Fort Erie Case Study – Transition from Fixed-Route to On-Demand Transit

Bonnie Powell
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Photo from the town of Fort Erie.
Motivation & Methodology

• Motivation
  – Part of an ongoing series of case studies conducted by NREL
  – Energy, emissions implications

• Fort Erie case study
  – Interviews with Fort Erie Transit and Pantonium (software partner)
  – Data provided by Fort Erie Transit and the software partner
  – Analyzed trips between October 2017 and July 2022
Close to Niagara Falls and Buffalo
Population: 32,901 (plus ~10,000 seasonal residents)
Area: 64 mi² (166 km²)
“Community of communities”, spread out population centers
• Fixed-route offered about 70% of population reasonable access to transit
• Low ridership, even lower during the pandemic
• Long ride and wait times

The fixed routes included four lines: East Blue, East Green, West Yellow, and North Red. Image from the town of Fort Erie.
Options Considered

• Research conducted in 2019/2020
• Options:
  – Switching direction of buses
  – First-mile/last-mile service
  – Partnering with a TNC
  – Fully on-demand with designated smaller vehicles and software partner
• Regional Limousine owns and operates vehicles and manages call center, Pantonium handles scheduling and dispatching software
On-Demand System

- Launched October 2021
  - Two-week overlap with fixed-route system
- Fleet – 7 regular Dodge Caravans, 2 wheelchair-accessible vans
- Schedule using phone call, webpage, or mobile app
- Walk-on boardings allowed at certain stops
- $3/ride – cash, credit/debit, reloadable smart card
- Operating hours: 6 a.m. – 9 p.m., Mon-Sat

Fort Erie’s On-Demand Transit – Rider App. Images from the town of Fort Erie.
Fixed routes (left) were “reasonably accessible” to 70% of Fort Erie residents. On-demand now serves the full town of Fort Erie. Images from the town of Fort Erie.
ADA Accessibility and Other User Features

• 2 wheelchair-accessible vans
• Bikes can be stored on trunk rack
• Strollers can be loaded in truck
• Passengers can bring their own car seats (optional)
Results
Ridership has exceeded pre-COVID levels and is still increasing.

*Total monthly riders before and after the on-demand system was instituted (October 1, 2017 to November 30, 2022)*
Increased Service Area

- On-Demand captures remaining 30% of population

A heat map showing where vehicles providing trips traveled, using latitude and longitude coordinates recorded every 30 seconds for all assigned trips from October 4, 2021, to July 19, 2022.
Pickup/Dropoff Locations

Pickup Locations

Drop-Off Locations
Pickup/Dropoff Locations

Top 10 Pickup Locations

Top 10 Dropoff Locations
Wait Times

<table>
<thead>
<tr>
<th>Overall</th>
<th>10.5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>For passengers using a wheelchair</td>
<td>14 minutes</td>
</tr>
</tbody>
</table>

*Box and whisker plot: the box extends from quartile 1 (Q1) to Q3 and has a line at the median. The whiskers extend to 1.5x the inter-quartile range.

Average wait time for each operating hour of the day, for all trips between October 4, 2021, and July 19, 2022. Outliers 1.5x the inter-quartile range, representing approximately 1.7% of trips, are not shown.
Average wait time for each operating hour of the day, for completed trips with a passenger using a wheelchair, between October 4, 2021, and July 19, 2022. 12 outliers 1.5x the inter-quartile range are not shown.
**Ride Times**

<table>
<thead>
<tr>
<th>Average Ride Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
</tr>
<tr>
<td>13.5 minutes</td>
</tr>
</tbody>
</table>

*Box and whisker plot: the box extends from quartile 1 (Q1) to Q3 and has a line at the median. The whiskers extend to 1.5x the inter-quartile range.*

Average ride time for each operating hour of the day, for all trips between October 4, 2021, and July 19, 2022. Outliers 1.5x the inter-quartile range, representing 3.7% of trips, are not shown.
Lower fuel consumption after on-demand
Fuel consumption now demand-responsive. Vehicles do not move until called.

Average fuel consumption per ride before and after the on-demand system was instituted (October 1, 2017 to May 1, 2022)
Total Fuel Consumption

- Total fuel is lower
- Fuel is now proportional to ridership

*Average monthly fuel consumption and monthly rides, with linear projection of rides.*
### Carbon Dioxide Emissions

#### Emissions per ride decreased by 63%

<table>
<thead>
<tr>
<th>Year</th>
<th>Time Period</th>
<th>System</th>
<th>Total Rides</th>
<th>Km Traveled (miles)</th>
<th>Fuel Consumed [Liters] (gal)</th>
<th>Avg L/100 km (gal/100 mi)</th>
<th>Emissions [kg CO2]</th>
<th>Emissions [kg CO2/km]</th>
<th>Emissions [kg CO2/ride]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>Six months*</td>
<td>Fixed Route</td>
<td>19,784</td>
<td>205,976 (127,988)</td>
<td>79,402 (20,976)</td>
<td>38.55 (16.39)</td>
<td>213,590</td>
<td>1.04</td>
<td>10.80</td>
</tr>
<tr>
<td>2021-2022</td>
<td>Six months**</td>
<td>On-Demand</td>
<td>18,381</td>
<td>180,908 (112,411)</td>
<td>31,373 (8,288)</td>
<td>17.34 (7.37)</td>
<td>72,785</td>
<td>0.40</td>
<td>3.96</td>
</tr>
</tbody>
</table>

*Annual 2019 data divided by two  
**October 2021 – March 2022

Table: Distance traveled, fuel consumed, and carbon dioxide emissions for half of 2019 (fixed route system) and a six month period from October, 2021 to March, 2022 (on-demand system).
• Current on-demand system uses Dodge Caravans.
• Potential to further reduce CO₂ emissions by using hybrid or plug-in hybrid mini-vans, or electric buses.

Estimated emissions per ride for the baseline case (Dodge Caravans) and two hypothetical scenarios where all vehicles are replaced with hybrid all-wheel drive Toyota Siennas or plug-in hybrid Chrysler Pacificas. Both upstream and tailpipe emissions are included, using an electricity grid mix for Buffalo, New York.
Operating Costs

• Single ride costs the customer $3 (same as fixed-route system)
• Costs per ride to Fort Erie Transit
  – On-demand: ~$17/ride
• Annual budget
  – Fixed-route: $1.4 million
  – On-demand: originally proposed at $950,000, increased to $1.4 million after ridership increases offset the decrease in operating costs

*All costs in Canadian dollars
Outreach and Customer Feedback

- Word-of-mouth was the most common way riders heard about the on-demand system.
- 84% of survey respondents rated their overall trip satisfaction as either a 4 or 5, average rating was 4.48.

Preliminary results from onboard comment cards, collected April and May 2022, show how riders heard about the on-demand system. The sample size was 46 respondents.
Conclusions

• Fort Erie’s on-demand system moves more people using less fuel and same annual budget
• Guided by Mobility Energy Productivity
  – Travel time / wait time
  – Cost (traveler/agency)
  – Energy & emissions
• High value of automatically collected data, potential to inform future changes to transit
• Scalability is a key consideration
• Just one case study, but shows potential of on-demand transit