

GREEN LINE LRT – ENVIRONMENTAL BENEFITS

EXECUTIVE SUMMARY

This report outlines Administration's current understanding and quantification of the potential environmental benefits associated with delivery and operation of Green Line, Calgary's third light rail transit (LRT) line. Information presented in this report, and additional information that becomes available in time, may be used in support of business cases being prepared for submission to provincial and federal governments. The Province of Alberta in 2015 released its Climate Leadership Plan and a new carbon tax scheme that would generate revenues potentially used to make investments in energy efficiency including public transit infrastructure.

Key environmental benefits of the Green Line include the following:

- Energy efficiency gains are achieved with only 18 passengers riding an LRT train, which is the "break even" point for LRT to save energy compared with 18 automobiles;
- It presents opportunities to leverage Calgary Transit's past investments and experience gained in energy efficiency, pollution control, and renewable energy;
- The introduction of Green Line would directly reduce greenhouse gas (GHG) emissions by 52,000 tonnes of carbon dioxide equivalent annually;
- Twenty-two million litres of gasoline and diesel fuel consumed annually would be displaced by renewable electricity (or lower carbon energy) used to power Green Line;
- A two per cent reduction of smog-forming tailpipe emissions is projected; and
- Land use densification in transit nodes and corridors will be facilitated by Green Line LRT development resulting in further long-term environmental benefits.

This new line, combined with ongoing transit service enhancements and changes in land use, is projected to result in significantly increased transit ridership on opening day with the benefits continuing to grow beyond 2024. The 3-line LRT network, with feeder buses and cross-town BRT routes that better connect all communities and key areas of employment, will offer Calgarians more accessibility to public transit and more convenience of use than ever before; It will offer not just a viable choice but, for more people, a compelling choice over the automobile for meeting daily needs. Green Line may be the critical catalyst for broader adoption of public transit and greater movement toward the modal split targets of Calgary Transportation Plan.

ADMINISTRATION RECOMMENDATIONS

Administration recommends that Council:

1. Receive this report for information; and
2. Utilize these environmental benefits to support The City's request for Provincial funding support of Green Line.

PREVIOUS COUNCIL DIRECTION / POLICY

At the 2016 January 26 Regular Meeting, Council approved the following as part of Notice of Motion NM2016-03 (Councillor Keating):

"THEREFORE BE IT RESOLVED that Transportation prepare a report that quantifies the benefit the Green Line LRT will make towards greater energy efficiency and a reduction in carbon emissions.

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AND FURTHER BE IT RESOLVED that this information report be presented at the regular Council meeting on February 22, 2016.”

BACKGROUND

The Green Line project vision is to create a transit service that improves mobility in existing and new communities in north and southeast Calgary, connecting people and places, and enhancing the quality of life in the city. A quarter of the city’s population lives along the 40 km long corridor.

Between 2013 and 2016 considerable work has been undertaken by Administration on both Green Line Southeast and Green Line North that includes:

- Stakeholder engagement;
- Land use planning policy amendment and development;
- Land use re-designations;
- Land acquisition for track, stations, and other associated infrastructure;
- Transit-oriented development (TOD) planning studies; and
- Engineering and environmental studies of the alignment.

By the end of 2016, functional planning for the northern and downtown sections of Green Line will be complete. Following Council approval of the functional plan, preliminary design work will commence. Some construction activities such as utility relocation can begin along the entire Green Line project as soon as 2017. The timeline for detailed design and construction will be influenced by the delivery method chosen for the project.

Attachments to the Green Line Funding, Staging and Delivery report (TT2015-0881) include projections for ridership and transit demand in the corridor, but the potential GHG emission reductions associated with those estimates were not quantified.

INVESTIGATION: ALTERNATIVES AND ANALYSIS

Energy Efficiency

Green Line presents opportunities to achieve greater energy efficiency in at least three ways:

1. It represents a technology shift from the internal combustion engine to an electric engine
2. It will enable more Calgarians to make a travel mode shift, from automobiles to transit
3. It will enable long-term changes in land use patterns by supporting urban intensification.

In general, electricity allows for more efficient use of energy resources for transportation purposes. The technology shift entails the movement of people by light rail vehicles, propelled by electric motors that are 96.5 per cent efficient, versus by automobiles with conventional gasoline internal combustion engines that are typically only 25 to 30 per cent efficient.

Additionally, a shift in travel mode from automobile to LRT (and from diesel bus to LRT) will result in significant energy efficiency gains owing to economies of scale. A person travelling by single occupancy vehicle (SOV) uses on average one kilowatt-hour of energy per kilometre (kWh/km) of travel, compared with a passenger on a lightly loaded (80 passengers/car) train who consumes only 0.07 kWh/km. Accordingly, in that comparison the energy efficiency gains achieved by mode shift would be 93 per cent in absolute terms.

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The “break even” point, in terms of energy efficiency per person compared with SOV driving, is reached with only 18 passengers on a 3-car train. Every additional LRT passenger increases that efficiency, and at maximum capacity (approximately 1050 passengers) the LRT is about 58 times more energy efficient than SOV driving on a per person basis.

A further consideration for greater energy efficiency has to do with the design and operation of the LRT system and associated facilities. In 2014 the Transportation department completed The City’s first Energy Management Plan to identify opportunities for energy efficiency and conservation, energy supply diversification, and shifting to lower carbon and renewable energy. A scan of technical literature and international industry practice was combined with a review of our own experience gained from the development and operation of Calgary’s Red Line and Blue Line over the past 25 years, including pilot applications and innovations in sustainable building, to identify potential energy saving opportunities. The following are examples of energy efficiency measures that have already been applied or explored by Calgary Transit, and are potentially applicable to Green Line for greatest energy efficiency:

- Leadership in Energy and Environmental Design (LEED) standards for facilities;
- Solar photovoltaic (PV) panel array installation at facilities with two-way metering;
- Light emitting diode (LED) lighting at stations, platforms, parking lots and facilities;
- Lighting control systems;
- Combined heat and power (CHP) energy systems at transit facilities and nodes;
- Recovery of train braking energy for reuse in traction power, and capturing that energy for storage on-board trains and/or wayside; and
- Choice of light rail vehicle (LRV) model, weight, and accessories affecting power draw and system efficiency.

Carbon Emission Reductions in 2024 with Green Line

Calgary’s CTrain is widely known to be North America’s first wind-powered public transit system. The City has been able to claim this credit as a result of various investments and initiatives, most notably its renewable energy supply contract with Enmax Energy Corporation. This renewable energy supply is key to The City being on track to meet its targeted 20 per cent reduction in corporate GHG emissions reduction from a 2005 baseline by the year 2020. However, there remains a wide gap between that target and community-wide emissions, with increasing automobile emissions (in step with population growth) partly accounting for that gap. The addition of Green Line to The City’s LRT network would significantly contribute to GHG emissions reduction primarily as a result of travel mode shifting, enabling more people to choose public transit over automobiles.

Quantification of emission reductions to be achieved with delivery and operation of Green Line in 2024 is influenced by several factors and assumptions. Significantly greater emission reductions may be achievable over the long term, as discussed later in this report.

The Forecasting division of The City’s Transportation Planning business unit employs a sophisticated travel demand model to perform detailed analysis and test different scenarios. This is a computer simulation of travel behaviour in the city and surrounding region for all travel

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modes. The Regional Transportation Model (RTM) is periodically updated with information collected through household travel and activity surveys, and with independent validation data that include road traffic, transit, bicycle and pedestrian counts. This data is used to develop the equations in the RTM that estimate travel demand and daily choices people make about where, when and how they travel on the transportation network. Many inputs to the model include data on the density and distribution of population and jobs, and other land use information.

The RTM was used to assess two different scenarios in the year 2024: a base scenario (with no new LRT) and a Green Line scenario. Results from the model run indicate that the introduction of Green Line would directly reduce carbon dioxide equivalent emissions by almost 52,000 tonnes annually, with the reduced consumption of approximately:

- 19.5 million litres of gasoline;
- 2.4 million litres of diesel fuel (from all vehicles); and including
- 2.1 million litres of diesel fuel from Transit vehicles.

The full emission reductions can be realized if the Green Line is powered by renewable energy. This includes two assumptions:

- 1) The City's Electricity Services Agreement with Enmax is renewed in 2026, including a continued renewable electricity commitment for City operations; and
- 2) A supply of new renewable electricity is available to meet the growth in demand created by Green Line and other City of Calgary infrastructure projects.

If Green Line draws from the provincial grid without being offset through the purchase of renewable electricity, the traction power demand of the new LRT would result in an increase of corporate GHG emissions of about 40,000 tonnes and therefore yield a net reduction of approximately 12,000 tonnes of carbon dioxide equivalent emissions per year. The net reduction would increase over time as coal-fired plants feeding the provincial electricity grid are phased out, and replaced with lower carbon and renewable sources. The quantification of this "greening" of the electricity grid over time would require further investigation.

Longer-term Carbon Emission Reductions

Community and corporate energy consumption both continue to increase in step with population growth, urban expansion, and the resulting extension of services and travel distances. Accordingly, community-wide emissions reductions in absolute terms remain a challenge. To address the challenge a Corporate Energy Plan (to support efficiency gains) and a related Climate Change Program both are currently in development at The City of Calgary.

With Calgary's growth there are cultural and demographic changes occurring and associated shifts in outlook and lifestyles, with further changes in the urban fabric anticipated. Land use densification, both in downtown areas and in transit nodes and corridors within established and suburban areas, is increasing and will be further facilitated by Green Line LRT development. This new line, combined with ongoing transit service enhancements and changes in land use, is projected to result in significantly increased transit ridership; it may be the critical catalyst for "turning the curve" in broader adoption of public transit, and greater movement toward the modal split targets outlined in Calgary Transportation Plan (CTP). Past and projected growth in transit ridership associated with expansion of the CTrain system is illustrated in Attachment 1.

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By 2024 the 3-line LRT network, with feeder buses and cross-town BRT routes that better connect all communities and key areas of employment, will offer Calgaryans more accessibility to public transit and more convenience of use than ever before. It will offer not just a viable choice but perhaps a compelling choice over the automobile for meeting daily needs. The GHG emissions reduction and other environmental benefits will continue to grow beyond 2024.

Stakeholder Engagement, Research and Communication

Green Line program engagement is focused on raising awareness of the benefits and alignment with Calgary's strategic objectives and economic opportunities. Southeast leg engagement is ongoing and North leg engagement is discussed in detail in report TT2015-0905 Green Line North Update. The research and analysis reported on herein may be used for the purposes of engaging with stakeholders and for demonstrating the alignment of this infrastructure investment with broader economic and environmental objectives.

Strategic Alignment

Green Line is aligned with the future vision of our city as articulated in the long-range sustainability plan imagineCALGARY. It is aligned with the environmental policy direction and strategic goals of the Municipal Development Plan (MDP) and CTP, the Community GHG Reduction Plan, and Council's Action Plan priorities. Green Line is included in The City's RouteAhead 30-year Strategic Plan for Transit. In quantifying and pursuing GHG emission reductions through Green Line, The City is seeking to prevent pollution and integrate broader environmental considerations into its planning and decision-making relating to growth, infrastructure, transportation and development, which is consistent with its overarching corporate Environmental Policy.

This strategic investment in infrastructure is well aligned with current policy initiatives at other levels of government. In 2015 the Province of Alberta released its Climate Leadership Plan and a new carbon tax scheme, to come into effect in 2017, that would generate revenues potentially used to make investments in energy efficiency including public transit infrastructure.

Social, Environmental, Economic (External)

Social

The Canadian Urban Transit Association (CUTA) has outlined the health benefits of public transit to include improved urban air quality and increased physical activity. With every vehicle removed from the road, the reduced fuel combustion translates to less air pollution from tailpipes. Green Line will result in a 1-3 per cent annual reduction of these air contaminants that contribute to smog: carbon monoxide, non-methane hydrocarbons, nitrogen oxides, and fine particulate matter. This health and environmental benefit is consistent with the objectives of the Calgary Region Airshed Zone management plan for particulate matter and ozone.

The increased physical activity that CUTA attributes to use of public transit can reduce human health risks and in turn reduce public health-related costs to society. Communities that provide a broad range of housing choices and commercial services, supported by high quality transit and transportation choices, allow people to meet many daily needs within their own neighbourhood

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and to access other services and opportunities with reduced automobile dependency.

Reducing automobile dependency also creates opportunities for individuals to reduce their combined housing and transportation costs, helping to increase affordability.

There is a combination of social, economic and environmental benefits that may be attributed to Green Line considering its potential to help alleviate traffic congestion on roadways and thereby facilitate more efficient movement of goods and people in the broader transportation system.

Environmental

A societal shift to greater use of public transit for all-purpose movements is key to achieving community-wide reductions in GHG emissions, as quantified in this report. Additionally, investment in light rail transit yields direct and indirect environmental benefits that extend beyond emission reductions. Considering the alignment of Green Line and current land uses and environmental conditions along the corridor, this particular transit investment presents the opportunity for significant environmental benefits that include:

- Remediation and re-purposing of brownfield sites;
- Enabling more compact forms of urban development, with reduced ecological footprint;
- Anchoring other cross-town and feeder bus transit services, further reducing the need to travel by automobile; and generally
- Enabling long-term changes in land use and mobility that result in lower overall GHG emissions in the City and region.

Economic

Green Line presents opportunities for both new development and redevelopment along the corridor, making use of existing infrastructure and spurring direct and indirect economic activity.

The City stands to lose a small share of grant revenue with the introduction of Green Line. The estimated 22 million litres reduction in gasoline and diesel fuel consumed in the Calgary urban area annually would translate to \$1.1 million of provincial gas tax (currently 5 cents per litre) that would not be returned to The City in grant funding delivered through the Municipal Sustainability Initiative, plus approximately half that amount again in federal gas tax funding.

The recently announced introduction of a carbon tax in Alberta is a further economic consideration. The Green Line presents economic benefits to the community in two ways: collectively for SOV drivers who shift modes to ride LRT the avoided carbon tax (as a portion of total fuel costs) could be in the order of \$1.35 million annually, based on projected ridership; and The City could save \$150,000 annually in avoided carbon taxes on fleet fuel.

Financial Capacity

Current and Future Operating Budget:

No impacts are associated with these recommendations.

Current and Future Capital Budget:

No impacts are associated with these recommendations.

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Risk Assessment

There are no significant risks associated with these recommendations.

REASON FOR RECOMMENDATION(S):

Information presented in this report, and additional information that becomes available in time, may be used in support of business cases being prepared for submission to provincial and federal governments.

ATTACHMENT(S)

1. Transit Ridership Growth in Calgary: 1980 - 2040