



Quebec Government Green Bond Program

Estimation of GHG emissions avoided by
the new Azur trains

Société de transport de Montréal

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Context

- The Government of Quebec **issued its first Green Bond on February 24, 2017.**
- The Quebec Green Bond Program funds projects that generate tangible benefits relating to environmental protection and more precisely:
 1. Reduction in greenhouse gas (GHG) emissions
 2. Climate change adaptation
- The Government of Quebec has committed to publishing an annual **report on project progress as well as GHG emission reduction and climate change adaption benefits.**
- **The first Green Bond issue funded the acquisition of the new Azur trains.**
- **This presentation explains the methodology used to estimate the GHG emissions avoided by putting the Azur trains into service.**



General methodology

- Public transit is a recognized and effective means of reducing GHG emissions.
- In 2016, a [study conducted by the firm Golder](#) for various municipal and provincial partners and transit authorities shows that the total GHG emissions avoided from public transit in the Greater Montréal area are **3,911,000 million tons of CO₂e per year**.
 - Quantification of GHG emissions avoided was realized according to the guidelines proposed in the [American Public Transportation Association's Recommended Practice for Quantifying Greenhouse Gas Emissions from Transit](#), based on three factors:
 1. **Mode shift to transit:** “Because of public transit, there are fewer cars on the road.”
 2. **Congestion relief:** “Because of public transit, there is less road congestion, idling and stop and go traffic.”
 3. **Land-use multiplier:** “Because of public transit, the territory has a greater density that promotes shorter trips, walking and cycling, and reduced car use.”
 - In addition, the **Transit Cooperative Research Program (TCRP)** methodology related to density was also used.
- The method used to estimate the GHG emissions avoided by the Azur trains only takes into account the **Mode shift to transit factor**.



Key assumptions and results

- **Mode shift to transit** effect associated with Azur:
 - If Azur had not been put into service, a part of the métro service could not be offered.
 - As a result, trips made on Azur trains and trips combining bus and Azur would have, in part, been made by car.
- The calculation is based on the following steps, which will be presented in more detail:
 - Step 1: Conversion of ridership into passenger-kilometres by métro and bus/métro
 - Step 2: Estimation of passenger-kilometres on Azur trains
 - Step 3: Estimation of vehicle kilometres by car avoided thanks to Azur
 - Step 4: Conversion of vehicle kilometres by car avoided into GHG emissions avoided.

Based on this methodology, we estimate that the service offered by Azur in 2017 made it possible to avoid the emission of 78,737 tons of CO₂e.

- Note: this quantification aims to identify the ongoing benefits associated with the Azur trains in terms of GHG emissions avoided from public transit use.



Step 1: Ridership conversion into passenger kilometres by métro and bus/métro (1/2)

- Passenger kilometres correspond to the annual accumulated distance travelled by users on the STM network.
- Passenger kilometres are calculated using: STM ridership (total number of annual trips) and the results of the [enquête Origine-Destination 2013](#) (2013 Origin/Destination Survey), which enables us to differentiate the distribution of trips and distances travelled by mode (bus, métro, bus and métro).

Trip mode	Percentage of mode of total STM trips	Average distance by métro	Average distance by bus
Métro only	41.7%	7.9 km	0.0 km
Bus only	30.6%	0.0 km	4.9 km
Bus and métro	27.7%	7.8 km	5.1 km

- We aim to quantify the passenger kilometres travelled on “métro only” and “bus and métro” trips.



Step 1: Ridership conversion into passenger kilometres by métro and bus/métro (2/2)

- ▶ Passenger kilometres by métro and bus/métro = *(total annual trips X percentage of métro trips (%) X average distance of métro trips (km)) + (total annual trips X percentage of bus/métro trips (%) X average distance by bus/métro).*
- ▶ In 2017, total *passenger kilometres by métro and bus/métro* (accumulated distance travelled by users on métro and bus/métro) were 2,956,364,607.



Step 2: Estimation of passenger kilometres on Azur trains

- At this step, we aim to identify the distance travelled on trips made on Azur trains and trips combining bus and Azur trains.
- There is no data that enables us to identify métro ridership or passenger kilometres by métro by type of rolling stock. In this case, we estimate the passenger kilometres by métro and bus/métro in proportion to the service offered in seat kilometres.
- Seat kilometres offered to users correspond to the number of seats available over the distance travelled by buses and métro cars during the year. In 2017, Azur seat kilometres represented 24.9% of métro seat kilometres.
- Passenger kilometres by Azur = *Passenger kilometres by métro and bus/métro* X *Percentage of métro seat kilometres travelled by Azur*.
- In 2017, the **passenger kilometres by Azur** (accumulated distance travelled by users on the Azur or combined bus/métro trips using Azur) are estimated at 737,112,977.



Step 3: Estimation of vehicle kilometres by car avoided by Azur

- At this step, we aim to identify what percentage of *passenger kilometres by Azur* would be travelled by car if the Azur had not been put into passenger service. We therefore consider that the portion of the service performed by the Azur could not be offered to users who would use other modes of transport, such as single occupant vehicle use, taxi, carpools, bike, walking, no trips.
- To do this, we use the modal transfer rate obtained by a survey in the [Quantification des émissions de GES évitées par le transport collectif](#) study (quantification of greenhouse gas emissions avoided from public transit) (see section 3.1.2.)
 - In this calculation, Montréal's modal transfer rate (47%) was used because the calculations relate to trips made by métro.
- Vehicle kilometres by car avoided by Azur = Azur passenger kilometres X modal transfer rate.
- In 2017, the **vehicle kilometres by car avoided by Azur** (accumulated distance travelled by users if the Azur had not been put into service) are estimated at 346,443,099.



Step 4: Conversion of vehicle kilometres by car avoided into GHG emissions avoided

- At this step, we aim to convert *vehicle kilometres by car avoided by Azur* into GHG emissions avoided.
- To do this, we use the emission rate per kilometre of an average car in Montréal provided in the [Quantification des émissions de GES évitées par le transport collectif](#) (quantification of greenhouse gas emissions avoided from public transit) study (see section 3.1.4.)
- Tons of GHG emissions avoided by Azur = Vehicle kilometres by car avoided by Azur X average emission rate per kilometre.
- **In 2017, GHG emissions avoided by Azur are estimated at 78,737 tons of CO₂e.**



Methodology summary

► Mode shift to transit effect associated with Azur for 2017:

- If Azur had not been put into service, a part of the métro service could not be offered.
- As a result, trips made on Azur trains and trips combining bus and Azur would have, in part, been made by car.

