, and $13,000 respectively, to maintain a temperature of 6˚C, 12˚C, and 18˚C in a 250 m² greenhouse.

The minimum daily light (or PAR) required for plant growth is another essential condition to consider. Light levels in the greenhouse vary according to the type of greenhouse envelope, which can be enhanced with artificial light. For example, in a double polyethylene (PEd) greenhouse, heating from November to January without artificial light is superfluous, as the daily PAR is insufficient for lettuce growth (Figure 2). With an artificial lighting system to reach the tomato growth threshold (Figure 3) in a PEd greenhouse maintained at 18˚C year-round, an additional energy consumption of 37 kilowatt-hours per square meter (kWh/m²) (+7%) is anticipated for high-pressure sodium (HPS) lighting and 15 kWh/m² (+3%) for LED lighting (Figure 4). The additional annual electricity cost of lighting in this small greenhouse is estimated at around $1,000 with high-pressure sodium (HPS) lamps and $500 with light-emitting diodes (LEDs).

Simulation results were used to quantify the impact of different technological choices and control strategies on the greenhouse's energy consumption. Taking into account installation and operating costs, as well as the environmental impact of the technologies, these choices will be made according to operating objectives, such as crop type.

Figure 2. Year-round daylighting in a double polyethylene (PEd) greenhouse, single polyethylene (PEs), polycarbonate (PC) and horticultural glass (VH)

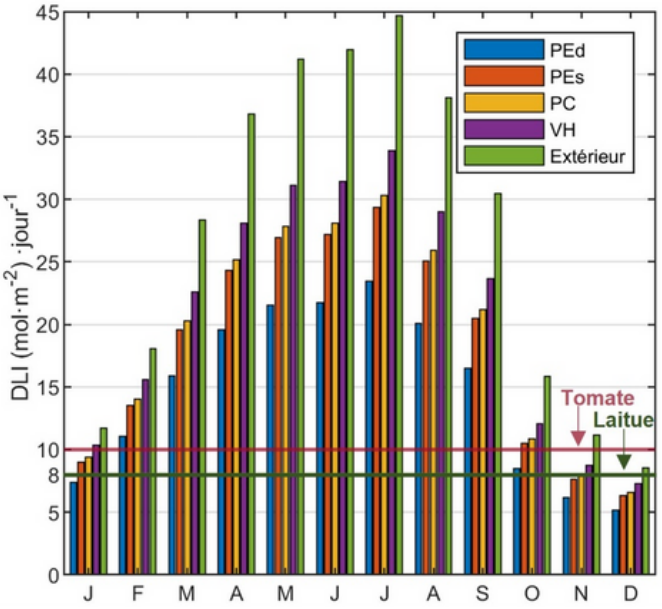


Figure 3. Year-round indoor temperature in a double polyethylene (PEd) greenhouse, single polyethylene (PEs), polycarbonate (PC) and horticultural glass (VH)

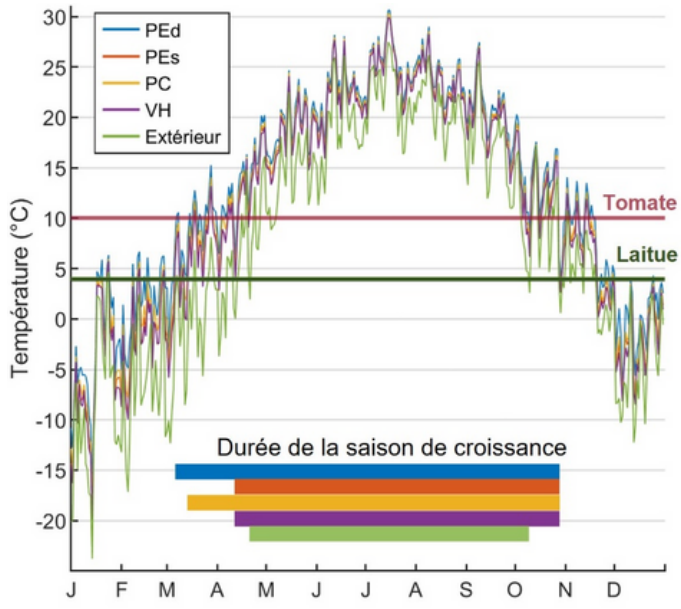
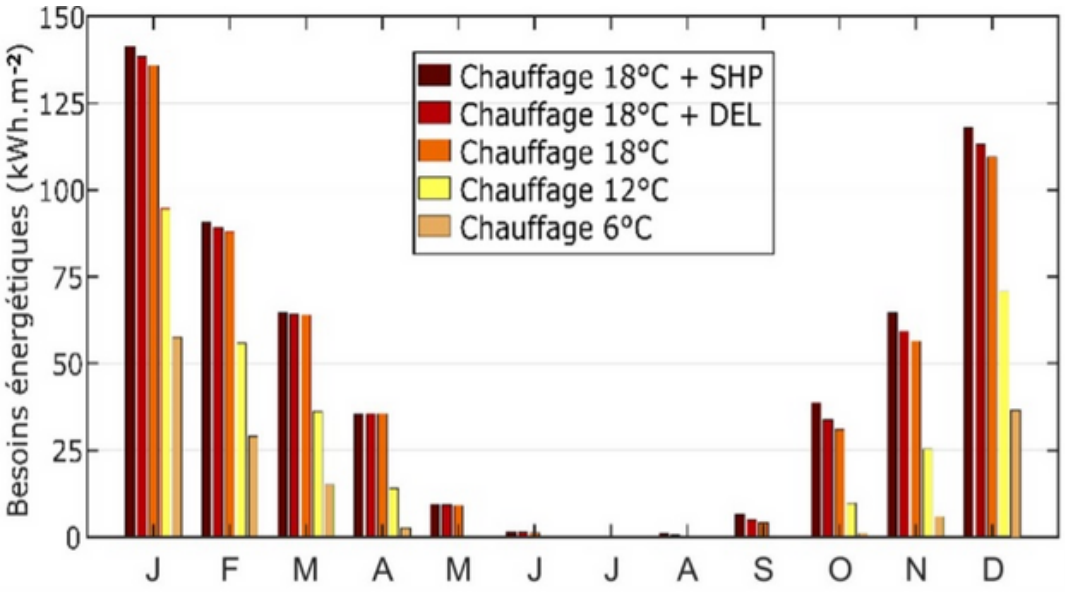


Figure 4. Total energy consumption of a PEd greenhouse by heating temperature and type of artificial lighting



The potential of geothermal energy to heat greenhouses

Annual heating costs can be reduced by up to 50% with a wide range of solutions, such as taking advantage of the thermal stability of the soil, partially insulating the greenhouse envelope or reducing its temperature. Horizontal geothermal heat exchangers (HGHEs), comprising buried polyethylene pipes carrying a heat transfer fluid connected to a heat pump, can also be installed under the greenhouse to cover a minimum of 25% of heating and cooling loads.

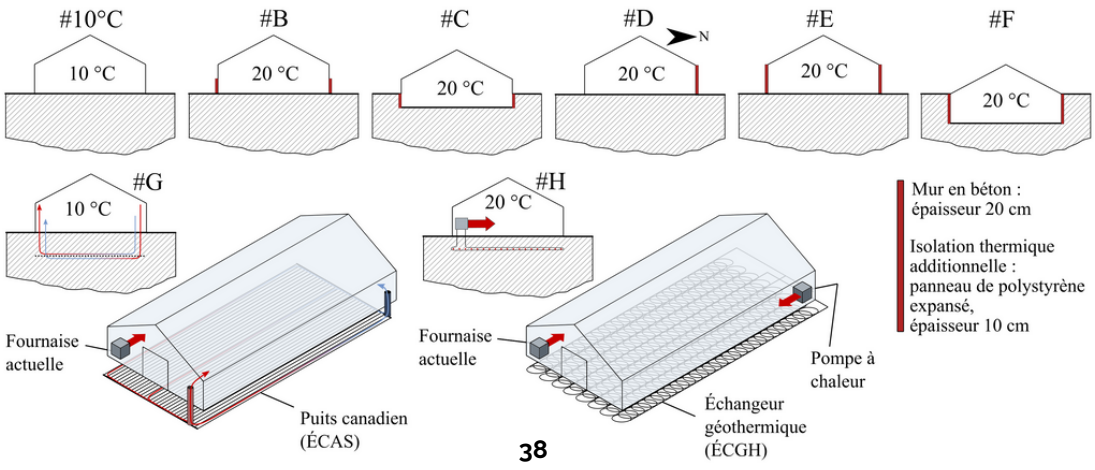
We studied the heating loads for different greenhouse configurations: the in-ground greenhouse (see #C, F in Figure 5), the thermally insulated greenhouse (#B, D, and E) and the cold greenhouse (#10°C). We also calculated the amount of heat that could be supplied by Canadian wells (or air-to-soil heat exchangers, ASHEs) and by a geothermal heat pump (PAC-geo with HGHEs).

In summary, we have found that **energy-saving scenarios using cold, insulated or buried greenhouses are the most promising in terms of both cost and energy efficiency**. Burying a greenhouse allows it to be insulated from atmospheric conditions by using the thermal stability of the ground, while the ground is a heat source and reservoir for Canadian wells (ASHEs) and ground-source heat pumps (GSHP). On the other hand, insulating the walls of a greenhouse reduces heat loss, while avoiding costly excavations. The cold greenhouse, on the other hand, focuses on energy savings.

The scenarios were numerically simulated. Numerical calculation tools were used to size the geothermal heat exchangers for the PAC-geo system, and to model the interaction between the greenhouse, the heat exchangers located just below it and the ground. The greenhouse used for modeling is 116.3 m^2(or 1250 ft^2), is heated year-round to 18-20°C and has an annual heating load of 210 gigajoules (GJ) (or 260 GJ when plant transpiration is taken into account). Although it is difficult to establish a definitive ranking of solutions, since construction costs and energy costs (gas, electricity, etc.) vary considerably, the best solutions from an engineer's point of view are those that maximize energy savings while minimizing their installation and operating costs.

The greenhouse with the north-facing wall thermally **insulated** (with a concrete wall and polystyrene insulation) appears to be one of the most cost-effective, with energy savings of 24-

Figure 5. Greenhouse configurations and heating scenarios studied, from the simplest to the most complex



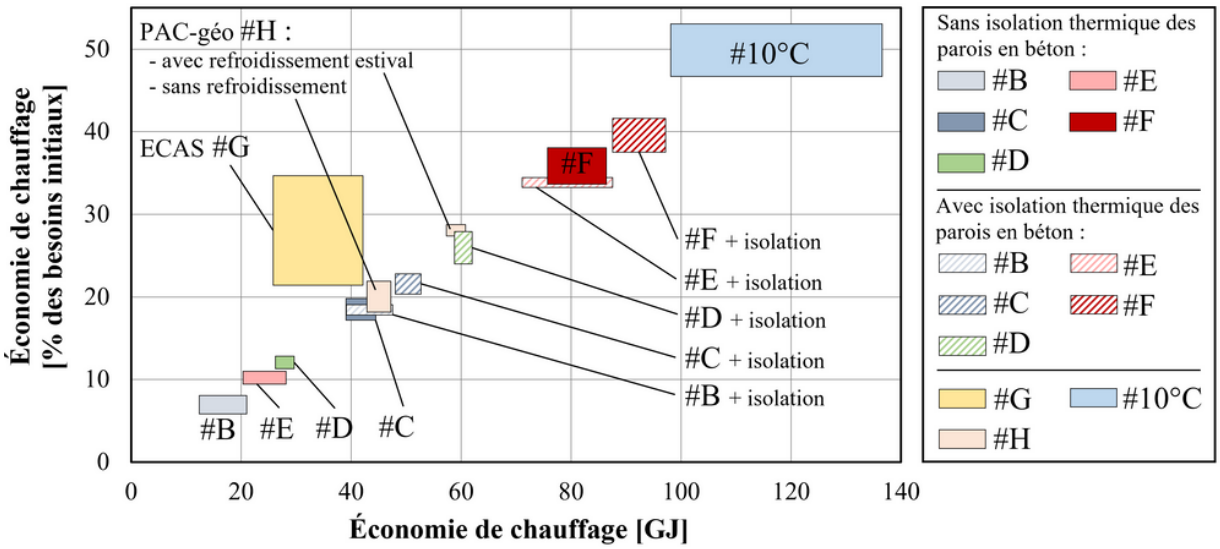
28% (#D in Figure 6).

The solution of a greenhouse buried at a depth of 2m, without additional insulation, also appears advantageous, with energy savings of 33-38% (#F). Adding thermal insulation, such as polystyrene panels, to an already buried greenhouse is counterproductive and does not significantly improve energy performance, while the high costs of excavation and thermal insulation add up. The Canadian well (ASHEs) is effective only for **cold greenhouses** (10°C), and can reduce heating consumption by 12% to 21%. A geothermal heat pump (PAC-géo) can provide between 20% and 27% of the needs of a **greenhouse heated** between 18 and 20°C year-round, with a horizontal geothermal exchanger placed solely under the greenhouse floor. Given the electricity requirements and complexity of geothermal heat pumps, it would seem preferable to consider them only if both heating and cooling needs are to be met. **Energy-efficient and energy-saving options (insulated, in-ground or cold greenhouses) are therefore to be preferred.** In fact, a cold greenhouse heated to 10°C cuts heating costs in half, without any installation costs. Growing under minimally heated (5°C) cover is gaining in popularity among organic market gardeners.

In Montreal's climate, **hybrid geothermal heat exchangers (HGHEs) covering one-and-a-half times the surface area of the greenhouse can provide around 30% of heating and cooling loads**, according to additional sizing calculations carried out with GLHEPro. In the context of an urban greenhouse, it is therefore unrealistic to cover 100% of heating and cooling loads in this way, since the space available is often limited. A HGHE coil buried in the ground at a depth of 1.5m and with a surface area of 14.6m by 9.1m, with no greenhouse above the system, can cover a minimum of 19% of the heating and cooling loads of a greenhouse of the same surface area, according to additional simulations. If the same greenhouse is placed above the HGHE system and maintained at a constant surface temperature of 21°C, the system covers a minimum of **25% of the heating demand and 18% of the cooling demand**. Consequently, installing the system under the greenhouse covers up to 6% of the total heating requirement.

In short, the solutions studied do not provide the same services and constraints. Canadian wells (ASHEs) and geothermal heat pumps (PAC-géo) consume electrical energy to circulate the fluid in the exchangers and operate the heat pump. The ASHEs and PAC-geo consume 0.1 GJ and 0.3 GJ respectively of electricity to provide 1.0 GJ of heating. A ground-source heat pump with a HGHE under the greenhouse can provide 25-30% of cooling requirements in summer, with additional electricity consumption (i.e. 0.3 GJ for 1.0 GJ of cooling). As for the ASHEs, it offers real savings for cold greenhouses only, which don't produce the same yields and crops as greenhouses heated to 20°C in winter. Conversely, insulated, in-ground greenhouse configurations have the disadvantage of reducing the amount of light available for crops by 10-50% from October to March, thus reducing production. This reduction in light is moderate for the rest of the year, from April to September.

Figure 6. Annual heating savings obtained in the scenarios studied



Heating savings are defined as the reduction in the heat input required by the greenhouse, with part of it being provided (or replaced) by another system in the case of the ASHEs and the PAC-géo. For each rectangle of the graph, the horizontal axis describes the variation in the amount of heating saved each year in gigajoules. The vertical axis describes the range of annual heating savings, expressed as a percentage of the original greenhouse's heating requirements (210 to 260 GJ).

The #10˚C and #F scenarios offer the greatest savings. Please note that the final energy savings, which will be deducted from the bill, depend on the efficiency of the heating systems and the cost of the energy source (gas, oil, electricity, etc.).

Water management: Towards the reuse of rainwater and leachate

Agriculture is by far the most water-intensive sector in the world. Around 70% of the world's freshwater is used for agricultural irrigation. Environmental contaminants, such as nitrogen and phosphorus from fertilizers like fertilizer or manure, can contaminate surface watercourses. How can an irrigated greenhouse be produced economically and with a low environmental footprint?

In summary, we have found that, for a community greenhouse in Montreal, the preferred sources of irrigation water are aqueduct water and reclaimed rainwater. The management of leaching water, currently little addressed in community greenhouses, also deserves attention. Water-retaining products, such as hydro-retaining soils based on natural fibers, seaweed-based fertilizers or polyacrylic acid gels should be considered to save water. Drip irrigation and the use of capillary irrigation mats are other water-saving strategies, while sub-irrigation with a flood table allows leached water to be recycled and reused to irrigate plants (see Figures 7, 8 and 9).

To examine water supply, leachate management and irrigation water conservation, we consulted literature reviews on greenhouse water management practices in Quebec, Ontario and elsewhere in the world, and we held discussions with MAPAQ, the City of Montreal and existing greenhouse project developers.

For a community greenhouse in Montreal, the sources of irrigation water to be favored are aqueduct water and rainwater collected from a surface, such as a roof with a gutter connected to a barrel with a valve. For a 100m^2 greenhouse, rain harvested from the same surface area (100m^2) will supply around 50% of the water requirement of the most demanding crops, which need 8L/m^2/d, while average rainfall in Montreal is 980mm per year from April to October. Thus, to meet all our water needs, we need a rainwater harvesting surface twice the size of the greenhouse. If economic measures such as drip irrigation are used, a greenhouse that consumes 60L of water per day in summer can be supplied with rainwater from a surface area of just 15m^2.

We considered the following water sources: municipal water supply, rainwater harvesting, groundwater catchment and surface water catchment. The selection criteria were: availability of water during the planned growing period (year-round, 10 months or 8 months), quality, accessibility, laws and regulations governing its use and operating cost. We also considered the amount of water required by the plants, which varies according to the overall radiation received per unit leaf area (joule/cm^2) under the greenhouse and the type of greenhouse cover.

All the community greenhouses evaluated in this project discharge their leaching water directly into the sewage system without prior treatment. This water still contains nutrients that could be used by plants and contaminate watercourses. Leachate management practices can therefore be improved.

Regardless of the water source chosen, an ecological greenhouse should optimize its use in the interests of economy, by recovering leached water and using only as much water as the plants need, particularly in anticipation

of summer droughts. To achieve these two objectives, we recommend the use of water-retaining products. There are three categories of water-retaining products: organic fertilizers based on seaweed, which reduce watering frequency by 30-60%; organic water-retaining soils based on coconut fiber or sphagnum moss, which retain 30-50% more water; and water-retaining gels based on non-toxic, 100% biodegradable polyacrylic acid, which reduce watering requirements by 50-80%. These gels are still little-known in Quebec, but are widespread in Europe and Africa. All these products have the advantage of being inexpensive and easy to use. Other water-saving techniques to consider are drip irrigation, capillary mat irrigation and flood table sub-irrigation, which recycles and reuses leached water to irrigate plants.

In short, reclaimed rainwater irrigation combined with the use of water-retaining products seem to be good strategies for irrigating a community greenhouse reliably, at reasonable cost and with a low ecological footprint.

Figure 7. Sub-irrigation system

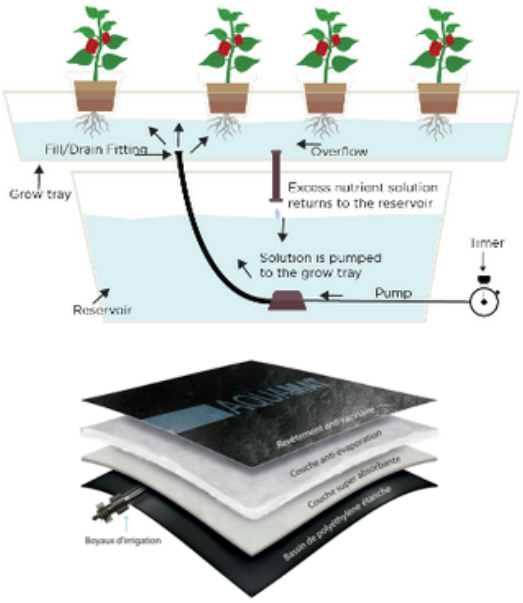


Figure 8. Irrigating capillary mat: a microperforated irrigation system integrated into the mattress delivers irrigation water to the mattress interior

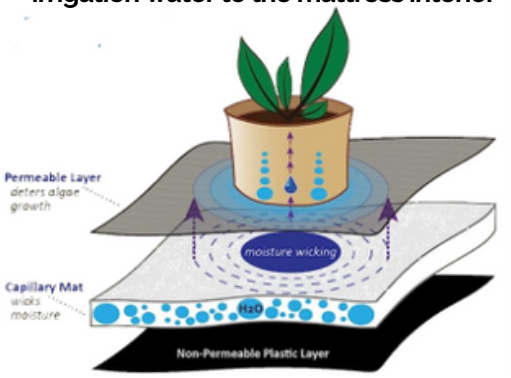
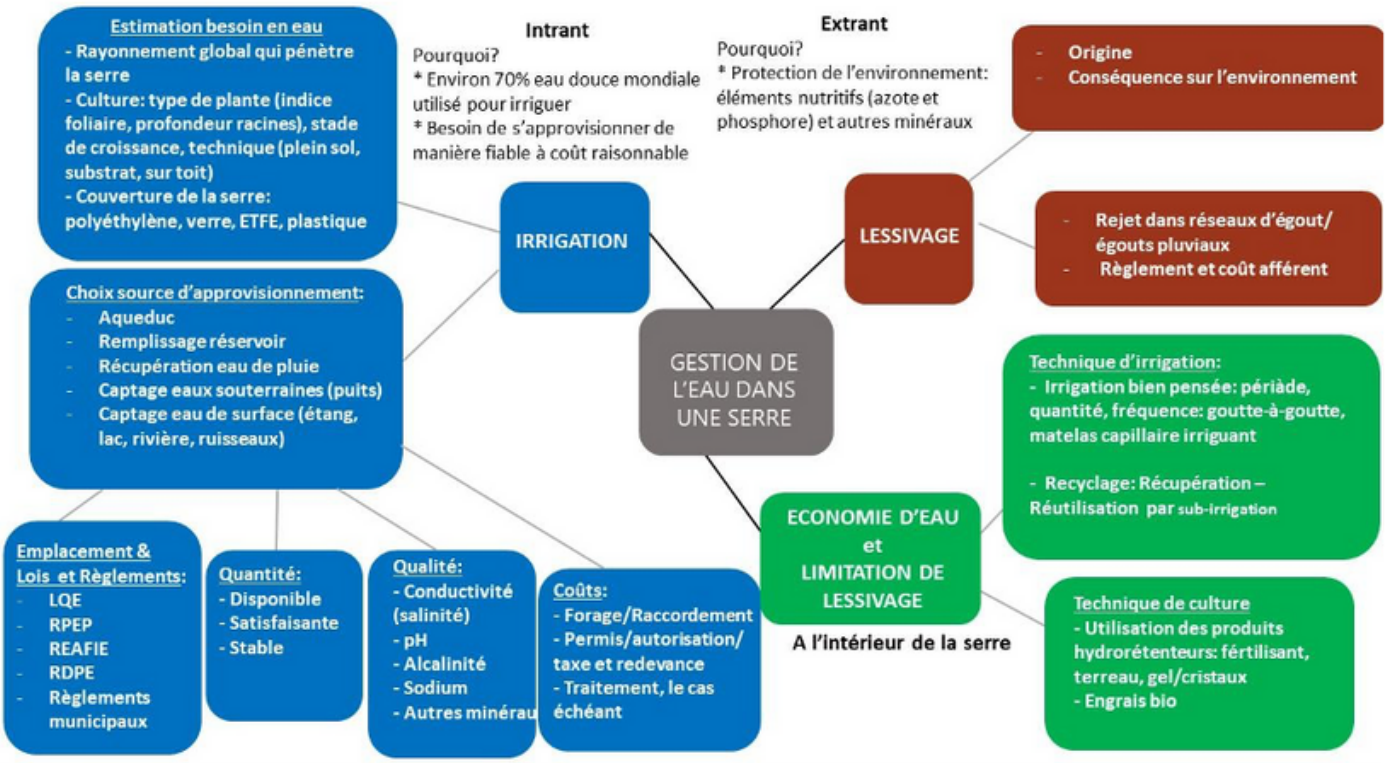


Figure 9. Above-ground rainwater collector from 200 L to 800 L

Figure 10. Questions for water management in a greenhouse



A GHG emissions calculator for urban community greenhouses

We have developed a greenhouse gas (GHG) emissions calculator for urban community greenhouses, so that project developers can make environmentally-friendly choices when designing and building greenhouses. The calculator includes calculations of direct and indirect greenhouse emissions, caused by heating, electrical appliances such as fans and lights, greenhouse materials and the travel of people working in the greenhouse.

Although the calculator aims to be as comprehensive as possible, covering a variety of scenarios, it can be improved by taking advantage of feedback from users. The calculator can be accessed via a QR code on the www.communoserres.info website. To help improve the calculator, the HTML code is available on a page of the CommunoSerre website, as well as on GitHub, so that users and developers can improve it.

Access the online calculator!

Calculating CO^2 emissions for an urban community greenhouse

Quelle est votre consommation electrique annuelle ? ____ **kWh**

Possedez-vous un chauffage ? ☐

Selectionnez le type de chauffage utilise :

☐ **Electrique**
☐ **Gaz**
☐ **Mazout**

Quelle est votre consommation de gaz annuelle ? ____ **m^3**

Quelle est votre consommation de mazout/fioul annuelle ? ____ **l**

Quelle est la superficie de votre serre ? ____ **m2**

De quel materiaux est consitue le toit de votre serre ?

○ **Verre**
○ **PVC**
○ **Bache**

Combien de personnes s'occupent-elles de votre serre ? ____ **personne(s)**

Combien d'entre elles prennent la voiture ? ____ **personne(s)**

Quelle est la distance moyenne parcourue ? ____ **Km**

Combien de fois par mois, ces personnes se rendent-elles a la serre ? ____

[Chauffage] Votre serre emet ____ kg de CO_2 equivalent par an.

[Constitution de la serre] Votre serre emet ____ kg de CO_2 equivalent par an.

[Manutention] Votre serre emet ____ kg de CO_2 equivalent par an.

Among the possible short-term improvements to the calculator, the impact associated with crops (i.e. emissions and reductions) could be added, as geothermal energy could be added in the heating options. What's more, this generic calculation tool has been designed to guide project developers' choices, but it has not yet been tested in a real project context. Using it will therefore enable us to target more precisely the main sources of GHG associated with greenhouse projects.

This calculator can be used upstream of a project to guide and compare the choice of compositions and technologies during greenhouse construction, in terms of both cost and environmental performance. It can also be used downstream to make adjustments and assess opportunities for offsetting greenhouse gas emissions.

V. Conclusion

Conclusion

Greenhouses mobilize and inspire. They bring together a large number of players for the futures they enable us to imagine. Greenhouses serve a variety of purposes: they can be used for psychosocial intervention, science education or horticulture, and are part of a network of community and entrepreneurial initiatives, sometimes linked to food security. Greenhouse projects are not easy to develop: you need to access land, secure financing and make a number of technical choices that have financial and social implications. If greenhouses are based on partnerships, these can be difficult to maneuver. Moreover, financing is not always adapted to the social mission of greenhouses.

Community greenhouse projects, and the investment envisaged, must therefore be thought through in terms of social objectives and horticultural yields, while considering the impact the greenhouse may have environmentally, economically and socially on the neighborhood. Greenhouse projects must take into account the specific context of the neighborhood, the target population, the project's motivations and potential funding. **Greenhouse project leaders will then ask themselves whether implementing the technologies will help them fulfill their mission, and whether the costs are realistic.** In some cases, low-tech solutions will be preferable for urban community greenhouses.

From a technical point of view, **the most promising scenarios for urban community greenhouses are those that focus on energy efficiency and sobriety**, like insulated, underground or cold greenhouses. Indeed, installation, maintenance and heating costs can quickly escalate, exceeding $10,000 annually for a double polyethylene greenhouse heated to 18˚C year-round. Nevertheless, investing in artificial lighting to increase horticultural output can be advantageous, resulting in $500 to $1,000 in recurring annual electricity costs. The choice of covering, meanwhile, will vary according to the objectives pursued. While a cold greenhouse (without heating or artificial lighting) can extend the lettuce growing season by one or two months, double polyethylene provides the longest growing season from March to the end of October. Otherwise, maintaining ideal conditions in a community greenhouse also poses significant challenges, requiring ongoing attention and additional technical knowledge. While community greenhouses are primarily focused on social interaction for education or intervention, they are also sensitive places easily disturbed by insect infestations or mold, especially when there is a high volume of comings and goings. Greenhouses may therefore require technical expertise in integrated insect control, or in the management of equipment to control greenhouse conditions. Rainwater and leachate recovery must also be considered in community greenhouses.

On the social front, measures linked to participation and inclusion need to be put in place, as greenhouses are sometimes gas pedals and sometimes indicators of gentrification. If community greenhouses are aimed at the most vulnerable, this population is not always aware that the services and food produced in greenhouses are aimed at them. A constant effort must therefore be made to recruit them and distribute to them.

In short, urban community greenhouses help create social links but require constant investment in capital and technical know-how for implementation and maintenance.

Glossary

Green gentrification
Green gentrification is a process resulting from the social consequences of urban greening and sustainable development policies, such as the introduction of parks, trees, pedestrian and cycling infrastructure, etc. These investments and infrastructure have the effect of increasing the attractiveness of a neighborhood and therefore the cost of housing, which excludes more vulnerable residents (Gould and Lewis 2016, Angelo 2019).

Circular economy
According to the Pôle québécois de concertation en économie circulaire, the circular economy is a "system of production, exchange and consumption aimed at optimizing the use of resources at all stages of the life cycle".

Heat transfer fluid
Liquid or gas responsible for transporting heat between several temperature sources. This fluid is often ethylene glycol-based products in geothermal systems (Grenier 2015).

Horizontal geothermal heat exchangers (HGHEs)
HGHEs consist of buried polyethylene pipes carrying a heat transfer fluid connected to a heat pump. They can be installed under the greenhouse to cover a minimum of 25% of heating and cooling loads. They can also be installed next to the greenhouse, but will lose efficiency and take up more space, an additional challenge in an urban context.

Geothermal energy
Clean, renewable energy from the earth's subsoil to meet heating or cooling needs (Hydro-Québec n.d.).

Food insecurity
State in which a person or group of people find themselves, when the availability of safe and nutritious food, or the ability to acquire food through socially acceptable means, is limited or uncertain (Blanchet and Rochette 2011).

Integrated pest management
Through regular scouting, integrated pest management reduces pesticide use by taking into account the specific context and needs of different crops. Biological control methods include the introduction of beneficials, physical control, cultural control and chemical control; these means can be combined and their effectiveness must be verified (Lambert 2000, AAFC 2012).

Glossary

Food mirage

According to the National Collaborating Centre for Environmental Health, food mirages refer to "barriers that impede low-income people's access to healthy, affordable food in their neighborhoods" (Chen and Gregg 2017, Breyer and Voss-Andreae 2013).

Canadian well

A geothermal air exchanger, more commonly known as a Canadian well, is a pipe buried below the frost line that is about 2m to take advantage of the inertia of the ground, which remains at a relatively constant temperature throughout the year, to supplement heating or cooling needs (Fauteux 2015, Écohabitation 2012).

Additional resources

CETAB (2021, 30 septembre) Principales étapes de construction de serres – Vitrine techno : cultures de climat frais sous abris [Video]. YouTube. https://www.youtube.com/watch?v=8zP2l7KCmio&t=1015s&ab_channel=CETABCentred%27expertiseenagriculturebiologique

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Seguin, R., Cohen, A., Vézina, M.-J., Duchemin, E. (2021) Fiche technique et économique : production maraîchère urbaine en serre sur toit ou au sol. Carrefour de recherche, d'expertise et de transfert en agriculture urbaine et Laboratoire sur l'agriculture urbaine, 32p. http://cretau.ca/wp-content/uploads/2021/04/Fiche-technique_et_economique_Serriculture-urbaine-3.pdf