Material Flow Analysis from a Circular Economy Perspective in Northern Quebec Territory

Synthesis Report for Six Communities and One Mining Company

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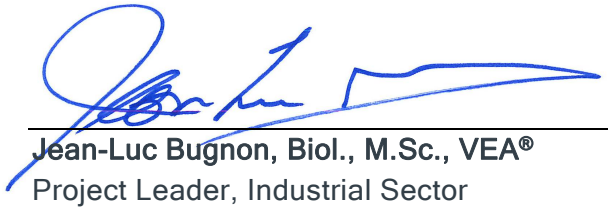

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Property and Confidentiality

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Executive summary

In summer 2021, RECYC-QUÉBEC commissioned Englobe to perform a material flow analysis (MFA) to develop an action plan promoting circular economy in northern communities and in a mining company. The project is supported by three partners, which are RECYC QUÉBEC, the Société du Plan Nord (SPN) and the Ministère des Ressources naturelles et des Forêts (MRNF).

The purpose of the project is then to identify optimization solutions for the use of certain materials for promoting circular economy north of the 49th parallel. Each MFA is an assessment using a quantitative approach of the materials flows entering and leaving the territories of the community or the mining company. This report presents the synthesis of the AFM results and identifies circular economy solutions.

Following the selection process, the participants of the MFA project from a circular economy perspective on the northern territory were Chapais, Chevery, Fermont, Inukjuak, Longue-Pointe-de-Mingan and Mistissini. The participating mining company was ArcelorMittal Mont-Wright (AMMW), which is linked to the city of Fermont.

Such a project – specifically focusing on northern communities and a mining company – is a first in Quebec. Residual materials management is a great challenge for remote communities as well as industrial, commercial and institutional establishments (ICI). These communities are often isolated due to their remoteness from major urban centres and the distances between communities. Generally, supply of perishable goods is made through trucks, boats or airplanes from major centres, while these are empty when they return. Moreover, isolated northern communities are often associated with the natural resources development sector or are single industry.

Material flow analysis

As part of this mandate, the method chosen is a hybrid one based on both methods. Englobe's methodology focused on four parameters (or flows): energy, water, materials extracted within the MFA boundaries and consumer products. Since the MFA aims to stimulate identification of circular economy potential, the primary focus was on identifying the inputs and outputs of each participant.

The types of inputs and outputs were determined using two approaches to collect the required data, including data from the territory's ICI, to identify inputs and outputs. The types of output estimate were then completed by a characterization of the residual materials disposed of by each participant. The MFA covered the period from January 1 to December 31, 2021.

Energy

The main energy inputs noted throughout the study are electricity, fossil fuels, wood fuel and solar energy. The electricity generally comes from Hydro-Québec's electrical distribution network. It is then imported into each community. Two exceptions were noted in Inukjuak as well as in Chapais. The petroleum products used in the communities are all imported. Regarding wood, it is used for heating residences mostly in Longue-Pointe-de-Mingan and in Chevery. Finally, a very small amount of solar energy is produced in Longue-Pointe-de-Mingan.

Energy is then imported or produced on site in each community, to eventually be consumed by several users. As for outputs, energy consumption generates releases into the environment (air emissions) and fuel wood combustion produces ash.

Sankey diagrams illustrate the circularity of material flows. For example, in addition to exportation, circular economy initiatives have been observed in Chapais, whose cogeneration plant plays a central

role regarding the municipality's economy. For other communities, the energy flow is linear (without any circularity).

Water

Generally, drinking water distributed through the water supply system comes from a municipal well except for Inukjuak where water is delivered by truck. In Chevery and Chapais, a few buildings have an individual well.

Water is consumed by citizens and ICI. As for the mining company, most of the water consumed is used during ore concentrating process. Municipal wastewater is mainly collected through a sewer system to be sent to a treatment facility. When there is no sewer system, buildings are equipped with a treatment system (septic tank and disposal field) except for Chapais, where a wastewater treatment construction project is being conducted and Inukjuak where each building is equipped with a disposal tank that is regularly emptied by a tank truck. As for isolated residences and resorts of all communities, they all have an individual well and a septic tank.

There is little circularity in drinking water use, except for the mining company.

Extracted materials

The project revealed that extraction activities are done in agricultural, forest and mining sectors.

Regarding outputs, agricultural activities generate fruits and vegetables that are generally exported as well as crop waste that are released into the environment. The same pattern applies for forest and mining activities. Forest activities generate timber that is exported as well as forest biomass residues that could be recovered while mining activities generate iron ore concentrate that is exported as well as mine tailings that are released into the environment.

Local consumption of vegetables produced in Longue-Pointe-de-Mingan is a circularity element. Circularity is well implemented in extraction activities performed in Chapais. Sawmill activities produce residues that can be used as raw material to produce pellets, essential oils and fuel for the cogeneration plant.

Consumer products

This category covers all goods, materials, products and equipment imported into each community. A certain portion of wood and construction material inputs are turned into buildings and infrastructure

Outputs associated with consumer products mainly are residual materials, which could be landfilled, thus being released into the environment. The output destination then directly depends on the residual materials management services available and implemented within the communities. Moreover, Mistissini is the only community where there is an organic matter collection service. There are ecocentres in every community reachable by route. The presence of drop-off points allowing the collection of the products covered by EPR or the retailers registered with the *Québec Integrated Used Tire Management Program* is different from one community to another. Finally, only one used goods store has been identified in Fermont during the project. In other communities, a certain form of sharing is done.

A few circular economy examples were observed, for example Longue-Pointe-de-Mingan where the landfill managers carry out considerable efforts to collect objects to give them a second life.

Circular economy solutions

Many circular economy solutions were identified for each of the participants. The cogeneration activities in Chapais generate steam that can be used for the greenhouse as well the manufacturing of essential oils. A portion of perishable goods are given in Chevery when they no longer meet standard sales, which reduces food waste. A used goods store is well established in Fermont's shopping centre. Some construction contracts in Inukjuak now contain a specific clause for residual materials management, which encourages the export of residual materials generated by construction. Finally, thanks to a

greenhouse construction done by Longue-Pointe elementary school's staff and students as well as a partnership with a cooperative, some fruits and vegetables are locally produced and consumed. In Mistissini, heavy equipment renting services provided by some companies using these types of equipment in their main operations (e.g. construction and excavation company).

Circular elements are also present within AMMW's operations, particularly in the energy flow where steam is recirculated and heat exchangers are present. This is also the case for the water flow, where process water reuse greatly reduces the amounts of fresh water collected in the lake close to the mine.

Circular economy solutions that may be put in place by participants were identified. Throughout the project, a total of 105 different ideas divided into 175 circular economy solutions have been identified, of which several could apply to different communities. Several circular economy solutions could thus be applicable to other communities not participating in the study. Most of these circular economy solutions identified are recycling and composting, responsible consumption and procurement, process optimization and recovery strategies.

Among the 175 circular economy solutions suggested to participants, Englobe considers that some circularity elements are prevailing due to their importance on one or many sustainable development pillars (social, economic and environmental). These solutions include ecocentres, the built environment, the sharing of equipment and storage space. Examples related to maintenance and repair, donating and reselling, and refurbishing were all identified. A search for outputs for ashes, mine tailings, mining waste as well as wood and ropes from fishing activities could be carried out. Metal exportation should also be carrier out by certain communities. To reduce quantities sent to the landfills, the communities should implement a service allowing the treatment of organic matter. The modernization of the deposit-refund and selective collection systems also offer great opportunities for northern communities.

Action plan to optimize material circularity

The action plan developed for each community presents circular economy strategies and opportunities that the community can implement.

About half of the actions suggested are part of the recycling and composting, recovery as well as donating and reselling strategies. These actions focus more on residual materials management.

For each participant, certain actions were judged a priority and other lower priority. The actions identified as priorities are related to many circular economy strategies. For example, it is suggested that Chapais upgrades its water distribution network as well as its wastewater treatment. For Chevery, it was recommended to improve management of recyclable materials and containers under the deposit-refund program. In Fermont and Inukjuak, the planning of a new landfill should be carried out. The recovery of used aggregates should be done for Longue-Pointe-de-Mingan and Mistissini. Finally, the mining company, should evaluate the recovery of mining waste and mine tailings. Other actions were suggested and presented for each participant.

The implementation of circular economy actions would reduce the quantity of natural resource imports and thus the quantity of waste released into the environment. Implementation of these strategies would also maximize the use of resources available within the communities and the mining company.

Although the study is specific to the project participants, which are the communities and the mining company, the circular economy solutions as well as the actions plans described in this report may help or inspire other northern communities and companies for promoting the emergence of similar initiatives within other organizations.

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ABBREVIATIONS

AMEM	ArcelorMittal Mining Canada G.P
AMIC	ArcelorMittal Infrastructure Canada G.P
AMMW	ArcelorMittal Mont-Wright site
AMQ	Association minière du Québec
CAE	Centre d'aide aux entreprises
CC	Childcare centre
CCRI	Circular cities and regions initiative
CERMIM	Centre de recherche sur les milieux insulaires et maritimes
CIRAIG	Centre international de référence sur l'analyse du cycle de vie et la transition durable
CIRANO	Centre interuniversitaire de recherche en analyse des organisations
CLSC	Centres locaux de services communautaires
CNG	Cree Nation Government
CNM	Cree Nation of Mistissini
CRD	Construction, renovation and demolition
CTTÉI	Centre de transfert technologique en écologie industrielle
CVBU	Centre de valorisation du bois urbain
DMO	Designated management organization
EIJBRG	Eeyou Istchee James Bay Regional Government
EPR	Extended producer responsibility
FCM	Federation of Canadian Municipalities
FCNQ	Fédération des coopératives du Nouveau-Québec
GHG	Greenhouse gases
HHW	Household hazardous waste
ICI	Industrial, commercial and institutional establishments
IPD	Institute for Product Development
Institut EDDEC	Institut de l'environnement, du développement durable et de l'économie circulaire
KRG	Kativik Regional Governement
MEDDE	Ministère de l'Écologie, du Développement durable et de l'Énergie
MEIE	Ministère de l'Économie, de l'Innovation et de l'Énergie
MELCCFP	Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs
MFA	Material flow analysis
MFQ	Minerai de fer Québec
MRNF	Ministère des Ressources naturelles et des Forêts
NL	Northern landfill
NODP	Official drop-off point
NTFP	Non-timber forest products
QBCRA	Quebec Beverage Container Recycling Association
RIMMROM	Régie inter municipal matières résiduelles de l'ouest de la Minganie
RCM	Regional county municipality
RMMP	Residual materials management plan
RMO	Recognized management organization
RRLIRM	Regulation respecting the landfilling and incineration of residual materials
SADC	Community Futures Development Corporations
SDBJ	Société de développement de la Baie-James
SPN	Société du Plan Nord
TL	Trench landfill

GLOSSARY

Circular economy
A production, exchange and consumption system aiming to optimize resource use in every stage in the life cycle of a product or service through a circular approach, reduce the environmental footprint and contribute to the well-being of individuals and communities (Pôle québécois de concertation sur l'économie circulaire, 2016).
Engineered landfill
A residual materials management site developed in accordance with the requirements of the Regulation respecting the landfilling and incineration of residual materials (RRLIRM) (Environment Quality Act [EQA], chapter Q-2, r.19; Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs [MELCCFP], 2022a).
Input
All resources, materials or objects produced within the MFA boundaries (domestic extraction) or coming from the outside of the MFA boundaries that are imported for consumption or use (imports).
Linear economy
An economic model used since the industrial revolution focusing on extracting, processing as well as using resources and then throw them away at the end of their useful life (take-make-waste) without considering how to reduce the quantity of resources entering the system or the amount of waste leaving it (Ellen MacArthur Foundation, n.d.).
Material flow
The sequence of a product or material from its introduction within an MFA (input), through its use, to its output from the system or release into the environment (output).
Material flow analysis
The material flow analysis (AFM) of a given system (territory, sector, activity, etc.) aims to quantify the flow of the materials generated though the system as mass or energy. An AFM firstly requires delineating the system analyzed for which inflows, outflows and stocked flows are quantified. The resulted are then analyzed to characterize the system in terms of its material needs, exchanges with other systems, external dependence, environmental impacts, etc. (Ministère de l'Écologie, du Développement durable et de l'Énergie [MEDDE], 2014).
Northern landfill
A residual materials management site developed in accordance with the requirements of the Regulation respecting the landfilling and incineration of residual materials (RRLIRM) to offer a disposal method suitable for small municipalities and remote or isolated territories (Environment Quality Act [EQA], chapter Q-2, r.19; Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs [MELCCFP], 2022a).
Output
Product exported for consumption, use, recycling or recovery outside the MFA boundaries or released into the environment (e.g. residual materials for disposal).
Stock
The difference between the quantities of materials entering and leaving a territory, corresponding to the net accumulation of materials within the territory (e.g. building and road infrastructure).

Trench landfill
A residual materials management site developed in accordance with the requirements of the Regulation respecting the landfilling and incineration of residual materials (RLIRM) to provide a disposal method suitable for small municipalities and remote or isolated territories (Environment Quality Act [EQA], chapter Q-2, r. 19) (Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs [MELCCFP], 2022a).

1 Project background

In summer 2021, RECYC-QUÉBEC commissioned Englobe to perform a material flow analysis (MFA) to develop an action plan promoting circular economy in northern communities and in a mining company. The project is supported by three partners, which are RECYC QUÉBEC, the Société du Plan Nord (SPN) and the Ministère des Ressources naturelles et des Forêts (MRNF). Also, the study is supported and is funded by the Quebec government as part of the *Northern Action Plan 2020-2023*, from the *Québec residual materials management policy* and the mining heritage component of the Natural Resources Fund.

Although, circular economy has been studied for a few years in Quebec, no large-scale study has been conducted on this concept in the province so far among northern communities and mining companies.

The project aims to meet the two objectives set by project partners:

– Raise awareness and mobilize six northern communities as well a mining company located north of the 49th parallel to act as a circular economy testing ground;

– Conduct an MFA and a residual materials characterization for each selected community as well as the mining company to identify opportunities for reducing and optimizing the use of resources. These opportunities are formulated based on circular economy strategies and designed to generate savings, support community life and improve environmental quality.

The purpose of the project is then to identify optimization solutions for the use of certain materials for promoting circular economy. The latter focuses on six communities as well as one mining company that were selected based on their interest and regional representativeness, which are:

– One northern village in Nunavik;

– One Cree community in the Eeyou Istchee territory;

– One non-native community from James Bay;

– One costal municipality in Côte-Nord;

– One village in the Basse-Côte-Nord (currently served by boats and airplanes);

– One mining company;

– One community linked to the mining company.

Such a project – specifically focusing on northern communities and a mining company – is a first in Quebec. Residual materials management is a great challenge for remote communities as well as industrial, commercial and institutional establishments (ICI). These communities are often isolated due to their remoteness from major urban centres and the distances between communities. Generally, supply of perishable goods is made through trucks, boats or airplanes from major centres, while these are empty when they return. Moreover, isolated northern communities are often associated with the natural resources development sector or are single industry.

Each MFA is an assessment using a quantitative approach of the materials flows entering and leaving the territories of the community or the mining company. This analysis is therefore using the concepts of inputs and outputs according to the conservation principles of mass and energy. As part of this project, the MFA is used to understand and outline the dynamics and interactions of resources and materials imported, extracted, used, released or exported at the scale of each organization studied.

The MFA is also based on data collected through questionnaires, interviews with ICI as well as a residual materials characterization carried out within the communities and the mining company. The MFA results made it possible to identify as many inputs and outputs as possible with a view to improving understanding of local resource management and thereby simplify the identification of potential circular economy solutions and the development of customized action plans for the communities and the mining company.

This report presents the synthesis of the AFM results and identifies circular economy solutions, for enabling the communities and the mining company to continue their efforts to divert significant quantities of residual materials from landfills, reduce energy and water consumption as well as implement circular economy actions. Circular economy solutions suggested in each customized action plan could also boost the economy while considering the ecosystemic carrying capacity.

Although the study is specific to the project participants, which are the communities and the mining company, the circular economy solutions as well as the actions plans described in this report may help or inspire other northern communities and companies for promoting the emergence of similar initiatives within other organizations.

2 Selection of the communities

The territory north of the 49th parallel covers an area of more than 1.2 million km and is occupied by just over 120,000 people, including 33,000 First Nations members and Inuit. Within this large territory, there are small communities with populations of less than 3,000 people. The geographical differences of the communities are significant. A systematic methodology was then used to select the communities that would be part of the study.

Next paragraphs outline the methodology used to select these communities.

2.1 Communication

The first step of the selection process was to communicate with existing local and regional organizations for each regions or categories identified by RECYC-QUÉBEC, which were:

- Northern village: Kativik Regional Government (KRG);
- Cree community in Eeyou Istchee: Eeyou Istchee James Bay Regional Government (EIJBRG) and Cree Nation Government (CNG);
- Non-native community in James Bay: EIJBRG, Société de développement de la Baie-James (SDBJ) and Pôle d'innovation nordique;
- Coastal municipality in Côte-Nord: Regional county municipality (RCM) of Minganie and Synergie 138;
- Village in Basse-Côte-Nord: RCM of Golfe-du-Saint-Laurent;
- Mining company: Quebec Mining Association (QMA) (through its environmental committee);
- Community related to the mining company interested in the project.

Following initial communications with these organizations, a written communication containing an explanatory summary of the mandate RECYC-QUÉBEC assigned to Englobe was sent. These communications allowed to regionally publicize the project, get the contact information of local officers, assess the interest of local communities as well as select the participating ones.

In Côte-Nord, participants have been designated unanimously since only one municipality and one village were interested in the project. The KRG and the CNG respectively designated the northern village and the Cree community.

As for the mining company, a project presentation was made to the members of QMA's environmental committee. As mentioned in the mandate, the participating mining company had to be located within the northern territory and have a strong link with one municipality. Following the project information given, one member of the QMA wanted to participate in the project. Then, Englobe communicated with the community having a strong link with the mining company, which also expressed its interest to participate in the project.

Thus, the only community that had to be chosen through a real selection process, which is described in Section 2.2, was the non-native community located in James Bay.

2.2 Selection grid

Since three non-native communities in James Bay were interested in the project, a selection process was carried out. Through the latter, criteria as well as their weighting have been set. A selection grid was prepared by Englobe and was then presented as well as commented by the client and project partners – RECYC-QUÉBEC, the SPN and the MRNF respectively – thus involving them in the participating community selection process since they graded them based on the grid. A score from 1 to 3 (weighting) was given for each criterion of the grid developed by Englobe (Table 1).

Table 1: Criteria used for the participating community selection process

Selection criteria (score from 1 to 3)	Weighting
Demography and population – If the population of this community is < 500 people = 1 – If the population is > 500 and < 3,000 = 2 – If the population is > 3,000 = 3	1
Current residual materials management and implemented services – If only one waste collection = 1 – If one waste and recyclable material collection = 2 – If, additionally, organic matter collection or circular economy initiatives = 3	3
In Quebec, this community expands the project geographical coverage of another community – Another community at less than 200 km = 1 – Another community located between 200 and 400 km = 2 – Another community at more than 400 km = 3	3
The community has a diversified economy and several major employers – Single-industry city and basic services = 1 – City with two main industries and minor services centre = 2 – City with a diversified economy and major services centre = 3	2
Goods can be transported to the site and outside of it through several ways (e.g. truck, train, boat and airplane) – If one means of transportation is used = 1 – If two means of transportation are used = 2 – If three or more means of transportation are used = 3	1
This community has enough resources to support Englobe and the conduction of the flow analysis – There are doubts = 1 – No reason to doubt = 2 – The community proves that it has enough resources = 3	3
We are confident that results and circular economy strategies will apply to communities in this category – Low level of confidence = 1 – Moderate level of confidence = 2 – High level of confidence = 3	3

Following this grid, the community of Chapais was then selected unanimously based on the following elements:

– Current residual materials management services;

– Local resources available for the conduction of the MFA.

2.3 Description of the communities and the mining company

Following the selection process, the participants of the MFA project from a circular economy perspective on the northern territory were then:

- Chapais (non-native community in James Bay);
- Chevery (village in Basse-Côte-Nord served by boats or airplanes);
- Fermont (city having a link with a mining company);
- Inukjuak (northern village in Nunavik);
- Longue-Pointe-de-Mingan (costal municipality in Côte-Nord);
- Mistissini (Cree community in Eeyou Istchee);
- ArcelorMittal Mont-Wright (AMMW) (mining company).

Figure 1 shows the location of these communities as well as the mining company selected as part of this study.

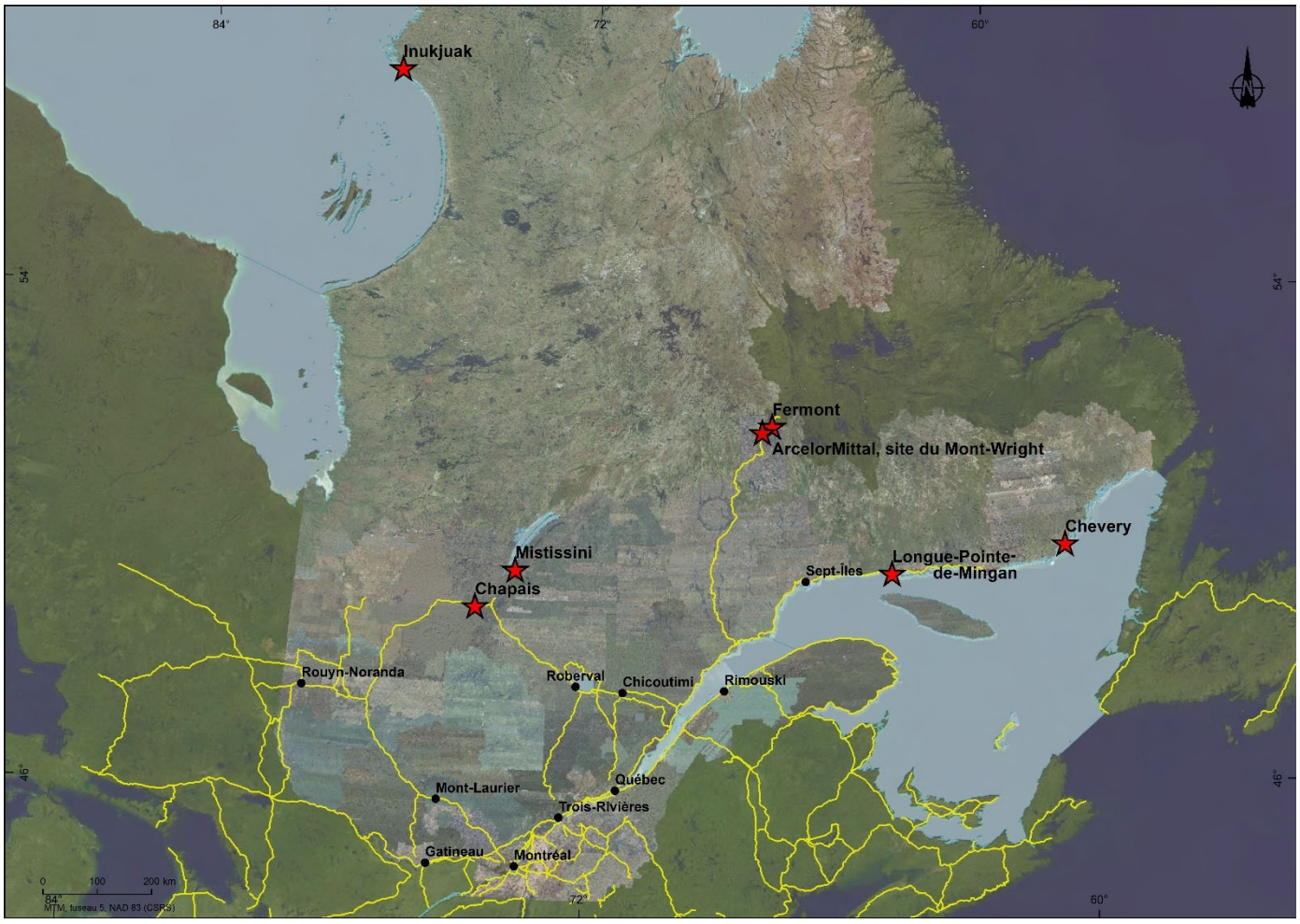

Figure 1: Location of project participants

2.3.1 Chapais

The city of Chapais, which was incorporated in 1955, is not part of an RCM and is in the southeastern part of the administrative region of Nord-du-Québec. The centre of the municipality is located 33 km from the Cree community of Oujé-Bougoumou and from 44 km from the Jamesian municipality of Chibougamau.

The city is landlocked by the territory of Eeyou Istchee James Bay, governed by the Eeyou Istchee James Bay Regional Government and jointly administered by Cree and Jamesian communities, whose city is Chapais.

The city is connected to the Quebec road network through Route 113, linking the region of Lac-Saint-Jean to the region of Abitibi. Chapais is served by the Chibougameau/Chapais Airport and is a Village-relais.

Chapais has implemented circular economy initiatives in the middle of 2010 when the city renewed its power sales agreement with Chapais Énergie. The thermal power plant then became a cogeneration plant whose thermal releases (steam) were recovered from different industries. The cogeneration plant is also powered by biomass and forest residues generated by other industries.

Industrial ecology is a circular economy strategy that is well implemented in Chapais mainly through the cogeneration plant and its operations. Figure 2, which was produced by the city of Chapais, shows the industrial development circularity in Chapais.

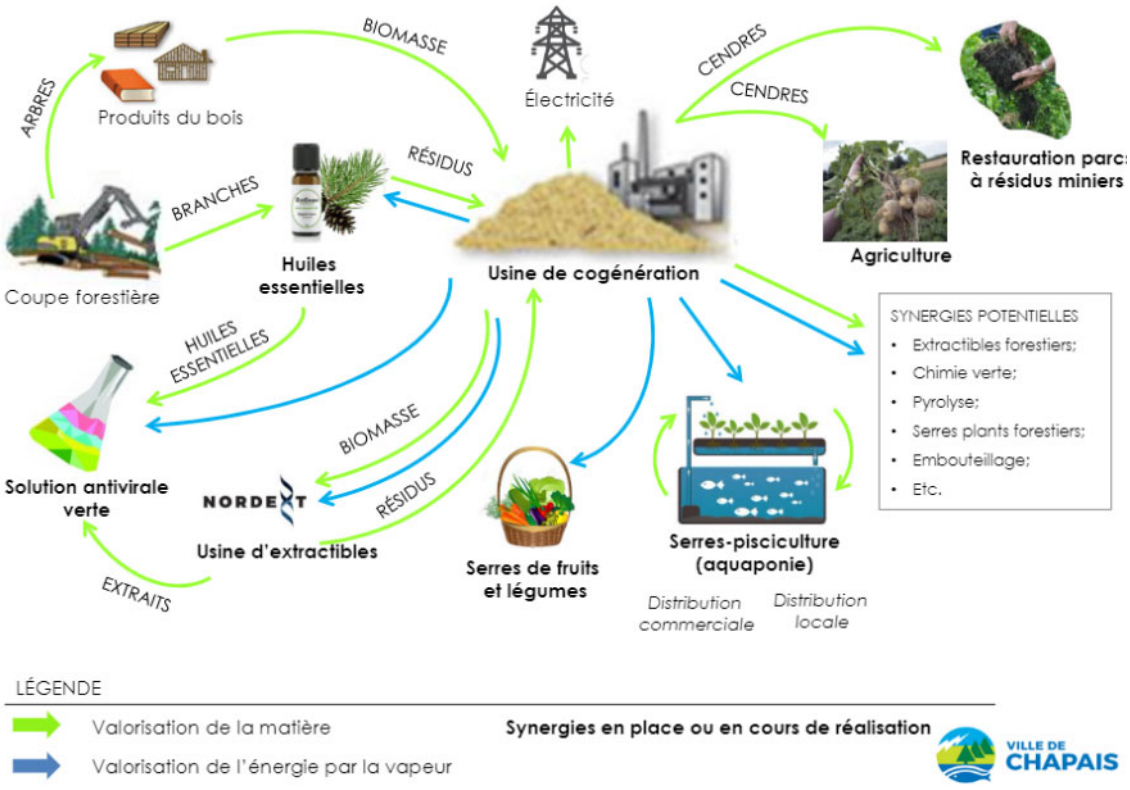

Figure 2: Industrial activity circularity in Chapais

Reference: Québec circulaire, 2023a.

Chapais' economic development strategies focus on the implementation of circular economy initiatives. The city was notably selected, with other cities, to be part of the first cohort of the *Circular Cities and Regions Initiative* (CCRI), an exchange and learning network between 15 Canadian communities involved in a circular economy process (CCRI, 2021). Some circular economy actions are already in place regarding Chapais' industrial growth, such as recovery of wood residues generated by forestry related to various sectors: energy (forest biomass), agriculture (reuse of ashes and steam), essential oils (reuse of residues and steam) as well as green chemistry (reuse of biomass and residues). The cogeneration plant (Chapais Énergie) is the centre of Chapais' circular economy and helps creating a significant number of indirect jobs (City of Chapais, 2020).

2.3.2 Chevery

Chevery is a village in Basse-Côte-Nord that is part of the municipality of Côte-Nord-du-Golfe-du-Saint-Laurent – along with the villages of Harrington Harbour, Kegaska, La Romaine and Tête-à-la-Baleine. Chevery is the administrative centre of this municipality, which is located in the RCM of Golfe-du-Saint-Laurent.

The territory of the village was already used in the 18th century. Nevertheless, Chevery was officially founded in the 1950s. Concerning current jobs in the village, they are all related to the sectors of fisheries and services (municipal offices, educational institution, etc.).

Chevery is an interesting case for an MFA since it can be reached by airplane (federal airport) or boat (ferry service between Chevery and Harrington Harbour). Indeed, the *Bella Desgagnés*, a supply ship, stops in Harrington Harbour, where Chevery's inputs are unloaded to be then transported by barge to the village. From a material flow perspective, Chevery has the particularity of importing resources into its territory by air and by sea.

Even though there is no roadway link in Chevery, the community is currently analyzing various residual materials management strategies, such as the shipment by boat of recyclable materials resulting from selective collection. The interdependence of the coastal villages located within the municipality of Côte-Nord-du-Golfe-du-Saint-Laurent, in Basse-Côte-Nord, regarding residual materials management and similarities between challenges respectively faced by them confirms the relevance of conducting an MFA in Chevery.

2.3.3 Fermont

The city of Fermont is part of the RCM of Caniapiscau, located in the administrative region of Côte-Nord. The city was incorporated in 1974 due to the mining development within the region (extraction of iron ore). The founding of Fermont coincides with the dissolution of Gagnon, a former mining city located further south on Route 389.

Fermont has the particularity of having a "screen wall" that is an arrowhead-shape building extending over 1.3 km that protects the city against strong northwest winds. This protective screen wall is part of a residential and commercial complex in which there are 350 dwellings, RCM offices as well as several services.

ArcelorMittal, the company operating Mont-Wright and Fire Lake mines (respectively 17 km and 60 km from Fermont), is the city's major employer. As for Quebec Iron Ore (QIO), it relaunched the Bloom Lake deposit operations, located about 10 km north from the city. The company also owns buildings for its workers that are located within the city.

By force of circumstance, Fermont's economy is closely connected to global economy, the demand for iron and ore value on markets. The financial situation of the two mines has then a great influence on Fermont's socio-economic and demographic conditions.

The activities and interests in Fermont are closely related to those of the surrounding mining companies. The Mont-Wright iron deposit that is now operated by ArcelorMittal is the reason why the city was founded. Moreover, some municipal services are provided by the mining company, such as a trench landfill (TL) located on lands owned by the company that is used by the city of Fermont. ArcelorMittal owns about 80% of the buildings located within Fermont, including the majority of the “screen wall”.

Although QIO is not one of the project participants, its collaboration was exceptional. Indeed, the entity comprehensively replied to the study’s questionnaire.

It is then within this partnership and synergistic context that the project was conducted and that the foundations of the circular economy action plan have been implemented.

2.3.4 Inukjuak

Inukjuak is an Inuit northern village located on the eastern shore of Hudson Bay in Nunavik. The northern village can be reached by airplane, helicopter or boat. Travels between adjacent communities of Nunavik are also carried out through small boats (summer) and snowmobiles (winter). The Inuit of Inukjuak use the vast territory surrounding their village, especially for their fishing and hunting traditional activities.

The MFA conducted in Inukjuak is especially relevant due to the construction project of the run-of-the-river hydroelectric plant currently taking place on the community territory and is also relevant for the persistent residual materials management challenges faced by local managers.

Indeed, the northern landfill (NL) of Inukjuak reached its full capacity. Solutions focusing on increasing its residual material disposal capacity should be found soon. The implementation of circular economy actions would reduce the quantity of natural resource imports and thus the quantity of releases into the environment, which will ease the pressure that is put on the NL. Given the lack of opportunities relating to the export of residual materials resulting from the geographical location of Inukjuak, which is isolated from the transportation networks within the province, it is beneficial for the community to investigate circular economy solutions.

2.3.5 Longue-Pointe-de-Mingan

The municipality of Longue-Pointe-de-Mingan is located within the RCM of Minganie, in Moyenne-Côte-Nord. The municipality is about 170 km east from Sept-Îles and is connected to the Quebec road network since 1976 through Route 138, which currently extends to Kegaska, a village located about 250 km to the east.

Concerning current jobs in In Longue-Pointe-de-Mingan, they are mainly related to industrial, hydroelectric development and tourism sectors. The village is in fact the entrance of the Mingan Archipelago’s heritage site that is known for its peculiar geology and its abundant fauna.

Longue-Pointe-de-Mingan is an interesting place for conducting an MFA since it has a TL receiving residual materials generated by all municipalities located in the western portion of Minganie. This TL, which is under the responsibility of the Régie intermunicipale de gestion des matières résiduelles de l’ouest de la Minganie, serves the municipalities of Havre-Saint-Pierre, Longue-Pointe-de-Mingan, Rivière-Saint-Jean and Rivière-au-Tonnerre as well as the Innu Nation of Ekuanitshit.

2.3.6 Mistissini

The Cree village of Mistissini is the place where the Cree Nation of Mistissini (CNM) is established, an indigenous community in the northern Quebec located within the territory of Eeyou Istchee James Bay. The members of the CNM occupy and manage a wide territory extending from Lake Mistassini to the

north-east, to the Caniapiscau Reservoir. There are several multi-family campsites on this large territory reachable by snowmobile, craft, helicopter or airplane.

Mistissini, which is about a hundred kilometers north from Chibougamau, is reachable via Route 167 and is served by the Chibougameau/Chapais Airport, located about 110 km southwest.

During the past few years, Mistissini implemented a wide range of residual material initiatives for reducing the quantity of materials landfilled in the TL, such as the creation of an ecocentre and the implementation of a program focusing on the collection of recyclable materials and organic matter. Through these actions, the community then became interested in developing local circular economy projects.

Due to its demography, geographical proximity to non-native communities and dynamism regarding residual materials management, Mistissini is a community that represents well the potential circular economy actions that could be implemented within the communities located in Eeyou Istchee James Bay, which are all connected to the provincial road network.

2.3.7 ArcelorMittal

The conduction of an MFA for both the city of Fermont and ArcelorMittal is particularly interesting since the activities carried out by these two organizations are closely linked. For example, for several years now, the waste generated by the Fermont citizens and ICI are landfilled in the TL located on the site of the mine. Also, ArcelorMittal is the largest landowner in Fermont. The company informed the City that, by 2025, it will no longer be possible to use the mine site to manage the city's residual materials.

ArcelorMittal's operations are divided in two additional entities – ArcelorMittal Mining Canada G.P. (AMMC) and ArcelorMittal Infrastructure Canada G.P. (AMIC) – both located in Fermont:

- AMMC operates two deposits, Mont-Wright and Fire Lake, and produces iron ore concentrate as well as iron oxide pellets for the world steel market;
- AMIC operates the 420 km railway linking the mine to Port-Cartier, which has, among others, 20 bridges, 5 tunnels and 19 sidetracks. Nowadays, a train consists of 210 wagons and is more than 2 km long, then requiring three locomotives (ArcelorMittal, 2021). Each year, 26 million tons of iron ore are shipped to international markets through this railway, which is still a strategic link (ArcelorMittal, 2021).

AMMC is in the RCM of Caniapiscau, about 17 km west from Fermont and 400 km north from Baie-Comeau by air or 567 km by road, in the administrative region of Côte-Nord. The Mont-Wright site is linked with the Quebec road network through Route 389, which extends from Baie-Comeau, on the coast of the Gulf of St. Lawrence, to the city of Fermont, then to Labrador. It is the only road leading to the mine and to Fermont.

3 Project methodology and timelines

3.1 Project timelines

The project ran for 17 months from fall 2021 to spring 2023 (Table 2).

Table 2: Project timelines

Activity	Fall 2021	Winter 2022	Spring 2022	Summer 2022	Fall 2022	Winter 2023	Spring 2023
Select participating communities	X						
Kick-off meetings with participating representatives		X					
Formulate methodology		X					
Plan community and mining company field visits			X				
Send out surveys to industrial, commercial and institutional establishments (ICI)			X				
Carry out the field visits (residual materials characterization, ICI visits, etc.)				X			
Process information obtained during the field visits, including the ICI visits				X	X		
Develop circularity scenarios and personalized action plans					X		
Prepare reports and synthesis report					X	X	
Submit reports to project partners and participants							X
Presentation of results							X

3.2 Methodology

The purpose of an MFA of a given system (territory, sector, activity, etc.) is to quantify its system-generated material flows as mass or energy. The first requirement of an MFA is to determine the boundaries of the system concerned and quantify its inflows, outflows and stocked flows. The MFA results are then analyzed to characterize the system in terms of its material needs, its exchanges with other systems, its external dependence or its environmental impacts.

The MFA then firstly implies to collect data to establish the most accurate picture of the situation on which the MFA is based.

Finally, it is important to remember that the purpose of the MFA is to help identify the participants circular economy potential.

3.2.1 Choosing an MFA

There are several methods to complete an MFA. In her essay called *L'analyse de flux de matières au Québec : méthodes et enjeux d'opérationnalisation dans une perspective d'économie circulaire* (Morris, 2016), Audrey Morris describes several methods to do so, including the one developed by Eurostat as well as the one designed by Peter Baccini and Paul H. Brunner.

Eurostat's "top-down" method (Morris, 2016) is based on macro data applied to a territory targeted for an MFA. This method is based on specific types of materials such as biomass, minerals and fossil-based energy. This method creates a kind of "black box" since is it solely based on the territory's inputs and outputs and does not consider interactions within the territory itself. In addition, it does not consider water consumption, as it represents an overly large quantity, thus masking the other results (Morris, 2016). Finally, it also does not consider issues associated with low mass flows, even if such flows are rare or toxic (Morris, 2016).

For its part, Baccini and Brunner's "bottom-up" method (Morris, 2016) was originally developed to describe and evaluate industrial processes. This method relies on detailed data to establish an accurate picture of the flows within a given system. It avoids the "black box" concept as it describes the various flows within the system. Baccini and Brunner's method is also based on activities, not only on types of materials.

As part of this mandate, the method chosen is a hybrid one based on both methods. Such a tailored method was used to conduct the MFA of the Brussels region in 2015 (EcoRes, 2015). It is also well suitable for the project's objectives since it identifies not only the communities and mining company's main activities (no "black box"), but also the materials related to these activities. Moreover, this hybrid method is also recommended when the aim of the MFA is to better understand the flow circulation in a target territory to assess whether it is possible to implement circular economy projects (Morris, 2016). This type of method was then preferred for the context of Mistissini.

Englobe's methodology focused on four parameters (or flows):

- Energy;
- Water;
- Materials extracted within the MFA boundaries;
- Consumer products.

All these flows are presented in the MFA to quantify them and understand how they behave in Mistissini's economic system. This exercise identified the main ressources that are incoming (inputs), whether imported or extracted, outgoing (outputs), whether exported or released into the environment, as well as the ones stocked (staying in the community) resources. As applicable, the flow dynamics obtained should also illustrate the loop of the outputs coming back to the communities and mining company, thus circular.

3.2.2 MFA boundaries in space and time

The administrative boundaries of each participant represent the geographical boundaries used for the MFA. In the case of the mining company, the geographical boundaries correspond to activities that are held at the Mont-Wright site.

The MFA covered the period from January 1 to December 31, 2021.

3.3 Data collection

Since the MFA aims to stimulate identification of circular economy potential, the primary focus was on identifying the inputs and outputs of each participant.

The types of inputs and outputs were determined using two approaches to collect the required data, including data from the territory's ICI, in order to identify inputs and outputs. The types of output estimate were then completed by a characterization of the residual materials disposed of for each participant.

It should be noted that outputs managed by municipal authorities are generally weighed or quantified. For example, loads of recyclable materials, HHW and EPR products are all weighed. On the other hand, the quantities of residual materials generated by the studied communities are not measured since the landfills do not have scales, but the generated volumes are registered. This information can be found in the RCM's residual materials management plans. When available, this public data was used to quantify outputs.

3.3.1 ICI

In efforts to get information regarding the ICI's inputs and outputs from studied territories, the following actions have been carried out:

- Submission of a questionnaire;
- Five-to-ten-day visits in the studied community to meet several ICI and see public infrastructure. A visit to the mining company also took place.
- When possible, a residual materials characterization specific to ICI was conducted if ICI waste collection was separated from residential waste collection.

3.3.1.1 Questionnaires

Four questionnaires were developed based on ICI sectors, either one questionnaire by type of ICI and one intended for the municipal administration. In addition, a questionnaire was specifically elaborated for the mining company.

One questionnaire was emailed to ICI within the studied territories to identify the different inputs and outputs related to their respective types of activities. These questionnaires focused on the material transformation processes occurring within the operations of these ICI as well as the by-products generated by their activities. A few questions relating to circular economy were also included. Prior to sending out these questionnaires, each community passed on information of the project to inform ICI of the upcoming study. In many communities, information was published in the local newspaper and a radio interview was conducted.

The municipal administration for each participant received a questionnaire to gather information on water production, residual materials management, road activities and new building constructions on the territory. In the case of the mining company, specific questions related to extraction activities and ore concentrations were requested.

3.3.1.2 ICI visits

Between the months of May to September 2022, Englobe professionals visited each community participating in the project. The ICI that were most active in raw material consumption and residual material generation were solicited for an information meeting.

The visits allowed Englobe to meet with main contributors to fill out questionnaires with them that were sent prior to the site visits. Among the six participating communities, Englobe met with 154 ICI while 325 ICI were targeted for the study (Table 3). From this number, 108 organizations agreed to participate in the project and answer the questionnaires.

Table 3: ICI participation within the studied communities

	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	Total
Targeted ICI	77	14	115	31	37	51	**325**
Number of ICI met	28	8	45	17	24	32	**154**
Number of ICI that completed the questionnaire	20	7	36	10	17	18	**108**

Through these questionnaires and meetings, inputs of the ICI visited were identified, including the raw materials required by industries. As for businesses, inputs mainly are items intended for retail sale. Inputs comprise materials imported into the community as well as those from domestic extraction, within the community (Morris, 2016). Outputs were also identified.

3.3.1.3 Infrastructure visits

In addition to the meetings with ICI, Englobe also visited each community residual materials management facilities relevant to the MFA. For example, according to the communites' installations, the wastewater treatment facility, the ecocentre, the transhipment centre for recyclable materials, the landfill, etc. were visited. These visits helped gather information on how these outputs are managed.

3.3.2 Disposed-of residual materials characterization

To specify the types of outputs generated by the community, Englobe performed characterizations of the residual materials sent to the landfills for each participating territory. The characterizations were sometimes conducted directly at the landfill and sometimes in a municipal building (e.g. municipal garage). The sampled materials were analyzed through 42 categories. When possible, an ICI residual materials characterization was conducted to identify specific outputs when there was a collection that only targeted ICI (e.g. at Fermont). However, in certain communities, for example Chevery, the waste collection included ICI and domestic waste. Therefore, this did not allow to distinguish these types of generators.

3.4 Data processing

An MFA is designed to obtain overviews of entire communities. However, not all the ICI participated in the MFA. Extrapolations therefore had to be made using the data gathered through the questionnaires and the information available about each of them, including their sector, site area and number of employees. Combined data from ICI and extrapolations were used to quantify all inputs and outputs for each community as well as the mining company.

Data gathered from questionnaires and the characterization were processed and converted into data that could be used to establish each of the participant's material flow. The data processing was adapted to inputs and outputs.

Particular attention was paid to material quantification to prevent inputs and outputs from being counted twice (in more than one flow).

The information gathered though the questionnaires, ICI visits and the residual materials characterization has been processed and analyzed in an Excel database. Data were processed to simplify the identification of the sectors that may contribute to optimizing local economy circularity.

3.4.1 Conversion of data into weight values

The information gathered from the questionnaires and the visits to the ICI showed that data on inputs (mostly purchases) and outputs (products sold, residual materials, etc.) are generally not quantified in terms of mass. The data have sometimes been collected in the form of:

– Volume (e.g. waste and recycling bin volume, fuel tank volume, litres of fuel, etc.);

– Monetary value (e.g. annual purchases of food, toilet paper, etc.);

– Numbers (e.g. number of pallets of materials received, number of cardboard boxes, number of car batteries, etc.).

The first step was then to convert this information into weight values. Research was conducted to develop a conversion table for converting the collected data into weight values. For example, this table shows:

– The weights of specific objects (e.g. wood pallets, car batteries, cardboard boxes, vehicle tires, etc.). The values used came from the literature as well as from the characterization;

– The precise density of materials (e.g. oil, gasoline, diesel fuel, etc.). The values used came from the literature as well as from the characterization;

– The density of various categories of materials (e.g. household waste, mixed recyclables, etc. The values used came from the literature as well as from the characterization;

– The monetary value conversion ($) of specific objects into weight values. For this conversion, Englobe had access to purchase orders from grocery and convenience stores indicating the weight and price of purchased items. Cost-per-weight ratios ($/kg) were calculated;

– The use of a common basis for measuring energy – in this case, the various energy sources (electricity, gasoline, diesel fuel, fuel oil, etc.) were converted into gigajoules.

3.4.2 Data annualization

After having converted the quantitative data into weight values, these were extrapolated for one year. This step was carried out taking into account the seasonal nature of the operations of some businesses and institutions not operating all year round (e.g. seasonal restaurants opened only during the summer tourist period).

3.4.3 Extrapolation based on response rate

The data and other information obtained by Englobe were processed to cover the entire territory of Fermont, bearing in mind that not all ICI participated in the study. This means that the data collected by the participating ICI must be extrapolated to represent the entire ICI sector for each community.

An initial extrapolation considered the response rate or the representativeness based on the number of employees. For example, in the case of Longue-Pointe-de-Mingan, the organizations that had answered the questionnaires represented 224 employees. According to the available data, there would be approximately 359 jobs in Longue-Pointe-de-Mingan. Considering that Englobe reached out to 224 employees in the context of this project, the Longue-Pointe-de-Mingan working population representativeness rate is 62%.

To complete the missing data, an extrapolation based on the number of employees, or on the production capacities was done. Englobe is conscious that production processes and business management methods are different and that in the context of an MFA, it would have been preferable to obtain all data and information’s regarding all ICI.

Some extrapolations were conducted for the commercial sector. For example, in one community, data from the catering sector had been obtained from a restaurant that participated in the study. This data was then extrapolated for other similar restaurants that had not transmitted data information.

To achieve this 100% representation, Englobe used two types of information, which are the number of ICI and the number of employees. The employee number variable was selected as being more representative. This representative proportion was then used to estimate the inputs of this entire working population to cover all ICI in the territory.

Note that for this project, the MFA is a tool used to elaborate a circular economy action plan, supported by interviews, key players and the teams experience and relations with the visited communities.

3.4.4 Output quantification and categorization

To precisely determine certain output quantities on the territory, in other words, those collected, recovered or disposed of, the data from residual materials management plans available were used (Minganie, Caniapiscau, Chapais and KRG). Also, when other studies relative to waste management were available, for example recent characterizations, these were used.

Finally, the characterization results from residential residual materials and ICI residual materials allowed to qualify certain generated outputs according to 42 material categories.

3.5 MFA limitations

Englobe obtained data directly from some of the ICI of the community. However, where this was not possible, Englobe proceeded by estimation. In such cases, Englobe used estimation factors that are available and recognized in the literature. The data sources, which are indicated when appropriate, come from organizations (e.g. Statistics Canada) and provincial or federal departments. When no information was available for Quebec or Canada, international estimation factors were used

3.5.1 Response rate

Most of the input data came from private companies, which represented the main obstacle in the execution of this MFA. Some companies may not have cooperated as effectively as possible in this analysis and may have refused to share certain sensitive information related to their activities (e.g. sales revenue). Where necessary, inputs and outputs were therefore estimated using publicly available assumptions and statistics.

Since a significant portion of the methodology relied on the questionnaires sent, the analysis could have been affected by a low ICI response rate. However, since the project implied a small community, the total number of ICI remained relatively small and reminders as well as follow-ups were made. The largest generators of inputs and/or outputs have thus been met (including the completion of the questionnaires) during the visits made by Englobe's professionals in each community.

3.5.2 Metals

In the case of consumer products, the questionnaire did not provide for a specific estimate of metal imports. Metals are mainly associated with vehicles and household appliances. Since the questionnaire was intended for ICI and given the absence of car dealers and appliance retailers, no metal-specific data were collected via the questionnaires.

To address this gap, Englobe used a metals-specific study prepared by the International Reference Center for Life Cycle Assessment and Sustainable Transition (CIRAIG) called *Métaux et économie circulaire au Québec – Analyse de flux de matières du cuivre, du fer et du lithium* (CIRAIG, 2017) was

used. The latter provides a complete picture of an MFA made for metals, including their extraction, the production of metal objects as well as their use and the end of their useful life. For the purposes of this project, only the "use" and "end-of-life" parameters were used. Quantities were estimated based on each participant (except for ArcelorMittal where the information was available).

3.5.3 Inputs from outside Mistissini

Since the questionnaires were only intended for ICI, they did not include the goods purchased outside the community's territory (e.g. purchases made in a superstore in Labrador or in Saguenay), which represented another limitation for this study. Theses goods may include, among other things, food, furniture, electronic devices, etc. Imported products bought online cannot be estimated as well. These inputs were not quantified.

3.6 Data collection confidence level

Each study allowed to reach most of the participating communities working population. In all cases, Englobe met with the communities' main employer and most important retail business representatives. Moreover, the companies operating a wide range of businesses (garage, restaurant, grocery store, hardware store, camping, factory workshops, etc.) were met with. Finally, almost all institutions were also met (childcare centres [CC], school, medical clinic).

For all these reasons, Englobe believes that the level of confidence in the MFA is adequate – a level that reflects the consensus view of the project team. However, this confidence level cannot be interpreted as a specific percentage applicable to the data.

4 MFA results

This section describes the flow of materials and the different types of energies from an MFA perspective. As previously mentioned, the hybrid methodology used is a combination of the Eurostat as well as the Baccini and Brunner methods. This approach focuses on four main parameters (flows):

– Energy;
– Water;
– Materials extracted in the community;
– Consumer products.

For each theme, the MFA identifies inputs that are either imported in the community (e.g. fossil fuels) and the ones and the ones directly extracted or created in the community (e.g. electricity produced through solar panels).

When these inputs are consumed, used or stocked, their consumption or use generates outputs that are either released into the environment (e.g. atmospheric emissions or landfilled waste) or exported outside the community (e.g. agricultural products, recyclable materials within the selective collection, etc.).

The following sections present the flow dynamics and an analysis of each of the parameters (energy, water and consumer products). The dynamics identify the different types of inputs and outputs as well as the consumers and users, while the analyses describe, for example, the input breakdown and the relative importance of consumers and users (expressed in percentage). Finally, circularity elements are identified, then Sankey diagrams show each flow in detail by associating quantities of inputs and outputs with users.

4.1 Energy

Here are the main energy inputs noted throughout the study:

– Electricity;
– Fossil fuels (gasoline, diesel fuel, fuel oil and propane);
– Wood fuel;
– Solar energy.

The electricity generally comes from Hydro-Québec's electrical distribution network. It is then imported into each community. Two exceptions were noted. The first one is in Inukjuak, where a diesel-powered thermal plant produces the electricity consumed by the community residences and ICI. In this situation, this type of energy is then produced within the community. However, the diesel fuel required for operating the thermal plant is imported. The second exception was noted in Chapais, where the electricity consumed is imported from Hydro-Québec, but also where electricity is produced through a cogeneration plant using forest biomass, then sold to Hydro-Québec, thus exported outside Chapais.

The petroleum products used in the communities are all imported. It should be noted that none of the participating communities has natural gas distribution services. Propane is mostly used by local companies (e.g. run a boiler or heat a terrace). The mining company also consumes large quantities of petroleum products, mainly for vehicles and ore drying.

Regarding wood, it is used for heating residences mostly in Longue-Pointe-de-Mingan and in Chevery. Since the wood fuel is collected directly within these territories, the MFA considers that this type of energy is produced on site. The other residences within the communities are mostly heated with electricity.

Finally, a very small amount of solar energy is produced in Longue-Pointe-de-Mingan.

4.1.1 Energy flow dynamics

Energy is then imported or produced on site in each community, to eventually be consumed by several users. The MFA focuses on residential, commercial, industrial and institutional as well as transportation energy use. For instance, gasoline and diesel fuel, which are both imported, are sold to the local service station. These types of fuels are almost exclusively used for motor vehicles.

The study showed that some industrial buildings are heated with propane or fuel oil.

The electricity consumed by the citizens and ICI of the communities comes from Hydro-Québec's distribution network, except for the thermal plant located in Inukjuak that is supplied by fuel oil. This type of energy is then imported into the communities, except for Inukjuak that generates its own electricity. Throughout the project, the communities whose residences are mainly heated with wood (Longue-Pointe-de-Mingan and Chevery) were identified. The wood used mainly comes from the community territory.

As for outputs, energy consumption generates releases into the environment (air emissions) and fuel wood combustion produces ash. The diagram in Figure 3 is an example showing the energy flow dynamics in Longue-Pointe-de-Mingan, being mostly like these of the other communities.

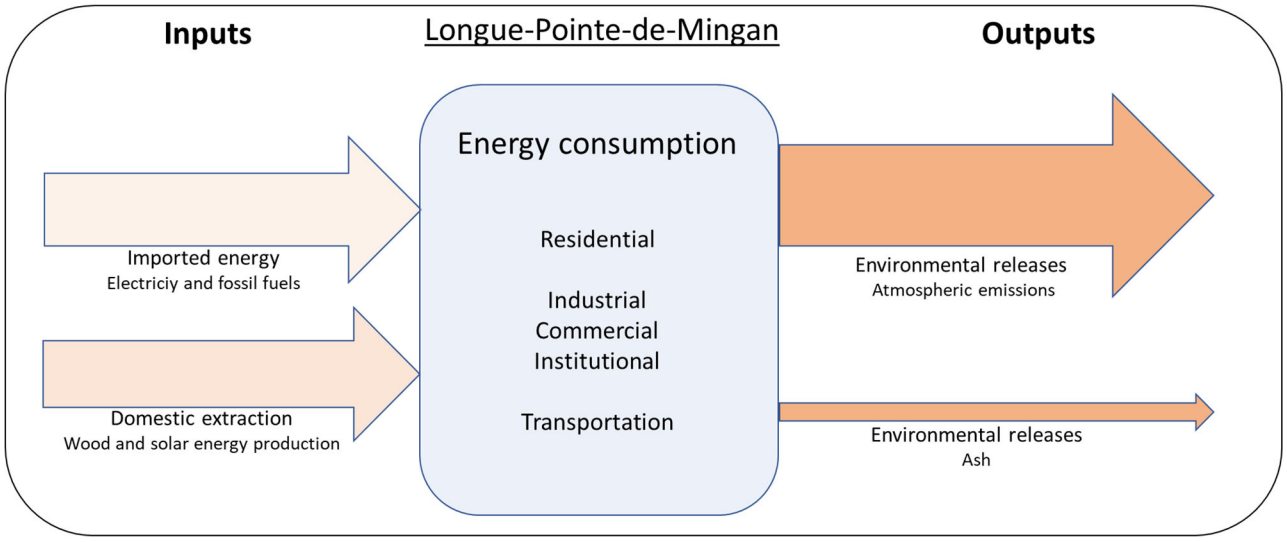

Figure 3: Energy flow dynamics in Longue-Pointe-de-Mingan

4.1.2 Energy flow analysis

Sankey diagrams showing the energy flow of each community participating in the project include the following elements:

- Value of each input imported or produced on site (gigajoule);
- Use of each input classified according to the different sectors (residential, industrial, commercial, institutional and transportation);
- Outputs generated following energy consumption (releases into the environment or electricity exportation for Chapais).

Sankey diagrams illustrate flow circularity. For example, in addition to exportation, circular economy initiatives have been observed in Chapais, whose cogeneration plant plays a central role regarding municipality's economy. Steam is used, for instance, for heating a greenhouse. Regarding ArcelorMittal, the residual steam used for ore drying is also used for preheating water, then producing new steam through heat exchangers. Nevertheless, the energy flow of some participating communities is sometimes linear (without circularity), such as in Chevery, Longue-Pointe-de-Mingan, Fermont, Mistissini and Inukjuak.

The following figures show an energy flow having a circular portion (Figure 4 for Chapais) as well as a linear energy flow (Figure 5 for Chevery).

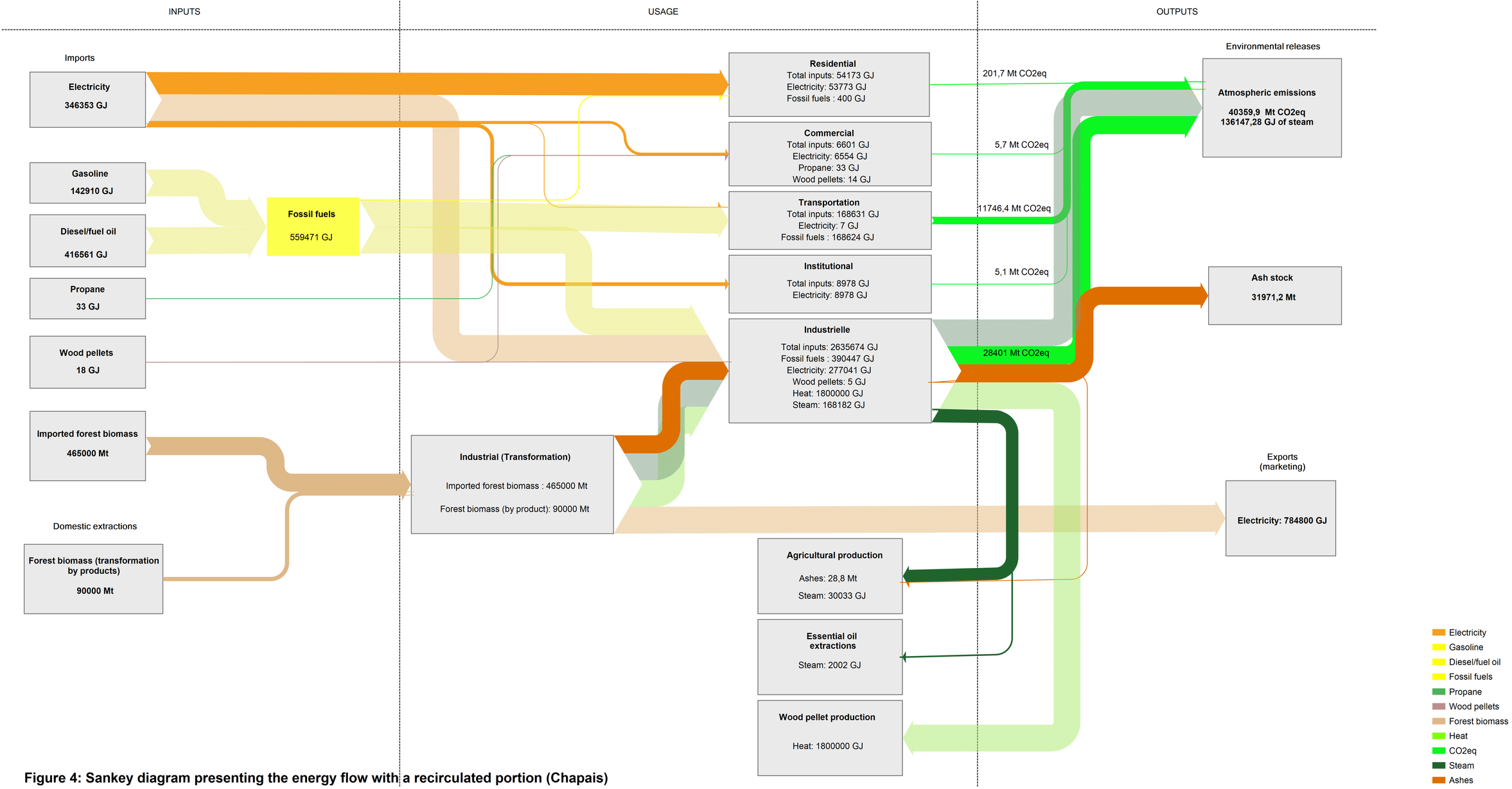

Figure 4: Sankey diagram presenting the energy flow with a recirculated portion (Chapais)

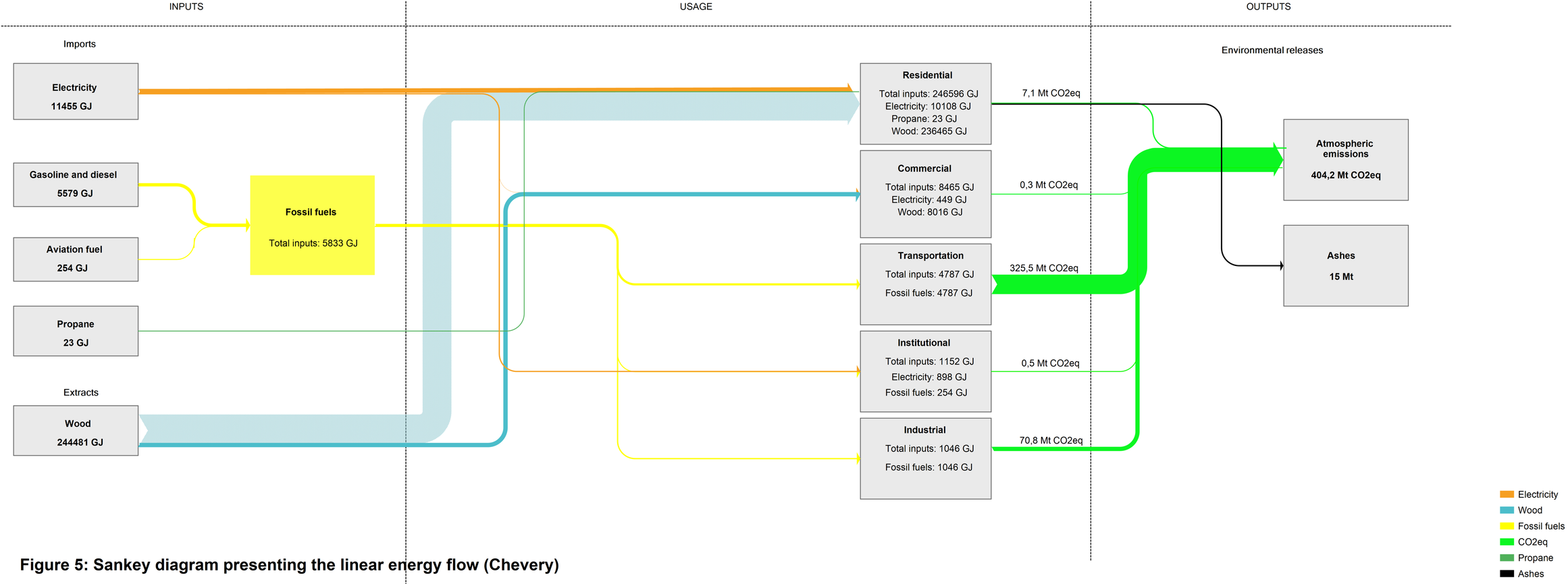

Figure 5: Sankey diagram presenting the linear energy flow (Chevery)

4.2 Water

Regarding water, the MFA focuses on the drinking water produced and consumed within the communities and the mining company. Generally, drinking water distributed through the water supply system comes from a municipal well, such as in Mistissini, Chapais, Fermont and Longue-Pointe-de-Mingan.

Water distribution is nonetheless different in Inukjuak and Chevery. In Inukjuak, it is not possible to develop underground infrastructure due to permafrost, thus forcing the village administration to deliver water to each building by truck. As for Chevery, only half of the village get water from the water supply system, while the other half is supplied with individual wells. Second residences located in Chapais also draw water from individual wells.

As for the mining company, most of the water consumed is used during ore concentrating process. Moreover, the seafood products processing plant located in Longue-Pointe-de-Mingan uses seawater.

4.2.1 Water flow dynamics

Water is consumed by citizens and ICI. When conducting the project, no extraction dedicated to water exportation within the communities was observed. Figure 6 shows a synthesis of the water production and use in Chapais as an example.

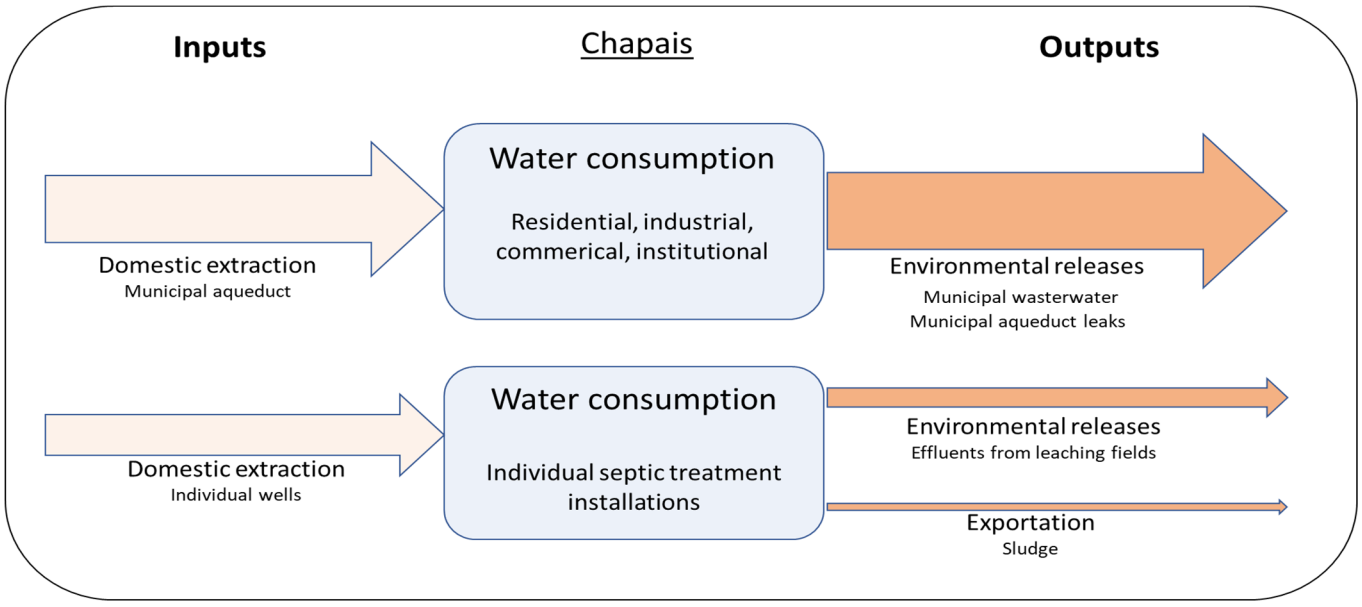

Figure 6: Water flow dynamics in Chapais

Generally, a chlorination treatment is required during drinking water production process within the communities, except for Chapais, where water is drawn in an esker, not requiring any filtration or chlorination process.

In Chapais and Longue-Pointe-de-Mingan, the largest water consumers are industries. Otherwise, the residential sector consumes most of the water. Regarding the mining company in Fermont, significant quantities of water are reused within the mines during ore concentrating process.

Water consumption necessarily implies wastewater production. Municipal wastewater is mainly collected through a sewer system to be sent to a treatment facility. When there is no sewer system, buildings are equipped with a treatment system (septic tank and disposal field). During the project, two exceptions were observed. The first one is in Chapais, where wastewater is collected through the sewer system, but released directly into the environment. Indeed, there is no wastewater treatment facility for now in Chapais, but a construction project is being conducted. The second one is in Inukjuak, where each building is equipped with a disposal tank that is regularly emptied by a tank truck. Wastewater is then released into a non-aerated pond intended for this purpose.

As for isolated residences and resorts of all communities, they all have an individual well and a septic tank. The pits are generally emptied every four years and sludge is sent to a licensed site.

4.2.2 Water flow analysis

Water from the municipal water supply system is sometimes used during industrial activities, which could be circular economy opportunities. For example, a portion of the energy produced in Chapais with this type of water is reused in the form of steam and heat.

Also, the largest water consumer in Longue-Pointe-de-Mingan is a fishing industry, who also uses during some operations carried out in the seafood products processing plant, which is then released into the sea following its use. Furthermore, a portion of the drinking water used in the plant is also released into the sea. The use of seawater reduces the consumption of municipal drinking water.

As for circular elements regarding water use for the mining company, more than 80% of the water consumed is process water mixed with runoff water, which is drawn from process water treatment basins.

These basins, accumulating and treating water, are the primary source of the water used during ore concentrating process.

Circular economy initiatives could also be implemented at the level of wastewater, especially for municipal biosolids. The water collected at the treatment facility eventually generates sludge as well as a compliant effluent that are released into the environment. Dewatered sludge could thus eventually be reclaimed and used as an input, for instance, by farm businesses, if meeting required agricultural conditions.

Within its report *Consommation d'eau municipale en 2019* (CIRANO, 2022), the Centre interuniversitaire de recherche en analyse des organisations (CIRANO) estimated the average residential water consumption at 268 L per person per day in Quebec. The project revealed that average residential water consumption of almost all participants was the same as the one estimated in CIRANO's report, except for Chapais and Mistissini. The amount of water consumed by the citizens of Chapais and Mistissini (residential use) is estimated respectively at 407 L and 600 L per person per day (Table 4), which is higher than CIRANO's data. A reduction in the drinking water consumption would help circularity.

Table 4: Average residential water consumption estimations per person per day, 2021

	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini
Average residential consumption (litre/person/day)	407	251	317	S.O.	228	600
Quebec's average[1]	268 litres per person per day					

[1] Reference: Cirano, 2022.

The following figures show a water flow with a circularized portion (Figure 7 for AMMW) as well as a linear water flow (Figure 8 for Mistissini). Thus, there is little circularity in drinking water use, except for the mining company.

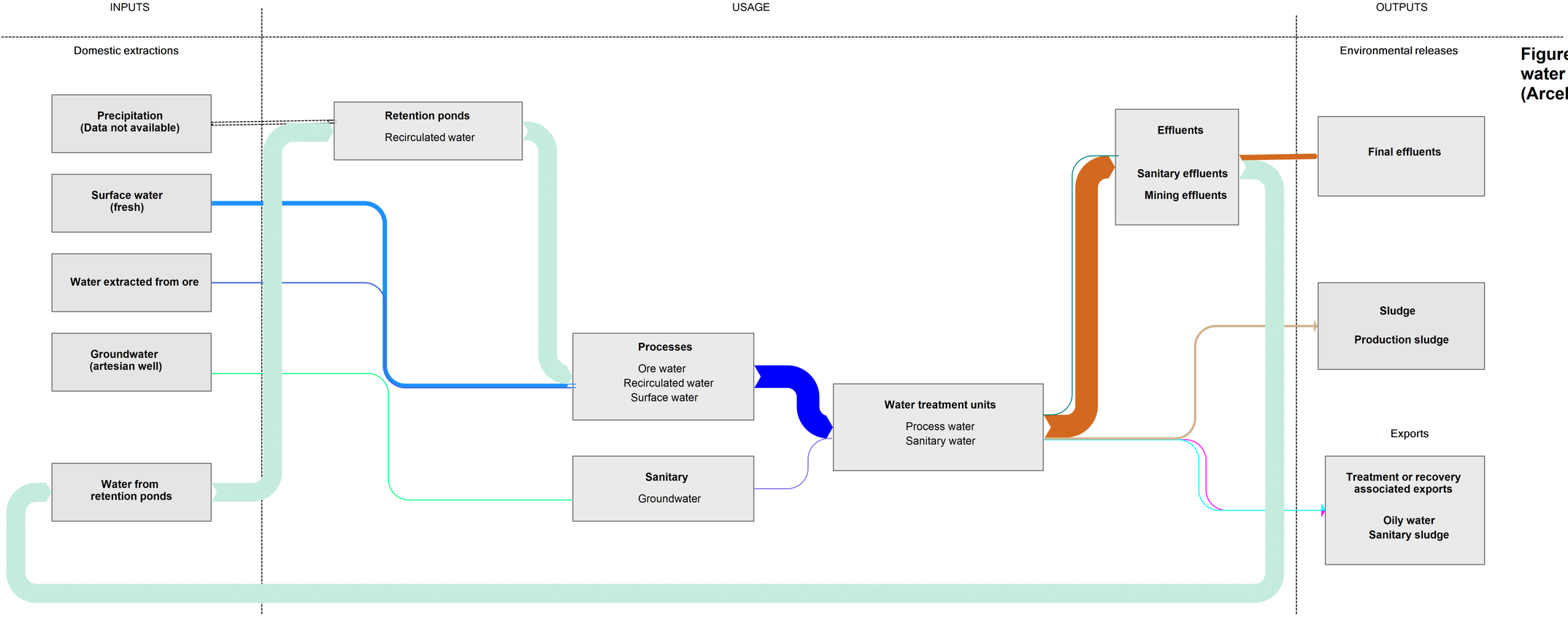

Figure 7: Sankey diagram presenting the water flow with a recirculated portion (ArcelorMittal)

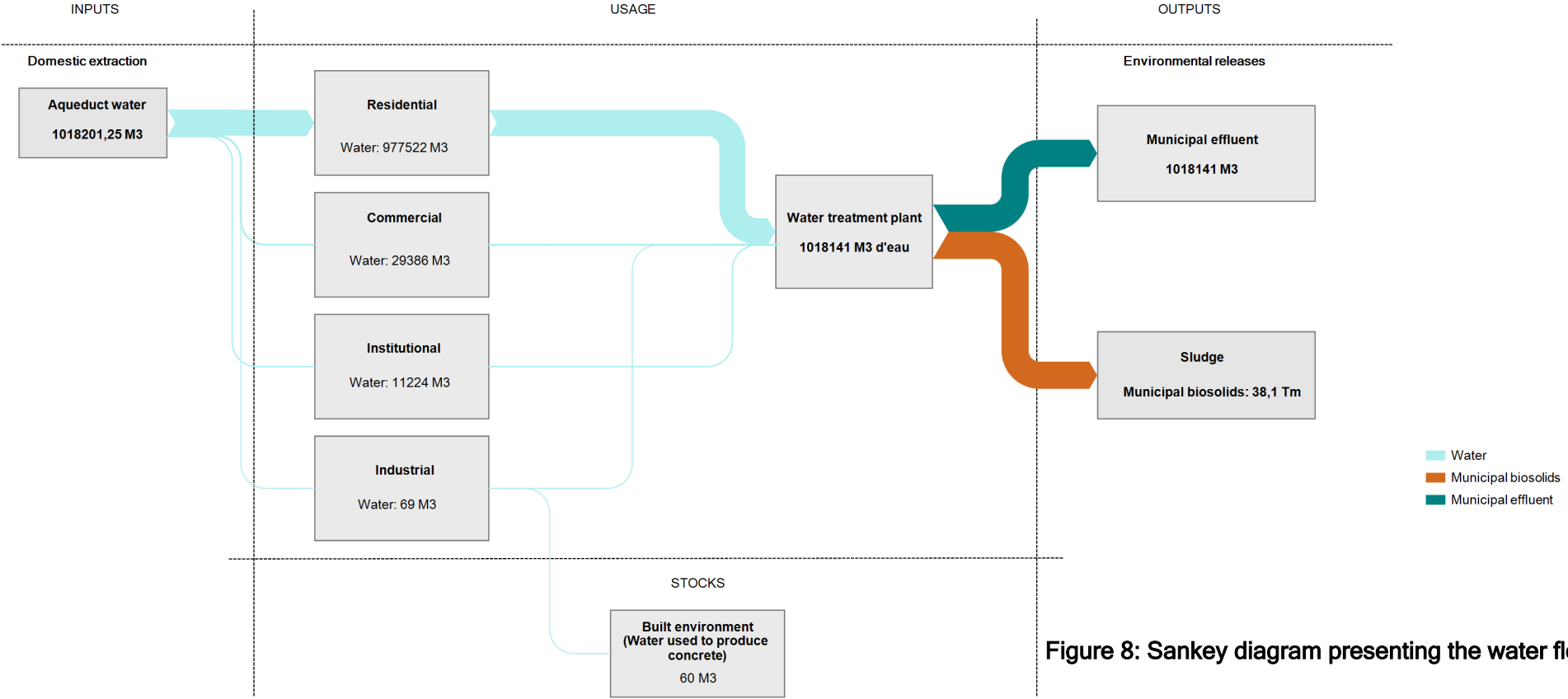

Figure 8: Sankey diagram presenting the water flow (Mistissini)

4.3 Extracted materials

This category presents materials extracted or created within the communities, including their manufacturing, if applicable. Extraction activities are done in agricultural, forest and mining sectors, including the sand pits and quarries.

4.3.1 Extracted material flow dynamics

In Longue-Pointe-de-Mingan, extracted materials come from agricultural activities – a blueberry field as well as a farm-market agricultural cooperative – and non-timber forest products (NTFP)[1], such as small fruits (cloudberry, crowberry, blueberry, Virginia strawberry, raspberry, Labrador tea, ligonberry, etc.), medicinal plants, edible plants and mushrooms. Vegetables produced locally are consumed within the municipality. The remaining crop is then exported. Agricultural activities require agricultural inputs and materials, for example, humus, compost, fertilizers, seeds or cuttings, that should be imported into Longue-Pointe-de-Mingan.

In Chapais, extracted materials come from agricultural and forest activities. Greenhouses in which tomatoes grow are present. Furthermore, forest residues or “forest biomass” are used as raw materials for producing essential oil. For these types of activities, agricultural inputs as well as materials should also be imported within the community.

In Fermont, the materials extracted mainly come from mining activities. Currently, two mines are in operation. In addition to the water and energy flows previously mentioned, extraction activities imply imports of equipment and materials required to carry them out. As for iron, it could be for vehicles, equipment parts, tires, products required through water treatment process, etc. Figure 9 shows the flow dynamics of mining activities in Fermont as an example.

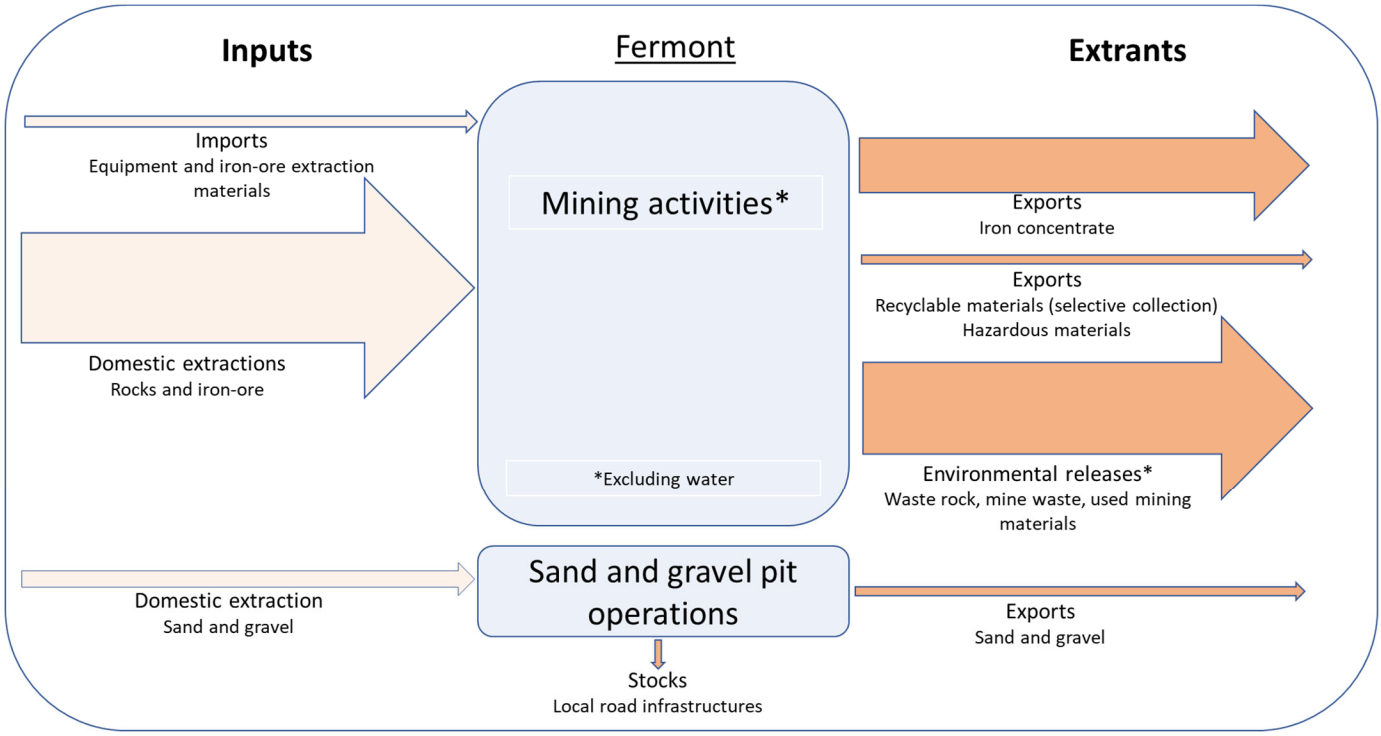

Figure 9: Flow dynamics of mining activities in Fermont

[1] NTFP are forest products other than wood and wood fibre.

Sandpit and quarry operations are also included in the extracted material flow, which could also be used for the construction of roads within the community. From an MFA perspective, it corresponds to stock. Aggregates could also be exported outside the community.

Regarding outputs, agricultural activities generate fruits and vegetables that is generally exported as well as crop waste that are released into the environment. The same pattern applies for forest and mining activities. Forest activities generate timber that is exported as well as forest biomass residues that could be recovered, while mining activities generate iron ore concentrate that is exported as well as mine tailings that are released into the environment. Mining companies also generate various residual materials that are exported to the southern part of the province, such as recyclable materials from selective collection and household hazardous waste (HHW).

4.3.2 Extraction activity flow analysis

Firstly, local consumption of vegetables produced in Longue-Pointe-de-Mingan is a circularity element. A local organization producing seeds suitable for the climate of Côte-Nord is present in this community.

Resource extraction activities carried out on the territory of are agricultural (production of fruits and vegetables) and forest (production of wood, pellets and essential oil) activities. Circularity is well implemented in extraction activities performed in Chapais. Nevertheless, it is not reflected in the Sankey diagram since the energy parameter was distinctively processed, but the greenhouse used for growing tomatoes is heated with waste heat generated by the cogeneration plant. Also, logging operations generate timber that is produced at the sawmill complex of Barrette-Chapais. Operations carried out in this complex generate residues used as raw materials for producing pellets, essential oil and fuel for the cogeneration plant.

There were few circularity elements in the MFA for the mining activities carried out in Fermont, except for water reuse. However, mine tailings in Fermont could be a starting point for circularity, as it the case for mine tailings in Thetford Mines and Val-des-Sources, which are rich in magnesium.

Examples of Sankey diagrams showing consumer products are presented in the following section.

4.4 Consumer products

This category covers all goods, materials, products and equipment imported, used and consumed within the community. According to the information gathered in in each community, goods, materials, products and equipment imported for consumption are brought into the community by residents and ICI. These importers are:

- Restaurants and grocery stores, which import perishable, frozen or non-perishable food (canned goods, pasta, etc.) as well as beverages;
- Hardware stores importing hardware elements and building materials (wood, paint, etc.);
- Companies, which import products (wood, HHW, EPR products, etc.);
- Schools, which import school supplies via the school service centre;
- Local community service centres (CLSC), which import medical equipment;
- Financial institutions who may import office supplies.

4.4.1 Consumer product flow dynamics

The composition of the flow of goods, materials, products and equipment in this study is as follows:

- Metals;
- Food products (food and beverages);
- Lumber;
- Building materials (gypsum, asphalt shingles and other construction materials);
- Hazardous materials;
- Products currently covered by the EPR:
  - Household appliances and air conditioners;
  - Oils, coolants and antifreeze as well as this their filters and containers;
  - Mercury lamps;
  - Batteries;
  - Electronics;
  - Paints and paint containers.
- Medical equipment and school supplies (including office supplies such as paper).

Food products mainly consist of the food and drink imported into the communities by retailers (e.g. grocery stores, etc.). The data associated with food products to which Englobe has had access is mostly expressed in total weight. This data does not include the weight of containers and packaging, such as wine or beer bottles (glass), water or soft drink bottles (plastic) and cardboard packaging. The characterization of residual materials, and, when possible, as well as the data collected during the selective collection execution were used to estimate the quantities of glass, plastic, cardboard, etc. of the communities as well as the mining company.

It is important to mention that a certain portion of wood and construction material inputs are turned into buildings and infrastructure. As part of an MFA, it corresponds to stock. As an example, between 2018 and 2021, the number of dwelling remained the same in Chapais, while three new commercial buildings were constructed. It is different in Mistissini, where about 20 buildings were constructed in 2021.

Finally, outputs associated with consumer products mainly are residual materials, which could be landfilled, thus being released into the environment. It is also possible to send containers, packaging and printing matter from selective collection to a sorting facility to be then recycled. In this case, these materials are exported. The output destination then directly depends on the residual materials management services available and implemented within the communities. Table 5 presents the services available within the participating communities.

Table 5: Residual material services available in each studied community

Infrastructures, services or nearest official drop-off point (NODP)	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini
Landfill site		X	X	X	X	X
Recyclable materials collection	X	X			X	X
Organic matter collection					*	X
Ecocentre	X		X		X	X
Mercury lamps (NODP)			X	X		
Electronics (NODP)	X	X	X	X	X	
Oils, coolants and antifreeze as well as this their filters and containers (NODP)	X	X	X	X	X	X
Household appliances and air conditioners (NODP)			X		X	
Paints and paint containers (NODP)	X		X	X	X	
Batteries (NODP)	X	X	X	X	X	X
Tires	X	X	X	X	X	X
Used goods store/Thrift shop	X		X			

* Marine waste collection generated by ICI

The existing services are greatly different from one community to another. For example, there is no landfill site in Chapais, where waste is exported outside the community. In this case, the final destination is the engineered landfill (EL) of Chibougamau.

The selective collection of recyclable materials is not available in Fermont and Inukjuak. As part of this study, Fermont is the only community reachable by road that does not have this service. Inukjuak, who is only reachable by airplane, helicopter or boat, does not have this service as well, while, in Chevery, whose situation is similar to Inukjuak, is able to export recyclable materials with a significant effort from volunteers.

Moreover, Mistissini is the only community where there is an organic matter collection service. Materials are manufactured on site using an industrial rotating composter.

There are ecocentres in every communities reachable by route. This does not mean that all collected materials are recycled.

The presence of drop-off points allowing the collection of the products covered by EPR or the retailers registered with the *Québec Integrated Used Tire Management Program* is different from one community to another. Generally, these services ate found in one place, which is the municipal ecocentre. It seems difficult to properly disposed of mercury lamps, household appliances and air conditioners. All services are provided in Fermont, while other communities only have a portion of these services. As for Chapais and Mistissini, several services are available in the nearby town Chibougamau, which is the nearest city.

Finally, only one used goods store has been identified in Fermont during the project. Even though there is no official service of that type in the other participating communities, goods sharing is present within these communities. Indeed, some objects normally landfilled are rather shared within the communities to giver them a new life. For example, citizens from regularly go to their respective landfill sites to take important parts for repairing different objects, such as for vehicles or household appliances. This circularity element is not officially organized, but it is well implemented within these communities.

4.4.2 Consumer product flow analysis

There are two manufacturing sectors for consumer products. The first one comprises recycling and composting. Selective collections and ecocentres are promoting the collection of several types of materials, metals as well as products covered by EPR. As part of an MFA, these materials are considered exported.

The second manufacturing sector is disposal, which are, in this case, releases into the environment. Nonetheless, if the landfill site is outside the MFA boundaries, it is then exportation.

As another example, the separate marine waste collection and treatment is a circularity element in Longue-Pointe-de-Mingan. Also, people in charge of the landfill site management make considerable efforts to collects objects to give them a new life.

Other examples of circularity have been observed throughout the project. Indeed, a portion of perishable goods are given within the communities when they no longer meet standard sales, which reduces food waste. It is, however, hard to show this type of distribution in a Sankey diagram due to its small proportion compared to the flows studied that are presented.

The following figures show an extraction and consumption flow with a circularized portion (Figure 10 representing Chapais) as well as a flow rather linear (Figure 11 representing Longue-Pointe-de-Mingan).

INPUTS

USAGE

STOCKS

OUTPUTS

Exports

Environmental releases

Figure 10: Sankey diagram presenting the extraction and consumption flow with a recirculated portion (Chapais)

IMPORTS

Metal
1588,9 Mt

Food
1650,3 Mt

Hazardous materials and EPR
435,4 Mt

Wood
1792,6 Mt

Other building materials
3638,7 Mt

Medical equipment and school supplies
0,1 Mt

Paper products
7,9 Mt

Other materials (textiles, animal food, hygiene products)
240,4 Mt

Raw wood
590 226 Mt

Forest biomass
465 000 Mt

Mining inputs
10,2 Mt

Agricultural inputs
111,1 Mt

DOMESTIC EXTRACTION

Agricultural production
Agricultural products : 2254,5 Mt

Logging
Wood: 1040,2 Mt

Mining
Mining exploiration drill cores: 280 Mt

Donation
Wood: 4,8 Mt
Textiles: 11 Mt

Local consumption
Metal: 1588,9 Mt
Food: 1443,5 Mt
Hazardous materials and EPR: 420,4 Mt
Other materials : 229,4 Mt
Medical equipment and school supplies : 0,1 Mt
Paper products : 7,9 Mt

Transformation
Raw wood : 590226,4 Mt
Mining inputs: 10,2 Mt
Raw wood : 1040,2 Mt
Forest biomass : 465000 Mt
Drill core and exploration : 280 Mt

Agricultural production
Ashes: 28,8 Mt
Agricultural inputs : 111,1 Mt
Agriculural products : 2254,5 Mt

Wood pellet production
Forest biomass : 220000 Mt

Built environment
Wood: 1474,7 Mt
Other building materials : 3071,5 Mt

Storage of drill cores
275 Mt

Ecocentre
Textiles: 7,5 Mt
Metal: 100,3 Mt
Wood: 17,8 Mt
Other building materials : 482,2 Mt
Hazardous materials and EPR: 39,6 Mt

MARKETING

Wood products
33675,5 Mt

Wood pellets
180000 Mt

Hydrolat
0,1 Mt

Agricultural products
2245,5 Mt

RECYCLING / RECOVERY

Metal
2 526,8 Mt

Recyclable materials (selective collection)
309,2 Mt

Hazardous waste and EPR
45,4 Mt

Refundables
28,2 Mt

Organic matter
2 Mt

Wood
112, 9 Mt

Residual materials landfilled at Chibougamau

Transformation by products
Hydrolat: 1800,1 Mt
Forest biomass : 220000 Mt
Ashes: 32000 Mt
Logging sludge: 1 Mt
Logging residues: 4 Mt

Stocks on Chapais' territory
Ashes: 29971,2 Mt

Rejects on Chapais' territory
Ashes: 2000 Mt
Logging sludge: 1 Mt
Logging residues: 4 Mt

Rejects in Chapais' sewage system
Hydrolat: 1800 Mt

Residual material categories (environmental releases)

Food
202,2 Mt

Other organic materials
216 Mt

Hazardous waste and EPR
15 Mt

Wood (residential and ICI)
151,1 Mt

Wood (CRD)
49 Mt

Other CRD (CRD)
85 Mt

Recyclable materials (selective collection)
1131,7 Mt

Eliminated metals
89 Mt

Other materials
Other materials:
317,8 Mt

Agricultural loss
9,1 Mt

Agriculture residues (organic)
125 Mt

- Wood
- Food
- Hazardous materials and EPR
- Other materials
- Paper products
- Medical equipment and school supplies
- Raw wood
- Forest biomass
- Drill core and exploration
- Mining inputs
- Logging residues
- Logging sludge
- Ashes
- Other building materials
- Metal
- Recyclable materials (selective collection)
- Refundables
- Other organic matter
- Textiles
- Hydrolat
- Agricultural products
- Agricultural inputs
- CRD
- Wood pellets

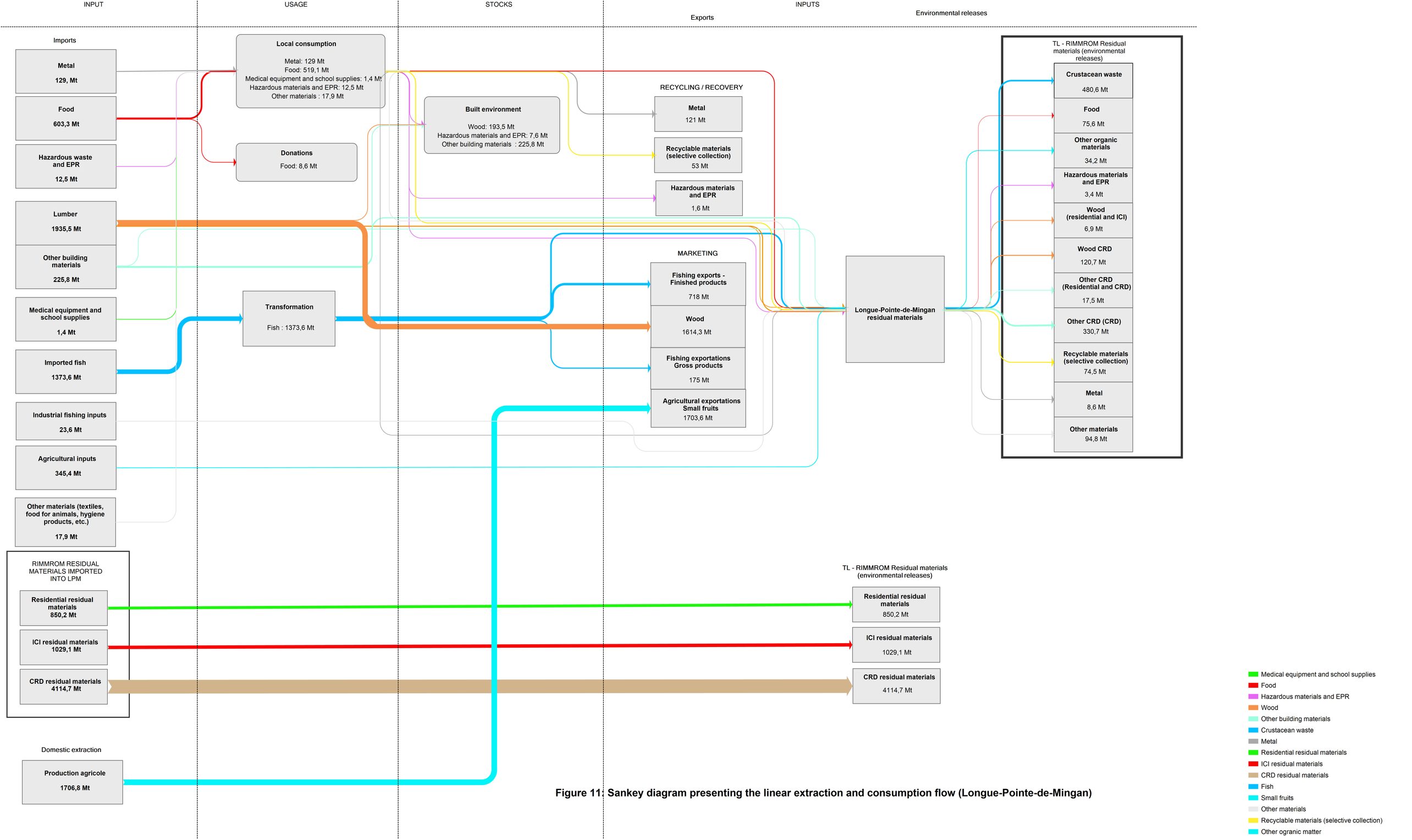

Figure 11: Sankey diagram presenting the linear extraction and consumption flow (Longue-Pointe-de-Mingan)

4.5 Flow synthesis

The flow synthesis aims to combining all the information gathered throughout the project in only one figure.

The following figures show a synthesis flow with a circularized portion (Figure 12 representing Fermont) as well as a flow rather linear (Figure 13 representing Inukjuak).

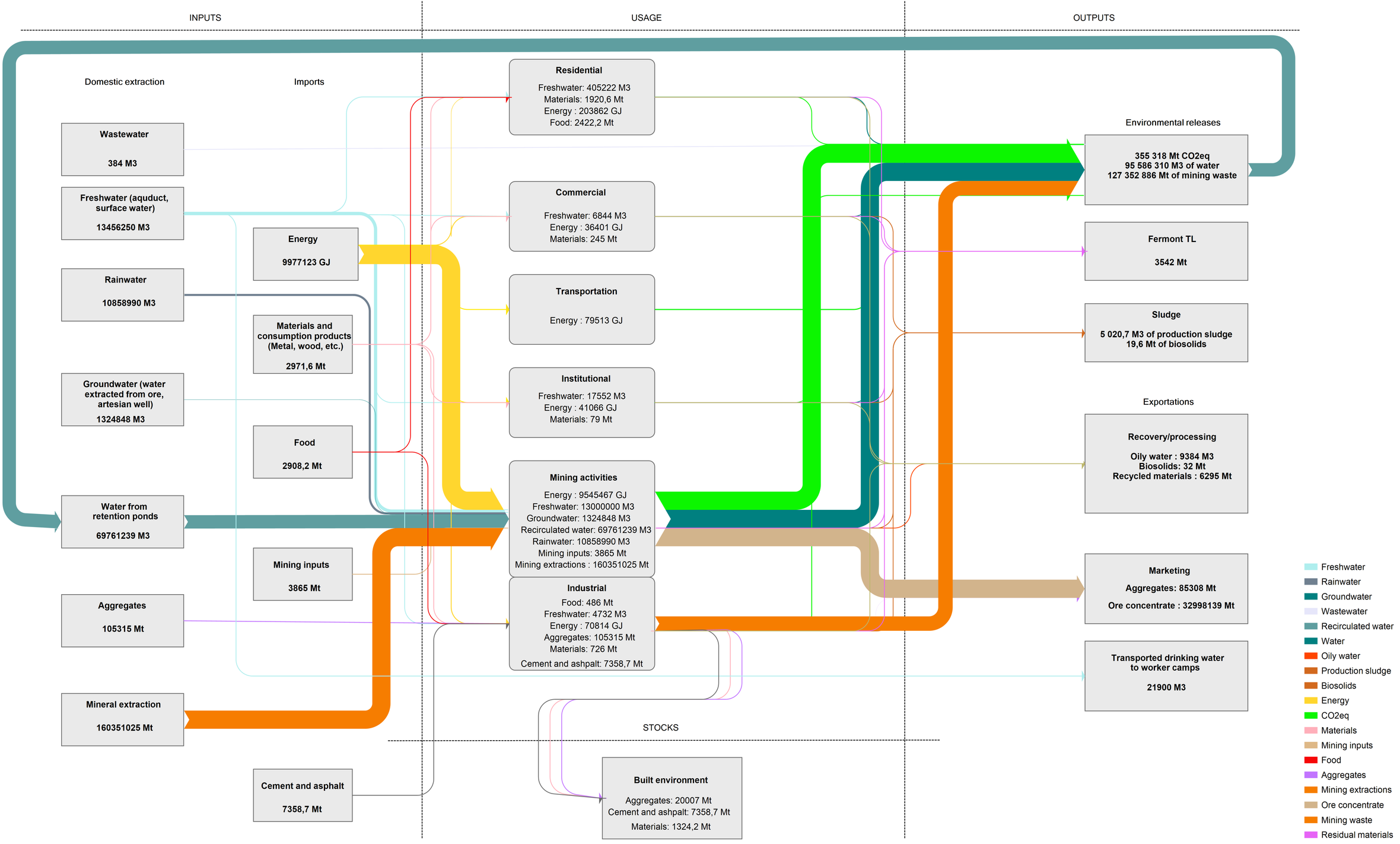

Figure 12: Sankey diagram presenting the flow synthesis with a recirculated portion (Fermont)

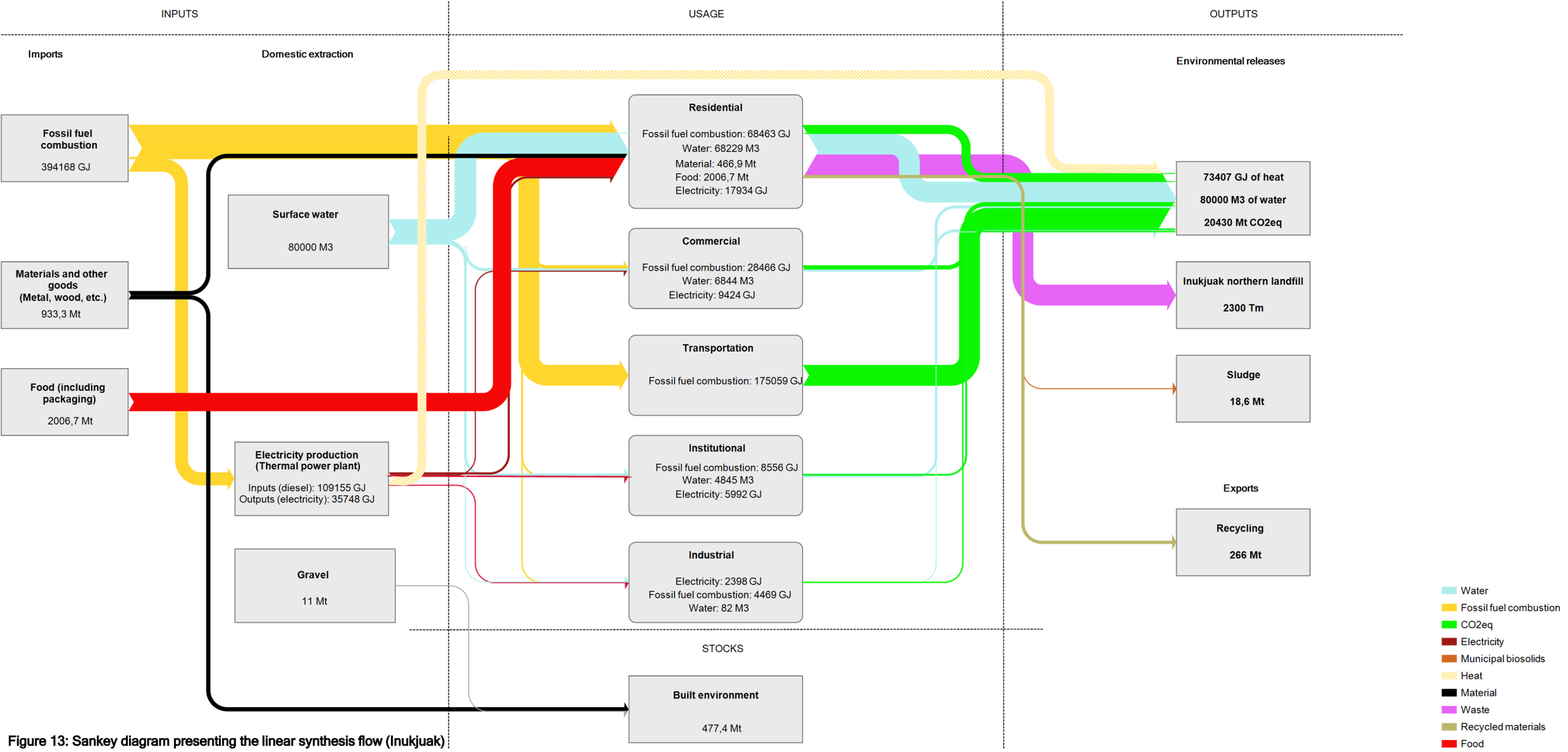

Figure 13: Sankey diagram presenting the linear synthesis flow (Inukjuak)

5 Circular economy solutions

Based on the results obtained through the questionnaires, the MFA, the visits, and the interviews done, it is possible to identify circular economy solutions for the communities as well as the mining company that participated in the project.

The MFA describes the participant's main flows identifying the movements of the materials entering and leaving the communities and the mining company. Onsite work and interviews done within the latter identified, among other things, the nature and the quantity of the residual material released as well as the existing initiatives and opportunities.

This chapter discusses opportunities for the implementation of circular economy solutions.

Circular economy is defined as "a production, exchange and consumption system aiming to optimize resource use in every stage in the life cycle of a product or service through a circular approach, reduce the environmental footprint and contribute to the well-being of individuals and communities" (Pôle québécois de concertation sur l'économie circulaire, 2016).

This economic model consists of 12 circular economy strategies broadly recognized in Quebec for achieving two main objectives:

- Rethink production and consumption patterns to consume fewer resources and protect the ecosystems that generate them;
- Optimize the use of resources that already circulate within societies by:
  - Intensifying product use;
  - Extending the life of products and components;
  - Giving resources a new life (RECYC-QUÉBEC, 2022a).

The 12 circular economy strategies with their respective objectives and definitions (RECYC-QUÉBEC, 2022b) are shown in Table 6, while the principles of the circular economy (Institut de l'environnement, du développement durable et de l'économie circulaire [EDDEC], 2018) are shown in Figure 14.

Table 6: Circular economy strategies

	Strategy	Objective	Definition
1	Ecodesign	Rethink	Integrating environmental aspects as early as possible in the design phase of products and services to minimize their environmental impacts throughout their life cycle.
2	Responsible consumption and procurement	Rethink	Integrating sustainable development and social responsibility in the purchasing or acquisition of goods and services by consumers or private and public organizations.
3	Process optimization	Rethink	Improvement of each of the organization's processes by seeking to reduce the consumption of raw materials, energy and water and the amount of waste generated.
4	Sharing economy	Optimize: intensify product use	A set of exchanges among users that relies on shared use, collaborative production, and barter. Preference is given to the temporary pooling of resources or the permanent redistribution of goods with or without compensation.
5	Short term renting	Optimize: intensify product use	Using goods or services for a fixed period in exchange of remuneration.
6	Maintenance and repair	Optimize: extend the life of products and components	The action of keeping objects in good condition to extend their life.
7	Donating and reselling	Optimize: extend the life of products and components	Putting used goods back into circulation by donating or selling them to a third party.
8	Refurbishing	Optimize: extend the life of products and components	Restoring objects for the purpose of resale.
9	Performance economy	Optimize: extend the life of products and components	Company business model that prioritizes sale of the use of the product rather than sale of the product itself. Users buy the function, not the product.
10	Industrial ecology	Optimize: give resources a new life	Network of companies and communities linked together by exchanges of materials (e.g., by-products), water or energy. These exchanges form synergies whereby the waste from one becomes the raw material for the other.
11	Recycling and composting	Optimize: give resources a new life	Recycling is defined as the use of collected materials to replace raw materials in manufacturing processes. Composting is defined as a biological treatment process that uses aerobic microorganisms to biodegrade organic matter.
12	Recovery	Optimize: give resources a new life	Any non-disposal operation that aims to obtain useful products or energy from residual materials.

Reference: RECYC-QUÉBEC, 2022a.

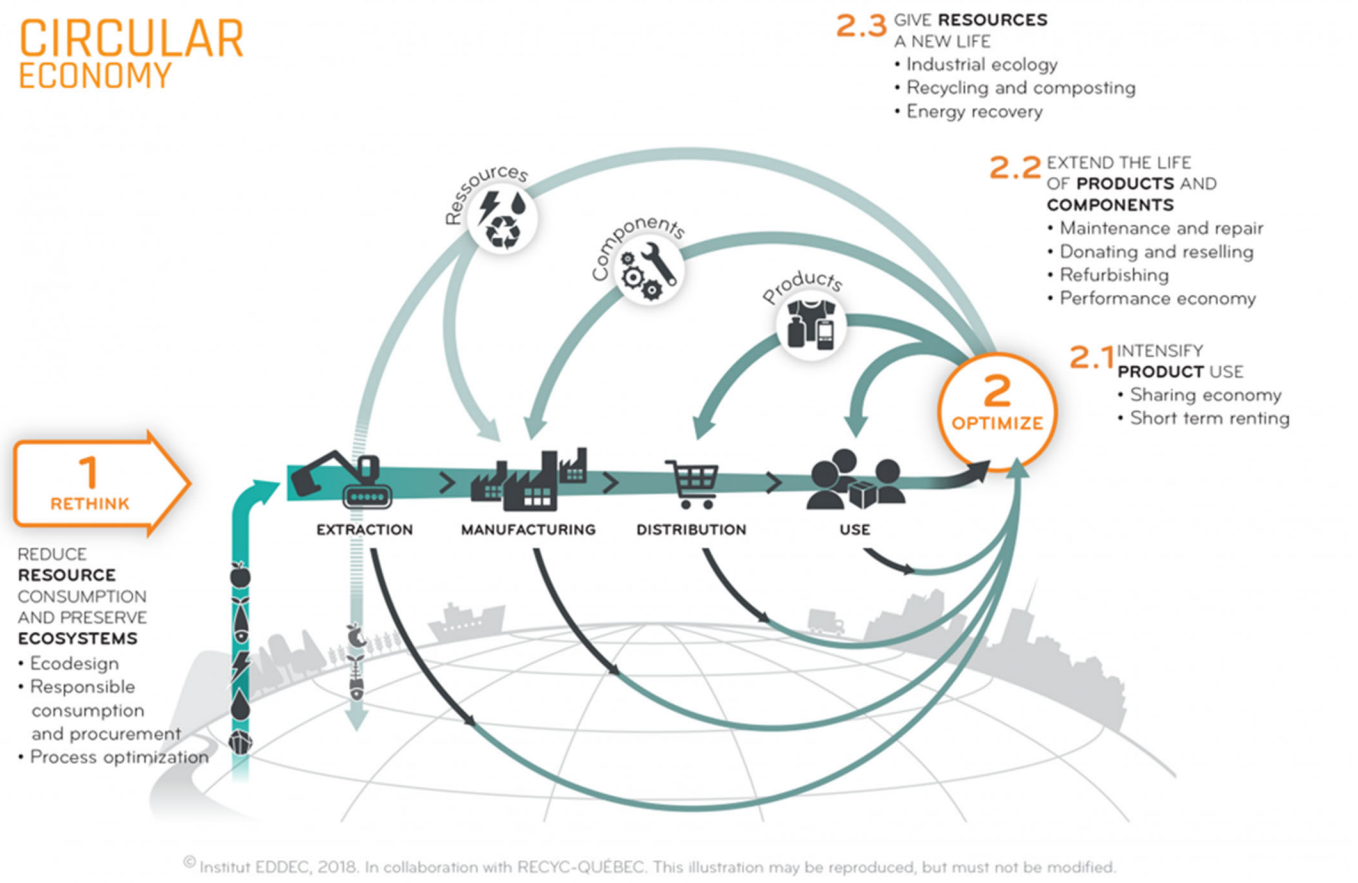

Figure 14: Circular economy diagram

These strategies offer circular economy solutions that the communities as well as the mining company that participated in the project could implement. Moreover, these are also suitable for general isolated communities. A series of examples, mostly from Quebec, relating to the 12 circular economy strategies are described in Appendix A.

5.1 Circularity already in place

The following sections describe the circularity elements currently specific to the participants.

5.1.1 Chapais

Chapais' economy has several circular flows. For example, the cogeneration plant Chapais Énergie mainly uses forest biomass from former stocks, forestry and sawmill of the region, including some outputs from the Barette-Chapais sawmill complex, for producing more than 200, 000 MWh of electricity.

Chapais Énergie's operations generate steam that is used for a greenhouse where tomatoes grow as well as an essential oil manufacturing company. The ash generated by Chapais Énergie was used for a long time for the revegetation of former mining sites, while it is currently stocked (at the time of the study) or used to improve market garden production.

For its part, the company BoreA uses forest biomass residues for manufacturing essential oil. Moreover, all its distillation residues are sent to the cogeneration plant for producing energy.

As for Barette-Chapais, it recovers most of its outputs, such as its wood waste (e.g. wood chips and sawdust) by producing wood pellets that are then marketed. Furthermore, the bark produced during the production process supplies the boilers used for wood and pellet drying.

In addition, other local and community smaller initiatives are also well implemented within Chapais. For example, some ICI are promoting local purchasing. Also, it is possible to identify reuse actions within the community, such as the tin can collection for the day camp activities taking place in summer, the clothing collection *Fripe ton style* to benefit student activities, a donation box *Croque-livres* and sports equipment donation to the arena. The used clothing store Marie-Reine, located on Springer Boulevard, is also well established.

5.1.2 Chevery

Chevery is geographically isolated and cannot be reached by road. Despite its significant constraint, there are several examples of circularity within the community. Indeed, a portion of perishable goods are given in Chevery when they no longer meet standard sales, which reduces food waste. Moreover, regarding reuse, when a company ceases its operations, reusable furniture and equipment are temporarily stocked by the village, rather than be disposed of, to be then sold at the auction.

Chevery is characterized by mutual support as well as equipment renting and sharing. For example, the Chevery airport is equipped with a mobile loader that is sometimes used for transporting residual material pallets to the wharf. Also, there is a grader within the village that can be shared with the airport for its operations. As another example, a company also owns a truck equipped with a crane (boom truck). This truck is sometimes rented or loaned by other members of the community.

The collection of recyclable materials, EPR products and HHW is also a circularity element within the community. Also, municipal officials and members of the community make significant efforts for collecting and shipping objects.

The most significant example of this is the selective collection that was implemented. Even though the benefits resulting from this initiative can be seen in the MFA, the complexities brought by the logistics and handling required for exporting cardboard, glass and plastic outside the village are not showed. As for Chevery, the significant efforts made to keep this type of logistics should be highlighted.

5.1.3 Fermont

Project results show that energy and water use in Fermont is more linear. However, several circularity elements have been identified. For example, almost all iron scrap and residues are sent to the southern portion of the province to be recycled. The City manages an ecocentre, promoting the collection of several types of materials, metals and products covered by EPR as well as goods that can have a new life thanks to the two maritime containers used to store them.

Moreover, a used goods store is well established in the shopping centre. This organization, only supplied by community donations, gives mainly a second life to clothes. Also, the grocery store uses a cardboard press to compact the cardboard generated by its operations into bales. Several ICI have also mentioned that they were giving their refundable containers.

The construction of the “screen wall” is a great example of ecodesign, where this type of screen is protecting the city against prevailing cold winds. This protective screen wall has been designed to allow the residents access to all the available services without used their vehicles and to avoid being exposed to strong northerly winds.

Finally, the group Info Fermont should be highlighted. This private group, which is available through the Facebook platform, is comprising more than 8,000 people. It is used to conveying information on what is happening in Fermont as well as to selling or giving away objects or second-hand materials (pallets, all-terrain vehicles, snowmobile, etc.) and to exchanging services (carpooling, childcare, etc.).

5.1.4 Inukjuak

Like all northern villages in Nunavik, Inukjuak is geographically isolated without any land access. At first sight, a strictly linear economy might be expected. However, some circularity has evolved in this community. As mentioned, these are mostly projects initiated by the Fédération des coopératives du Nouveau-Québec (FCNQ) and the KRG, as well as by certain ICI. Although shipping materials south comes at a significant cost, these organizations also have easy access to carriers since they import many containers of goods and are already renting these containers.

Construction materials, cardboard, pallets, refundable cans, tires, car batteries and HHW are then collected. Some companies also donate leftover building materials to the community.

Some construction contracts in Inukjuak contain a specific clause for residual materials management, which encourages the export of residual materials generated by construction. For example, contractors from southern Quebec operating in Inukjuak are required to bring their building materials with them and then take back the construction, renovation and demolition (CRD) waste generated by their work. Consequently, more CRD waste are sent to the southern part of the province, rather than in the Inukjuak NL.

Efforts to make alternative use of expiring food were also noted. In fact, groceries are trying to cook prepared meals for sale using this close-to-expiration food. Moreover, foods are sometimes given to the community when their expiration date is close.

In addition, the FCNQ gives cardboard boxes from their imported goods to their customers to pack their groceries in. The hotel has also implemented smaller-scale actions, including reusing hotel towels as cleaning rags and donating old sheets to the sewing centre. In addition, a portion of Northern's perishable food is distributed in the community when it no longer meets consumer safety standards. This helps reduce food waste.

As for the NL, residents sometimes explore this site for interesting materials for their own use that they call “Canadian Tire”. Along the same lines, the Inukjuak Buy, Sell, Trade or Swap Facebook group is a marketplace for community members to sell, trade or donate certain materials. About 15 notices are posted every day.

5.1.5 Longue-Pointe-de-Mingan

The study revealed that Longue-Pointe-de-Mingan’s economy is characterized by linear flows, which means that, at first sight, little action regarding circular economy would currently be in place.

However, during the visit carried out within the community, some existing circular economy initiatives have been identified. Among the latter, a pilot project has been launched for extracting crustacean residues from former disposal trenches specific to crustaceans and using this material rich in organic matter as a soil enricher during the revegetation of closed trenches in the TL.

Another example is at-source sorting of glass from other recyclable materials that were selectively collected, then enabling glass to be recycled in an effective manner from a specialized company and even generating earnings. The glass collected in Longue-Pointe-de-Mingan is then recirculated.

Also, some fruits and vegetables are locally produced – through a greenhouse built by the elementary school students and teachers as well as a cooperative with whom they are in partnership – and distributed or sold, to be then consumed within the community, reducing their import. Even though these fruits and vegetables represent small amounts, this action is implemented. Finally, during the site visit, Englobe noticed that food donations were made by businesses and restaurants.

5.1.6 Mistissini

The project results reveal that Mistissini’s economy is characterized by linear flows. Industrial symbiosis is difficult when there are no industrial or manufacturing activities.

However, some circular economy strategies, such as responsible consumption, process optimization or renting, have been identified during the visit of Englobe:

– Heavy equipment renting services provided by some companies using these types of equipment in their main operations (e.g. construction and excavation company);
– Facebook groups called Mistissini Qc Buy, sell & everything else and MISTISSINI, BUY SELL & TRADE & COMMUNITY ANNOUNCEMENTS allowing community members to sell, trade or donate some materials (about 15 posts are published every day);
– Some small actions, such as heat recovery from refrigerators in a service station to heat the building;
– The decision by some companies to change their lighting system to use LED bulbs;
– An existing regulation banning the use of single-use bags in Mistissini.

Finally, Mistissini is the only community providing a collection service for organic matter whose treatment is done locally.

5.1.7 ArcelorMittal, Mont-Wright site

The study reveals that a lot of circularity is present within AMMW's operations, especially regarding the energy flow, with steam recirculation and heat exchangers. This is also the case for the water flow, where process water reuse greatly reduces the amounts of fresh water collected in the lake close to the mine.

Also, AMMW owns an infrastructure from which the City of Fermont benefits that is intended to landfill the residual materials It would thus be easy to see it as a linear management, but, on the contrary, the purpose of AMMW is rather to improve resource use. For example, the company has a cardboard press and manages metal residues and waste from the entire city of Fermont. Several tons of used tires are also recovered annually.

The challenge is still transportation to the southern part of the province. The company uses a train, but the site is designed to load bulk ore. The arrival destination, in Port-Cartier, is designed to unload the bulk. Transshipment of recyclable material bales then requires adjustments. Also, the rail has met its capacity limit.

5.2 Overall picture of identified circular economy solutions

Circular economy solutions are ideas of projects or initiatives that could be implemented within the communities as well as the mining company participating in the project. The ideas presented in this section could also apply within other northern communities. Throughout the project, a total of 105 different ideas divided into 175 circular economy solutions have been identified, of which several could apply to different communities. Several circular economy solutions could thus be applicable to other communities not participating in the study.

Most of these circular economy solutions identified are recycling and composting, responsible consumption and procurement, process optimization and recovery strategies.

On the contrary, there are less circular economy solutions regarding refurbishing, performance economy, as well as ecodesign strategies, due to the difficulties for communities to implement these to their situation.

Table 7 provides an overall picture of the circular economy solutions identified and presented throughout the project for the different project participants.

Table 7: Number of solutions presented for each circular economy strategy

	Strategy	Number of solutions presented in the study	Example of a circular economy solution
1	Ecodesign	11	Built environment planning: The construction of new commercial, institutional, or residential buildings must consider specific designs to reflect regional climates. In this context, an appropriate built environment planning could reduce supplemental energy needs, such as generators, thus reducing the generation of greenhouse gas (GHG) emissions.
2	Responsible consumption and procurement	19	Electrification of vehicles: When replacing its current fleet of vehicles, municipal authorities could prioritize the purchase of electric vehicles (substituting gasoline or diesel vehicles for electric vehicles).
3	Process optimization	19	Support services for ICI to optimize their operations: ICI could be guided by a specialist to determine whether their operations could be optimized as well as performing energy assessments based on ISO 5001 principles.
4	Sharing economy	15	Sharing of storage space: Identify vacant land available for outdoor storage as well as other spaces for indoor storage while ensuring the security of goods.
5	Short term renting	12	Rental of housing, furniture and household appliances: In the context of temporary workers, the implementation of a business model designed to establish agreements for trailers, furniture and household appliances, during the temporary leasing/rental of homes.
6	Maintenance and repair	15	Repair activities and sewing classes: Organize events where volunteers offer their services to repair various items (including clothes) could be organized. This would be an opportunity to not only extend the useful lives of residents' appliances and devices but also to energize the community.
7	Donating and reselling	14	Creation of a used goods store and web platform: A used goods store would allow the recirculation of objects and material initially destined to be landfilled.
8	Refurbishing	8	Refurbishing of household appliances and small electrical devices: Setting up a repair and refurbishing project of household appliances and small electrical devices.
9	Performance economy	9	Performance economy consortium (Économie de la fonctionnalité et de la cooperation au Québec [EFC Québec]): In 2021, EFC Québec created a consortium composed of 20 companies to support them in replacing sale of products by value of use. The results of this pilot project that will be completed in spring 2023, should be analyzed to inspire the community.
10	Industrial ecology	15	Implementation of an industrial symbiosis: Organize a networking workshop with ICI followed by some coaching so that potential synergies with ICI can be achieved. Potential inter-ICI exchanges of materials (industrial ecology strategy) could be identified.
11	Recycling and composting	21	Collection and processing organic matter: Implementing an organic matter collection is a global initiative that must include solutions for processing and recovery of the output. This type of project is usually established at the level of RMC. This action must be accompanied by the development of an organic matter processing facility.
12	Recovery	18	Wood, ashes and municipal biosolids recovery: Important quantities of deconstruction wood are currently landfilled or stocked. This represents a recovery potential. Furthermore, the ashes and municipal biosolids lend themselves well with an industrial ecology approach.

Table 8 presents all the circular economy solutions suggested to each participant based on their leading strategy. The table also includes the number of circular economy solutions suggested to each participant. For further details about the circular economy solutions suggested, reader must refer to the customized report of each participant.

Table 8: Circular economy solutions

Circular economy solutions	Participants						
	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe	Mistissini	ArcelorMittal
Ecodesign							
Review of the drinking water supply network	x						
Built environment renovation	x						
Mine tailings storage							x
Use of iron as fuel							x
Built environment planning		x	x	x	x	x	x
Use of ecodesign extraction equipment							x
Responsible consumption and procurement							
Electrification of municipal vehicles	x	x		x	x	x	
Electrification of municipal vehicles and transportation of workers			x				
Electrification of vehicles							x
Renewable energy fuel supply					x		
Building wood and pallets responsible consumption			x				
Implementation of sustainable procurement criteria for the Mistissini ICI						x	
Responsible purchasing of consumption products		x		x			
Processing plastics				x			
Eliminating the use of single-use shopping bags				x			
Responsible water consumption			x				
Optimizing use of resources							x
Reduction in packaging		x		x			
Process optimization							
Support services for ICI to optimize their operations	x	x	x	x	x	x	
Improving energy efficiency				x			x
Improving energy efficiency and wall insulation			x				
Optimizing the residual material landfill			x				
Optimizing residual materials management				x			
Implementation of a deconstruction permit	x		x				
Weigh scale installation							x
Industrial processes modularity							x
Replacing trucks with conveyors							x
Technological developments to optimize operations							x
Reducing water consumption				x			
Reducing food waste				x			
Modifying the transportation barge		x					

Circular economy solutions	Participants						
	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe	Mistissini	ArcelorMittal
Sharing economy							
Sharing of storage space	x	x	x	x			x
Sharing of storage spaces and equipment					x	x	
Sharing cardboard press and other equipment			x				
Sharing equipment to collect cardboard				x	x		
Developing equipment sharing agreements							x
Sharing of the railway track for recyclable material transportation south of the province			x				x
Developing an inventory system for pieces of equipment							x
Carpooling or shuttle to Chibougamau						x	
Short term renting							
Rental of furniture and household appliances			x	x	x	x	
Woodchipper rental			x		x		
Implementation of a list for the rental services offered by companies						x	
Goods rental for temporary workers							x
Rental of housing, furniture, and household appliances	x						
Renting tools through a tool library				x			
Renting equipment used by ICI				x			
Rental planning of strategic equipment		x					
Maintenance and repair							
Repair activities	x		x	x	x	x	
Repair activities and workshops		x					
Improving services offered by the village mechanic workshop				x			
Preventive maintenance of municipal vehicles				x			
Maintenance and repair of equipment							x
Maintenance and renovation of buildings				x			
Preventive maintenance of buildings							x
Offer the population sewing courses	x	x	x		x		
Donating and reselling							
Reusing equipment operated by third parties in Inukjuak				x			
Creation of a used goods store	x	x		x	x	x	
Implementation of a community refrigerator project						x	
Creating of a donating and reselling web platform	x	x			x		x
Circuit allowing reuse of wooden pallets			x		x		x
Refurbishing							
Refurbishing of household appliances and small electrical devices	x			x	x	x	x
Refurbishing of electronics (student implication)		x				x	
Refurbishing and reselling centre			x				

Circular economy solutions	Participants						
	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe	Mistissini	ArcelorMittal
Performance economy							
Performance economy consortium (EFC Québec)	x	x	x	x	x	x	
Obtaining tire changing service based on usage	x						x
Household appliances and furniture subscription system							x
Industrial ecology							
Networking workshops	x	x					
Search for critical minerals outlets							x
Atmospheric carbon sequestration							x
Search for mine tailing and road infrastructure outlets							x
Search for ash outlets	x						
Use of outputs generated by the village				x			
Implementation of an industrial symbiosis			x	x	x	x	x
Search for marine residue outlets		x			x		
Evaluate recovery and network possibilities with tailing sites			x				
Recycling and composting							
Collection and processing organic matter	x	x	x	x	x		
Collaborating for the implementation of the collection and processing of organic matter							x
Organic matter management improvement						x	
Setting up an ecocentre				x			
Improvements to the ecocentre						x	
Collection of refundable containers						x	
Developing communication tools for glass collection					x		
Collection and recycling ropes		x			x		
Collecting metals		x					
Collection and exporting metals				x			
Optimizing deposit-refund and selective collection systems		x					
Improving selective collection							x
Recyclable material collection			x				
Modernizing of selective collection				x			
Studies on the feasibility of collecting certain materials				x			
Recycling wood				x			
Recovery							
Aggregates recovery	x				x		
Used aggregate recovery						x	
Ash recovery	x	x			x		
Wood energy recovery	x		x				
Wooden pallet recovery							x
Municipal biosolids recovery			x	x	x	x	
Biosolids recovery							x

Circular economy solutions	Participants						
	Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe	Mistissini	ArcelorMittal
Clean wood recovery					x	x	
Cardboard recovery		x					
Energy recovery				x			
Total	**20**	**22**	**24**	**34**	**24**	**21**	**31**

5.3 Prevailing circular economy solutions

Among the 175 circular economy solutions suggested to participants, Englobe considers that some circularity elements are prevailing due to their importance on one or many sustainable development pillars (social, economic and environmental). The following sections bring together, under different themes, circular economy solutions that could have positive impacts for the communities or the mining company when implemented.

5.3.1 Built environment

Some communities are experiencing population growth or ecotourism, which could require to develop new infrastructure. Built environment planning through the ecodesign strategy is crucial.

The construction of new houses could be based on ecodesign principles regarding material choice and energy supply. Proper built environment planning could result in better use of sustainable and energy-efficient materials, which would have positive impacts beyond the building envelope. Indeed, the more durable the materials used, the less the replacement materials imported, thereby reducing CRD waste as well as the impacts related to the transportation of these new materials.

But long before the construction stage, the design is also important and should prioritize buildings that could be adapted to future needs to prevent their obsolescence. These types of buildings could then be adapted over time, then preventing their obsolescence. Furthermore, the adaptation ability of these buildings simplifies their deconstruction at the end of their life as well as reuse of materials.

Building maintenance and renovation (maintenance and repair strategy) ensure their durability to avoid their deterioration and thus the early construction of new buildings. Also, building renovation should considers the regional climate implying extreme cold periods. These buildings could thus be better insulated then reducing heating needs and as well as GHG emission generation.

Furthermore, process optimization strategies could be used throughout both building construction and renovation, such as the addition of forced-air heating system and heat pumps. New heat pumps could now still run at temperatures down to -30 °C. It would be appropriate for industrial, commercial and institutional infrastructure to have an energy analysis based on the principles of ISO 50001 standard, which is intended to improve energy performance of any organizations, especially in identifying energy efficiency solutions.

Throughout building construction, maintenance and renovation, ecodesign strategies could be implemented for collecting and reusing materials in existing or new constructions. The communities should then promote stocking of the materials not used, then allowing them to be independent during renovation or maintenance work. When materials could not be reused, the companies in charge of the work should keep these residues when completed.

Construction and renovation permits issued by municipalities could include ecodesign requirements, such as energy efficiency requirements for new buildings, then ensuring a built environment design meeting the specific requirements of northern communities. Permits could also require new infrastructure to be adaptable or CRD waste in good condition to be reused. Finally, regarding waste that could not be reused, it could be the contractor's responsibility to bring them to a collection and recovery site.

To encouraging construction while minimizing the amount of CRD waste generated, some municipalities could implement a renovation and construction tax credit together with "deconstruction permits". This solution could involve several strategies: process optimization for the management of the municipality, responsible procurement or donating and reselling. The purpose is that some of the materials removed during renovation work are still in good condition and could be reused. Basically, these permits are intended to encouraging citizens and contractors to promoting reuse by notably providing advice (e.g. information sessions) as well as financial (e.g. municipal tax reductions) and time incentives (permits obtained quickly).

5.3.2 Equipment and storage space sharing

Several ICI met within the communities indicated they have a lack of "standard" storage spaces to stock their equipment. For example, vacant and available land for outdoor storage as well as other spaces for indoor storage could be identified. The possibility of sharing these spaces so that several ICI might use them while ensuring the security of the goods of the individual ICI concerned should be examined. Spaces could be available for monthly and annually renting thus incorporating principles based on sharing economy and renting strategies.

In addition, equipment could also be shared between the ICI of a same community from a sharing economy strategy perspective. Large quantities of cardboard are generated by the ICI within the communities. The different retailers could share a cardboard press for the purpose of exporting cardboard to a recycler, then sharing investment and maintenance as well as intensifying the use of the equipment. Another equipment sharing example has been observed by Englobe's team. Indeed, the project revealed the presence of an organization having a refrigerated container not used at its full capacity. It would then be possible to share this equipment.

This whole initiative could be coordinated via a web platform to assign spaces.

Another interesting element related to the sharing economy strategy, especially in Fermont, is the railway owned by ArcelorMittal directly linking Fermont and Port-Cartier. This infrastructure is used for transporting ore concentrate to the pellet plant located in Port-Cartier. Since it is a private railway, only ArcelorMittal can decide whether it shares it or not the railway. In theory, a train could be used for transporting recyclable materials to a recycler. Nevertheless, transportation (wagons), loading and unloading equipment are made for transporting ore. Thus, if other types of materials are transported through it, some adjustments to equipment and operations would have to be done, such as using a wagon that could hold a container specific to these materials. This wagon could then be attached to the train when passing and managed by the municipality rather than AMMW.

Several companies having contracts within the communities import machinery for performing their operations. At the end of their project, rather than be returned in the south, the equipment could be sold within the community if it could be used by the latter, which is totally part of the donating and reselling strategy.

A parts and equipment inventory system could be implemented based on the sharing economy strategy, especially within the mining company. Most mining companies have their individual replacement parts and equipment, which could be replaced by a joint inventory that would be shared by several mining companies from the same region (Institut EDDEC, 2016).

However, companies having the same types of operations could refuse this strategy, just as ArcelorMittal in Fermont that has a competitor (iron deposit sector). From a global economy perspective, it is sometimes hard to implement shared economy strategies between two competitors within the same community.

An option could then be for a joint venture to providing parts and equipment to both companies. Replacement parts could be available and specialized equipment could temporarily be rented, thus avoiding top purchase it. This alternative is also part of renting as well as donating and reselling circular economy strategies.

5.3.3 Maintenance, repairing, donating, reselling and refurbishing

Maintenance and repair, donating and reselling as well as refurbishing strategies allow for some products and components to have their life extended. By using these, communities consume less products, then also reducing landfilling.

To this end, repairing workshops could be provided to citizens for extending the life of products. For example, these could be sewing, joinery and electronic products repairing learning workshops.

Also, it would be interesting to organize a local mobilizing event during which volunteers would repair different kinds of objects, thereby extending the life of the citizen's goods while being involved in citizen mobilization.

Developing a space where reusable items would be received, sorted and stored could be a great idea for promoting donating and reselling. Normally, a used goods store is divided into two areas. The first one is used for receiving, inspecting and sorting the objects donated. Sometimes, the objects in poor condition are refurbished (refurbishing strategy). The second area is more like a retail space used to sell reusable objects.

In the same idea, citizens could post publications on social networks concerning reusable objects they want to sell or give away, which is already seen in several northern communities.

Repairing and refurbishing could be done on specific objects, such as household appliances, small appliances and electronic products. Based on the products, this project could take place in an ecocentre, be related to a used goods store project or be offered by secondary school or post-secondary students. For example, refurbishing workshops for electronic products could be offered to secondary school students, who would receive a training to be able to extend the life of electronic materials of the students and staff's families as well as products used in school. When refurbishing would be impossible, parts in good condition could be removed to eventually reused them for repairing other appliances. It could also be interesting to creating an in-home repairing project.

5.3.4 Ecocentre

In a remote region, it is even more important for the ecocentre to be effective. The ecocentre, or waste treatment centre, is a place where materials are accumulating prior to their reuse, refurbishing or transportation to a place where recycling or recovery is done. As mentioned in Table 5, several communities participating in the project have an ecocentre. These could nonetheless be reviewed to improving their space organization or enhance services provided there, which is part of the recycling and composting strategy.

For example, the infrastructure could be improved for allowing all the materials currently covered by EPR to be collected by recognized management organizations (RMO). Furthermore, for avoiding materials to be accumulating on the site, communities could undertake the necessary steps with RMO for their ecocentre to become official collection points for all materials covered by EPR.

To become so, the communities will have to meet the storage requirements under regulations and the different RMO of EPR to ensure products are managed by them. Besides, storage methods of materials to be sent within several ecocentres could be optimized. Materials are often segregated, but these are sometimes directly placed on a permeable soil. Therefore, these are not protected against weather conditions and water may accumulate, for example, in containers.

Implementing good practices in ecocentres could then simplify sorting, improve storage areas as well as diverting more materials normally sent to landfills by collectors from the region or from Quebec. It would be necessary to provide ecocentre's users with good information to ensuring a great sorting at source.

For communities who have not yet developed this type of infrastructure, it is necessary to develop an ecocentre to minimally collect HHW, products from EPR as well as CRD waste. Such an ecocentre could even be organized using maritime containers, where only one employee or more could be required to manage it as well as manage HHW (compliant storage).

5.3.5 Search outlets for certain outputs

During the visits within the communities and the mining company, some materials identified were not collected or recovered. A research concerning the possible outlets to collecting or recovering these materials could be carried out, then reducing landfilling of residual materials and maybe the use of new resources. Some examples of materials related to different strategies (e.g. recycling and composting as well as recovery) have been identified.

Ashes are generated by biomass burning made by companies or the heating of residences. It would be interesting to choose a recovery strategy focusing on using these ashes for fields or forest environments rather than using calcium hydroxide or phosphate and potassium fertilizers since ashes have a significant agricultural value (Majeau et al., 2013). It should be noted that this type of recovery could not be done without having previously validated the process conformity with applicable regulations.

Mining extraction operations generate mine tailings. Tailings is actually a source rock not containing the type of ore sought, while mine tailings come from extraction and concentration operations of the ore sought. These types of releases could, however, have a certain value. The Quebec government issued in its *Québec Plan for the Development of Critical and Strategic Minerals 2020-2025* specific actions focusing on mine tailings research and development (actions 1.2.2, 2.2.2 and 3.1.3) (Government of Quebec, 2020), which include significant investments in research and technological development to give mine tailings a new life or develop new complete extraction technologies for critical minerals. It would then be important to analyze the different use or recovery opportunities regarding mine tailings based on their composition. To this end, it is necessary to have a deep knowledge about mine tailings' characteristics for their recovery strategy, which would lead to seizing arising recovery opportunities, such as the recurring work done on Route 389 linking Baie-Comeau to Fermont.

Communities carrying out fishing activities generate two types of used ropes, which are ropes for cages and ropes made of lead. These are currently landfilled. A new life could be given to ropes used within fishing activities by braiding them to make, for example, carpets. These solutions are then part of the recycling and composting strategy. In France, the organization Ecordage creates carpets and doormats using fishing ropes (Figure 15). Currently, there is no outlet for this type of project, but recovery projects are carried out with the Centre de recherche sur les milieux insulaires et maritimes (CERMIM). When preparing this report, there were no results made public concerning this project. The communities concerned could express their interest to the CERMIM to be part of this research program.

Figure 15: Examples of recycled rope carpets

For the communities in Inukjuak and Chevery, metal management is a major issue since it cannot be burnt, and the transportation costs associated with its export are high. Metal exportation requires local resources (human and financial resources) and the help of a partner having specialized equipment. There are companies specialized in it, however, the cost requires for exporting is higher than metal value. It would be possible to optimizing its temporary storage, then simplifying and optimizing its transportation. For examples, some metals could be compacted. The Cree village of Mistissini uses a hydraulic press to compact barrels on site. To have financial assistance for implementing such a project, the communities could search for a financial assistance program. This is part of the recycling and composting strategy.

Wood, in the form of transportation pallets, is an output for the communities and the mining company studied. There are several opportunities to give this material a new life, such as reuse, energy recovery, agricultural soil-enricher, bulking agent in the compost production. These different initiatives are part of the recycling and composting as well as recovery strategies. Potential outlets will be influenced by the available quantities, supply regularity, ground wood quality, etc. Each organization should thus analyze the best strategies to be implemented.

The examples presented show that the communities and the mining company could find outlets for generated materials. To add circularity regarding materials produced within a territory, an industrial symbiosis project could be developed in the regions, such as networking workshops for the project participants' ICI. Industrial ecology strategies, such as potential material exchanges between ICI, could be identified, then reducing the quantities of residual materials generated and the use of resources. A practical guide, outlining the steps for creating industrial symbiosis (industrial ecology), has been prepared by the Centre de transfert technologique en écologie industrielle (CTTÉI, 2013). This centre could help the communities in implementing industrial symbiosis.

5.3.6 Organic matter management

For reducing the quantity of materials to be landfilled, the communities could implement a service for the organic matter (e.g. food waste, green residues and biosolids) processing, which would be part of a

recycling and composting strategy. Finally, outlets should be found for the output produced, such as the revegetation of the TL, mining reclamation, a greenhouse project, distribution to citizens or any other recovery strategy.

Also, projects focusing on reducing food waste could be implemented using different circular economy strategies. A lack of human resources means that food waste reduction solutions are limited. However, several organizations in Quebec are specialized in implementing mechanisms to reduce food waste. Moreover, Nutrition North Canada (Government of Canada, 2022) funds the transportation of food to ensure food security in isolated communities. This federal agency would benefit from contributing to capacity-building to reduce food waste in northern communities. RECYC-QUÉBEC provided municipalities with an information kit comprising the tools necessary to make citizens aware and help them reducing food waste as part of the *Love Food Hate Waste* campaign (RECYC-QUÉBEC, 2023a).

5.3.7 Recyclable materials management

Modernization of selective collection and deposit systems (ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs [MELCCFP], 2023) is part of the recycling and composting strategies and is a great opportunity for northern communities. Éco Entreprises Québec is the DMO responsible for selective collection while the Quebec Beverage Container Recycling Association (QBCRA) is the DMO responsible for the beverage container deposit system. The changes that these two DMO have planned and will implement should enable the communities to reduce the volume of materials landfilled. However, the implementation of these in northern communities may take time. For example, the rollout of the recycling system for all northern villages is not scheduled until 2027. However, at least one northern village is expected to be served by 2025 (Government of Quebec, n.d.). The communities who does not have any recyclable material collection and refundable containers processes could thus contact these DMO to express their desire to benefit from these services.

6 Action plan

The action plan developed for each community presents circular economy strategies and opportunities that the community can implement. This action plan is based on the MFA, the residual materials characterization and the interviews with concerned organizations and partners. The plan consists of brief descriptions of each proposed action, the main steps for its implementation as well as the organizations and partners involved.

The feasibility of each action is then assessed using a timeline and a preliminary budget framework. The timelines are presented according to one or other of three timeframes:

- Short term: less than 2 years;
- Medium term: 2 to 5 years;
- Long term: more than 5 years.

Budget estimates are provided in terms of one or other of four financial ranges:

- $: less than $25,000;
- $$: $25,000 to $100,000;
- $$$: $100,000 to $1,000,000;
- $$$$: over $1,000,000.

The budget estimates are based on the team's knowledge and not on specific price quotes from potential suppliers. The estimates must therefore be used with some reservation regarding budgets that could be associated with the implementation of the actions.

Finally, the positive and negative elements for each action are presented though a SWOT (strengths, weaknesses, opportunities and threats) approach.

- Strengths correspond to the inherent strengths of the stakeholders involved in each strategy. This may include staff expertise, operational efficiency, low staff turnover, etc. Variables or situations over which stakeholders have some control are also considered;
- Weaknesses are the internal factors that reduce a given stakeholder's ability to achieve its goals. These weaknesses could include lack of expertise, lack of space or equipment, obsolete machinery, etc. Negative or unfavourable situations that stakeholders can address were also considered;
- Opportunities are external factors that enable organizations to grow and become more profitable. These may take the form of government support, regulatory requirements, etc.;
- Threats are external obstacles that must be overcome to implement the strategy. These obstacles may be a declining economy, labour shortages, lack of social acceptability, stringent regulations, etc.

To develop these action plans, Englobe has carefully analyzed some of the circular economy solutions identified throughout the project. These actions were selected to embrace a broad vision of each participant, considering specific regional characteristics while implying as many circular economy strategies as possible. Some of the actions may involve multiple solutions. However, even if every circular economy solution is not included in the action plan, the other solutions suggested in the previous section deserve to be analyzed in terms of the relevance of their implementation. The complete and specific action plans of all project participants are presented in Appendix B.

6.1 Actions and strategies suggested for participating communities

About half of the actions suggested are part of the recycling and composting, recovery as well as donating and reselling strategies.

These actions focus more on residual materials management. The study revealed that several participants were concerned or had problems regarding the operation as well as the lifetime of their landfill site. Recycling and composting, recovery as well as donating and reselling initiatives are the same as the 3 RV hierarchy principles, which would result in a reduction of the materials eliminated as well as a life extension of landfill sites.

The implementation of an industrial ecology where waste of one become the raw materials of others, requires a significant amount manufacturing activities and residues generated in sufficient quantities at a steady rate. This type of strategy seems difficult to implement in small communities of a few hundred inhabitants. Linkage activities have nonetheless been suggested to paint a portrait, have basic knowledge on the materials available and determine the circularity potential in the participating communities. For example, fishing activities generate significant quantities of ropes. Crustaceans processing plants generate organic matter. Forest activities generate biomass. As for mining extraction, it generates mine tailings that could contain other minerals. Linkage also enables a certain level of knowledge to be used as a basis to discuss future projects or initiatives.

Based on the specific situation of each community, the actions suggested have been classified into two categories, which are the actions that are priorities and the ones that are less priorities. One action similar to another could be classified as a priority, while being classified as a less priority in another.

Table 9 presents actions that have been classified as priorities as part of the project. Some actions were similar for several participants, such as food outlet research. Other actions meet a specific need within one or two communities, such as metal collection and exportation as well as recovery of aggregates.

Table 10 presents the suggested actions classified as less priorities.

Table 9: Actions suggested and classified as priorities

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal – Mont Wright site
Ecodesign **Process optimization**								
Upgrading freshwater distribution infrastructure as well as wastewater treatments	Planning and work require large investments (long term). Action that will allow optimizing and reduction of the water resource use.	X						
Responsible consumption and procurement **Donating and reselling** **Recycling and composting** **Recovery**								
Raising awareness among workers about personal equipment use	This objective would modify the employees work culture and change employees' behaviour to promote optimal resource use. Constant investments required by AMMW, but at a relatively low cost. A return on the investment is even a possibility.							X
Process optimization **Recycling and composting**								
Optimizing the ecocentre layout	Important investments required to restructure the physical storage space. Requires the establishment of material input and output management.						X	
Improving deposit-refund and selective collection management	Low cost action that could be quickly implemented by purchasing a hydraulic press for metal barrels, a cardboard press as well as a reverse vending machine for containers under the deposit-refund program..		X					
Process optimization								
Implementing a new landfill	Important investments that are necessary for the community. Requires studies and authorizations.			X	X			
Improving the transportation barge	Project that can take a certain amount of time before being implemented. High cost project implicating provincial government authorities.		X					
Sharing economy								
Evaluating the possibility of optimizing rail transport of recyclable materials	Transhipment installations in Fermont and Port-Cartier could be required. The technical feasibility of this transportation linked to the ore transportation needs to be validated.							X

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal – Mont Wright site
Short term rental								
Woodchipper rental	Action that can be quickly implemented. Requires wood segregation, the development of a storage space with MELCCFP authorizations. Fees must be negotiated with the equipment owner.			X		X		
Donating and reselling								
Creating a donating and reusing space	Action requiring volunteers. Generally inexpensive but may require storage capacity for certain objects as well as the reception logistics and inventory management.			X			X	
Industrial ecology								
Evaluate tailings and waste rock recovery potential	This action allows to picture the residues and mine tailings economic potential. Important investment that can be carried out by phases.							X
Industrial ecology Recovery								
Developing ash recovery outlets	Requires a physicochemical characterization. Medium investments that can, however, be carried out with multiple partners.	X						
Industrial ecology Other applicable circular economy strategies								
Supporting ICI in order to promote use of circular economy strategies including industrial ecology	Action that can require time and commitment to implement a support committee for organizations in the creation of symbiosis. Modest initial investments according to the project size. Funding available.	X				X		
Recycling and composting								
Collection and processing organic matter	Important investment that can be carried out in several phases. Requires multiple studies to request financing through the program for the treatment of organic matter through biomethanization and composting (PTOMBC). Realistic timeline to implement the project within three years.	X	X	X	X	X		
Cardboard collection	Action requiring medium commitment to implement the system, also requesting logistics at the level of transportation and sorting building. Allows progressive collection within the community.			X	X			

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal – Mont Wright site
Management of the products concerned by the EPR	Requires moderate investments since this action mainly consists of contacting the EPR and take steps in becoming an official drop off point.						X	
Collection and exporting metals	Requires important precise planning and operation logistics. Metal transportation costs may be expensive. Funding programs are available for these types of projects.		X	X				
Optimizing compost production	Little investment required since this action mainly consists of implementing procedures and protocols allowing to optimize compost quantities and quality. These actions can quickly be implemented at a low cost.						X	
Promoting source sorting of glass containers	Action that is simple to implement within the community's ICI to raise awareness among tourists and temporary workers.					X		
Recycling and composting Recovery								
Setting up an ecocentre	Action requiring important administration commitment. May be more or less expensive depending on the chosen infrastructure. Can be done through multiple phases. Ideal occasion to plan for a donation and reselling space.				X			
Development of new outlets for wood	Initial studies are quickly obtained and at a relatively low cost. Implementation requires more time, and at higher costs to recover and divert wood from the landfill.	X		X		X		
Recovery								
Recovery of used aggregates	Requires the physicochemical characterization of aggregates that could be available for recovery. Requires governmental authorizations.	X				X	X	
Compost recovery	Action with a simple implementation and at a relatively low cost.						X	
Defining wood recovery solutions	Action that can be quickly implemented. The fees must be negotiated with the equipment's owner.							X

Table 10: Actions suggested and classified as a lower priority

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal - site de Mont-Wright
Responsible consumption and procurement								
Replacing fossil fuelled municipal vehicles	The planning of this action varies according to the lifespan of municipal vehicles (according to their mileage). Significative investments depending on the type of vehicle that is to be replaced. Carry out a replacement plan based on the needs and usage of vehicles to support this action.			X		X		
Responsible consumption and procurement **Process optimization**								
Implementing a deconstruction system	Relatively simple to implement. Requires the commitment of many city departments as well as new employment. Possibility to pair this project with the used goods store and ecocentre. If paired with the used goods store action, the investment can be relatively high.	X						
Responsible consumption and procurement **Donating and reselling** **Recycling and composting** **Recovery**								
Developing wood recovery outlets	Initial studies are quickly obtained at a relatively low cost. Implementation requires significant amounts to recover and divert wood from landfills.	X		X		X	X	
Process optimization								
Reviewing the fresh water supply network	Important monetary investments, but the planning of this type of network is realistic and can be inspired by real Quebec examples (the case of Harrington Harbour). Responds to a public health problem.				X			

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal – site de Mont-Wright
Process optimization **Recycling and composting**								
Developing communication tools for organic matter collection	Action simple to implement. An awareness campaign has already been carried out in the past and can serve as a basis for new tools.						X	
Sharing economy								
Establishing storage spaces	This action may be expensive if it requires the construction of a new storage space. To validate its relevance, a pooling of all storage needs must be done within the ICI.		X					
Short term rental								
Woodchipping equipment rental	Action that can be quickly implemented. Requires wood segregation. ICI will need to put back into circulation pallets that are still usable before chipping them. A storage area will need to be planned out and authorized by the MELCCFP as well as the chipping activities. The fees are to be negotiated with the equipment manager.			X		X		
Donating and reselling								
Reusing equipment operated by third parties	Action that can be quickly implemented but requires the collaboration of temporary actors on the territory. The protocol is inexpensive, and the purchase of equipment must be negotiated with the owners. These purchases must be based on the community needs.				X			

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal - site de Mont-Wright
Donating and reselling Maintenance and repair Refurbishing								
Creating a used goods store and/or a donation and reselling web platform	Action requiring population participation (volunteering). Generally inexpensive, but can require object storage capacity. This action also requires reception logistics and inventory management. Important investments depending on the community ambitions.	X	X		X	X		
Performance economy								
Validating the use of a performance economy tire approach	Action requiring a change in the mining companies' business models. This action may allow handing over responsibilities to external suppliers. Studies to implement such an initiative may require an important investment.							X
Industrial ecology Recovery								
Validating the possibility of extending the steam network to other buildings and site sectors	Extending the steam network to other buildings will allow AMMW to reduce fossil fuel consumption. A study should, however, be carried out to evaluate the importance of required investments as well as long term cost reductions.							X
Industrial ecology Other applicable circular economy strategies								
Supporting ICI in order to promote use of circular economy strategies including industrial ecology	Action requiring a lot of time to implement initial low investments. The investments depend on the size of the projects. Funding available.			X				

Action description	Summary assessment of the investment and recommendations	Participating communities						
		Chapais	Chevery	Fermont	Inukjuak	Longue-Pointe-de-Mingan	Mistissini	ArcelorMittal - site de Mont-Wright
Recycling and composting								
Optimizing selective collection of recyclable materials	This action aims to standardize the selective collection for the mining company, including camps and offices. Financial investments may be important and the operation of such a system will cause recurrent exploitation fees.							X
Collection and exporting metals	Actions require a significant amount of efforts and material transportation planning. Many requests must be down with different organizations to facilitate the planning and associated costs. Direct impact on the reduction of scrap metal sent to the TL.				X			
Implementing organic matter collection and treatment	Important investment that can be carried out by phase and in pair with the City of Fermont. The organic matter collection of the mining companies should be included in the project in order to save money on the compost production. This compost could then be used by the mining company to revegetate.							X
Recovery								
Cardboard recovery	As a pilot project, this action has a relatively low cost. The production of cardboard logs could be carried out from soiled cardboard or cardboard of lower quality. This recovery will not replace wood in heat energy needs, but will possibly reduce pressure on the forest harvesting.		X					

7 Conclusion and recommendations

Circular economy initiatives in Quebec are becoming more numerous. Several completed projects show that communities can join forces to consume fewer resources and pool their tools and resources. Regional actors must collaborate to initiate and foster regional projects with the various ICI. For example, Synergie 138, a regional organization specialized in circular economy must be involved to support the implementation of circular economy initiatives in Côte-Nord.

Englobe recommends that a circular economy committee be set up within each municipality or company wishing to move in this direction. This committee should consist of stakeholders wishing to promote circular economy from a regional point of view. Municipal and regional public employees, citizens, private companies, non-profit organizations, economic organizations as well as environmental organizations could be part of this committee. Its purpose would be to provide a picture of local circularity and make recommendations to the council of the municipality or organization for identifying the priority actions. Then, based on the circular economy potential of each action, a subcommittee could be formed to implement these actions.

Existing funding programs may be a determining factor in selecting which actions to prioritize. In addition to funds, these programs can sometimes provide specialized resources to help the communities as well as the mining company implement projects. To learn more about the support and funding options available, the following government organizations and agencies can be contacted: the community futures development corporation (SADC) and the business development centre (CAE) of the region for federal funding as well as the central business development corporation (BDC), the Chamber of commerce or the local development centre of the region for provincial funding. As for the ministère de l'Économie, de l'Innovation et de l'Énergie (MEIE), it brings together economic development ecosystem players in each Quebec region (MEIE, 2023).

The purpose of this study was to carry out an MFA that would serve as the basis of an action plan to promote the circular economy in northern communities and a mining company. This report was prepared for the company ArcelorMittal (Mont-Wright site) as well as for the communities of Chapais, Chevery, Fermont, Inukjuak, Longue-Pointe-de-Mingan and Mistissini

Data collected for each project participant were used to identify inputs, outputs and stocks to then perform an MFA based on four main flows, which are energy, water, extracted materials and consumer products. Generally, the MFA of the northern communities and the mining company are characterized by linear flows, which means there are several implementation opportunities regarding circular economy solutions. Despite this observation, some communities already have actions in place, such as for water and energy circularity as well as industrial ecology.

The MFA information highlights circular economy solutions that can be implemented within the communities. From these solutions, several that have been classified into different circular economy strategies have been analyzed. Other actions could be raised and analyzed by the members of the communities and the mining company.

Circular economy actions would reduce the quantity of natural resource imports and thus the quantity of waste released into the environment. Implementation of these strategies would also maximize the use of resources available within the communities and the mining company.

Successfully transitioning from a linear economy to an increasingly circular economy will depend on the involvement of the members of the community. Major local challenges are due to the community's remoteness from urban centres. However, the possibility of reducing imports of products and energy through the actions proposed in this report could give the region a greater sense of belonging and reduce the impacts of residual materials burial landfill or the loss of the resources that are in high demand elsewhere in Quebec and the rest of Canada.

Implementation of a circular economy also increases the resilience of these communities, which, during supply disruptions, have developed mechanisms and reflexes to overcome a lack of resources.

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Appendix A
Circular economy examples

ENGLOBE

1 Circular Economy Examples

This appendix describes the 12 circular economy strategies. A definition and sample projects are included for each strategy. Several of the listed projects that may involve more than one strategy are still presented under only one strategy.

The examples below were initiated by organizations. The senior management of these organizations integrated circular economy strategies into their organization's business model. These initiatives can inspire other organizations to set up similar projects or integrate circular economy principles into ongoing projects.

Please consult the references below to learn about other circular economy projects in Quebec besides those described in this appendix. This list of references for projects that include circular economy principles is not exhaustive.

- RECYC-QUÉBEC, 2022a
- Esplanade Québec, 2022
- Québec circulaire, 2023
- Centre de transfert technologique en écologie industrielle, 2022
- Centre de transfert technologique en écologie industrielle, 2021
- Centre de transfert technologique en écologie industrielle, 2020
- Environnement Mauricie, 2022b

1.1 Ecodesign

Ecodesign involves integrating environmental aspects as early as possible in the design phase of products and services in order to minimize the environmental impacts of these products and services throughout their life cycle (RECYC-QUÉBEC, 2022a). Ecodesign is applicable to all economic sectors.

Planning projects to reduce CRD waste

CRD waste represents nearly 22% of the total materials disposed of in Quebec in 2021 (RECYC-QUÉBEC, 2023b). Resource extraction and landfill usage can be reduced by applying circular economy principles to the construction industry. At the project planning stage, materials with low environmental impact can be selected and can also be used for other purposes if a given project is redesigned or dismantled. Eco-design can also be applied to building renovation. In Hamilton, Ontario, a multi-unit residential building was retrofitted as a passive house and qualified for international passive house certification by the Passive House Institute (FCM, 2023). A passive house refers to the energy intensity required to maintain a pleasant environment. Passive house design involves certain features, namely, structure, spatial orientation, thermal insulation, and building sealing, all of which reduce GHG emissions from air conditioning.

Various Quebec organizations now train individuals or companies to implement ecological housing projects. For example, training topics include incorporating green heating methods, choosing green materials, and excavating in a responsible manner (ERA Solution, 2023). In this way, environmental protection can be integrated into home design.

Using recycled materials in the manufacture of skis

An analysis of the life cycle of Rossignol Group's alpine skis found that their components represented 60%–70% of the product's total environmental impact. This French company then redesigned its products to facilitate their end-of-life management. For example, the company designed its *Essential* skis to contain less material, include 34% recycled material and 39% biosourced material. The company also minimized the environmental impact of its packaging (Rossignol, 2022).

Using lighting fixtures that require less material and energy

Lumec, an outdoor lighting fixture manufacturer, designed an LED lighting fixture to replace traditional fixtures. The new model is lighter and smaller than the previous one, requiring 27% less material to manufacture and 35% less energy to use. In addition, 80% of the fixture can be recycled after dismantling (IDP, 2016).

1.2 Responsible consumption and procurement

Responsible consumption and procurement constitute a circular economy strategy that integrates sustainable development and social responsibility in the purchasing or acquisition of goods and services by consumers and private or public organizations (RECYC-QUÉBEC 2022a). This strategy reduces resource consumption and preserves ecosystems. It offers a goods and services procurement process that integrates environmental, social and economic considerations.

Reducing GHG emissions through regenerative agriculture

Prana Foods, an agri-food company, has partnered with a farmer in the Centre-du-Québec region to source organic pumpkins, grown according to regenerative agriculture principles (Prana Foods, n.d.). This production method produces several benefits such as higher soil carbon content (ICPA, 2019).

Free electric van use by users of the Joliette regional county municipality's ecocentre

The Joliette regional county municipality (RCM) lets its citizens borrow an electric van free of charge to transport residual materials to its ecocentre. The sole requirement is simply to contact the ecocentre to book the van. This initiative reduces not only GHG emissions in the RCM but also the costs associated with residual materials management. The environmental gains are huge, especially in relation to bulky household waste, which currently has a low recovery rate partly due to transportation challenges (MRC de Joliette, 2017).

Combating food waste with LOOP

LOOP Mission is a Quebec company that combats food waste by transforming rejected fruits, vegetables and other products from the food industry into juices, beers, gin, soap and more. To date, more than 15,000 tons of fruit and vegetables have been recovered and recycled, 12,000 tons of GHG emissions avoided, and 900,000,000 litres of water not consumed (LOOP Mission, 2023).

Electrification of mining vehicle fleets

Newmont Corporation (Goldcorp) built the first electric underground mine in Canada (Newmont Borden Mine, Ontario). Since the beginning of its operations in 2019, all vehicles and equipment used in the mine are battery-powered, then reducing about 7,000 tons of GHG emissions per year (Enviro Integration Strategies Inc. and MERG, 2021).

Battery-powered vehicles are also used in other Canadian mine, as it is the case for the Glencore project, an underground mine project called *Onaping Depth*. As part of the latter, Glencore chose to change its complete fleet of production support vehicles, such as mining, transportation and underground loading vehicles, for an electric one (MacLean Engineering & Marketing Co., 2022).

1.3 Process optimization

process optimization is a strategy that improves each of an organization's processes by seeking to reduce the consumption of energy, water and raw materials as well as the amount of waste generated (RECYC-QUÉBEC, 2022a).

Energy efficiency at the CISSS in Lanaudière

The CISSS in Lanaudière is an integrated health and social services centre that is committed to improving the energy efficiency of its buildings, namely, the Centre hospitalier régional de Lanaudière (CHRL) and 10 residential centres (ÉNERGÈRE, 2023a). The measures implemented include installing a geothermal system at the CHRL, which has resulted in significant savings due to reduced need for natural gas. The centre's energy bill has decreased by 35% and annual CO_2 emissions have dropped by 5,467 metric tons (ÉNERGÈRE, 2023a).

Redistributing heat at Harnois Énergies

In winter, the Harnois Énergies distribution centre in Saint-Thomas redistributes the heat produced by its machinery throughout its building to certain parts of the building; in summer, simply expels the heat. This approach reduces the company's heating costs and ecological footprint through lower natural gas consumption (Québec Circulaire, 2021a).

Modernizing the City of Shawinigan's streetlamps

In 2016, the City of Shawinigan collaborated with Énergère to upgrade 6,141 of its municipal streetlamps by using LED technology and a smart control system. The remote-control system facilitates network monitoring in various ways, such as modulating lighting intensity in real time, diagnosing failures and intervening as required. This smart lighting management system has resulted in energy and servicing savings and a reduction in GHG emissions (ÉNERGÈRE 2023b).

Storage of mine tailings for subsequent extraction based on technology development

Some Quebec companies implemented mine tailings practices that may subsequently allow mines to diversify their operations and be more resilient to metal price fluctuations, which is the case for the company Canadian Electrolytic Zinc Limited. The latter has a site dedicated to mine tailings containing zinc and other metals that could be interesting in the future based on the economy and technological developments (Institut EDDEC, 2016).

Use of a windmill at the Raglan mine

In 2014, a windmill was installed at Glencore’s Raglan mine for reducing the GHG emissions generated from its diesel fuel consumption. After 18 months, more than 3.4 million litres of diesel fuel and about 9,000 tons of GHG emissions were then avoided (Enviro Integration Strategies Inc. et MERG, 2021).

1.4 Sharing economy

Sharing economy is a set of exchanges among users that relies on shared use, collaborative production, and barter. Preference is given to the temporary pooling of resources or the permanent redistribution of goods with or without compensation (RECYC-QUÉBEC, 2022a).

The emergence of numerous networking or e-commerce platforms has facilitated and multiplied financial transactions between individuals. Carpooling and short-term accommodation for a fee are exchanges fall into this category.

These are just two of many forms of the sharing economy. Some other sharing economy examples are described in this appendix.

Maski Récolte, a harvest gleaning project

The aim of Maski Récolte, a project set up in the Maskinongé RCM in 2018, is to organize people to glean post-harvest residue in the fields of participating farms. These gleanings are then equally divided among the RCM's gleaners, producers, institutions and community organizations. This prevents the waste of certain crops that would otherwise be abandoned in the field (Maski Récolte, 2023). This project has inspired other similar projects. For example, the Des Chenaux organization has drawn on the experience of the Maskinongé RCM to collect food in the neighbouring Des Chenaux RCM.

La Petite Expé (Le Grand défi Pierre-Lavoie)

La Petite Expé, an initiative spearheaded by Le Grand défi Pierre-Lavoie (a fundraising initiative based on cycling), encourages partner cross-country ski centres to lend ski equipment for free to all children under 12 years old. Thanks for this initiative, ski equipment is made accessible to all elementary schools in Quebec during the week and on weekends so that children can enjoy this sport with their families (Cubes Énergies, 2023). This initiative encourages the sharing of sports equipment among communities and maximizes their use.

Le Partage Club

Le Partage Club [The Sharing Club] is a mobile app in Quebec that facilitates the unlimited sharing of items among neighbours. It encourages people to borrow before buying (thus limiting consumption); it also promotes the reuse of items and reduces waste. The app offers multiple categories of goods, shares information about people's needs, reinforces neighbourly trust, and provides a borrowing management calendar (Le Partage Club, 2023).

Nemaska Lithium and sharing economy

The Whabouchi lithium mine, a Nemaska Lithium project located in the Eeyou Istchee territory in northern Quebec, will normally start its operations by 2025. For its operations, the company wishes to implement several sharing economy projects. The mining company first wants recyclable materials to be co-managed with the Cree community of Nemaska. Moreover, it wishes to implement an industrial laundry service project within this Cree community (Québec Mining Association, 2020).

1.5 Short term renting

Short term renting is the use of goods or services for a fee within a defined framework (RECYC-QUÉBEC, 2022a). Renting facilitates the optimal use of products by increasing their usage frequency. When owners rent physical property; usage of the property is maximized by having several renters. As the following examples demonstrate, rental can involve both goods and workspaces.

La Remise, a tool library

A model like La Remise [The Shed], an initiative of the Villeray citizens' collective could be implemented in other communities (La Remise, 2022). Its primary aim is to share knowledge, workspaces and useful equipment by discouraging overconsumption. For example, it lets its members borrow commonly used items as well as workspaces (e.g., a woodworking shop or a sewing space). La Remise also offers training and promotes intergenerational and intercultural exchange. Its catalogue of available items includes tools for woodworking, horticulture, cooking, gardening and so on. The borrowing principle is the same as at a library. Members can borrow up to 12 tools at a time for a period of seven days. Membership simply requires a monthly or annual subscription (La Remise, 2022). This initiative combats overconsumption and maximizes the use of resources. It is both a short term renting strategy and a sharing economy strategy.

A Quebec rental platform

The Circule platform is a Quebec-based web app for renting and sharing geolocated objects among individuals and professionals. This promotes environmentally responsible solutions by encouraging local consumption, less waste (and packaging), and less travel (Circule, 2023). This leads to a better use of resources and maximizes use of the rented items.

UniverCyclo, bike rentals at the Université de Montréal

UniverCyclo is a long-term bike rental service for international students at the Université de Montréal. For the students, this service is an alternative to buying a bike that would only be used for a few months. Abandoned bicycles found on campus are recovered, repaired and then rented to students (Université de Montréal, 2022). This project reuses bikes that would otherwise be thrown away and avoids buying one that would only be used temporarily.

Toromont Cat

Along with selling new and used heavy equipment, Toromont Cat (formerly Hewitt Equipment Limited) also implemented a heavy equipment rental service allowing their clients to rent more than 500 machines and 1,300 work tools. It is then possible for companies requiring machines or tools in the short or medium term to benefit from the company’s services (Institut EDDEC, 2016).

1.6 Maintenance and repair

A maintenance and repair strategy keeps objects in good condition in order to extend their useful life (RECYC-QUÉBEC, 2022a). This strategy can be implemented by either item owners or specialized organizations. Many such initiatives and opportunities can easily be integrated within ICI and the general population.

Repair café and getting together

In recent years, many community-based repair initiatives have been set up across the province. These include initiatives like Maski s'répare set up by the Comité citoyen carboneutre [Carbon-neutral citizens' committee] in the Maskinongé RCM where residents in a particular district combat overconsumption by getting together from time to time to repair their everyday items (Carboneutralité de la MRC de Maskinongé, n.d.). Repair cafes are another similar initiative. La Patente in Quebec City is one such example. It is a regular weekly workshop that connects repair experts with people who want to have their broken items repaired (Atelier La Patente, 2023).

"La couturière volante" [Flying seamstress]

"La couturière volante" is a mobile sewing service in the Matane region that repairs clothing onsite for various clients such as thrift stores as well as for the general population. The seamstress travels to different municipalities in the region to offer her services. This initiative aims not only to repair clothing, but also create new products from recovered fabrics and offer sewing training to develop this skill in the local population (Québec circulaire, 2022a).

Fingz repair company (France)

Fingz is an online platform in France that combats overconsumption by connecting consumers with artisans who can repair items and extend their useful lives. People submit their repair requests by simply registering on the website. The system then recommends repairers and suggests appointment times (Fingz, 2023).

Toromont Cat

As part of the heavy equipment maintenance and repair contract, the company Toromont Cat provides an optional preventive maintenance service (Toromont Industries Limited, 2023) preventing unplanned downtime.

1.7 Donating and reselling

The donating and reselling strategy involves putting used goods back into circulation by donating or selling them to a third party (RECYC-QUÉBEC, 2022a). This strategy thus extends the useful life of products that are no longer needed by their owners but are still in good condition by putting them back into circulation. This form of circular economy is widespread in Quebec.

Éco-Réno

Éco-Réno is a Montreal social economy enterprise that specializes in the recovery and resale of new and used materials, as well as old architectural fixtures like wood, windows, doors, bathtubs, sinks, lamps, etc. Besides operating a storefront, the enterprise's services include picking up donations and transporting materials. They also offer a consulting service on projects to dismantle or reuse materials (Éco-Réno, 2023).

Community fridges

To combat food waste and encourage generosity and social solidarity, hundreds of community fridges are now available throughout Quebec. People simply leave freshly prepared food or meals in these fridges (Radio-Canada, 2022a). A directory of community fridges in Quebec is available on the Sauve ta bouffe website (Sauve ta bouffe, 2020).

Donation of electronic products

Several mines in Quebec donate electronic products to non-profit organizations, school boards, food banks or libraries, for example, as it is the case for Agnico Eagle Mines, Eldorado Gold and Glencore. Sometimes, items are refurbished or remain as they are prior to being donated (QMA, 2020).

Donation to schools

Arjo Magog is a medical equipment manufacturing company that used to have stocks of discontinued parts. Since this equipment was no longer available on the market due to safety considerations, the company donated some of it for educational purposes to the Sherbrooke CEGEP (a general and vocational college) and the Université de Sherbrooke (Québec Circulaire, 2021b). Niobec, a mining company, donated four mining vehicles to a heavy vehicle training centre. Moreover, their used parts are all donated to this training centre (AMQ, 2020).

1.8 Refurbishing

A refurbishing strategy involves restoring objects for resale (RECYC-QUÉBEC 2022a). This strategy extends the useful life of products. Items can be refurbished at both the municipal and ICI levels through projects like Réemploi+.

Le Vélo Vert

Le Vélo Vert [Green Bike] is a Quebec City-based company that recovers used bicycles for future use. More than 2,000 bicycles are recovered each year and then resold in the company's store. Bikes can be donated directly to the store or through a seasonal home collection service. To encourage buyers to

return their old bikes, Le Vélo Vert offers a 15% discount on the purchase of a new bike (Le Vélo Vert, 2023).

Insertech

Insertech extends the useful life of computers by repairing, refurbishing and reselling them. The company trains unemployed young adults to refurbish computer equipment. In this way, it combats overconsumption, obsolescence and resource wastage, and participates in the social reintegration of young adults in difficulty (Insertech, 2022).

Réemploi+

Réemploi+ is a social economy enterprise that reuses residual materials from the ecocentre network in the Lac-Saint-Jean census metropolitan area (CMA) by diverting them from the landfill. A drop-off area at each ecocentre has been designated for donated items. These items are then sold either 'as is' in R+ hardware stores or reclaimed in R+ workshops before being resold (Réemploi+, 2022a, 2022b). In 2022, the Lac-Saint-Jean CMA won a 2022 FCM sustainable community award in the residual materials category for its Réemploi+ project (FCM, 2023).

Piscines et Spas Poséidon

Piscines et Spas Poséidon is a spa and swimming pool business that installs, opens, repairs, decommissions and closes both residential and commercial spas and pools (CPQ, CPEQ, EEQ, 2018). The company sells new spas, and also retrofits and refurbishes spas between 4 and 8 years old to extend their useful life (Piscine et Spa Poséidon, 2023).

Cat Reman's refurbishing service

The company Caterpillar provides refurbishing services through its brand Cat Reman. The company then clean and inspect end-of-life product, to then refurbished them. Clients exchange their end-of-life equipment/products (e.g. an equipment part) for a credit. More than 57,000 tons of end-of-life equipment have been collected in 2021 (Institut EDDEC, 2016).

1.9 Performance economy

Performance economy is a circular economy strategy that extends the useful life of products based on company business models that prioritize sale of the use of the product rather than sale of the product itself. The focus is on the actual usage. Users buy the function, not the product (RECYC-QUÉBEC, 2022a). Since the emphasis is on the use of the product, consumers purchase a service rather than a good.

Xerox

Xerox developed a system for renting photocopiers to businesses. This system avoids the need for each company to purchase its own photocopiers. Instead, Xerox manages the use of all its photocopiers. In this way, it retains ownership of the equipment and directly manages their life cycle. This approach also supports the development of recycling techniques and makes it easier to retrofit equipment (Chauveau, 2006).

Michelin

Michelin has stopped selling tires to heavy truck fleets. Their business strategy is now to retain ownership of these products while committing to service, inflate and repair the tires as required. Heavy truck customers no longer buy Michelin tires, but instead pay for a package deal that takes into account the distances covered by the tires. With this approach, Michelin takes over the life cycle management of its tires. This approach has succeeded in extending the life cycle of Michelin heavy truck tires by up to 1 million km (Chauveau, 2006; Économie de fonctionnalité, 2010).

Retournzy

The Retournzy cooperative is a social economy enterprise that rents and distributes returnable food containers to the food services industry (restaurants, food trucks, food combats, etc.). The company collects, washes, sanitizes and redistributes clean containers. In this way, it reduces at-source waste in the event, corporate, institutional and food-service sectors (Retournzy, 2023, Québec Circulaire, 2020). With this business strategy, food service companies can offer ecological and sustainable alternatives to their customers.

1.10 Industrial ecology

Industrial ecology is a circular strategy that gives resources a new life by encouraging the inter-organizational exchange of materials, energy or resources. This strategy is defined as a network of companies and communities linked together by exchanges of materials (e.g., by-products), water or energy. These exchanges form synergies whereby the waste from one becomes the raw material for the other (RECYC-QUÉBEC, 2022a). For example, the output of one company could be used in the production process of another. Industrial ecology in terms of linkages among different ICI is becoming increasingly popular these days.

Recycling 18-litre plastic bottles for use in fields

La Hutte is a cooperative currently working on a synergy project with Onibi, a company that produces still and carbonated water in a variety of flavours. The co-op wants to reuse 18-litre bottles of Onibi drinks that are currently sent for recycling. The co-op intends to conduct trials on using these bottles as growing containers for field tomatoes (Québec Circulaire, 2022b).

The City of Quebec reclaims some of its concrete

The City of Quebec wanted to reclaim the concrete from its ecocentres as part of its Vision 2018-2028. However, the recovery of this concrete through traditional channels was more complex due to the heterogeneous nature of the concrete and the presence of contaminants. The city therefore turned to its internal market to develop a value-added product for its own needs. The concrete from its ecocentres was thus crushed to remove contaminants and then used to construct a snow dump embankment (CTTEI, 2021).

SIMAX, a manufacturer of urban furniture

SIMAX uses recycled polystyrene to manufacture a range of urban furniture. In practice, this approach results in a relatively solid product. SIMAX obtains its raw material from Éco-Captation, a company that recovers polystyrene from ecocentres (Chaumont, 2022). SIMAX products can thus contain up to 70% recycled polystyrene and glass. Moreover, the company can crush its products at the end of their lifecycle and reintegrate the material directly into their manufacturing process (SIMAX, 2021; Chaumont, 2022).

Treatment of lithium sulphate releases from the Johnson Matthey plant

Nemaska Lithium carries out the treatment of lithium sulfate from the Johnson Matthey Battery Materials (JMBM) plant located in Candiac for producing lithium hydroxide. The plant then has its releases stocked in an effective manner and allows lithium hydroxide procurement at a competitive price with Nemaska Lithium compared to Asian companies (QMA, 2020).

Synergies created by Metal Tech Alley (British Columbia)

As part of the movement initiated by Metal Tech Alley, various ICI as well as research centres occasionally meet for identifying potential business opportunities from a circular economy perspective. It started when the mining company Teck was looking for solutions for recovering 35 materials identified within their releases. Metal Tech Alley's initiative connected digital and metal manufacturing companies in addition to creating business opportunities for recycling, circularity, innovation and other as well as

addressing various problems within the mine tailings recovery sector (Enviro Integration Strategies Inc. and MERG, 2021).

1.11 Recycling and composting

Recycling and composting extend the life of resources. Recycling is defined as the use of recovered materials to replace raw materials in manufacturing processes. Composting is defined as a biological treatment process that uses aerobic microorganisms to biodegrade organic matter (RECYC-QUÉBEC, 2022a).

Modix Plastique

Modix Plastique is a company that recovers plastic film by transforming it into LDPE (low density polyethylene) resins. The plastic film come from various sorting centres in Quebec and other parts of North America. The resins produced are then sent to various plastic product manufacturers. This reduces the need for raw materials and extends the life of plastic film (Québec Circulaire, 2022c).

Glass recycling with Groupe Bellemare

Groupe Bellemare, a Quebec company based in Trois-Rivières, recycles tons of glass every year. By grinding the glass into different sizes, the company creates a range of by-products. These include material for sandblasting, swimming pool filtration, and decorative flower bed mulch. When ground into glass powder, this material can also be added into various processes for making concrete, fibreglass, insulation wool, and cellular glass (Rochette, 2022).

Mandatory composting for 30 ICI in Drummondville

In 2018, the City of Drummondville required 33 large generators of organic materials to join its municipal residual materials collection system. The other ICI in the city were given the option of joining voluntarily. This initiative has supported the ICI in a rapid shift towards managing their organic materials, while also improving the City's residual materials management performance (Ville de Drummondville, 2018; Phare Climat, n.d.-a).

Centre de valorisation du bois urbain

The Centre de valorisation du bois urbain [Urban wood recovery centre] in Montérégie is a social economy enterprise that extends the life of urban wood. For example, in recent years many ash trees across Quebec have had to be cut down due to infestation by emerald ash borer. As an alternative to disposing of these trees in a landfill, the wood can be processed to make paper, lumber, or hardwood flooring (CVBU, 2020).

Use of mine tailings as aggregates

Les Minéraux Harsco, a company located in Contrecœur, recovers mine tailings. Indeed, the company markets aggregates so that they are integrated in structures as construction materials (e.g. in road infrastructure) (Institut EDDEC, 2016).

1.12 Recovery

Recovery is the ultimate strategy to prevent residual materials from ending up in the NL. Recovery is defined as any non-disposal operation that aims to obtain useful products or energy from residual materials (RECYC-QUÉBEC, 2022a).

Spreading crab shells on fields in the Magdalen Islands

The CERMIM (Centre de recherche sur les milieux insulaires et maritimes) a Centre for research on island and marine environments has launched a project to reuse marine residual materials from processing plants

in the Magdalen Islands. Marine shells fresh from the processing plants are now used by local farmers as a source of amendments and lime for spreading on their fields. Although not all marine residual materials are reclaimed in this way, CERMIM is trying to create a product that can be stored for longer before being used on fields (Radio-Canada, 2022b).

Reclaiming biosolids from wastewater treatment in Repentigny

The City of Repentigny's water resource recovery plant (StaRRE) recovers all the biosolids from its wastewater treatment. This sludge is sent to biomethanization centres for digestion and then to rotary presses for dehydration in order to obtain a class B organic amendment. This amendment is then used on farmland in Lanaudière (Phare Climat, n.d.-b).

Energy recovery from biomass

Biomass-fueled heating networks are becoming increasingly common in Quebec. In 2012, for example, the City of Causapscal in the Lower St. Lawrence region installed a biomass system to heat seven buildings (including the city hall, the arena and the community hall) via a network of underground pipes. This innovation generated the city annual savings of 72,000 litres of fuel oil and 47,000 litres of propane. In addition to heating the seven buildings, the municipality also sells this biomass energy to a church and a nearby elementary school (Vision Biomasse Québec, 2022).

Several Quebec companies have also opted for this heat source. For example, hog farmer Les Viandes biologiques de Charlevoix turned to biomass as a heat source when their hog barn burned down in 2017 (Radio-Canada, 2017). The company now uses biomass supplied by the Groupe Lebel sawmill in Saint-Hilarion, located a few kilometres away. This change was made possible with financial assistance from Transition énergétique Québec (TEQ). It has been estimated that the cost of this biomass system will pay for itself in less than five years (Radio-Canada, 2020).

Recovery of mine tailings as construction materials – Example of Vale, Brazil

Vale recovers its mine tailings for manufacturing construction materials as structural concrete blocks, chains, sealing blocks and layered floor. Based on its experience, about 30,000 tons of mine tailings have been manufactured (Vale, 2020; Enviro Integration Strategies Inc. and MERG, 2021).

Heat recovery in mines

The Lamaque mine (Eldorado Gold Quebec) installed a closed-loop system at its ore processing plant. Some heat sources are then recovered through the loop for integrating heat into the air supply system. Another recovery example is Niobec, a company from Magris Resources, who uses heat generated from its aluminothermic process for heating the building comprising the converter during winter (QMA, 2020).

Appendix B
Action plan for each participant

ENGLOBE

Action plan for each participant

1 Chapais

1.1 Priority actions

Collection and processing organic matter		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Setting up the collection and processing of organic matter in the east of the Eeyou Istchee Baie-James territory as well as setting up a regional organic matter processing infrastructure (Chapais, Chibougamau and Oujé-Bougoumou).	
Implementation phases	– Conduct a feasibility study for setting up the collection and processing of organic matter (targeted customers, estimation of quantities, cost of collection and bins, collection modalities, comparative study in regards to processing in or out of the region, location and processing method selection, etc.); – Delegate jurisdictions for organic matter collection, transportation and processing; – If processing is done in the region, perform the steps allowing organic matter processing (select type of processing and location, request authorization, conception, construction, search for outlets, etc.); – Apply for a grant from the program for the treatment of organic matter through biomethanization and composting (PTMOBC) to treat organic matter and/or purchase recovery equipment (MELCCFP, 2022d); – Prepare tendering process for organic matter collection, transportation and if applicable, processing; – Select equipment and complete the tendering process for their purchase; – Modify regional organic matter management regulations; – Create IAE tools.	
Organizations and partners involved	– City of Chapais and Chibougamau; – Oujé-Bougoumou Cree Nation; – Eeyou Istchee James Bay Regional Government; – Regional citizens and businesses (including those from Chapais).	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Number of brown bins distributed; – Number of homes served; – Organic matter recovery rate (annual quantity recovered vs. quantity generated); – Quality of materials collected with respect to type of collection (% contaminated); – Quantity and quality of outputs produced (e.g. compost).
Strengths		**Weaknesses**
– Services desired by the population; – Redistribution of compost to the population; – Reduction in the quantity of residual materials eliminated at the engineered landfill;		– Reorganization of waste collection schedules and addition of organic matter collection; – Possible purchase of a new collection vehicle or involvement of a private partner; – Availability of workers and expertise;

Potential opportunities and levers regarding the strategy	Potential threats and obstacles to the strategy
– Output may be used to revegetate gravel quarry or abandoned sand pits; – Regulatory requirements to recover organic matter; – Amendments to the *Regulation respecting the charges payable for the disposal of residual materials;* – Funding available through the PTMOBC; – Reduction in GHG emissions; – Increase the lifespan of the engineered landfill; – The possibility of integrating septic sludge and biosolids (when the infrastructure will be in function), as well as wood chips as inputs; – Possible recovery of compost in a greenhouse project (in partnership with the school), greening degraded areas, etc.	– Low population density (long distances to travel and relatively low quantities to collect); – Risk of contamination by non-compostable materials (glass, plastic, etc.); – No authorized organic matter processing site in the immediate area; – High investment in machinery, facilities, transportation equipment, etc.; – Need to find one or more outlets for the output produced (e.g. compost).

Development of new outlets for wood		
Circular economy strategy	**Responsible consumption and procurement, donating and reselling, recycling and composting recovery**	
Brief description of the action	This action aims to divert wood (e.g. wooden pallets, wood received at the ecocentre) from elimination to reuse it (e.g. energy, composting input, mulch, pyrolysis, pellets, etc.).	
Implementation steps	– Characterize the wood sent to the EL and the ecocentre (type, quantity, quality, etc.) to get an accurate picture of the types of wood generated in Chapais and Chibougamau; – Evaluate the possibility of including wood generated in Chibougamau and Oujé-Bougoumou; – Analyze the different supply sources (the generators); – Describe current residue management based on generators; – Identify regulatory requirements; – Identify issues and constraints related to wood collection and recovery; – Identify the different recovery options for wood, such as heating, conversion of wood value-added products (pellets, pyrolysis oil, etc.), reuse of pallets, use of wood as an input for organic matter recovery, etc.; – Identify potential recovery actors in the region and the acceptability parameters and criteria for recovery (e.g. conditioning and necessary equipment); – Analyze advantages and disadvantages for the different recovery options; – Implementation of logistics for wood recovery (e.g. source recovery of wood, storage, if required, conditioning and transportation).	
Organizations and partners involved	– Cities of Chapais and Chibougamau; – Cree Nation of Oujé-Bougoumou; – Eeyou Istchee James Bay regional government; – Chapais Énergie; – Generators, conditioners and recovery actors; – Major energy consumers.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$-$$$$	– Quantity of wood diverted from the landfill; – Wood recovery rate; – Number of stakeholders involved.
Strengths		**Weaknesses**
– Wood available in large quantities in the region; – Presence of non-contaminated wood users (as combustible); – Potential input as a structuring agent for composting; – Stimulation of the regional economy.		– Variable wood quality subject to changes; – Requires creating a storage and conditioning space; – Lack of expertise on the generators outside Chapais and on potential recovery actors.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Regulatory obligations to be established (e.g. prohibit sending wood to the landfill, prohibit repairs of fuel furnaces, etc.); – Possibility of energy transition and development opportunities of renewable energy systems with financing support (e.g. programs from Transition énergétique Québec (TEQ), such as *ÉcoPerformance* [MELCCFP, 2023b] and *Bioénergies* [MELCCFP, 2023c] as well as the *Programme d'aménagement durable des forêts* [ministère des Forêts, de la Faune et des Parcs; MFFP], 2021); – Life extension of the EL.		– Little control over procurement; – Ministerial authorization required for storage and conditioning; – Development of a market nearby to dispose of collected and conditioned wood; – Potential investments necessary from recovery; – High transportation costs; – Lack of knowledge for companies on the possibility to recover wood in their operations.

<table>
<tr><th colspan="3">Developing ash recovery outlets</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Industrial ecology and recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">The physicochemical characterization of ash aims to understand the detailed physical composition of this combustion residue. The characterization should aim fly ash and fireplace ash. This analysis should minimally address the availability of nutritive elements (nitrogen, phosphor, potassium, calcium, magnesium, etc.) and maximum levels of heavy metals (for example, cadmium, chrome, copper, lead, arsenic).
According to the obtained results, studies for recovery/reusing projects should be undertaken, to know for example, if the ash has potential to be reused in the framework of agricultural or forestry projects, if the materials can serve in the production of fertilizers, compost, or organic amendments, and if the ash can be incorporated in industrial activities such as concrete production for road maintenance.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Proceed to sampling and sending out the samples to an accredited lab:
  – Establish a sampling method for the ashes (number of samples, parameters, protocols, etc.) to understand the recovery potential of the residue;
  – Contact specialized industrial ecology resources;
  – Proceed to the results analysis and establish recovery potential in collaboration with specialized industrial ecology resources.
– According to the characterization results, produce a list of possible recovery options;
– Carry out studies on similar projects around the world and determine analysis parameters that should be privileged.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Chapais Énergie;
– Accredited laboratory;
– Organizations such as CTTÉI, the Centre de recherche industrielle du Québec (CRIQ) or the INNOSPHÈRE.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td>– Number of samples;
– Number of analysis.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Ashes are available in large quantities;
– Railway available for material transportation;
– Specialized industrial ecology Quebec organizations.</td><td>– Geographic remoteness and isolation of Chapais (in comparison with major urban centres in the province);
– Lack of specialized labour.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Projects and recovery opportunities and restoration of mining sites in the Chapais and Chibougamau region;
– Abandoned gravel and sand pits in the region that could need ashes for revegetation.</td><td>– Cost price of ash by-products compared to a new product.</td></tr>
</table>

<table>
<tr><th colspan="3">Aggregates recovery</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Since authorized storage and conditioning spaces are lacking, brick concrete and asphalt aggregates are illegally stocked and sent to the EL. This strategy consists of endowing the region with an authorized conditioning space.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Carry out a characterization for all aggregates sent to the TL to get an accurate picture of the available materials;
– Analyze different supply sources (industries, large construction sites, municipal projects, etc.);
– Identify regulatory requirements;
– Select a site and operator to implement activities that meet MELCCFP requirements;
– Implementation of a logistics allowing aggregates recovery (e.g. storage, conditioning and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– City of Chapais;
– Eeyou Istchee James Bay Regional Government;
– Construction sector businesses.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$</td><td>– Quantity of recovered aggregates;
– Aggregate recovery rate (according to the total generation).</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Available resources in the region;
– Available forest roads for aggregate recovery.</td><td>– Requires the implementation of a storage and conditioning space through funding.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Projects may be carried out by city administration or private companies;
– Increase the lifespan of LET;
– Integrate criteria for use of recycled aggregates in public tenders.</td><td>– Little control on the quality and quantity of the supply source;
– Ministerial authorization required for storage and conditioning.</td></tr>
</table>

<table>
<tr><th colspan="4">Upgrading freshwater distribution infrastructure as well as wastewater treatments</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Process optimization and ecodesign</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">This study established that freshwater production and distribution in Chapais could be improved and optimized. In fact, the aqueduct network is at its useful end of life and its layout is not fully adapted to winter conditions in the region. This forces Chapais to take actions which results in water waste, for example, forcing residents to leave the water running to prevent ice formation in domestic and municipal pipes. The main consequence is that the city produces more water than necessary, approximately half of the freshwater is not consumed and lost in the water network distribution.
Repair works and upgrades to the aqueduct network should allow to reduce loss of water in the distribution network. Chapais' high water production levels probably impact the conception and planning of the future wastewater treatment plant that the city hopes to put in place.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– The ministère des Affaires municipales et de l'Habitation (MAMH) proposes a program called Plan d'intervention pour le renouvellement des conduites d'eau potable, d'égout et des chaussées. Chapais' administration should contact the ministry to learn about the program's modalities and see how this could be applied to the city's realities;
– A municipal aqueduct infrastructure specialized firm could also be contacted to, for example, produce a diagnosis of the network, detect large leaks, and complete the different documents needed for the MAMH program;
– The preliminary steps could include the following:
– Contact the MAMH about the Plan d'intervention pour le renouvellement des conduites d'eau potable, d'égout et des chaussées ;
– Establish and action plan according to Chapais' needs;
– In parallel, Chapais could pursue knowledge acquisition and data on their aqueduct network by installing water meters and investigating leaks.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– City of Chapais;
– Eeyou Istchee James Bay Regional Government;
– MAMH;
– Businesses in the construction/conception of aqueducts sector.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Long term</td><td>$$$$</td><td colspan="2">– Number of water meters installed;
– Quantity of freshwater distributed in the aqueduct network;
– Changed pipe lengths.</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Optimize and reduce water usage;
– Reduce quantities of water directed to the future water treatment and wastewater treatment plant.</td><td colspan="2">– Major costs;
– Need to plan and establish priorities;
– Applicability for many years.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Financial assistance programs with the MAMH.</td><td colspan="2">– Deadlines and criteria must be specified with the MAMH;
– Support by a specialized firm to complete the process.</td></tr>
</table>

1.2 Lower-priority actions

<table>
<tr><th colspan="4">Implementing a deconstruction system</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Responsible consumption and procurement and process optimization</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">This action aims to promote reuse of building materials while reducing the quantities sent to the LET or recycled. In that sense, it was suggested to establish a “deconstruction permit” that would promote deconstruction rather than demolition. Deconstruction generally requires more time but allows reuse of material that is found in homes. This may include for example, doors and windows, electric fixtures (light fixtures), plumbing equipment (sinks, toilets, etc.), and construction wood.
This may also include concrete, reinforced concrete, bricks, metals, etc.</td></tr>
<tr><td>Implementation steps</td><td colspan="3">– Carry out a pilot project with the following objectives:
  – Identify materials and objects that can be recovered using deconstruction;
  – Determine the costs and advantages of a deconstruction permit.
– Establish regulation context and tags;
– Establish a new permit delivery system (including pricing and tracking);
– Review the deconstruction system (analyze the structure, establish equipment and labour needs, proceed to deconstruction, sorting and conditioning of the materials for donation and reselling.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– City of Chapais;
– Specialized organizations in regulations and reuse;
– Construction contractors;
– CRD residue conditioners.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$</td><td colspan="2">– Number of permits delivered;
– Quantities of reused materials and objects that have been reused, recycled or recovered.</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Putting back into circulation materials that can be reused a second time;
– Increase volumes of recovered and recycled materials;
– Reduce elimination costs and quantities sent to the landfill;
– Reduce resource and energy consumption.</td><td colspan="2">– Could require hiring new employees in the context of labour shortage;
– Requires space to store materials and objects from deconstruction;
– May require the implication of several city departments (finance, environment, town planning, etc.).</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Favorable temporal conjuncture (the majority of buildings in Chapais were constructed during the same period of time);
– Possibility of integrating this project to the used good store project or space for reusing at the ecocentre;
– Possibility of integrating this project to the recovery of aggregates (brick, concrete, asphalt).</td><td colspan="2">– Financial incentive that is consequent with the cost increase related to deconstruction;
– Tracking tools to be developed and implemented.</td></tr>
</table>

<table>
<tr><th colspan="3">Creating a used goods store and a donation and reselling web platform</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Donation and reselling, maintenance and repair, refurbishing</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Implementation of a tool to sell or donate reusable articles in the region of Chapais.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Create a virtual space dedicated to Chapais citizens (e.g. private Facebook group, possibility of including Chibougamau);
– Name responsible group administrators;
– Publicize the web platform at the scale of the city and wider region;
– Assess the feasibility of setting up a physical space, for example at the ecocentre, to receive, sort, store and give away or sell certain reusable items (e.g., building materials or electrical appliances);
– Implement the project;
– Prepare a periodic report on the items that have been offered online and diverted from the landfill.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– City of Chapais;
– City of Chibougamau.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term for virtual exchange</td><td>$ for virtual exchange</td><td rowspan="2">– Number of items recirculated;
– Quantity of materials diverted from the landfill;
– Value of items recirculated.</td></tr>
<tr><td>Medium term for a physical space</td><td>$$ for a physical space</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Virtual space is easy to implement and relatively inexpensive;
– Ecocentre is well known and frequented.</td><td>– Requires the creation of a storage space;
– Requires the hiring of employees or presence of volunteers.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Reduction in residents' expenses (free products or cheaper than buying the same new product);
– Social impact (mutual aid and reduction in isolation);
– Reduction of the quantity of materials sent to the TL;
– Possibility of links between the already existing virtual exchange space and the physical space (e.g. weekly publication of "new arrivals" with photos);
– Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [2022]);
– Opportunity for a part-time municipal employee to combine his tasks to the used store project;
– Financial support program.</td><td>– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc. ;
– Surplus items must be managed in the physical space (storage or disposal of unsold items).</td></tr>
</table>

<table>
<tr><th colspan="4">Supporting ICI in order to promote use of circular economy strategies including industrial ecology</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Industrial ecology and other applicable circular economy strategies</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">Chapais developed a unique expertise in industrial ecology and circular economy. The Corporation de développement économique communautaire (CDEC) and City could convey their knowledge and/or support to businesses, organizations and even other municipalities who wish to develop actions in circular economy (renting storage spaces, procurement of specialized equipment, networking between businesses, etc.). Moreover, the ICI generating outputs could be used as resources for other ICI in the region. These ICI should be supported to exchange materials and implement circular economy projects. ICI that were met mentioned having circular economy ideas that could be implemented in the city. A networking workshop for ICI within the territory could be organized in Chapais.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– This action requires the identification of stakeholders so they can be included in the process;
– The achievement of this action relies on the knowledge of the shops and businesses' needs. To be aware of these needs, different activities could be organized, such as network workshops, symposiums, lunch conferences, communications with sectoral associations, etc. ;
– A regional strategic plan could be prepared to identify steps as well as prioritize and plan actions to implement regional industrial synergies;
– Once the needs are known, a support for ICI should be provided (search for funding, grants, potential partners, etc.) to implement these synergies.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– City of Chapais and Chibougamau;
– Cree Nation of Oujé-Bougoumou;
– Eeyou Istchee James Bay Regional Government;
– Industry associations;
– Economic associations (chamber of commerce, CDEC, etc.).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Variable, depends on the project</td><td>Variable, depends on the project</td><td colspan="2">– Variable, depends on the project</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Presence of an organization whose mandate includes circular economy (CDEC);
– Growing knowledge of the circular economy concept and its benefits;
– Many actors are willing to contribute to the circular economy transition;</td><td colspan="2">– Lack of human resources with the ICI;
– Requires regional planning and priority establishment
– Applicability over the next few years.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Financial aid programs (ex.: Fonds Écoleader [Fonds Écoleader, 2021], Programme Virage Vert [Réseau des SADC + CAE, 2021], etc.);
– Economic productivity (e.g.: cost reduction for businesses; outputs [stocks] and inputs [procurement];
– Optimization of local resources (intensive use of a same resource);
– Examples of many successful projects driven by Quebec organizations and companies;
– GHG emission reduction;
– Increase LET lifespan;
– Reinforcement of social cohesion between ICI in the region.</td><td colspan="2">– Aid programs are relatively unknown by ICI;
– Timeframes and criteria need to be respected;
– Support organization and businesses in order to start the process;
– Business process modifications.</td></tr>
</table>

2 Chevery

2.1 Priority actions

<table>
<tr><th colspan="3">Collection and processing organic matter</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Setting up the collection and processing of organic matter in the RCM du Golfe-du-Saint-Laurent's territory.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Conduct a feasibility study in regards to setting up the collection and processing of organic matter (targeted customers, estimation of quantities, cost of collection and bins, collection modalities, comparative study in regards processing in or out of the region, location and processing method selection, etc.);
– Carry out pilot tests in regard to organic matter collection and processing based on the composting method selected by the population and local authorities;
– Delegate jurisdictions for organic matter collection, transportation and processing;
– Identify steps allowing organic matter processing (select type of processing and location, request authorization, conception, construction, search for outlets, etc.);
– Apply for a grant from the program for the treatment of organic matter through biomethanization and composting (PTMOBC) to treat organic matter and/or purchase recovery equipment (MELCCFP, 2022b);
– Prepare tendering process for organic matter collection, transportation and if applicable, processing;
– Select equipment and complete the tendering process for their purchasing;
– Modify regional organic matter management regulations;
– Create IAE tools.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– MRC du Golfe-du-Saint-Laurent;
– Chevery's population and ICIs.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td>– Number of brown bins distributed;
– Number of homes served;
– Organic matter recovery rate (annual quantity recovered vs. quantity generated);
– Quality of materials collected with respect to type of collection (% contaminated);
– Quantity and quality of outputs produced (e.g., compost).</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Because of the proximity of the NL, it could be used as the processing location;
– Service desired by the population;
– Redistribution of compost to the population;
– Reduction in the quantity of residual materials at the NL;</td><td>– Reorganization of waste collection schedules and addition of organic matter collection;
– Possible purchase of a new collection vehicle or involvement of a private partner;
– Availability of workers and expertise;</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory requirements to recover organic matter;
– Amendments to the Regulation respecting the charges payable for the disposal of residual materials;
– Funding available through the PTMOBC;
– Reduction in GHG emissions;
– Increase the lifespan of the engineered landfill;
– Possibility of integrating septic sludge and biosolids (when the infrastructure will be in function), as well as wood chips as inputs;</td><td>– The MRC du Golfe-du-Saint-Laurent can only participate to the Programme sur la redistribution aux municipalités des redevances pour l'élimination de matières résiduelle five years after their first residual management plan, deemed compliant, is available;
– No authorized organic matter processing site in the immediate area;
– High investment in machinery, facilities, transportation equipment, etc. ;</td></tr>
</table>

	– Need to find one or more outlets for the output produced (e.g., compost).

Improving deposit-refund and selective collection management		
Circular economy strategy	**Process optimization and recycling and composting**	
Brief description of the action	The modernization of the Quebec deposit-refund and selective collection systems could take many years before being implemented in northern villages. The option of quickly requesting this service through the DMOs so it can be implemented in Chevery is a possibility. However, if the DMOs are unable to implement this service soon, improvements of the collection and recovery of specific materials could be beneficial for the community of Chevery. Therefore, this action aims to facilitate and improve recyclable materials sorting operations and management by reducing the volume occupied by these materials. To begin with, metal barrels, cardboard and deposit refund containers could be targeted. This action relies on the procurement of equipment such as a hydraulic press for metal barrels, a manual press for cardboard and a reverse vending machine for returnable containers. Over the medium or long term, a door to door collection could simultaneously be implemented with the building receiving and temporarily storing the recyclable materials, and this, jointly with the DMOs.	

Implementation steps	– Optimize storage space and metal barrels exportation:
	  – Identify a space for metal barrels storage;
	  – Proceed to the purchase and installation of a hydraulic press.
	– Optimize the management of returnable containers and purchase a reverse vending machine:
	  – Find a space to install the reverse vending machine (where electricity is accessible);
	  – Proceed to equipment purchase and installation.
	– Optimize the management of cardboard:
	  – Find a space to install a manual press (either in the shelter used for recyclable materials or elsewhere);
	  – Proceed to equipment purchase and installation;
	  – Plan temporary storage of cardboard bales.
	– Train employees in using this equipment;
	– Modify current storage and expedition practices of recyclable materials (optimization of transportation pallets with cardboard bales and compacted returnable containers).
	–	

Organizations and partners involved	– Côte-Nord-du-Golfe-du Saint-Laurent municipality; – Netagamiou school (students and staff responsible for the collection); – Chevery's local municipal committee; – DMOs	
Timeline	**Budget estimate**	**Timeline**
Short term	$	– Metal, cardboard and returnable container collection rates; – Compare data with previous years.
Strengths		**Weaknesses**
– Manual press is easy to use; – Optimize stored material volume as well as the volume related to transporting the pallets; – Increase weight of transported pallets.		– Reverse vending machine requires electricity; – Requires labour for the conditioning of recyclable materials.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Increase the NL lifespan; – Carrying out a presorting of materials will increase the quality and value of recyclable materials; – Possibility of cardboard diversion for other uses (represents a source of carbon-rich material or can be used as a structuring agent in a compositing process, such as raw material for cardboard log productions, etc.).		– Recyclable material manipulation required for maritime transportation; The MRC du Golfe-du-Saint-Laurent may only participate to the Program of Redistribution to Municipalities of Charges Payable for the Disposal of Residual Materials five years after their first RMMP has come into force and is compliant with the residual materials management government politics.

Improving the transportation barge		
Circular economy strategy	**Process optimization**	
Brief description of the action	The barge is operated by the Société des traversiers du Québec (STQ). This society also owns the boat. Currently, merchandise containers destined to Chevery arrive by the supply boat, Le Bella Desgagnés. This boat stops at the Harrington Harbour dock and unloads Chevery's containers. These containers are opened on the dock and pallets carrying merchandise are transferred by the transportation barge. A crane with more power, located on the barge, would allow the transferring of a container within one operation, which could then be transported out to Chevery,	
Implementation steps	– Initiate discussions with the STQ; – Asses the project's technical feasibility (sufficient barge size to transport maritime containers, adequate dock installations at both Chevery and Harrington Harbour, sufficient drought waterway at Chevery's dock, etc.); – Proceed to the purchase and installation of equipment, etc.; – Train employees in using the new equipment.	
Organizations and partners involved	– STQ ; – Côte-Nord-du-Golfe-du Saint-Laurent municipality and the ministère des Transports et de la Mobilité durable (MTMD); – Manager at Harington harbours dock.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Changing the crane.
Strengths		**Weaknesses**
– Improving the transhipping of all materials imported and exported by ship.		– High costs; – The barge is not owned by the municipality.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Time saving; – Decreases manipulations.		– Technical feasibility needs to be evaluated; – STQ's interest in carrying out the necessary modifications must be validated; – Useful lifespan of the NM Mecatina may not allow its replacement.

Collection and exporting metals		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Scrap metal is an important issue for many isolated communities like Chevery. There are two main reasons for this. First, scrap metal cannot be incinerated and thus cannot be eliminated at the NL. Second, the cost of transporting scrap metal is higher than the value of the metal itself. In the absence of road connections, scrap metal in Inukjuak cannot be collected by truck and transported to an urban centre. Collection and removing scrap metal in a community like Chevery requires financial assistance and shipping by sea. This action involves removing from the territory of Chevery the metals that have accumulated for decades in and around the NL.	
Implementation phases	– Assess policy levers to ensure that the importation of new vehicles (cars, trucks, motorcycles, snowmobiles, ATVs, etc.) into the village is accompanied by a requirement that these vehicles be returned for recycling at the end of their useful life to an urban centre in the southern part of the province. – Optimize the classifying and processing of scrap metal (separation of ferrous and non-ferrous metals, vehicle decontamination [e.g., remove oils and fluids], and storage and packaging for shipment according to recycler requirements). – Request that transportation and recovery programs for the metal stockpiles in Basse-Côte-Nord villages are put in place (as seen in Kangirsuk and Aupaluk); – Take steps allowing the implementation of programs optimizing residual materials management in the north with concerned ministries.	
Organizations and partners involved	– Côte-Nord-du-Golfe-du Saint-Laurent Municipality ; – MRC du Golfe-du-Saint-Laurent ; – Funding organizations; – MELCCFP, MAMH, SPN et RECYC-QUÉBEC ; – Specialized companies	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Quantity of recycled metals.
Strengths		**Weaknesses**
– Metals present in large quantities; – Industrial, commercial or residential land freed up next to the NL; – Reduction in the quantity of scrap metal in the NL.		– Possibility that some metals, stockpiled for several years, are more difficult to recycle; – Transportation costs higher than the value of the metals; – No road connection.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Political momentum in the wake of the BAPE report on ultimate residues; – Available funding (e.g.: Programme de soutien aux communautés isolées [RECYC-QUÉBEC, 2023a]).		– The MRC du Golfe-du-Saint-Laurent may only participate to the Program of Redistribution to Municipalities of Charges Payable for the Disposal of Residual Materials five years after their first RMMP has come into force and is compliant with the residual materials management government politics.

2.2 Lower-priority actions

<table>
<tr><th colspan="4">Establishing storage spaces</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Sharing economy</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">Chevery’s visit revealed that organizations and contractors lack storage space to store their materials.
This action consists of establishing a common space, easily accessible and convivial by creating a secure and heated storage warehouse for ICI that could contain a few hundreds pallets. This space could be available for monthly or annual renting. A structure type “megadome” like the arena could be used. This action meets a collective need for storage space, that community members must currently fulfill on their own.</td></tr>
<tr><td>Implementation steps</td><td colspan="3">– Survey ICI and the population to quantify, in volume and area, the needs for storage;
– Choose a site to implement equipment;
– Establish the required storage needs and carry out an economic feasibility analysis to estimate construction costs and revenues;
– Prepare a call for tenders and construct building;
– Proceed to renting out spaces.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– Côte-Nord-du-Golfe-du Saint-Laurent municipality ;
– Chevery’s ICI.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td colspan="2">– Number of users;
– Number of stored pallets;
– Storage units rented (number or area).</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Meets an ICI need;
– Avoids that each constructs their own storage spaces.</td><td colspan="2">– Absence of road links which may impact the building costs;
– ICI cost of use.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Extend the use of the storage units to the neighbouring village of Harrington Harbour.</td><td colspan="2">– Possible appearance of an individual culture therefore limiting the collective and sharing economy approach.</td></tr>
</table>

<table>
<tr><th colspan="3">Creating a used goods store and a donation and reselling web platform</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Donation and reselling</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Implementation of a tool to sell or donate reusable articles and textiles in the region of Chevery.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Create a virtual space dedicated to citizens from the municipality of Côte-Nord-du-Golfe-du-Saint-Laurent (e.g. private Facebook group);
– Name responsible group administrators;
– Publicize the web platform at the scale of the city and wider region;
– Assess the feasibility of setting up a physical space, for example at the ecocentre, to receive, sort, store and give away or sell certain reusable items (e.g., building materials or electrical appliances). This space could be located at the NL site entrance;
– Implement the project;
– Prepare a periodic report on the items that have been offered online and diverted from the landfill.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Municipality of Côte-Nord-du-Golfe-du-Saint-Laurent;
– MRC du Golfe-du-Saint-Laurent;
– Citizens from Chevery, Harrington Harbour, and other villages associated to the Côte-Nord-du-Golfe-du-Saint-Laurent municipality.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$</td><td>– Number of items recirculated;
– Quantity of materials diverted from the landfill.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Virtual space is easy to implement and relatively inexpensive;
– NL is well known and frequented by citizens.</td><td>– Requires the creation of a storage space;
– Requires the hiring of employees or presence of volunteers.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Reduction in residents' expenses (free products or cheaper than buying the same new product);
– Social impact (mutual aid and reduction in isolation);
– Possibility of links between the already existing virtual exchange space and the physical space (e.g. weekly publication of "new arrivals" with photos);
– Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [2022]);
– Opportunity to add a refurbishing section to the project;
– Financial support program.</td><td>– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc.;
– Surplus items must be managed in the physical space (storage or disposal of unsold items).</td></tr>
</table>

<table>
<tr><th colspan="4">Cardboard recovery</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">This action consists of transforming cardboard into a domestic combustible that can be used in a wood-burning stove. This recovery would prevent sending the cardboard to the NL as well as overloading the shelter used for the selective collection. This action could be implemented in the framework of a pilot project, in collaboration with the school. Many tutorials and videos covering this subject are available online. Fabrication recipes could be tested by the students. A log press could also be elaborated. The challenge would be to find a good recipe, both in terms of production than combustibility.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– Inventory and characterization of available cardboard (for example waxed cardboard used for transporting fruits is suitable for cardboard log fabrication);
– Research fabrication recipes;
– Fabricate a log press;
– Carry out combustibility tests.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– ICI generating important quantities of cardboard;
– School staff and students.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Short term</td><td>$</td><td colspan="2">– Number of logs produced;
– Quantity of produced cardboard;
– Quantity of recovered cardboard;</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Simple action and low cost;
– The majority of houses are equipped with a wood-burning stove;
– Reduction of pressure forest resources.</td><td colspan="2">– Requires labour for log fabrication.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Pedagogical project with the possibility of involving school staff and students;
– Possibility of exporting this concept to other villages in the municipality.</td><td colspan="2">– Requires a work space for drying/storing the logs;
– Requires a step for research and development to find the best recipe adapted to Chevery;
– Requires a step for research and development to fabricate the press.</td></tr>
</table>

3 Fermont

3.1 Priority actions

<table>
<tr><th colspan="3">Implementing a new landfill</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Process optimization</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to equip Fermont with an authorized landfill for residual materials. This action is related to the fact that the current TL is at the end of its useful life and that the next TL will not be located on ArcelorMittal's territory (as it is currently the case). The construction, management and operation will be under Fermont's authority who has already initiated feasibility studies for a future TL.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Carry out a feasibility study addressing the implementation of the TL in Fermont (identification of potential sites, cost estimations, development plan, etc.);
– Delegate competencies for a landfill exploitation;
– Prepare the process of obtaining the ministerial authorization for the developpement and exploitation of a TL;
– Prepare a call for tenders for the preparation and construction of the site;
– Select equipment and begin the tender processes for the purchase of equipment;
– Implement measures allowing quantity reductions of materials sent to the TL (e.g. implement the collection of recyclable materials and organic matter, reuse or refurbish articles).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– City of Fermont;
– MRC de Caniapiscau;
– Other regional stakeholders (ArcelorMittal, MFQ, etc.).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Long term</td><td>$$$$</td><td>– Quantity of residual materials sent to the landfill.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Reduction of nuisances associated to the current TL (management and environment);
– Possibility of planning the future TL site by integrating composting;
– Environmental impact reduction according to the new development standards;
– Possibility of adding a scale.</td><td>– Lack of available expertise;
– High costs related to construction.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory obligations to eliminate residual materials in an authorized site;
– Improvement of the living conditions and public health issues.</td><td>– High investments for studies;
– High costs related to labour.</td></tr>
</table>

Collection cardboard		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Currently, there is no collection of recyclable materials carried out by the City of Fermont. However, according to the RMMP (2020-2027), the City of Fermont will need to implement a collection service for recyclable materials before 2027 (MRC de Caniapiscau, n. d.). In addition, Quebec's modernization of its deposit-refund and selective collection systems may take several years to be updated in northern villages. The option of applying quickly to the DMO to set up this kind of collection service in Fermont remains possible. However, if the DMO cannot implement this service in Fermont in the near future, the collection and recovery of a single material could help establish mechanisms that could assist future recovery projects in northern communities. With this in mind, cardboard seems to be generated in large quantities. In fact, the residual materials characterization carried out in Fermont (Appendix D) indicated that 9% of residual materials sent to the TL were cardboard. The implementation of cardboard collection could be an interesting opportunity for the community. Also, to minimize the volumes of materials, and transportation, it is suggested that a pre-sorting of the cardboard as well as the preparation of bales could be carried out directly in Fermont.	
Implementation phases	– Find a building to receive, sort and temporarily store the cardboard. – Buy a cardboard press (bales). – Identify grants or funding available for this type of project. – Make agreements to ship and process the cardboard. – Purchase and distribute cardboard collection containers to residents and ICI. – Create IAE tools.	
Organizations and partners involved	– City of Fermont; – MRC de Caniapiscau; – Fermont citizens, organizations, businesses and institutions (ArcelorMittal, MFQ and major commercial institutions [grocery stores, convenience stores, hardware stores and other]); – Transportation compagnies.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$	– Number of containers sent down south; – Cardboard collection rate; – Cardboard collection annual quantity;
Strengths		**Weaknesses**
– Possibility of implementing the selective collection by starting with cardboard; – Reduction in materials sent to the TL; – Availability of a cardboard press in the city; – Easy-to-use manual press; – Speedy handling because only one material to sort; – Raising community awareness about material sorting; – Reduction of landfill needs therefore reducing the CAPEX for the TL construction.		– Requires a closed building for temporarily storing and processing the cardboard; – Requires workers to collect and process the cardboard; – Requires equipment (manual press, pallet trucks to move the bales, etc.); – Requires revamping the use of residual material containers; – High transportation costs.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Extending the useful life of the TL; – Implementing a cardboard drop off point thereby promoting source pre-sorting; – Quality pre-sorting to increase the value of the cardboard – Possibility of mutual aid within the community; – Possibility of partnerships with the mining companies by using the train as a means of transportation; – Opportunity to combine IAE and implementation efforts with the collection of organic matter; – Opportunity to establish basic principles for the deposit-refund and selective collection systems that will be set up by 2027; – Possibility of using cardboard as a source of carbon-rich material, or as a structuring agent in a compositing process; – Funding available through the GMF.		– Need to find an outlet, either a company or recycling company that would accept to receive cardboard.

<table>
<tr><th colspan="4">Collection and processing organic matter</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">Organic matter such as food scraps are not welcomed in TL. This action aims to implant organic matter collection and processing on Fermont's territory.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– Conduct a feasibility study in regards to setting up the collection and processing of organic matter (targeted customers, estimation of quantities, cost of collection and bins, collection modalities, comparative study in regards processing in or out of the region, location and processing method selection, etc.);
– Perform the steps allowing organic matter processing (select type of processing and location, request authorization, conception, construction, search for outlets, etc.);
– Apply for a grant for the program for the treatment of organic matter through biomethanization and composting (PTMOBC) to treat organic matter and/or purchase recovery equipment (MELCCFP, 2022b);
– Select equipment and complete the tendering process for their purchasing;
– Create IAE tools.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– City of Fermont;
– MRC de Caniapiscau;
– Fermont's population and ICI.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$$</td><td colspan="2">– Number of brown bins distributed;
– Number of homes served;
– Organic matter recovery rate (annual quantity recovered vs. quantity generated);
– Quality of materials collected with respect to type of collection (% contaminated);
– Quantity and quality of outputs produced (e.g., compost).</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Possibility of including organic matter processing to the future TL planification;
– Service desired by the population;
– Redistribution of compost to the population;
– Infinite possibility to recover compost for the tailings;
– Reduction in the quantity of residual materials sent to the TL.</td><td colspan="2">– Reorganization of waste collection schedules and addition of organic matter collection;
– Possible purchase of a new collection vehicle or involvement of a private partner;
– Reorganization of residents' containers to receive residual materials;
– Availability of workers and expertise.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory requirements to recover organic matter;
– Amendments to the Regulation respecting the charges payable for the disposal of residual materials;
– Funding available through the PTMOBC;
– Funding available through the GMF;
– Reduction in GHG emissions;
– Increase the lifespan of the TL;
– The possibility of integrating septic sludge and biosolids (when the infrastructure will be in function), as well as wood chips as inputs;
– Creation of a partnership with regional businesses who would have an interest in using the outputs in their activities.</td><td colspan="2">– Risk of contamination by non-compostable materials (glass, plastic, etc.);
– High investment in machinery, facilities, transportation equipment, etc.</td></tr>
</table>

<table>
<tr><th colspan="4">Development of new outlets for wood</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Responsible consumption and procurement, donating and reselling, recycling and composting, recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">This action aims to divert wood (e.g. wooden pallets, wood received at the ecocentre) from elimination to reuse it (e.g. energy, composting input, mulch, pyrolysis, pellets, etc.).</td></tr>
<tr><td>Implementation steps</td><td colspan="3">– Characterize the wood sent to the TL, the ecocentre (type, quantity, quality, etc.) and the wood generated by mining companies to get an accurate picture of the types of wood generated;
– Analyze the different supply sources (the generators);
– Describe current residue management based on generators;
– Identify regulatory requirements;
– Identify issues and constraints related to wood collection and recovery;
– Identify the different recovery options for wood, such as heating, conversion of wood value-added products (pellets, pyrolysis oil, etc.), reuse of pallets, use of wood as an input for organic matter recovery, etc.;
– Identify potential recovery actors in the region and the acceptability parameters and criteria for recovery (e.g. conditioning and necessary equipment);
– Analyze advantages and disadvantages for the different recovery options;
– Implementation of logistics for wood recovery (e.g. source collection of wood, storage, if required, conditioning and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– City of Fermont;
– MRC de Caniapiscau ;
– Generators, conditioners and recovery actors;
– Major energy consumers.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$-$$$$</td><td colspan="2">– Quantity of wood diverted from the landfill;
– Number of stakeholders involved.</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Wood available in large quantities in the region;
– Possibility of extending the project to Labrador City and Wabush;
– Stimulation of the regional economy.</td><td colspan="2">– Variable wood quality subject to changes;
– Requires creating a storage and conditioning space;
– Lack of knowledge on the generators outside Fermont and on potential recovery actors.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory obligations to be established (e.g. prohibit sending wood to the landfill, prohibit repairs of fuel furnaces, etc.);
– Possibility of energy transition and development opportunities of renewable energy systems with financing support (e.g. programs from Transition énergétique Québec [TEQ], such as ÉcoPerformance [MELCCFP, 2023b] and Bioénergies [MELCCFP, 2023c] as well as the Programme d’aménagement durable des forêts [ministère des Forêts, de la Faune et des Parcs; MFFP], 2021);
– Life extension of the TL.</td><td colspan="2">– Little control over procurement;
– Ministerial authorization required for storage and conditioning;
– Development of a market nearby to dispose of collected and conditioned wood;
– Potential investments necessary from recovery;
– High transportation costs;</td></tr>
</table>

Creating a donating and reusing space		
Circular economy strategy	**Donation and reselling**	
Brief description of the action	The community already has an ecocentre, two virtual exchange groups and a physical store selling secondhand clothes and tableware. However, no used goods stores are available to sell objects and different materials. This action therefore aims to optimize the mechanisms that are already in place to sell or to give reusable materials in the Fermont region.	
Implementation steps	– Assess the feasibility of extending the physical space available at the ecocentre to receive, sort, store and give away or sell certain reusable items (e.g., building materials or electrical appliances); – If applicable, buy or recover shipping containers; – Promote virtual exchange groups in Fermont (Info-Fermont and *Le marché aux puces virtuel de Fermont*); – Establish ties between the City, virtual groups, the ecocentre and *La Brocante* who sells clothes and tableware; – Implement the project; – Prepare a periodic report on the items that have been offered at *La Brocante* and diverted from the landfill.	
Organizations and partners involved	– City of Fermont; – La Brocante; – Le marché aux puces virtuel de Fermont ; – Info-Fermont.	
Timeline	Budget estimate	Success indicators
Short term	$	– Number of items recirculated; – Quantity of materials diverted from the landfill.
Strengths		Weaknesses
– Virtual space is easy to implement and relatively inexpensive; – NL is well known and frequented by citizens;		– Requires the creation of a storage space; – Requires the hiring of employees or presence of volunteers.
Potential opportunities and levers regarding the strategy		Potential threats and obstacles to the strategy
– Reduction in residents' expenses (free products or cheaper than buying the same new product); – Social impact (mutual aid and reduction in isolation); – Possibility of links between the already existing virtual exchange space and the physical space (e.g. weekly publication of "new arrivals" with photos); – Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [2022]); – Opportunity for a part-time municipal employee to combine his tasks to the used store project; – Financial support program.		– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc. ; – Surplus items must be managed in the physical space (storage or disposal of unsold items).

3.2 Lower-priority actions

<table>
<tr><th colspan="3">Supporting ICI in order to promote use of circular economy strategies including industrial ecology</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Industrial ecology and other applicable circular economy strategies</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This study allowed to identify certain ICI that may develop actions in circular economy. Moreover, certain ICI, such as mining companies, have infrastructure and means that could benefit the community (e.g. transportation by train). Finally, ICI generate outputs that could be used as resources for other ICI in the region. These ICI should be supported to exchange materials and implement circular economy projects. A network workshop could be organized by the City of Fermont, in partnership with Synergie 138. Eventually these networks could be extended to other cities such as Labrador City and Wabush.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– This action requires the identification of stakeholders so they can be included in the process;
– A regional strategic plan could be prepared to determine the limits of territory, identify steps, select organizations that should be approached, and prepare a financial package;
– The achievement of this action relies on the knowledge of the shops and businesses' needs. To be aware of these needs, different activities could be organized, such as network workshops, symposiums, lunch conferences, communications with sectoral associations, etc. ;
– Once the needs are known, a support for ICI should be provided (search for funding, grants, potential partners, etc.) to implement these synergies.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– City of Fermont;
– Synergie 138;
– Industry associations;
– Mining companies and economic associations (Chamber of commerce, SADC, etc.).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Variable, depends on the project</td><td>Variable, depends on the project</td><td>– Number of supported businesses;
– Number of synergies carried out;
– Savings made by participating ICI;
– GHG emissions avoided;
– Quantity of materials diverted from the landfill or unused resources.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Presence of an organization whose mandate includes circular economy (Synergie 138);
– Growing knowledge of the circular economy concept and its benefits;
– Many actors are willing to contribute to the circular economy transition.</td><td>– Lack of human resources with the ICI;
– Requires regional planning and priority establishment;
– Applicability over the next few years;
– Lack of technical knowledge and stabilization of the Fermont community.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Financial aid programs (ex.: Fonds Écoleader [Fonds Écoleader, 2021], Programme Virage Vert [Réseau des SADC + CAE, 2021], etc.);
– Economic productivity (e.g.: cost reduction for businesses; outputs [stocks] and inputs [procurement];
– Optimization of local resources (intensive use of a same resource);
– Examples of many successful projects driven by Quebec organizations and companies;
– GHG emission reduction;
– Increase LET lifespan;
– Reinforce social cohesion between ICI in the region.</td><td>– Aid programs are relatively unknown by ICI;
– Timeframes and criteria need to be respected;
– Business process modifications.</td></tr>
</table>

<table>
<tr><th colspan="3">Woodchipper rental</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Short-term rental</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to promote wood recovery by carrying out the first conditioning step, the chipping, which involves the use of a mobile equipment available in the region and that could be rented out.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Settle an agreement with the woodchipper owner;
– Determine wood generators whose outputs could be processed;
– Identify a space to store the wood that meets the MELCCFP requirements;
– Implement mechanisms to ensure wood procurement: source sorting at the ecocentre and/or TL;
– Carry out special collections with businesses;
– Develop wood outlets.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Le Phare ;
– City of Fermont;
– MRC de Caniapiscau ;
– Mining companies;
– Synergie 138.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td>– Signing an agreement with the partner;
– Annual quantity of chipped wood;
– Quantity of wood used by recovery businesses associated with the project.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Availability of raw material;
– Mobile equipment available in the region;
– Reduction of usage fees associated with the machinery;
– No long-term financial engagements.</td><td>– Requires the planning of a storage and conditioning space;
– Requires cost considerations for the machinery transportation;
– Requires training to operate the woodchipper.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Potential operation cost reductions by recovery businesses.</td><td>– Final products must meet the users’ needs.</td></tr>
</table>

<table>
<tr><th colspan="3">Replacing fossil fuelled municipal vehicles</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Responsible consumption and procurement</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to assess the feasibility of replacing the current municipal vehicle fleet by electric or hybrid vehicles.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Establish a list of municipal vehicles by type (cars, vans, heavy vehicles) by indicating the age, the total mileage, the annual mileage and the general condition;
– Establish a list of equivalent vehicles according to the types of vehicles used;
– Verify that the autonomy for each type of electric vehicle is compatible with its actual and projected use;
– Carry out a comparative economic analysis, including the fuel, maintenance and purchasing or renting options;
– Prioritize vehicles which need to be replaced by an electric option;
– Evaluate the possibility of sharing unused vehicles with the citizens (sharing economy).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– City of Fermont;
– Car rental business established in Fermont;
– Mining companies</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td>– Number of electric vehicles acquired;
– Savings made after the purchase of electric vehicles (usage fees and maintenance);
– Quantity of GHG emissions avoided.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– The size of the territory is compatible with the vehicle autonomy available in the current market;
– Possibility of grouped purchases allowing cost reductions;
– Facilitates annual budget management because it avoids fuel cost fluctuations;
– Reduction of the environmental impact in the community (GHG emissions and sound).</td><td>– Requires training on eco-driving and energy management;
– Change of vehicles must be planned;
– Preconceptions concerning the effectiveness of electric vehicles;
– Only one charging station available on the territory (Circuit électrique, 2023).</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Existence of tax incentives (e.g. Roulez vert [MELCCFP, 2022b] government program and the Écocamionnage program [MTMD, 2023b]);
– Usage and maintenance costs are lower for electric vehicles;
– Action from the Plan pour une économie verte 2030 - Plan de mise en œuvre 2022-2027 (Gouvernement du Québec, 2022) ;
– When they are not used, municipal vehicles could be rented out by citizens. This could help maximize the return on investment of the electric-vehicle purchases.</td><td>– Purchase cost is higher for electric vehicles;
– Poor electric vehicle availability.</td></tr>
</table>

4 Inukjuak

4.1 Priority actions

<table>
<tr><th colspan="3">Developing the new NL and closing the existing NL</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Process optimization</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Several problems are associated with the two Inukjuak NLs. The current NL is at the end of its useful life and its location directly upstream of the village causes leachate to flow and accumulate in the urbanized portion of the village. In addition, winds blow waste from the NL into the village. At the same time, the site designated for the new NL is prone to flooding and is not used. The purpose of this action is to regularize the situation of the two NLs by properly closing the current NL and restructuring the new NL site to make it usable. To ensure that the new NL can be used over a long period of time, measures to reduce the quantity of materials sent to it should be implemented.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Carry out the studies required to prevent leachate seeping from the current NL into the village's urban area.
– Correct the drainage problem that causes recurring flooding at the new NL, carry out a hydrological study and a topographic survey, take the necessary corrective steps, fill the site, etc.
– Based on the results of the studies, identify a new site for the new NL if the existing site is not suitably located.
– Close both the current NL and the new NL.
– Discontinue using the current NL.
– Reduce the quantity of materials sent to the new NL (e.g., eliminate the use of single-use shopping bags, rent furniture and appliances to temporary workers, open a used goods store, etc.).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– The northern village of Inukjuak
– KRG
– Specialized firms (surveying, hydrology, etc.)</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$$</td><td>– Number of trucks using the new NL;
– Number of incineration at the new NL;
– Number of measures implemented to reduce the quantity of waste sent to the NL;
– Quantity of materials disposed of at the new NL.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Reduction in nuisance problems associated with the two NLs;
– Provision of services the population wants;</td><td>– Availability of expertise;
– Rocky land not suitable for normal fencing.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory requirements related to operating an NL;
– Extending the useful life of the NL;
– Improving quality of life and addressing a public health issue.</td><td>– Substantial investment in exploratory studies;
– High labour costs.</td></tr>
</table>

Setting up an ecocentre		
Circular economy strategy	**Recycling and composting and recovery**	
Brief description of the action	Setting up a site to receive and temporarily stock EPR materials is an interesting strategy for Inukjuak. In addition to collecting tires (administered by RECYC-QUÉBEC and not covered by EPR), the residual materials to be handled would include batteries, electronics, paints and paint containers, household appliances and air conditioners, mercury lamps, oils, and similar products. Other products such as wood could be added. By starting with a small pilot project, Inukjuak could become a model for setting up ecocentres in Nunavik. The Inukjuak ecocentre could be set up using locally available marine containers. At least one employee would be required for the ecocentre. Grants are also available to help isolated communities (e.g. the Programme d'aide financière visant l'optimisation du réseau d'écocentres québécois, 2023b).	
Implementation phases	– Begin by approaching each EPR organization to become an official drop-off point; – Conduct a feasibility study on setting up the ecocentre (estimate material quantities, labour requirements, cost of containers and site development, etc.); – Locate a site for the ecocentre; – Identify a funding program; – Purchase and install containers (tendering process, etc.); – Hire and train workers; – Create IAE tools;	
Organizations and partners involved	– The northern village of Inukjuak; – KRG; – Inukjuak residents and businesses (Hydro-Quebec, FCNQ, North West Company, etc.) – EPR organizations (EPRA-Québec, SOGHU, RecycFluo, GoRecycle, ÉcoPeinture, Appel à recycler, etc.); – RECYC-QUÉBEC for tire management; – Marine shipping companies.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$	– Quantities collected/recovered by the various agencies; – Number of containers shipped south;
Strengths		**Weaknesses**
– Consolidation of residual materials management activities and services in a single location (the new NL); – Potential for Inukjuak to be an example of EPR implementation in isolated communities; – Possibility of adding an adjacent used goods store.		– Need for new infrastructure; – Need for workers to operate the site; – Substantial storage requirement (six months to a year) due to limited number of shipments.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Potential for partnership among different EPR organizations to optimize transportation; – Replicable flagship project for Nunavik and improvement based on the pilot project's results; – Available grants; – Extending the useful life of the NL. – Fewer negative impacts caused by the NL.		– Action potentially dependent on development of the new NL; – High transportation costs for relatively small quantities.

Collection cardboard		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	No household recyclable materials are currently collected in the community, except for refundable cans through the FCNQ initiative. In addition, Quebec's modernization of its deposit-refund and selective collection systems may take several years to be updated in northern villages. The option of applying quickly to the DMO to set up this kind of collection service in Inukjuak remains possible. However, if the DMO cannot implement this service in Inukjuak in the near future, the collection and recovery of a single material could help establish mechanisms that could assist future recovery projects in northern communities. Cardboard is a material that seems to be generated in large quantities in Inukjuak. Indeed, according to the residual materials characterization carried out in Inukjuak in fall 2022 (Appendix D), 32% of the residual materials disposed of at the NL were cardboard. Setting up a cardboard collection service could be an attractive opportunity for the community.	
Implementation phases	– Find a building to receive, sort and temporarily stock the cardboard; – Buy a cardboard press (bales); – Identify grants or funding available for this type of project; – Make agreements to ship and process the cardboard; – Purchase and distribute cardboard collection containers to residents and ICI; – Create IAE tools.	
Organizations and partners involved	– The northern village of Inukjuak; – KRG; – Inukjuak residents and ICI (FCNQ, the North West Company, Hydro-Québec, etc.); – Marine shipping companies.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$	– Number of containers sent south – Annual quantity of cardboard collected
Strengths		**Weaknesses**
– Reduction in materials sent to the NL; – Easy-to-use manual press; – Speedy handling because only one material to sort; – Raising awareness among the community material sorting.		– Closed building for temporarily storing and processing the cardboard; – Workers to collect and process the cardboard; – Equipment required (manual press, pallet truck to move the bales, etc.); – Revamping the use of residual material containers; – High transportation costs.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Extending the useful life of the NL; – Quality pre-sorting to increase the value of the cardboard – Available grants; – Opportunity to combine IAE and implementation efforts with the collection of organic matter; – Opportunity to establish principles for the deposit-refund and selective collection systems that will be set up by 2027.		– Need to prepare the cardboard for shipping by sea; – Availability of a recycler in Quebec (ideally near the shipping company's dock) who will agree to receive the cardboard.

Collection and processing organic matter		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Organic matter like food waste is not the kind of material NLs are intended to handle. Besides attracting vermin and other animals, these residues are usually waterlogged, which reduces combustion efficiency in an NL. The presence of water creates more smoke and partly incinerated residues. This action aims to set up a collection system for organic matter on the territory of Inukjuak and infrastructure for processing these materials.	
Implementation phases	– Continue implementing the project initiated by the KRG, namely, the installation of a rotating composter in Inukjuak; – Update a feasibility study on collection and processing organic matter (estimated quantities, collection and bin costs, waste and organic matter collection methods); – Evaluate the possibility of applying for a grant from the program for the treatment of organic matter through biomethanization and composting (PTMOBC) to treat organic matter and/or purchase collection equipment (MELCCFP, 2022c); – Train employees to operate and maintain the rotating composter; – Create IAE tools.	
Organizations and partners involved	– The northern village of Inukjuak; – KRG; – Inukjuak residents and businesses.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Number of brown bins distributed; – Number of homes served; – Organic matter collection rate (annual quantity collected versus quantity generated); – Quality of materials collected with respect to type of collection (% contaminated); – Quantity and quality of outputs produced (e.g., compost).
Strengths		**Weaknesses**
– Proximity of the NL that can be used as a processing site; – Redistribution of compost to the population; – Reduction in the quantity of residual materials at the NL.		– Reorganization of waste collection schedules and addition of organic matter collection; – Possible purchase of a new collection vehicle or involvement of a private partner; – Reorganization of residents' containers to receive residual materials; – Availability of workers and expertise.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Regulatory requirement to recover organic matter; – Amendments to the *Regulation respecting the charges payable for the disposal of residual materials;* – Funding available through the PTOMBC; – Reduction in GHG emissions; – Possible recovery of compost in a greenhouse project (in partnership with the school), revegetate degraded areas, etc.		– Risk of contamination by non-compostable materials (glass, plastic, etc.); – Presence of large fauna (polar bears); – No authorized organic matter processing site in the immediate area; – High investment in machinery, facilities, transportation equipment, etc.; – Need to find one or more outlets for the output produced (e.g., compost).

4.2 Lower-priority actions

<table>
<tr><th colspan="4">Opening a used goods store</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Donating and reselling</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">The Inukjuak community does not have a used goods store, ecocentre, or physical site for the donation and reuse of objects, materials or other items with the exception of the Inukjuak Buy, Sell, Trade or Swap Facebook group. In addition, due to the difficulty of transporting materials into the village, contractors often order and bring in more materials than they need for projects, repairs, renovations, etc. Some contractors mentioned that they would like to hand over these materials to the community members, but since it involves additional management, it is easier to take them directly to the NL. In fact, for northerners, the term "Canadian Tire" is often associated with the NL because locals can find everything there! The objective is to develop a tool to facilitate the sale or donation of reusable items and goods in Inukjuak.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– Assess the feasibility of setting up a physical space, for example at the ecocentre, to receive, sort, stock and give away or sell certain reusable items (e.g., building materials or electrical appliances);
– Inventory and prepare available items (separate, clean, etc.) and stock;
– Implement the project;
– Prepare periodic reports on the items that have been donated online and thus diverted from the NL.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– The northern village of Inukjuak;
– KRG;
– Inukjuak community organizations.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$</td><td colspan="2">– Number of items recirculated;
– Value of items recirculated.</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– NL known and frequented by residents (if the physical space is located there).</td><td colspan="2">– Requires a storage space (e.g., marine containers);
– Requires volunteers or hired staff.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Reduction in residents' expenses (free products or cheaper than buying the same product new);
– Social impact (mutual aid and reduction in isolation);
– Reduction in the quantity of materials disposed of at the NL;
– Possibility of links between the already existing virtual exchange space and the physical space (e.g., weekly publication of "new arrivals" with photos);
– Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [Lac-Saint-Jean intermunicipal residual materials management agency] (2022);
– Possibility of adding an item refurbishing section;
– Possibility for a part-time employee from the village to combine their work with this used goods store project.</td><td colspan="2">– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc.;
– Surplus items must be managed in the physical space (storage of unsold items).</td></tr>
</table>

Collection and exporting metals		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Scrap metal is an important issue for many isolated communities like Inukjuak. There are two main reasons for this. First, scrap metal cannot be incinerated and thus cannot be eliminated at the NL. Second, the cost of transporting scrap metal is higher than the value of the metal itself. In the absence of road connections, scrap metal in Inukjuak cannot be collected by truck and transported to an urban centre. Collection and removal of scrap metal in a community like Inukjuak requires financial assistance and shipping by sea. This action involves removing from the territory the metals that have accumulated for decades in and around the NL.	
Implementation phases	– Assess policy levers to ensure that the import of new vehicles (cars, trucks, motorcycles, snowmobiles, ATVs, etc.) into the village is accompanied by a requirement that these vehicles be returned for recycling at the end of their useful life to an urban centre in the southern part of the province. – Optimize the classifying and processing of scrap metal (separation of ferrous and non-ferrous metals, vehicle decontamination [e.g., remove oils and fluids], and storage and conditionning for shipment according to recycler requirements). – Request that the transportation and recovery program for the metal stockpiles in Kangirsuk and Aupaluk be extended to Inukjuak and other northern villages. – Engage with the following ministries and organizations for support to implement programs to optimize residual materials management in the North: MELCCFP, MAMH, SPN, RECYC-QUÉBEC, etc.	
Organizations and partners involved	– The northern village of Inukjuak – KRG – Makivik Corporation – MELCCFP, MAMH, SPN, RECYC-QUÉBEC – Funding agencies – Specialized companies	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Quantity of recycled metals.
Strengths		**Weaknesses**
– Metals present in large quantities – Industrial, commercial or residential land freed up for economic growth in the village – Reduction in the quantity of scrap metal in the NL		– Possibility that some metals, stockpiled for several years, are more difficult to recycle – Transportation costs higher than the value of the metals – No road connection
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Available funding – Political momentum in the wake of the BAPE report		– The KRG and the northern villages are not eligible for the Program of Redistribution to Municipalities of Charges Payable for the Disposal of Residual Materials. – Some industrial or mining exploration projects leave their metal debris behind.

<table>
<tr><th colspan="3">Reusing equipment operated by third parties in Inukjuak</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Donating and reselling</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">As a continuation of the used goods store project, this action aims to promote and facilitate the reuse of large equipment brought in by institutions or companies. For example, a company currently operating in Inukjuak mentioned that they brought in an incinerator to manage certain residual materials. However, there is no guarantee that this company will remain in Inukjuak once the project is completed. It would be interesting to know whether this equipment could be useful to the Inukjuak community and whether the owner could leave it behind. This incinerator is only mentioned as an example of equipment operated by third parties in Inukjuak; other examples could include heavy vehicles, worker camp materials, other specific equipment, etc. Transporting certain types of equipment is expensive. Under certain conditions, it could be interesting for companies to consider selling, renting or leaving behind some of their equipment, with the agreement of the village administration.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Establish a protocol for identifying equipment currently used in Inukjuak.
– Include in tenders for equipment, vehicles, etc. a clause that could potentially benefit the community after the work concerned is completed.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– The northern village of Inukjuak
– KRG
– Contractors and institutions carrying out needed projects in Inukjuak</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$
(Budget will vary depending on the agreements made with contractors)</td><td>– Number of devices or equipment donated, rented or sold through this protocol.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Reduction in the company's transportation costs
– Reduction in the northern village’s transportation costs
– Example of collaboration in reuse</td><td>– Requires assessing the real need for certain machinery and other equipment.
– Requires inspection and warranty.
– Some equipment may require specific training.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Favourable demographic context (growing population and need for new buildings and infrastructure)
– Possibility of work for residents in the short and medium term
– Possibility of links and mutual aid between the northern villages
– An equipment reserve potentially useful for other contractors. with possible income from sale or rental</td><td>– Risk that this action could become an easy solution for contractors wishing to dispose of end-of-life or poor-quality equipment
– Acquisition of a large quantity of equipment without any intended use
– Potentially difficult and expensive to service and repair the equipment due to the village's remote location</td></tr>
</table>

Reviewing the drinking water supply system		
Circular economy strategy	**Process optimization**	
Brief description of the action	Underground piping to deliver drinking water to Inukjuak residents is virtually impossible due to permafrost. The drinking water distribution system has had to adapt to the specific conditions of the local environment. This means that, in practice, water is distributed to each residence using tanker trucks that draw from a reservoir in the village. Despite the permafrost-related difficulties, insulated overhead pipe distribution is available. Harrington Harbour on the Lower North Shore experiences extreme climatic conditions as well as rock throughout the village. This small village has an overhead, insulated and heated system for distributing water and collecting wastewater. Water distribution and wastewater management require the use of fossil fuels. However, the question of the drinking water supply system can now be revisited given the pending completion of the electrical system powered by the new run-of-river hydroelectric power station.	
Implementation phases	– Organize a discussion forum between Harrington Harbour and Inukjuak to discuss drinking water distribution issues prior to a diagnosis of Inukjuak's water production and distribution system. – Identify issues associated with climatic and geotechnical conditions. – Involve regional actors in implementing a pilot project to develop a permanent water distribution and collection solution for Inukjuak. – Identify training requirements for the workforce and for servicing the system (the water distribution and collection system's truckers could also be assigned to service the system). – Install water-efficient appliances (toilets, showerheads, etc.). – Raise awareness about water conservation and the new infrastructure.	
Organizations and partners involved	– The northern village of Inukjuak – KRG – CFP – Specialized companies	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$$	– Functional drinking water distribution system
Strengths		**Weaknesses**
– Reduction in the use of fossil fuels – Reduction in periods of restricted usage due to water shortages or full wastewater tanks – Reduction in the quantity of plastic bottles to be handled		– Risk of increased water consumption due to new abundance
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Responds to a serious public health issue – Awareness campaign on responsible water consumption		– Need for worker training – Distribution system that may seem to disturb the visual landscape (exposed overhead pipes) – More complex system to maintain – Specialized labour may be difficult to access in the event of major breakdown

5 Longue-Pointe

5.1 Priority actions

<table>
<tr><th colspan="3">Collection and processing organic matter</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Setting up the collection and processing of organic matter in the territory of Minganie.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Conduct a feasibility study in regards to setting up the collection and processing of organic matter (targeted customers, estimation of quantities, cost of collection and bins, collection modalities, comparative study in regards processing in or out of the region, location and processing method selection, etc.);
– Delegate jurisdictions for organic matter collection, transportation and processing;
– If processing is done in the region, perform the steps allowing organic matter processing (select type of processing and location, request authorization, conception, construction, search for outlets, etc.);
– Apply for a grant from the program for the treatment of organic matter through biomethanization and composting (PTMOBC) to treat organic matter and/or purchase recovery equipment (MELCCFP, 2022b);
– Prepare tendering process for organic matter collection, transportation and if applicable, processing;
– Select equipment and complete the tendering process for their purchasing;
– Modify regional organic matter management regulations;
– Create IAE tools.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Minganie municipalities (including Longue-Pointe) ;
– MRC de la Minganie;
– Régie intermunicipale des matières résiduelles de l’ouest de la Minganie;
– Minganie’s population and ICIs (including those of Longue-Pointe).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td>– Number of brown bins distributed;
– Number of homes served;
– Organic matter recovery rate (annual quantity recovered vs. quantity generated);
– Quality of materials collected with respect to type of collection (% contaminated);
– Quantity and quality of outputs produced (e.g., compost).</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Because of the proximity of the TL, it could be used as the processing location;
– Service desired by the population;
– Redistribution of compost to the population;
– Reduction in the quantity of residual materials at the NL;</td><td>– Reorganization of waste collection schedules and addition of organic matter collection;
– Possible purchase of a new collection vehicle or involvement of a private partner;
– Availability of workers and expertise;</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory requirements to recover organic matter;
– Amendments to the Regulation respecting the charges payable for the disposal of residual materials;
– Funding available through the PTMOBC;
– Reduction in GHG emissions;
– Increase the lifespan of the TL;
– The possibility of integrating septic sludge and biosolids (when the infrastructure will be in function), as well as wood chips as inputs;
– Putting unused vehicles and machinery back into service;
– Creation of a partnership with regional businesses who would have an interest in using the outputs in their activities.</td><td>– Low population density (long distances to travel and relatively low quantities to collect);
– Risk of contamination by non-compostable materials (glass, plastic, etc.);
– No authorized organic matter processing site in the immediate area;
– High investment in machinery, facilities, transportation equipment, etc. ;
– Need to find one or more outlets for the output produced (e.g., compost and digestate).</td></tr>
</table>

Development of new outlets for wood		
Circular economy strategy	**Responsible consumption and procurement, donating and reselling, recycling and composting, recovery**	
Brief description of the action	This action aims to divert wood (e.g. wooden pallets, wood received at the ecocentre) from elimination to reuse it (e.g. energy, composting input, mulch, pyrolysis, pellets, etc.).	
Implementation steps	– Characterize the wood sent to the TL and the ecocentre (type, quantity, quality, etc.) to get an accurate picture of the wood generated; – Analyze the different supply sources (the generators); – Describe current residue management based on generators; – Identify regulatory requirements; – Identify issues and constraints related to wood collection and recovery; – Identify the different recovery options for wood, such as heating, conversion of wood value-added products (pellets, pyrolysis oil, etc.), reuse of pallets, use of wood as an input for organic matter recovery, etc. ; – Identify potential recovery actors in the region and the acceptability parameters and criteria for recovery (e.g. conditioning and necessary equipment); – Analyze advantages and disadvantages for the different recovery options; – Implementation of logistics for wood recovery (e.g. source collection of wood, storage, if required, conditioning and transportation).	
Organizations and partners involved	– Minganie municipalities (including Longue-Pointe municipality); – MRC de Minganie ; – Régie intermunicipale des matières résiduelles de l'ouest de la Minganie ; – Synergie 138 – SADC Côte-Nord ; – Generators, conditioners and recovery actors; – Major energy consumers.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$-$$$$	– Quantity of wood diverted from the landfill; – Number of stakeholders involved.
Strengths		**Weaknesses**
– Wood available in large quantities in the region; – Stimulation of the regional economy.		– Variable wood quality subject to changes; – Requires creating a storage and conditioning space; – Lack of knowldege on the generators outside Longue-Point and on potential recovery actors.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Regulatory obligations to be established (e.g. prohibit sending wood to the landfill, prohibit repairs of fuel furnaces, etc.); – Possibility of energy transition and development opportunities of renewable energy systems with financing support (e.g. programs from Transition énergétique Québec [TEQ], such as *ÉcoPerformance* [MELCCFP, 2023b] and *Bioénergies* [MELCCFP, 2023c] as well as the *Programme d'aménagement durable des forêts* [ministère des Forêts, de la Faune et des Parcs; MFFP], 2021); – Life extension of the TL.		– Little control over procurement; – Ministerial authorization required for storage and conditioning; – Development of a market nearby to dispose of collected and conditioned wood; – Potential investments necessary from recovery; – High transportation costs; – Lack of expertise for companies on the possibility to recover wood in their operations.

<table>
<tr><th colspan="4">Woodchipper rental</th></tr>
<tr><th>Circular economy strategy</th><th colspan="3">Short-term rental</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">This action aims to promote wood recovery by carrying out the first conditioning step, the chipping, which involves the use of a mobile equipment available in the region and that could be rented out.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– Settle an agreement with the woodchipper owner;
– Determine wood generators whose outputs could be processed;
– Identify a space to store the wood that meets the MELCCFP requirements;
– Implement mechanisms to ensure wood procurement:
  – Source sorting at the ecocentre and/or TL;
  – Carry out special collections with businesses;
  – Etc.
– Develop wood outlets.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– Le Phare ;
– Minganie municipalities (including Longue-Pointe);
– MRC de la Minganie;
– Régie intermunicipale des matières résiduelles de l’ouest de la Minganie ;
– Synergie 138.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td colspan="2">– Signing an agreement with the partner;
– Annual quantity of chipped wood;
– Quantity of wood used by recovery businesses associated with the project.</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Availability of raw material;
– Mobile equipment available in the region;
– Reduction of usage fees associated with the machinery;
– No long-term financial engagements.</td><td colspan="2">– Requires the planning of a storage and conditioning space;
– Requires training to operate the woodchipper.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Potential operation cost reductions by recovery businesses.</td><td colspan="2">– Final products must meet the users’ needs.</td></tr>
</table>

<table>
<tr><th colspan="3">Supporting ICI in order to promote use of circular economy strategies including industrial ecology</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Industrial ecology and other applicable circular economy strategies</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This study allowed to identify certain ICI that may develop actions in circular economy (refrigerated storage space rentals, cardboard collection by acquiring a press, etc.). Moreover, ICI generate outputs that could be used as resources for other ICI in the region. These ICI should be supported to exchange materials and implement circular economy projects. A network workshop could be organized by the Longue-Point Municipality, in partnership with Synergie 138.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– This action requires the identification of stakeholders so they can be included in the process;
– A regional strategic plan could be prepared to identify the limits of territory, identify steps, select organizations that should be approached, and prepare a financial package;
– The achievement of this action relies on the knowledge of the shops and businesses' needs. To be aware of these needs, different activities could be organized, such as network workshops, symposiums, lunch conferences, communications with sectoral associations, etc. ;
– Once the needs are known, a support for ICI should be provided (search for funding, grants, potential partners, etc.) to implement these synergies.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Longue-Pointe municipality ;
– Synergie 138 ;
– Industry associations;
– Economic associations (Chamber of commerce, CAE, etc.).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Variable, depends on the project</td><td>Variable, depends on the project</td><td>– Number of supported businesses;
– Number of synergies carried out;
– Savings made by participating ICI;
– GHG emissions avoided;
– Quantity of materials diverted from the landfill or unused resources.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Presence of an organization whose mandate includes circular economy (Synergie 138);
– Growing knowledge of the circular economy concept and its benefits;
– Many actors are willing to contribute to the circular economy transition.</td><td>– Lack of human resources with the ICI;
– Requires regional planning and priority establishment;
– Applicability over the next few years;
– Lack of technical knowledge and stabilization of the Fermont community.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Financial aid programs (ex.: Fonds Écoleader [Fonds Écoleader, 2021], Programme Virage Vert [Réseau des SADC + CAE, 2021], etc.);
– Economic productivity (e.g.: cost reduction for businesses; outputs [stocks] and inputs [procurement];
– Optimization of local resources (intensive use of a same resource);
– Examples of many successful projects driven by Quebec organizations and companies;
– GHG emission reduction;
– Increase LET lifespan;
– Reinforce social cohesion between ICI in the region.</td><td>– Aid programs are relatively unknown by ICI;
– Timeframes and criteria need to be respected;
– Business process modifications;
– Organization and business support required to begin the process.</td></tr>
</table>

<table>
<tr><th colspan="4">Aggregates recovery</th></tr>
<tr><th>Circular strategy</th><th colspan="3">Recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="3">The aggregates are brick, concrete and asphalt.. Because authorized storage and conditioning spaces are lacking, brick concrete and asphalt aggregates are stocked and sent to the NL. This strategy involves providing the
region with an authorized conditioning space.</td></tr>
<tr><td>Implementation phases</td><td colspan="3">– Carry out a characterization for all aggregates sent to the TL to get and accurate picture of the available materials;
– Analyze different supply sources (industries, large construction sites, municipal projects, etc.);
– Identify regulatory requirements;
– Select a site and operator to implement activities that meet with MELCCFP requirements;
– Implementation of a logistics allowing aggregates to be recovered (e.g. storage, conditioning and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="3">– Longue-Pointe municipality;
– MRC de la Minganie;
– Régie intermunicipale des matières résiduelles de l’ouest de la Minganie ;
– Construction sector businesses.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th colspan="2">Success indicators</th></tr>
<tr><td>Medium term</td><td>$$</td><td colspan="2">– Quantity of recovered aggregates;
– Aggregate recovery rate (according to the total generation).</td></tr>
<tr><th colspan="2">Strengths</th><th colspan="2">Weaknesses</th></tr>
<tr><td colspan="2">– Available resources in the region;
– Space available for this activity at the TL.</td><td colspan="2">– Requires the implementation of a storage and conditioning space through funding.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th colspan="2">Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Project may be carried out by city administration or private companies;
– Increase the lifespan of TL;
– Integrate criteria for use of recycled aggregates in public tenders;
– Using materials for other uses after they have reached their useful end of life</td><td colspan="2">– Little control on the quality and quantity of the supply source;
– Ministerial authorization required for storage and conditioning.</td></tr>
</table>

5.2 Lower-priority actions

<table>
<tr><th colspan="3">Replacing fossil fuelled municipal vehicles</th></tr>
<tr><th>Circular strategy</th><th colspan="2">Responsible consumption and procurement</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to assess the feasibility of replacing the current municipal vehicle fleet by electric or hybrid vehicles.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Establish a list of municipal vehicles by type (cars, vans, heavy vehicles) by indicating the age, the total mileage, the annual mileage and the general condition;
– Establish a list of equivalent vehicles according to the types of vehicles used;
– Verify that the autonomy for each type of electric vehicle is compatible with its actual and projected use;
– Carry out a comparative economic analysis, including the fuel, maintenance and purchasing or renting options;
– Prioritize vehicles which need to be replaced by an electric option;
– Evaluate the possibility of sharing unused vehicles with the citizens (sharing economy).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Longue-Pointe municipality.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td>– Number of electric vehicles acquired;
– Savings made after the purchase of electric vehicles (usage fees and maintenance);
– Quantity of GHG emissions avoided.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– The size of the territory is compatible with the vehicle autonomy available in the current market;
– Possibility of grouped purchases allowing cost reductions;
– Facilitates annual budget management because it avoids fuel cost fluctuations;
– Reduction of the environmental impact in the community (GHG emissions and sound).</td><td>– Requires training on eco-driving and energy management;
– Change of vehicles must be planned;
– Preconceptions concerning the effectiveness of electric vehicles;
– Only one charging stations available on the territory (Circuit électrique, 2023).</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Existence of tax incentives (e.g.: Roulez vert [MELCCFP, 2022b] government programs and the Écocamionnage program [MTMD, 2023b]);
– Usage and maintenance costs are lower for electric vehicles;
– Action from the Plan pour une économie verte 2030 - Plan de mise en œuvre 2022-2027 (Gouvernement du Québec, 2022) ;
– When they are not used, municipal vehicles could be used by citizens. This could help maximize the return on investment of the electric-vehicle purchases.</td><td>– Purchase cost is higher for electric vehicles;
– Poor electric vehicle availability;
– Use of public charging stations.</td></tr>
</table>

<table>
<tr><th colspan="3">Creating a used goods store and a donation and reselling web platform</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Donation and reselling, maintenance and repair, refurbishing</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Implementation of a tool to sell or donate reusable articles in the region of Longue-Pointe.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Create a virtual space dedicated to Minganie citizens (e.g. private Facebook group, possibility of including Chibougamau);
– Name responsible group administrators;
– Publicize the web platform at the scale of the city and wider region;
– Assess the feasibility of setting up a physical space, for example at the ecocentre, to receive, sort, store and give away or sell certain reusable items (e.g., building materials or electrical appliances);
– Implement the project;
– Prepare a periodic report on the items that have been offered online and diverted from the landfill.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Municipality of Longue-Pointe;
– MRC de Minganie ;
– Régie intermunicipale des matières résiduelles de l’ouest de la Minganie ;
– Carrefour Famille Minganie;</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term for virtual exchange</td><td>$ for virtual exchange</td><td rowspan="2">– Number of items recirculated;
– Quantity of materials diverted from the landfill;
– Value of items recirculated.</td></tr>
<tr><td>Medium term for a physical space</td><td>$$ for a physical space</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Virtual space is easy to implement and relatively inexpensive;
– Ecocentre is well known and frequented.</td><td>– Requires the creation of a storage space;
– Requires the hiring of employees or presence of volunteers.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Reduction in residents' expenses (free products or cheaper than buying the same new product);
– Social impact (mutual aid and reduction in isolation);
– Reduction of the quantity of materials sent to the TL;
– Possibility of links between the already existing virtual exchange space and the physical space (e.g. weekly publication of "new arrivals" with photos);
– Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [2022]);
– Opportunity for a part-time municipal employee to combine his tasks to the used store project;
– Financial support program.</td><td>– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc. ;
– Surplus items must be managed in the physical space (storage or disposal of unsold items).</td></tr>
</table>

<table>
<tr><th colspan="3">Promoting source sorting of glass containers</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">The MRC de Minganie source sorts different types of glass by collecting them separately from other recyclable materials. If the MRC citizens are well aware of this practice, the tourists and temporary workers may not. Therefore, it would be beneficial for municipalities to promote this practice to increase the quality of this source separation.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Create IAE tools;
– Distribute this material to accommodation facilities;
– Add a new drop off point to sort glass and allow its' voluntary deposit.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– MRC de Minganie;
– Accommodations and tourist establishments from the region of Minganie.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Budget estimate</th></tr>
<tr><td>Short term</td><td>$</td><td>– Number of glass drop-off points;
– Quantity of glass collected by the drop-off points according to the other available collection methods (recyclable materials collection and waste collection).</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Simple action and low cost;
– Infrastructure and equipment are already in place;
– Improvement of the source sorting quality.</td><td>– Seasonal effectiveness (during the tourist season).</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Favourable circumstances with the modernization of the deposit-refund and selective collection systems, in particular for the returnable wine glass bottles that represent an important part of glass collection.</td><td>– Modification of the source sorting procedures with the selective collection modernization;
– Return sites to be implemented in the territory of Québec in the next few years.</td></tr>
</table>

6 Mistissini

6.1 Priority actions

Improvements to the ecocentre		
Circular economy strategy	**Process optimization as well as recycling and composting**	
Brief description of the action	The ecocentre is successful. Thus, new storage spaces for materials received and operational changes should be made so that materials are exported at a steady rate.	
Implementation steps	– Make a list of the materials currently stocked on the site; – Implement an input register to document arrival frequencies of new materials; – Assess storage needs based on the requirements of the different materials on the site and collected by the ecocentre; – Have containers designed to stock HHW; – Install shelters (maritime container, trailers, MegaDome^{MD} buildings, etc.) for the other materials; – Purchase and install different storage structures; – Implement a management protocol input and output materials.	
Organizations and partners involved	– CNM; – CNG.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$	– Quantities of input and output materials; – Compliance of facilities.
Strengths		**Weaknesses**
– Ecocentre already used by citizens; – Improvement regarding the site cleanliness; – Reduction of environmental impacts at the ecocentre; – Reduction of the quantity of materials landfilled at the TL.		– Storing structure currently used by a heavy equipment (loader); – Possible reorganization related to the parking area of the loader; – Administrative delays related to purchases.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Regulatory requirements related to HHW storage; – Contractual requirements related to EPR material storage (between the CNM and the organizations managing EPR); – Life extension of the TL; – Financial support programs.		– High investment regarding storage work and infrastructure.

<table>
<tr><th colspan="3">Management of the products concerned by the EPR</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Action intended to turn Mistissini into an official collection point for all materials covered by EPR and directly related to the optimization of the ecocentre space organization, as described above.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Contact every RMO and complete the required administrative processes to obtain the official title;
– Train the staff of the ecocentre regarding compliance with the requirements related to material condition, storage and access;
– Develop a schedule for the collection to avoid materials accumulation at the ecocentre;
– Monitor new materials managed by an RMO (e.g. fuel pressure cases and pharmaceutical products).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– CNM;
– CNG;
– All the RMO regarding EPR (RecycFluo, EPRA-Québec, SOGHU, GoRecycle, Éco-Peinture, Appel à Recycler, etc.);
– RECYC-QUÉBEC.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$</td><td>– Number of agreements with RMO;
– Quantities of materials collected;
– Quantities of materials managed by RMO.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Service desired by the population;
– Reduction of the quantity of materials landfilled at the TL;
– Better storage management at the ecocentre.</td><td>– Requirements and constraints regarding storage;
– Rigorous administrative monitoring to avoid accumulation.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– EPR materials have a regulatory framework;
– Regulation amending the Regulation respecting the recovery and reclamation of products by enterprises.</td><td>– Action dependent on the storage organization of the materials at the ecocentre (action 6.1.1).</td></tr>
</table>

<table>
<tr><th colspan="3">Compost production optimization</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recycling and composting</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">By implementing organic matter collection as well as a composting process, Mistissini is ahead of a large number of municipalities. During the on-site visit made by Englobe, the rotating composter (designed by from Brome Compost inc.), was not in operation due to a mechanical failure. Moreover, a quick analysis of the compost produced in 2022 revealed the presence of contaminants, such as plastic bags. The compost production process could be improved to avoid another equipment failure and improve the quality of the compost produced.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Determine the cause of the mechanical failure with the manufacturer;
– Review operational processes and protocols of the composter to avoid another failure;
– Perform physical changes on the site where the composter is located, if required;
– Remind employees on the information received concerning composter use and operation;
– Sieve the compost to remove contaminants (the sifter could also be used for residual granular materials);
– Analyze the compost for grade and quality identification;
– Carry out IAE with communities and ICI.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– Brome Compost inc.;
– CNM.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td>– Hours of operation for the composter;
– Quantity of compost produced;
– Quantity of compost used.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Collection system already implemented;
– Reduction of the quantity of materials landfilled at the TL.</td><td>– Resources and specialized resource availability to operate, maintain and repair the composter;
– Training needs;
– May require the addition of new equipment (rotating sifter).</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Future regulatory requirements to recover organic matter;
– Funding available with the Program for the treatment of organic matter through biomethanization and composting (PTOMBC) (MELCCFP, 2022d);
– Reduction of GHG emissions;
– Life extension of the TL.</td><td>– Risk of contamination by non-compostable materials (glass, plastic, etc.);
– Need to find one or many new outlets for the output (the compost produced).</td></tr>
</table>

<table>
<tr><th colspan="3">Creation of a space for donation and reuse</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Donating and reselling</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">The community of Mistissini does not have a used goods store or physical sites for the donation and reuse of objects, materials or others. Therefore, a space to receive and donate reusable materials and items in Mistissini could be implemented. Generally, it requires an area to receive (and temporarily store) donations. These objects are inspected and are displayed in the area dedicated to donating and reselling if they meet quality and reuse criteria. Items should preferably be stored in places protected against weather conditions.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Assess the feasibility of setting up a physical space, for example at the ecocentre, to receive, sort, store and give away or sell certain reusable items (e.g., building materials or electrical appliances);
– Purchase storing structures (standard maritime containers, modified ocean containers, MegaDome[MD] buildings, etc.);
– Implement an online platform to publish new available items;
– Prepare a periodic report on the items that have been offered and diverted from landfills.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– CNM;
– CNG;
– EIJBRG.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$</td><td>– Number of items recirculated;
– Value of items recirculated;
– Quantity of materials diverted from landfills.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Ecocentre known and used by citizens;
– Reduction of goods imports through reuse.</td><td>– Requires the creation of a storage space;
– Requires the hiring of employees or presence of volunteers.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Reduction in residents' expenses (free products or cheaper than buying the same new product);
– Social impact (mutual aid and reduction in isolation);
– Reduction of the quantity of materials landfilled at the TL;
– Possibility of links between the already existing virtual exchange space and the physical space (e.g. weekly publication of "new arrivals" with photos);
– Use of existing business models (e.g., ÉcoDon operated by the Régie de gestion des matières résiduelles du Lac-Saint-Jean [2022]);
– Possibility of adding an item refurbishing section;
– Financial support program.</td><td>– The management of a physical space (e.g., at the ecocentre) requires a minimum of logistics to separate reusable material from broken materials, ensure some rotation of available items, etc.;
– Surplus items must be managed in the physical space (storage or disposal of unsold items).</td></tr>
</table>

<table>
<tr><th colspan="3">Recovery of residual granular materials</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">During spring street cleaning, the CNM collect the abrasives that were used during winter. They are mainly composed of sand and fine gravel. These residual granular materials are temporarily stored on a site within the community. The strategy is then to sieve these materials to reuse them for next winter.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Carry out a characterization of residual granular materials to analyze their condition, confirm whether they contain contaminants, etc.;
– Identify regulatory requirements;
– Start processes to obtain storage authorizations, sieving and recovery of materials;
– Implement logistics to recover residual granular materials (e.g. storage, conditioning, sieving size and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– CNM;
– CNG;
– MELCCFP;</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$</td><td>– Quantity of residual granular materials.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Resources available in the region;
– Storage spaces already available.</td><td>– Presence of residual materials (that will be managed during sieving) in residual granular materials;
– Characterization work that is expensive and that lasts for a long time.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Good examples of reuse and successful projects elsewhere in Quebec;
– Possibility to use the same rotary sieve used for the compost;
– Life extension of the TL;
– Reuse of materials following the end of their useful life.</td><td>– Little control over procurement quality and quantity;
– Ministerial authorization required for storage and conditioning;
– If recovery criteria are not met, these materials could be residual hazardous materials.</td></tr>
</table>

Compost recovery		
Circular economy strategy	**Recovery**	
Brief description of the action	At the moment of the on-site visit (July 2022), the compost produced in Mistissini was not recovered. This action, related to the optimization of the compost process, focuses on finding new outlets for the compost locally produced.	
Implementation steps	– Sieve the compost to remove contaminants; – Characterize the compost to analyze its quality; – Recover the compost based on its quality and use specified through regulations. It could be forest projects, distribution to citizens, improvements of grass surfaces, etc.; – If required, recover the compost for a possible greenhouse project; – In the absence of such a project, use the compost to restore or revegetate degraded sites (e.g. the former TL).	
Organizations and partners involved	– CNM; – CNG.	
Timeline	Budget estimate	Success indicators
Medium term	$	– Quantity of compost recovered (in weight or volume).
Strengths		Weaknesses
– During the distribution to citizens, it would reward people involved in the organic matter collection.		– Requires logistics; – A sieving should be carried out; – Potential presence of contaminants in organic matter.
Potential opportunities and levers regarding the strategy		Potential threats and obstacles to the strategy
– The use of the compost is the logical continuation of the compost production; – Compost improves soil quality.		– Possible use of the output depending on the quality of the compost; – Quality of the compost related to the processes, the quality of raw materials collected and the success of the awareness-raising efforts put regarding organic matter collection.

6.2 Lower-priority actions

<table>
<tr><th colspan="3">Development of new outlets for wood</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Responsible consumption and procurement, donating and reselling, recycling and composting as well as recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to divert wood (forest residues and wood pallets) from elimination to reuse it (e.g. reuse of CRD waste, energy, composting input, mulch, pyrolysis, pellets, etc.).</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Characterize the wood sent to the TL and the ecocentre (type, quantity, quality, etc.) to get an accurate picture of the types of wood generated;
– Analyze the different supply sources (the generators);
– Describe current residue management based on generators;
– Identify regulatory requirements;
– Identify issues and constraints related to collection and recovery;
– Identify the different recovery options for wood, such as heating, manufacturing of wood value-added products (pellets, pyrolysis oil, etc.), reuse of pallets, use of wood as an input for organic matter recovery, etc.;
– Separate wood used for construction work to be reused for the renovation or construction of new buildings;
– Identify potential recovery actors in the region (e.g. in Chibougamau or in Chapais) and the acceptability parameters and criteria for recovery (e.g. conditioning and necessary equipment);
– Analyze advantages and disadvantages for the different recovery options;
– Implementation of logistics for wood recovery (e.g. wood collection at the source, storage, if required, conditioning and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– CNM;
– CNG;
– People generating, conditioning and recovering;
– Major energy consumers (Chapais énergie, Chantier Chibougamau and Barrette-Chapais ltée).</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$-$$$$</td><td>– Quantity of wood diverted from elimination;
– Number of stakeholders involved.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Wood available in large quantities in the region;
– Stimulation of the regional economy.</td><td>– Variable wood quality subject to changes;
– Requires creating a storage and conditioning space;
– Lack of knowledge on the generators outside Mistissini and on potential recovery actors.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Current of future regulatory requirements (e.g. prohibition regarding wood elimination or regarding oil furnace repairs, etc.);
– Development of a heat network based on the approach set by the community of Oujé-Bougoumou or for a greenhouse;
– Possibility of energy transition and development opportunities of renewable energy systems with funding support (e.g. programs from Transition énergétique Québec [TEQ], such as ÉcoPerformance [MELCCFP, 2023b] and Bioénergies [MELCCFP, 2023c] as well as the Programme d'aménagement durable des forêts [ministère des Forêts, de la Faune et des Parcs; MFFP], 2021);
– Life extension of the TL.</td><td>– Little control over procurement;
– Ministerial authorization required for storage and conditioning;
– Development of a market nearby to dispose of collected and refurbished wood;
– Potential investments necessary from recovery actors;
– High transportation costs;
– Lack of expertise for companies on the possibility to recover wood in their operations.</td></tr>
</table>

<table>
<tr><th colspan="3">Development of IAE tools for the collection of organic matter</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Process optimization</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Results from the characterization of residual materials revealed that significant quantities of organic matter, mainly food waste, are thrown away in Mistissini. An awareness campaign has already been conducted. A new awareness campaign would then be necessary, especially since the organic matter collection service has been temporarily stopped due to a mechanical failure of the composter.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Develop an awareness campaign on organic matter collection;
– Benefit from this campaign to develop IAE tools to raise awareness among the community about food waste and suggest tools to reduce it;
– Focus on citizens and ICI;
– Carry out the campaign as well as a follow-up.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– CNM;
– CNG.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$</td><td>– Number of new participating ICI;
– Quantity of organic matter collected;
– Quantity of compost produced;
– Collection rate of organic matter;
– Quantity of contaminants in the compost.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Collection system already implemented;
– Possibility to recruit new participants;
– Possibility to improve the quality of the composted materials;
– Reduction of the quantity of materials landfilled at the TL.</td><td>– Resources and specialized resource availability for the awareness campaign.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– IAE tools on organic matter collection (RECYC-QUÉBEC, 2023c) and on food waste (RECYC-QUÉBEC, 2023d) developed by RECYC-QUÉBEC for municipalities;
– Regulatory requirements to recover organic matter;
– Amendments to the Regulation respecting the charges payable for the disposal of residual materials;
– Reduction of GHG emissions;
– Life extension of the TL.</td><td>– No potential threat or obstacle.</td></tr>
</table>

7 ArcelorMittal

7.1 Priority actions

<table>
<tr><th colspan="3">Evaluate tailings and waste rock recovery potential</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Industrial ecology</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">AMIC has already carried out actions to understand the waste rock and mine tailings' compositions. The next step would be to evaluate recovery or reusing opportunities of these materials according to their physicochemical characteristics. Opportunities could emerge and additional analysis or other studies could be necessary. For example, is there a potential to reuse waste rock in the framework of road projects or can the silica found within this mine tailings be used as raw material for other types of projects?</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Produce a list of recovery possibilities according to Mont-Wright's waste rock and tailings characteristic;
– Carry out studies on similar worldwide projects to determine recovery potential that should be privileged;
– Contact industrial ecology specialized expertise;
– Evaluate the implementation of such a pilot project.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– AMEM and AMIC;
– AMQ ;
– Testing laboratories;
– Organizations such as the CTTEI, the Centre technologique des résidus industriels (CTRI) or Innosphère.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td>– Determining the waste rock's and tailings' potential.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Waste rock and tailings are available in large quantities;
– Railway available for material transportation;
– Existence of specialized industrial ecology Quebec organizations working with mining waste.</td><td>– Geographic remoteness and isolation of the AMMW site (compared to major urban centres in the province);
– Lack of specialized labour.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Major reconstruction projects on route 389 (which will require important quantities of materials);
– Action plan: Plan québécois pour la valorisation des minéraux critiques et stratégiques 2020-2025 (Gouvernement du Québec, 2020).</td><td>– Availabilities of electric energy must be validated for new uses;
– Requires finding one or many outlets for mine tailings and/or waste rock.</td></tr>
</table>

<table>
<tr><th colspan="3">Raise awareness with workers about personal equipment use</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Responsible consumption and procurement, donation and reselling, recycling and composting and recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action consists of raising workers' awareness about the replacement of equipment that is still in good condition such as helmets, headlamps, gloves of all sorts, etc. One of the challenges this action holds is that the majority of the workers opereate on a rotation system. For a worker to be able to reuse his equipment, he must be able to store it properly during his time off, when the workers are away from the AMMW site.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Integrate this challenge in the existing environmental committee (or implement a joint committee similar to the health and safety committee);
– Inform and raise workers' awareness on the objectives and challenges of this action;
– Establish a list of reusable objects;
– Identify incentives to promote reusing equipment;
– Consider the option of giving away the material rather than throwing it away;
– Publish the performance of this action.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– AMEM and AMIC;
– Board members, unions and workers.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$</td><td>– Personal equipment purchases;
– Quantities of donated equipment;
– Disposal rate of functional equipment measured by characterization.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Reduction of materials sent to the TL;
– Budget saving.</td><td>– Development of an indicator for calculating the normal lifespan of each equipment;
– Detailed report of the works, tasks, and certain equipment that may get soiled quickly.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Implement an equipment cleaning system to promote reuse;
– Implement a measuring system per worker for equipment replacement.</td><td>– This action must be seen as an advantage for the environment and not as a means of control or loss of acquired rights for workers;
– Change resistance from workers.</td></tr>
</table>

<table>
<tr><th colspan="3">Defining wood recovery solutions</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Responsible consumption and procurement, donating and reselling, recycling and composting, recovery</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">This action aims to divert wood (mainly wood pallets) from elimination to give them second life (e.g. energy, composting input, mulch, pyrolysis, etc.). Note that AMEM undertook steps to recover wood and is looking forward to continuing these initiatives.</td></tr>
<tr><td>Implementation steps</td><td colspan="2">– Characterize the wood sent to the TL and the ecocentre (type, quantity, quality, etc.) to get an accurate picture of the wood generated;
– Identify issues and constraints related to wood collection and recovery;
– Identify the different recovery options for wood, such as heating, conversion of wood value-added products (pellets, pyrolysis oil, etc.), reuse of pallets, use of wood as an input for organic matter recovery, etc.;
– Identify potential recovery actors in the region and the acceptability parameters and criteria for recovery (e.g. conditioning and necessary equipment);
– Define an organic wood recovery pilot project for mine tailings sites;
– Analyze advantages and disadvantages for the different recovery options;
– Implementation of logistics for wood recovery (e.g. source collection of wood, storage, if required, conditioning and transportation).</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– AMEM and AMIC;
– City of Fermont;
– MRC de Caniapiscau ;
– Synergie 138 – SADC Côte-Nord ;
– MELCCFP.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Short term</td><td>$$</td><td>– Quantity of wood diverted from the landfill;
– Number of stakeholders involved.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Wood available in large quantities in the region;
– Stimulation of the regional economy.</td><td>– Variable wood quality subject to changes;
– Requires creating a storage and conditioning space;</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– Regulatory obligations to be established (e.g. prohibit sending wood to the landfill, prohibit repairs of fuel furnaces, etc.);
– Develop a heat network on the same basis of the Oujé-Bougoumou community or for a green house;
– Possibility of energy transition and development opportunities of renewable energy systems with financing support (e.g. programs from Transition énergétique Québec [TEQ], such as ÉcoPerformance [MELCCFP, 2023b] and Bioénergies [MELCCFP, 2023c] as well as the Programme d'aménagement durable des forêts [ministère des Forêts, de la Faune et des Parcs; MFFP], 2021).</td><td>– Little control over procurement;
– Ministerial authorization required for storage and conditioning.
– Development of a market nearby to dispose of collected and conditioned wood.</td></tr>
</table>

Evaluating the possibility of optimizing rail transport of recyclable materials		
Circular economy strategy	**Sharing economy**	
Brief description of the action	Accessibility and transportation are major challenges for the region of Fermont. This action aims to evaluate the possibility of optimizing the use of the railway. The first objective will always be to transport iron concentrate to Port-Cartier. This project would aim to evaluate, on a technical point, if a railroad car carrying out recyclable materials could be added.	
Implementation steps	– Carry out an optimization study of railway use; – If appropriate, estimate additional costs associated with the transportation of one or more railroad cars containing recyclable materials; – If appropriate, determine the means of transportation (e.g. type of railroad car) and a loading method; – If appropriate, negotiate an agreement with the City of Fermont for the transportation of recyclable materials.	
Organizations and partners involved	– AMEM and AMIC; – City of Fermont.	
Timeline	**Budget estimate**	**Timeline**
Short term	$$$	– Carry out a feasibility study; – Quantity of recyclable materials carried out by railway transportation.
Strengths		**Weaknesses**
– Optimize an existing infrastructure; – Examples of the cooperation between the City and company; – Possibility of sharing costs with the City.		– This project cannot harm the transportation of iron ore.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Modernization of the deposit-refund and selective collection systems; – Increase quantities of recyclable materials diverted from the TL.		– Equipment investments for transhipping.

7.2 Lower-priority actions

<table>
<tr><th colspan="3">Optimizing selective collection of recyclable materials</th></tr>
<tr><th>Circular economy strategy</th><th colspan="2">Recyclage et compostage</th></tr>
<tr><td>Brief description of the action</td><td colspan="2">Certain initiatives related to the sorting of recyclable materials are already established and equipment to press cardboard are in place. However, the implemented selective collection is disparate from one building to another. This action aims to upgrade this service and follow up the Mont-Wright and Fire-Lake selective collection available throughout the worker campsites and complexes of Fermont.</td></tr>
<tr><td>Implementation phases</td><td colspan="2">– Install sorting equipment on the overall site. Replace any orphan waste receptacles by two-way bins (recyclable materials and waste). Standardize the collection equipment;
– Identify temporary storage space for recyclable materials on each site;
– Maximize the use of the cardboard press. If needed, move the press to other areas where cardboard is generated in larger quantities;
– Establish a transportation strategy between the different sites and identify a central sorting space at Mont-Wright. Ideally, the storage central should be close to the railway to facilitate the railroad cars loadings;
– Considering that the recyclable materials are transported by train, reflect on the best way to tranship and transport recyclable materials by taking into considerations the AMMW's and Port-Cartier's loading and unloading infrastructure (e.g. use the railroad cars transporting iron ore or use close railroad cars);
– Evaluate the available transportation capacity on the railway convoy according to the number of railroad cars, amount of iron ore and number of engines;
– Create IAE tools.</td></tr>
<tr><td>Organizations and partners involved</td><td colspan="2">– AMEM and AMIC;
– Le Phare ;
– City of Fermont.</td></tr>
<tr><th>Timeline</th><th>Budget estimate</th><th>Success indicators</th></tr>
<tr><td>Medium term</td><td>$$$</td><td>– Number of cardboard bales;
– Quantity of recycled materials transported to Port-Cartier;
– Recyclable material collection rate;
– Number of carloads of recyclable materials transported to Port-Cartier.</td></tr>
<tr><th colspan="2">Strengths</th><th>Weaknesses</th></tr>
<tr><td colspan="2">– Cardboard press already available on the site;
– Selective collection offered in many areas of the site.</td><td>– Transportat of recyclable materials less automated than ore transport, and requires more manipulations and labour;
– Requires the development of a new storage and processing space.</td></tr>
<tr><th colspan="2">Potential opportunities and levers regarding the strategy</th><th>Potential threats and obstacles to the strategy</th></tr>
<tr><td colspan="2">– The Québec 2020-2024 action plan from the Politique québécoise de gestion des matières résiduelles plans to help out isolated communities in their residual materials management;
– Modernization of the deposit-refund and selective collection systems;
– Acquiring an attestation or certification (e.g. ICI on recycle +);
– Possibility of a partnership with the City of Fermont.</td><td>– Possibility of railway transportation costs to increase (addition of new materials to transport).</td></tr>
</table>

Collection and processing organic matter		
Circular economy strategy	**Recycling and composting**	
Brief description of the action	Setting up the collection and processing of organic matter at the mining site (in complement to the City of Fermont).	
Implementation phases	– Conduct a feasibility study in regards to setting up the collection and processing of organic matter (targeted customers, estimation of quantities, cost of collection and bins, collection and processing modalities); – Select sorting equipment; – Install 3-way sorting stations (organic matter, recyclable materials and waste). Standardize the collection equipment in locations where organic matter are most susceptible to be generated (e.g. kitchens, work camps and residential complexes); – Place collection equipment (bins and containers) in strategic locations; – Evaluate the possibilities of partnership/agreements for processing of organic matter; – Create IAE tools.	
Organizations and partners involved	– AMEM and AMIC; – City of Fermont; – MRC de Caniapiscau; – Fermont workers and citizens.	
Timeline	**Budget estimate**	**Success indicators**
Medium term	$$$	– Number of brown bins distributed; – Organic matter recovery rate (annual quantity recovered vs. quantity generated); – Quality of materials collected with respect to type of collection (% contaminated); – Quantity and quality of outputs produced (e.g., compost).
Strengths		**Weaknesses**
– Reduction in the quantity of residual materials at the TL; – Regional need of organic matter for mining sites restoration.		– Reorganization of waste collection schedules and addition of organic matter collection; – Availability of workers and expertise.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Regulatory requirements to recover organic matter; – Amendments to the *Regulation respecting the charges payable for the disposal of residual materials;* – Reduction in GHG emissions; – Increase the lifespan of the TL; – Funding available through the PTMOBC (MELCCFP, 2022c); – The possibility of integrating septic sludge and biosolids (when the infrastructure will be in function), as well as wood chips as inputs;		– Risk of contamination by non-compostable materials (glass, plastic, etc.); – No authorized organic matter processing site in the immediate area; – Investment in machinery, facilities, transportation equipment, etc. ;

Validating the possibility of extending the steam network to other buildings and site sectors		
Circular economy strategy	**Industrial ecology and recovery**	
Brief description of the action	A steam network is already in place at the AMMW site. The objective of this action would be to consolidate this existing network in order to limit steam loss. Then, it will be necessary to verify that this network and heat can be used in other sectors or buildings to, for example, replace the electrical heating.	
Implementation phases	– Establish a maintenance, repair and follow-up plan in regards to the existing network (to stop leaks for example); – Determine the actual usage of the boiler (can the equipment produce enough steam?); – If appropriate, for each building on the AMMW site, including the worker camp sites, determine the technical feasibility to use the steam produced in substitution to another source of energy; – According to the results of the technical feasibility, analyze the economic aspect.	
Organizations and partners involved	– AMEM and AMIC; – The City of Fermont.	
Timeline	**Budget estimate**	**Success indicators**
Mid term	$$ - $$$$ (depends on the project and if the network is expanded)	– Length of the steam network; – Energy savings.
Strengths		**Weaknesses**
– Boiler in place and functional; – Stimulation of the regional economy.		– Requires infrastructure investments.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Favourable Nordic climate; – Financial aid programs such as *Valorisation des rejets thermiques* (Gouvernement du Québec, 2023b).		– High cost.

Validating the use of a performance economy tire approach		
Circular economy strategy	**Performance economy**	
Brief description of the action	The company buys, consumes and uses large quantities of tires, in particular oversized tires. These tires are bought through different suppliers. This action consists of assessing the interests of one or more suppliers in opting for a performance economic approach.	
Implementation phases	– Elaborate and conduct a performance economy training at AMEM and AMIC. The objective would be to understand the requirements and benefits for this unconventional approach; – Contact tire suppliers; – Implement new purchasing procedures.	
Organizations and partners involved	– AMEM et AMIC ; – Tire suppliers.	
Timeline	**Budget estimate**	**Success indicators**
Medium to long term	N.A.	– Training session on the subject; – Number of employees trained; – Signing an agreement with a supplier concerning performance economy; – Number of tires targeted by the agreement.
Strengths		**Weaknesses**
– No large investment needed for the acquisition of tires; – Transfer the tire management to the suppliers; – Reduction of residual materials generated.		– New tire cost increase to consider because the tire management done for its whole life cycle (inflation, tire pressure, maintenance, etc.) will be included in the price; – New approach that is relatively unknown; – New types of relations with the suppliers.
Potential opportunities and levers regarding the strategy		**Potential threats and obstacles to the strategy**
– Represents an organizational innovation example for AMEM and AMIC; – Frequent or permanent contact with suppliers, loyalty, dialogues and exchanges to improve the products. – Possible support by the Économie de la fonctionnalité et de la coopération au Québec (EFC Québec), a program that is under the CTTEI's coordination; – Possibility to focus on the tires that are already on the site, without new inputs.		– Requires a change in the business model; – Requires negotiations with suppliers; – Such agreements are relatively rare for oversize tires (but this type of agreement already exists with cars and trucks).

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