NO LITTLE PLAN:

Electrifying GO Transit

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TRANSIT FOR A HEALTHY CITY

Transport Action Ontario

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NO LITTLE PLAN: ELECTRIFYING GO TRANSIT

BY

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PART 3 of 4: CHAPTERS 4, 5 and APPENDIX A

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4.0 The Metrolinx GO Electrification Study

"I don't want to pre-empt the discussion with Metrolinx, but we've said all along that the reason we wanted the electrification study was because we believe that it's an important thing to consider, that the electrification of the system is something that is an aspirational goal."

Hon. Kathleen Wynne
Minister of Transportation of Ontario
January 19, 2011

When Metrolinx released its 1,705-page its GO Electrification Study Final Report on January 19, 2011, the headline on the website of veteran transit advocate and commentator Steve Munro summed it up best: "Not Quite Greased Lightning: GO Transit to Electrify, Eventually."

After all the negativity experienced in the workshop sessions, it surprised many of the participants when the study team recommended electrification of the ARL/Georgetown and Lakeshore corridors, with the former as the first priority. The two-route plan was approved unanimously by the Metrolinx directors exactly one week later and, within minutes of the board's decision, Minister of Transportation Kathleen Wynne announced the initiation of the Environmental Assessment process.

The GO Electrification Study Team reached its decision based on a combination of factors, including:

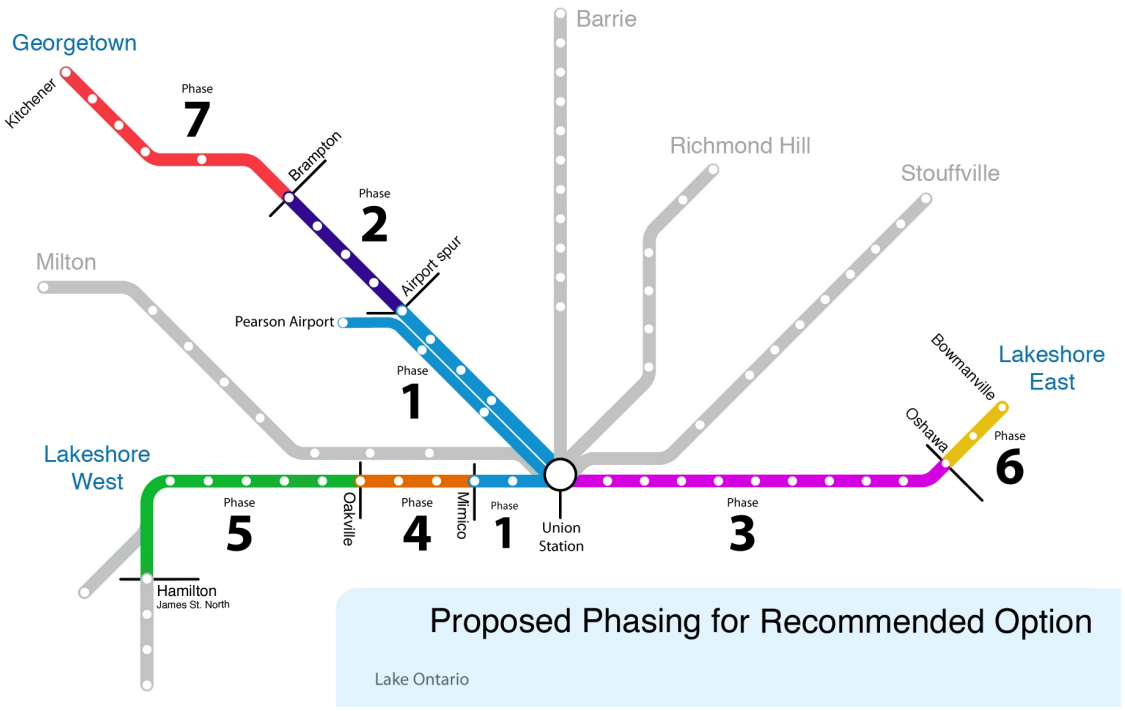
- Journey time savings;
- Operating and maintenance cost savings;
- Anticipated future ridership growth, which would increase the cost savings; and
- Electrification's contribution to the long-term attainment of the objectives of *The Big Move*.

At an estimated cost of $1.6-1.8 billion, the implementation of electrification on the two corridors would be on a lengthy, staged basis:

CORRIDOR SEGMENT	COMPLETION
Union Station-PIA and Willowbrook (EA and Design)	2014-2015
Union Station-PIA and Willowbrook (Construction)	2018-2020
Airport Spur Junction-Brampton Mount Pleasant	2020-2022
Union Station-Oshawa and Eastern Maintenance Yard	2024-2026
Willowbrook-Oakville	2026-2028
Oakville-Hamilton James Street	2028-2030
Oshawa-Bowmanville	2030-2032
Brampton Mount Pleasant-Kitchener	2032-2035

Although advocates welcomed the decision to partially electrify GO, the final report struck many as an underwhelming endorsement that matched the lack of enthusiasm displayed by the Metrolinx study team at the public workshop sessions. In fact, the report seemed to damn electrification with faint praise. The timeline for the implementation seemed a farce when compared with the schedules being implemented by other railways now or soon to be engaged in electrification around the world.
As Munro commented on his website following the release of the study:

> *Whether Metrolinx (and more importantly GO) has actually embraced this concept, or will mutter disparagingly to anyone who will listen, remains to be seen. I cannot help noticing an analogy to the TTC where, for a time, LRT was embraced as a viable technology, only to be eclipsed when its political sponsor left office. Will electrification suffer a similar fate if the Liberals are defeated in fall 2011?*



While the final report made some valid points in favour of electrification, these had all been contained in previous GO-funded studies based on real-world input from established electric commuter rail operators, leading one to wonder why so much time and public money needed to be spent restudying these issues. The most notable positive findings of the Metrolinx final report were:

- Electrification unit costs drop as the size of the network expands (the "network effect");
- Electrified rail services attract more riders and revenue than diesel (the "sparks effect"); and
- Electrification yields substantial operating and maintenance savings.

On the latter point, the study found full GO network conversion would yield annual operating and maintenance savings in 2021 of almost $53 million, escalating to $79 million by 2031. For the combination of the ARL/Georgetown and Lakeshore lines, the annual savings would be $33 million in 2021 and $48 million in 2031, assuming diesel fuel costs will increase at twice the rate of electricity.

Perhaps the most useful revelation was regarding the cost of GO electrification. In the run-up to the report's release, Metrolinx staff up to and including Chair Rob Pritchard portrayed electrification as overly expensive and probably unaffordable by the Government of Ontario. They estimated electrification of the full GO system at up to $7 billion. Instead, the study pegged the price at $3.7-4.2 billion.

But mixed in with the few positive points in the final report, there were also the contradictions, false assumptions and myths Metrolinx staff raised in the workshop sessions. Given the appearance of propriety by virtue of their publication in the study, these negative points could play a role in delaying or even derailing the GO electrification plan at a later date. They should not go unchallenged.

4.1 The Reference Case

"To ensure that only those costs and benefits associated with electrification were included, the Study assessed the incremental costs and benefits of electrifying the GO rail network."

The slightly expanded system that would be in place in 2021 as a result of the GO 2020 plan was the reference case on which analysis was performed. This was the subject of much debate at the Metrolinx electrification workshop sessions. Many participants requested that electrification be assessed in the context of how it could assist in the transformation of GO into a high-frequency, all-day service, as promised in *The Big Move*. But Metrolinx took the view that the assessment should be on the basis of a 2021 benchmark using diesel-hauled bi-level trains on all lines except the ARL, where single-level diesel and electric multiple unit rolling stock would be compared.

The result is electrification has been assessed on a one-for-one replacement basis mixed with a limited amount of service expansion and the ARL as a tack-on project. On the bulk of the system, electrification would occur slowly as GO gradually adds hourly off-peak, two-way service over a number of years.

This falls far short of what many advocates feel is vital if the GTHA is going to experience a significant modal shift. As was envisioned in *The Big Move*, there is a demand and need for the conversion of GO into a European-style urban rail service with higher day-long frequencies in both directions on all routes. Only with such an approach can GO divert a large number of commuters to transit, especially within the boundaries of Toronto. As has been proved elsewhere, electrification is essential to this objective.

While the Electrification Study failed to view electrification in the context of GO's future service model, others at Metrolinx haven't been so blinkered. Another study team has acknowledged electrification's transformational properties, especially in the context of Union Station's capacity constraints.

According to the final electrification study report, Union Station can handle the doubling of traffic as contemplated under the GO 2020 expansion plan it used as its reference case. But the current rebuilding of the facility will not be capable of handling the additional traffic generated if all the expansion plans embodied in *The Big Move* are carried through to completion and the Union Station's traffic quadruples.

An October 20, 2010, stakeholder presentation on the Metrolinx Union Station Study and the Downtown Rapid Transit (DRT) Study acknowledged that electrification could have a significant bearing on the course pursued for Union Station. It identified the electrified services in Melbourne and Sao Paulo as "examples of rapid transit expansion being achieved by upgrading electrified commuter rail lines to a metro/subway standard, using rapid transit equipment, to dramatically increase the extent of rapid transit services into the growing hinterlands."

The presentation went even further into the realm of GO electrification and its benefits – indeed, its necessity – in the examination of one option:

- *What if the required resources for the DRT were used to provide a high speed tunnel connecting selected GO Rail lines directly to the centre of the downtown core (along Queen or King streets or somewhere in between) rather than continuing to operate to/through Union?*
- *We are assuming this would require the type of electrified commuter rail services operated in Melbourne and Sao Paulo using rapid transit equipment, consistent with the Super GO concept assumed in the RTP [The Big Move] for selected corridors.*

Whether this monumental project is ever undertaken is not as important as the fact that its mere contemplation indicates at least some members of the Metrolinx team can see the transformational capabilities of GO electrification. It would have been more productive if the members of the electrification study team had been as equally forward looking. Unfortunately, they weren't and the result is a report that views electrification as far less of a system development tool than it should be.

Sao Paulo EMU commuter train in the city's new Brooklin financial district on the Emerald Line. The system carries about 1.2 million riders every weekday.

4.2 Tier 4 Diesel Traction

"The Reference Case also assumed that Tier 4 Diesel MP40 rolling stock will be in operation as GO Transit has committed to convert to Tier 4 emission standards.... This is therefore the rolling stock against which other technologies were compared in the study."

The Metrolinx study team placed boundless faith in the ability of new Tier 4 diesel locomotives to deliver major environmental and health benefits at reasonable cost. Mandated by the U.S. Environmental Protection Agency (EPA) for introduction on all locomotives produced in the U.S. as of 2015 and accepted as the new voluntary standard for the locomotives GO will purchase after that date, Tier 4 aims to reduce particulate matter by 70 per cent and oxides of nitrogen (NOx) by 76 per cent.

There's just one problem: No manufacturer has yet been able to produce a commercially viable Tier 4 diesel. In rebuttal, Metrolinx maintains that manufacturers have previously been able to meet the standards mandated by previous EPA emission reduction orders, but that's far from reassuring. And there are major concerns within the railway industry concerning the financial and operation effects of these new standards, if they can be attained.

The two largest suppliers of diesel locomotives – General Electric (GE) and Electro-Motive Diesel (EMD) – are attempting to develop new diesels to meet the Tier 4 standards, but neither has been successful so far. Reports on their efforts are not encouraging. In an article in the September, 2008, edition of the trade magazine, *Railway Age*, EMD's manager of emissions compliance, David E. Brann, outlined the financial impact of Tier 4, including:

- *Tier 4 locomotives will be more expensive. The after-treatment devices are likely to cost as much as or more than the diesel engine itself, driven by large size, low volumes, and the platinum-group metals used in catalyzed particulate filters.*
- *Operating costs of Tier 4 locomotives will increase. The reagent for selective catalytic reduction devices is an additional fluid that will have to be replenished....*
- *Maintenance costs will increase. Locomotives will be even more tightly packed with equipment than they are now. There are packaging concerns, and space now empty will be filled with after-treatment components, making maintenance more difficult and time-consuming. Periodic cleaning and replacement of after-treatment catalyst elements will also add cost.*
- *The technical expertise necessary to overhaul and maintain locomotives in certified configuration will increase. Suppliers will be required to produce higher technology versions of emissions-critical components such as pistons, rings, cylinder liners, turbochargers, and fuel injectors.*

Metrolinx has verified the impact of Tier 4 – provided the manufacturers can even attain the standards – on its future capital costs. The 57 Motive Power Industries MP40PH-3C diesel-electric locomotives in GO's current fleet were built to the previous Tier 2 standards and cost the agency $5.5 million each in 2009. The proposed Tier 4 MP40 equivalents are estimated to cost $7.8 million – a 40 per cent increase.

Despite all the drawbacks and unknown variables, Metrolinx accepted Tier 4 as the benchmark against which electrification would be judged. In so doing, the study team violated its own criteria. At the beginning of the study, the team set out three standards by which all equipment should be assessed:

- Is the technology proven?
- Is the technology commercially viable?
- Is the technology compatible with the reference case service levels?

Tier 4 diesel technology is neither proven nor is there evidence it will be commercially viable, making it incompatible with the Metrolinx reference case service levels. It is, at best, a high risk technology. Electrification meets all three criteria. Despite the final report's claim that "the magnitude of the transformation to electrification presents significant risks," it is a risk-free technology, as proved by the millions of train-miles racked up annually by electric railways worldwide.

4.3 Motive Power and Rolling Stock Selection

"While the electric locomotive was used in the detailed evaluation, the Study notes that electric multiple units (EMUs) over the long term will be able to take the GO Rail system closer to The Big Move vision for Express Rail with significant journey time savings."

The question of what type of equipment would be selected for high-level evaluation resulted in much debate at the workshop sessions. Before the final report was delivered, Metrolinx revealed that staff had rejected the use of self-propelled EMUs except possibly for the ARL. The study team said this was due to cost, estimating that the selection of EMUs versus the diesel option for anything other than the ARL would result in "around 40% more in capital costs, while over the 30-year life cycle they were around 2.5 times more expensive, meaning a significantly larger capital and operating budget would be required."

However, senior railroaders with extensive experience on other North American commuter rail systems who were consulted by this writer felt these costs were overstated, especially in view of the superior performance of EMUs and their effect on system operating costs over an extended period. Yes, bi-level EMUs would cost more initially. But their superior acceleration, deceleration and operational flexibility give them a considerable edge over locomotive-hauled train operation. The Metrolinx study even admits they would offer time savings twice or greater than those achievable with electric locomotive haulage of the existing bi-level coach fleet. It is this level of performance that has led the majority of electric commuter rail operators worldwide to select EMUs in preference to locomotive-hauled rolling stock.

When the issue of bi-level EMUs was raised at the stakeholder workshops, Metrolinx fell back on the argument that an FRA-compliant bi-level EMU does not currently exist. They rejected the use of the FRA-compliant EMUs employed in Chicago. Although known on those electric systems as bi-levels, they are actually gallery cars that can be best described as partial bi-levels, with lower capacity and poor passenger flow compared with the Bombardier full bi-levels used by GO and 12 other North American commuter railways. Testing and rejection of this gallery design in the mid-1970s led GO to develop the current full bi-level design in cooperation with Bombardier predecessor, Hawker-Siddeley.

As well, Metrolinx rejected suggestions they consult with their counterparts on the San Francisco Caltrain electrification project, which will make use of North America's first fleet of non-FRA-compliant, European bi-level EMUs, which is covered in detail in Appendix B. However, Metrolinx consultant LTK did note:

> *Caltrain has worked with the FRA and has recently secured a waiver to allow the operation of proven, European design, non-FRA-compliant vehicles intermixed with its current diesel LHC fleet and limited freight. This waiver required years of technical review, including sophisticated computer simulations of train-to-train and train-to-highway vehicle collisions to argue that an equivalent level of passenger safety would be maintained between compliant and non-compliant rolling stock. Metrolinx should not underestimate the effort required to obtain their own approval, particularly since they are under jurisdiction of Transport Canada rather than the FRA.*
>
> *The European EMU design ... takes advantage of crash energy management features, such as engineered crush zones. It is believed that a 25 kV, European-derived multi-level EMU may be a feasible and commercially viable alternative for Metrolinx's consideration.*

A possible bi-level EMU fleet strategy was not carried forward for detailed evaluation by Metrolinx because GO remains wedded to locomotive-hauled operation of its existing bi-level coaches and cab cars. Using electric locomotives with this rolling stock protects GO's past investment and leaves its current 10-year fleet strategy untouched. While this makes some financial sense, it is short-sighted and unnecessary.

A Sydney CityRail H-series EMU train arriving in Scarborough – New South Wales, that is.

The 1992 GO Electrification Study examined the possible conversion of the non-powered GO bi-level cars into FRA-compliant EMUs. The study team found the existing cars couldn't be easily converted, but the design itself could be adapted to create new, Thunder Bay-built bi-level EMU power cars capable of hauling existing GO bi-level coaches, producing two-car sets that could be marshalled into trains of any length. This would use of all of GO's current bi-level fleet and protect its sunk cost. It could also open up new markets for Bombardier, the manufacturer of the highly-successful, Thunder Bay-built bi-levels.

Furthermore, with four of GO's seven existing lines remaining as diesel operations under the Metrolinx electrification scenario, the existing bi-level fleet will be amply employed until its retirement is physically and financially desirable.

The EMU issue needs to be revisited. Given the leisurely schedule on which Metrolinx intends to electrify, new rolling stock will not be required until at least 2024. This is more than enough time for Metrolinx to cooperatively develop an Ontario-built EMU version of the Bombardier bi-level coach or develop a plan for the introduction of proven, non-FRA-compliant bi-level EMUs, similar to that in progress on Caltrain.

4.4 Health, Environmental, Social and Community Benefits

> ***"There are transportation and economic benefits to electrification. There are also small environmental, social and community benefits. Health benefits are expected to be marginal."***

These findings stand in stark contrast with what has been reported by other railways investigating electrification. For example, in the U.K. Department for Transport's 2009 report, *Britain's Transport Infrastructure: Rail Electrification*, which led to the current £1.3 billion commitment to electrify numerous lines for commuter, intercity passenger and freight service, the government agency reported:

> *Electric trains generally perform better than equivalent diesel vehicles even on the basis of the current electricity generation mix. Typically an electric train emits 20–35% less carbon per passenger mile than a diesel train. This advantage will increase over time as our power generation mix becomes less carbon intensive....*
>
> *Electric trains have zero emissions at the point of use, which is of particular benefit for air quality in pollution 'hot-spots' such as city centres and mainline stations. Electrification reduces rail's reliance on imported diesel fuel. Electric trains are quieter than diesel trains, and virtually silent when waiting at stations.*

In San Francisco, Caltrain has repeatedly stated that electrification results in a 90 per cent reduction in emissions, not to mention the fact that "electric trains are significantly quieter, a plus for neighbours living and working near the corridor."

Transportation library bookshelves are lined with reports delivering the same verdicts on these issues. But Metrolinx has presented the evidence on the multiple health, environmental, social and community impacts of electrification in such a way as to imply either a strange sense of logic on its part or a deliberate effort to downplay the benefits. This specifically applies to what Metrolinx describes as the marginal health benefits. To make this case stick, Metrolinx has reported those benefits in the context of GO's anticipated emissions on a regional basis, not directly on the affected corridors:

> *By electrifying larger sections of the GO Transit Rail network, greater GHG [greenhouse gas] reductions can be achieved – electrifying the entire network would deliver a 94% reduction of GO Transit Rail's future contribution to GHG emissions, although this reduction would only be a small fraction (0.32%) of the overall region's emissions. Nevertheless, all options with the exception of Option 1 (the electrification of the Georgetown line) meet or exceed the Big Move's Regional Transportation Plan strategic target of reducing GHG emissions per passenger by 25%.*
>
> *Electric trains do not emit CAC [critical air contaminant] from the locomotives, but rather at the source of electricity generation. The impacts of CAC on the local community and adjacent sensitive receptors were considered, and the more the network is electrified, the more people benefit from improved air quality. However,*

analysis of the concentrations of air contaminants such as particulate matter (PM2.5), NOx and SOx with Tier 4 Diesel locomotives shows that the impact of the Reference Case service levels would already be well below the stringent World Health Organization standards. As more corridors are electrified, the local air quality improves, but the health benefit associated with electrification is likely to be relatively small.

However, the City of Toronto's Medical Officer of Health examined the data using a different yardstick. In his report, Dr. David McKeown wrote:

Metrolinx estimates that GHG emissions from the GO rail system would be more than twice as high with Tier 4 diesel as they would be if the Georgetown and Lakeshore corridors were electrified (338,000 tonnes of GHGs each year, measured in carbon dioxide equivalents (tonnes CO2e/year), compared to 151,000 tonnes CO2e/year). Furthermore, GHG emissions from a Tier 4 system would be approximately 18 times higher than from a fully electrified system (19,000 tonnes CO2e/year).

The GHG emissions reductions that could be achieved by upgrading Tier 4 diesel to electric trains on the Georgetown and Lakeshore corridors would enable Metrolinx to reach its target of 21 percent GHG reduction per passenger for their operations. It would also be an important contribution to the Ontario government's target of 6 percent GHG emissions reductions from freight and diesel transportation as set out in the Move Ontario 2020 plan.

The health, environmental, social and community benefits of electrification are large. The minimization of these benefits by Metrolinx only served to make the final report look skewed in favour of sticking to GO's Tier 4 diesel strategy, which remains a chimera at this point. The issue needs to be revisited, particularly because it has implications for the other lines in the GO system that the study rejected for electrification.

In this regard, it is worth noting Dr. McKeown's recommendations to the members of the Board of Health:

1. The Board of Health urge the Minister of Transportation to provide secure and dedicated funding to electrify the GO Transit rail service as soon as possible, starting with the Georgetown and Lakeshore corridors; and
2. The Board of Health request the Government of Ontario commit to electrification of the entire GO Transit rail service.

These recommendations were adopted by the Board of Health on February 2, 2011.

4.5 Economic Impact

"Electrifying the GO Transit Rail network is expected to generate economic benefits during construction (due to construction employment) and in operation (due to faster commutes, less congestion), which in turn increase the economic output."

Yes, but this misses the mark by quite a distance, as previous GO electrification studies proved in their detailed assessment of the numerous benefits in terms of economic spinoff and job creation. Throughout North America, as governments of all levels have awakened to the benefits of improved and expanded rail service, attention has been devoted to quantifying those benefits. In general, it is recognized that rail investment has a substantial impact on numerous aspects of a region's economy, including:

- Diversion of traffic from other publicly-subsidized modes of transportation, such as highways;
- Job creation during the construction or equipment manufacturing phases;
- Ongoing jobs and economic spin-off from the operation;

- Savings in health care costs due to diversion of traffic from less safe modes and reductions in emissions that affect the public's health;
- Savings in national energy costs, given the higher energy efficiency and reduced fuel requirements of rail, especially if it is electrified; and
- Residential and/or commercial development and economic activity in the areas surrounding the stations and other facilities.

The U.S. Department of Commerce (USDOC), the Association of American Railroads (AAR), the American Public Transportation Association (APTA) and States for Passenger Rail (S4PR) have produced a series of calculators that may be used to arrive at rule-of-thumb figures on the potential impact of any rail investment program. Applying these multipliers to the financial requirements of the various GO electrification options reveals the following benefits:

GO Electrification Economic Benefits

NETWORK OPTION	COST ESTIMATE (BILLIONS)	USDOC[1] (BILLIONS)	APTA[2] (BILLIONS)
ARL/Georgetown	$0.783-0.886	$2.349-2.758	$3.132-3.544
Lakeshore	$1.142-1.293	$3.426-3.879	$4.568-5.172
ARL/Georgetown + Lakeshore	$1.619-1.831	$4.857-5.493	$6.476-7.324
ARL/Georgetown + Lakeshore + Milton	$1.921-2.163	$5.763-6.489	$7.684-8.652
ARL/Georgetown + Lakeshore + Milton + Barrie	$2.468-2.772	$7.404-8.316	$9.872-11.088
Full GO System	$3.755-4.202	$11.325-12.606	$15.020-16.808

[1] U.S. Dept. of Commerce (USDOC) Formula: $1.00 investment = $3.00 in economic activity

[2] American Public Transportation Association (APTA) Formula: $1.00 investment = $4.00 in economic activity

GO Electrification Job Creation Benefits

NETWORK OPTION	COST ESTIMATE (BILLIONS)	AAR[1] (JOBS CREATED)	S4PR[2] (JOBS CREATED)
ARL/Georgetown	$0.783-0.886	15,660-17,772	23,490-27,580
Lakeshore	$1.142-1.293	22,840-25,860	34,260-38,790
ARL/Georgetown + Lakeshore	$1.619-1.831	32,380-36,620	48,570-54,930
ARL/Georgetown + Lakeshore + Milton	$1.921-2.163	38,420-43,260	57,630-64,890
ARL/Georgetown + Lakeshore + Milton +Barrie	$2.468-2.772	49,360-55,440	74,040-83,160
Full GO System	$3.755-4.202	75,100-84,040	113,250-126,060

[1] Association of American Railroads (AAR) Formula: $1 million investment = 2,000 jobs

[2] States for Passenger Rail (S4PR) Formula: $1 million investment = 3,000 jobs

These benefits are substantial and must be considered in any project of the magnitude of GO electrification. Furthermore, they need to be assessed in terms of their local impact, a point on which the Metrolinx study was silent. Previous GO electrification studies analyzed the local impact and found considerable regional benefits that would flow to a wide range of Ontario manufacturers equipped to provide the required goods and services.

The electrification of BC Rail's Tumbler Ridge freight branch in the 1980s resulted in 89 per cent of all the catenary materials being procured locally, as well as the production of the electric locomotives at the General Motors (now Electro-Motive Diesel) plant in London, Ontario. That this study didn't investigate Ontario sourcing and stimulus opportunities in detail is a glaring omission.

4.6 Implementation

"The implementation of the Electrification Options on the existing GO network that is an operating railway presents a number of challenges."

In the 1880s, the Canadian Pacific Railway built the world's first transcontinental railway under a single management. In four years, eight months and 19 days, the company completed the construction of more than 4,700 route-kilometres of railway, traversing the rugged Canadian Shield, spanning the Prairies and conquering four mountain ranges with technology that was crude by today's standards. It is, therefore, difficult to fathom how the electrification of 235 route-kilometres of existing railway could possibly require the 21 to 24 years proposed by Metrolinx.

In other countries, electrification proceeds at a much faster pace. Part of the reason is these rail operators, anxious to reap the benefits of converting to electric traction, have devised techniques and technologies to make it happen quickly and without unduly disrupting existing rail traffic. In its July, 2009, report, *Britain's Transport Infrastructure: Rail Electrification*, the U.K. Department for Transport observed:

> *Network Rail has developed proposals for an electrification process to minimise disruption. These proposals involve construction techniques which make extensive use of overnight closures of not more than eight hours. The application of modular techniques and the deployment of rapid delivery systems to improve the rate of production will be of key importance. The proposed methodology is designed to operate within normal 'rules of the route' possessions. To achieve this it is expected that construction techniques which are capable of working with the adjacent line open to traffic will be required.... [For] straightforward stretches of line between major junctions and complex stations Network Rail's work suggests the use of 'factory trains'. This will enable standardisation as far as possible. The factory trains will be flexible units, capable of working individually or in combination, and as such, could play a useful on-going role in the efficient maintenance of the electrified network.*

It is obvious that other operators are far ahead of GO in the implementation of electrification. As a complete novice in this field, GO should be calling upon and learning from those railroaders who are capable of electrifying their railways in a fraction of the time Metrolinx has proposed. Furthermore, even Metrolinx suggested a method for advancing its electrification plan more expeditiously and at lower cost:

> *The available time for construction is limited by the level of service and therefore if the Reference Case service level increases were delayed until the electrification construction work has been completed on each corridor there would be savings in construction schedule and cost.*

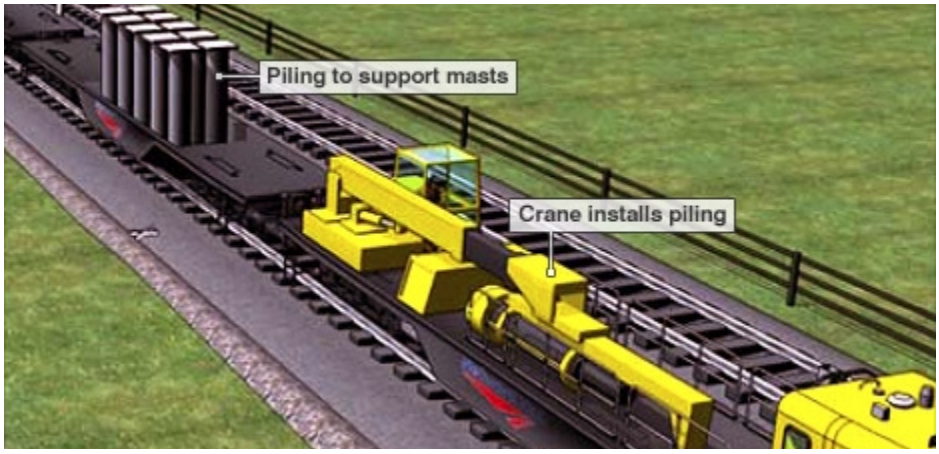
Despite this valid observation, the plan remains to first proceed with the infrastructure and service expansion contained in the GO 2020 reference case and deal with electrification afterward, thus inflicting time and cost penalties. Metrolinx needs to be directed to study this issue in much greater detail and, with the benefit of real-world input of other electric railroaders worldwide, reduce both its electrification timelines and cost estimates.

In yet another example of contradiction found within the final report, Metrolinx advises:

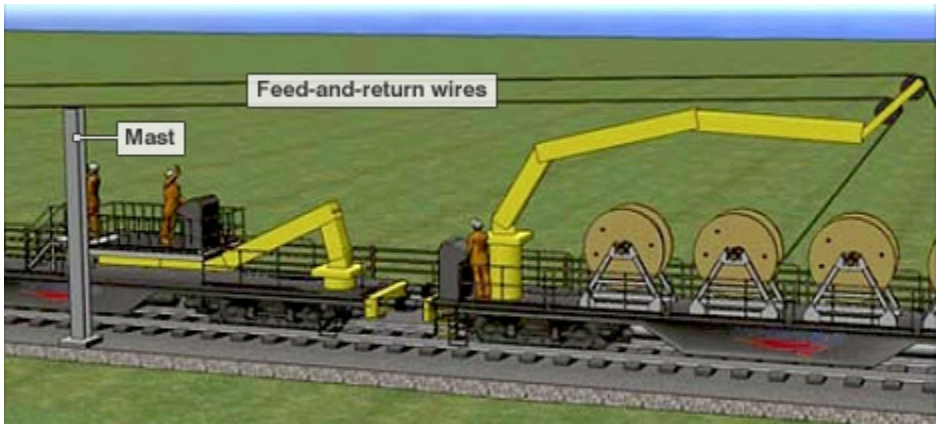
> *The conversion to electrification of Option 3 is a long-term investment. To wait until expanded future services are in place would increase both the time and the cost of implementation. Commencing a phased approach now, while service levels are lower, minimizes construction disruption and ensures that the electrification infrastructure is in place as ridership grows.*

Metrolinx would do well to heed its own advice on this issue.

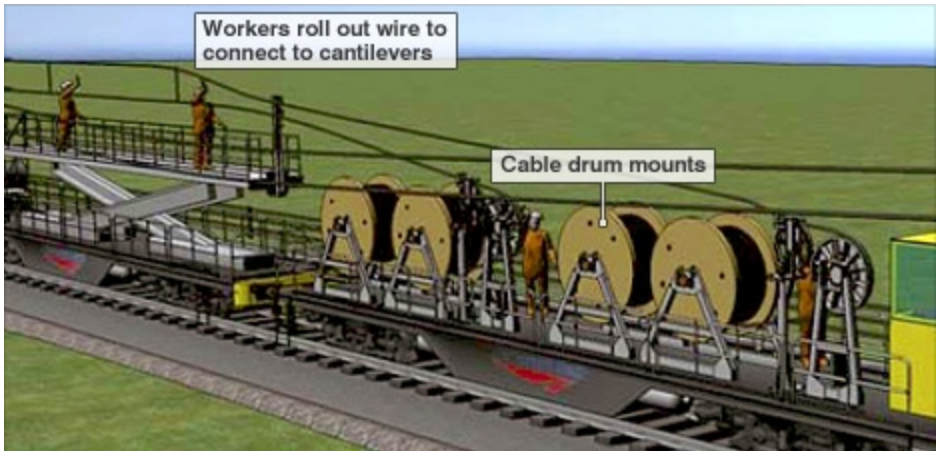
U.K. Catenary Factory Train



A factory train can install 1.5 km of cable in an eight-hour shift. First, it drills piles beside the track to support the overhead catenary wires.



The factory train moves along unravelling wire at a steady pace. The feed-and-return wires are attached to the masts to supply the catenary wires with electricity.



Workers attach the cantilever support arms to the masts and wires to the cantilevers. Finally, essential grounding and safety inspections are carried out.

4.7 The ARL Project

"In the case of the ARL, it is assumed that the initial deployment of DMUs will be replaced by EMUs if the Georgetown line is electrified either in part or in full.... These EMUs could be conversions of the DMUs or new vehicles with the DMUs redeployed to other GO corridors."

Without a doubt the most controversial and questionable aspect of the GO Electrification Study was the recommendation to proceed with the ARL as a "convertible" diesel service to be completed in time for the two-week Pan Am Games in July, 2015. Metrolinx has stated that all infrastructure work for the diesel incarnation of the ARL and the expansion of GO's Georgetown service will be "electrification compatible."

In fact, the decision to proceed with the ARL as a diesel-first service wasn't a recommendation based on detailed study. It was a directive from Premier McGuinty. On several occasions, members of the study team revealed to the participants in the workshops that construction of the ARL as a convertible diesel service was a "given" because it was allegedly impossible to electrify the 35.6 route-km. from Union Station to the airport and Willowbrook Yard by 2015. No concrete proof of this has ever been provided and one suspects it is merely Metrolinx staff's opinion. Nonetheless, staff maintained the delivery of the ARL was locked in by the Province's commitment to the Pan Am Games.

Proof that the ARL would proceed as a diesel-first project was provided by Metrolinx on November 16, 2010, more than two months before the Electrification Study was released, when the agency announced negotiations were under way with Sumitomo Corporation of America for the untendered purchase of 12 to 18 DMUs. Construction of the carshells and initial assembly will take place at the plant of Sumitomo's rail manufacturing partner, Nippon Sharyo, Ltd., at Toyokawa in south central Japan. Each car will then be shipped for final assembly at Nippon Sharyo's new plant in Rochelle, Illinois, which still hasn't been completed.

Metrolinx has said it is investigating the possibility of some Canadian content in the DMUs, but this is not required under the contract with Sumitomo, sidestepping the Government of Ontario's usual domestic content rules for publicly-funded transit equipment. Metrolinx says these rules do not apply to the purchase of "heavy locomotives," although it would be difficult to qualify this lightweight rolling stock as such.

Artist's rendering of the Sumitomo DMUs for the Sonoma Marin Rail Transit District, which will serve as the base order on which the Metrolinx ARL equipment is being purchased without competitive bidding.

The Sumitomo DMUs will be purchased using an option on a base order placed by the Sonoma-Marin Area Rail Transit District (SMART). The 18-car base order for this troubled San Francisco Bay Area project included options for up to 196 additional cars, which could be exercised by other North American transit agencies.

This has become a favourite tactic of manufacturers eager to avoid multiple competitive bidding processes. Having secured the first competitively tendered order, the potential purchaser in another jurisdiction attempts to make the case that a new tendering process is unnecessary because the original one proved the superiority of the equipment technically and financially. This is exactly what has occurred with the ARL equipment order.

In an attempt to tamp down any public and alternate manufacturer opposition to this curious deal, Metrolinx had the former Integrity Commissioner of Ontario, Justice Coulter Osborne, Q.C., examine the transaction and he pronounced it fair. However, it is apparent to anyone with experience in the rail equipment field that Justice Osborne may not have been provided with all the facts. One aspect of his report is especially puzzling.

Canada's Bombardier Transportation was asked to bid on this order, but declined due to its small size and low potential profit margin. Germany's Siemens Mobility was interested and entered into discussions with Metrolinx, but was ultimately rejected, as stated in Justice Osborne's report. The company has remained quiet about this, but industry sources report Siemens was perplexed by the whole process. The company has North American credentials in this field, having supplied 12 married pairs of the diesel version of its highly-successful DMU/EMU Desiro self-propelled cars to San Diego's North County Transit District for use on its Oceanside-Escondido Sprinter service.

What was not addressed in Justice Osborne's report – likely because he was never informed – was the willingness of the Moncton, New Brunswick, firm, Industrial Rail Services, Inc. (IRSI) to bid on the project. IRSI was the supplier connected with the original SNC Lavalin Blue 22 version of the ARL, slated to deliver fully-remanufactured ex-VIA stainless steel Budd rail diesel cars equipped with all-new diesel engines of a proven European design and meeting high emissions standards.

Given that GO and Metrolinx executives have confessed that the Sumitomo convertible DMUs will probably not be converted, but redeployed to other lines and replaced with new EMUs when the ARL is electrified, there is every reason to believe IRSI could have supplied a thoroughly acceptable fleet at a significantly lower cost. These remanufactured Budd cars would have a high Canadian content and a longer service life due to the documented longevity and sturdiness of the stainless steel carbodies. Justice Osborne's report and Metrolinx are mute on this issue.

In the end, the contract with Sumitomo was signed on March 29, 2011. By a strange coincidence, the oft-delayed SMART project then reduced its order from 18 to 12 DMUs immediately after Metrolinx signed its contract. At SMART's April 20, 2011, board meeting, the directors approved the reduction and it was noted this was only possible because another buyer had been found to enable the agency to exercise an escape clause in its contract with Sumitomo. That buyer is, of course, Metrolinx.

It should also be noted that SMART is relying heavily on LTK Engineering Services, which also served as a consultant on the Metrolinx Electrification Study. The company has so far billed SMART for $4,202,190 in design engineering and management operations services and an LTK staff member has been appointed as the agency's acting operations director. At the April 20 SMART board meeting, approval was given to increase LTK's contract to a total of $4,833,864.

No matter which equipment manufacturer was ultimately selected and how that decision was reached, the issue of the impact of a high-frequency DMU service remains unchanged and it is of great concern to online residents. It was a similar type of diesel service under the original Blue 22 proposal in 2003 that spurred these residents into action and led to the creation of the Weston Community Coalition and the Clean Train Coalition (CTC).

The current version of the service – even if it can be built to the promised Tier 4 standards – is hardly an improvement. With the ARL operating every 15 minutes in both directions from 5 a.m. to 1 a.m., residents will have to contend with the emissions and noise from 140 trains daily. In addition, there will be the expanded GO Georgetown service (29 trains daily by 2015 with more to follow) plus VIA, CN and CP traffic. In total, this will result in 206 diesel trains on the corridor between West Toronto and Weston daily.

Under the approved electrification implementation plan, some relief will be provided if the ARL is converted as promised between 2018 and 2020. A further reduction in the level of diesel-powered service will occur between 2020 and 2022 if implementation of the two-phase Georgetown electrification plan occurs, but diesel-hauled GO service won't be totally eliminated until sometime between 2032 and 2034. As the CTC points out, that's a long time to endure an intensive diesel-powered rail service.

Another controversial aspect of this plan is the so-called Weston Tunnel, which remains under discussion and design. In reality, it is a concrete-walled trench that will carry the GO Weston Subdivision underneath John, King and Church streets in Weston. The latter two will remain open to vehicular traffic, but John Street will be a pedestrian-only crossing. As well, the parallel CP MacTier Subdivision will remain at its present level with grade crossings at these three locations. Further south, the Denison Avenue grade crossing over both rail lines will be replaced with a full road underpass.

It is apparent to all who have slogged it out through the stakeholder consultation process that the ARL is a "done deal." The intervention of the Premier and his Cabinet has assured that. Still, many questions remain and the public has a right to some straight answers.

Q. Is the ARL really the transportation and environmental benefit that this government has touted?

Premier McGuinty has said the ARL will immediately replace 1.2 million trips by car annually. That translates to 3,287 daily, although Metrolinx has boasted the service will carry 5,000 daily within five years. With 140 frequencies daily, that means the 126-seat ARL trains will handle an average of 23 passengers per train at the start of service and 35 per train within five years. To put this in perspective, the TTC's King streetcar carries about 56,000 passengers every weekday.

Frankfurt International Airport's long distance rail passenger station. A second station serves two commuter and three regional rail routes.

Five million trips are made annually between downtown Toronto and Pearson, so 5,000 per day would account for 36 per cent of all those trips. That's an ambitious goal. Major airports in Europe with multiple high-quality transit connections have difficulty attaining that rate of passenger capture.

Zurich's Kloten Airport, for example, is served by intercity and commuter trains, two streetcar lines and buses. These services combined handle 46 per cent of all air passengers. In fact, the Zurich Airport Authority is mandated by the government to reach 42 per cent in order to receive funding. This is an unusually high passenger capture rate.

By comparison, Frankfurt International – the third busiest airport in Europe and the ninth globally – is served by two intercity rail passenger routes, five regional and commuter rail lines, and buses, all of which capture about 26 per cent of air passengers.

Q. Why maintain the fiction concerning the conversion of the DMUs to EMUs?

Numerous Metrolinx staff members have already said the agency will most likely buy new EMUs if and when the ARL is electrified; the DMUs will be redeployed to other light-density GO services. The conversion of self-propelled rolling stock from one mode of traction to another is a rarity in the railway world. The few operators that have gone this route have ultimately regretted it for financial and mechanical reasons. Experienced railroaders in the U.S. and Europe who were consulted for this report see this equipment conversion plan as high risk.

Q. How can the public be reassured that the Sumitomo DMUs for the ARL will actually perform as promised, as well as meet Tier 4 emissions standards?

As of the writing of this report, Metrolinx is still unable to answer many technical questions regarding the DMUs. They can't even say which make and model of diesel power plant will be used in the cars or even its exact horsepower rating. This is hardly reassuring, especially given the difficulties the world's largest diesel manufacturers are having in attaining the promised Tier 4 emissions standards.

Q. What is the final price tag for these DMUs and are they proper value for money?

While the Metrolinx study made much of the risks of GO electrification, it seems to have not been as concerned when it came to the ARL. Sumitomo's carbuilding partner, Nippon Sharyo, has delivered a total of 302 DMUs of 18 different designs for 12 clients, but the company has never built an FRA-compliant DMU for a North American operator, let alone one that is convertible to electric operation.

It must also be asked just what penalties the modifications to the original SMART design to create a convertible version for Metrolinx has inflicted on the cost of the rolling stock. The SMART DMUs will cost $6.2 million per two-car pair. The Metrolinx versions will cost $9.2 million per pair, not including taxes and import duties. Conversion to EMUs will cost $3.2 million per two-car set. Although the ARL cars will have slightly different interiors than the SMART cars, it is difficult to account for a cost difference of $3 million per two-car set.

One might also ask why is it necessary to buy six two-car sets when only four sets are required for the service. The plan is to use four two-car trains in service daily, another pair as a spare to fill in when one of the assigned sets is out of service for maintenance and yet another two-car set as a "hot standby" that can be quickly placed in service should one of the regularly-schedule trains fail. A 50 per cent spare ratio is more than twice as high as the accepted industry standard. This is a function of operating with such a small and specialized fleet dedicated to the ARL only. If Metrolinx was ordering a common fleet of EMUs for the ARL and all other electrified GO services, it would be unnecessary to maintain such a large spare ratio. With a larger, common fleet pool, it would be possible to have a reasonable number of spares that could be tapped to replace assigned equipment used on any electrified service that failed or was removed from revenue service for scheduled preventive maintenance.

North American FRA-Compliant Commuter Rail Equipment Costs

MODEL/TYPE	BUYER	ORDER PLACED	COST (MILLIONS CDN)
LOCOMOTIVES			
Siemens ACS-64 Cities Sprinter Electric	Amtrak	2010	$6.3
Bombardier ALP-46A Electric	NJ Transit	2008	$8.3
Bombardier ALP-45DP Dual-Mode	AMT	2008	$10.8
MPI MP40PH Tier 2 Diesel	GO Transit	2009	$5.5
MPI MP40PH Tier 4 Diesel (proposed)	GO Transit	(2014)[1]	$7.8[1]
BI-LEVEL LOCOMOTIVE-HAULED CARS			
Bombardier BiLevel Coach	GO Transit	2011	$2.5
Bombardier BiLevel Coach	GO Transit	2009	$3.0
Bombardier BiLevel Cab Car	GO Transit	2009	$3.2
Sumitomo Gallery Coach	Virginia Rail Express	2008	$2.2
SINGLE-LEVEL DIESEL MULTIPLE UNIT CARS			
Sumitomo	GO Transit ARL	2011	$4.6
Sumitomo	SMART	2010	$3.1
Colorado Railcar (company now defunct)	Portland Westside Express	2005	$4.0
Siemens Desiro VT-642	San Diego NCTD Sprinter	2004	$2.0
SINGLE-LEVEL ELECTRIC MULTIPLE UNIT CARS			
Sumitomo (with DMU-EMU conversion)	GO Transit ARL	2011	$6.2[2]
Kawasaki M8	Connecticut DOT	2006	$2.9
Rotem Silverliner V	SEPTA Philadelphia	2006	$2.6
BI-LEVEL ELECTRIC MULTIPLE UNIT CARS			
Sumitomo Gallery High-Liner	Chicago Metra	2010	$3.4
Sumitomo Sharyo Gallery Bi-Liner	NICTD South Shore	2007	$3.3

[1] GO Electrification Study Final Report, Appendix 8B
[2] GO Electrification Study Final Report, Appendix 8B (DMU-to-EMU conversion @ $1.6 million per car)

Foreign Non-FRA-Compliant Electric Multiple Unit Equipment Costs

MODEL/TYPE	BUYER	ORDER PLACED	COST (MILLIONS CDN)
SINGLE-LEVEL			
Alstom X'Trapolis	V/Line Melbourne	2009	$2.2
Alstom-Bombardier ET-430	DB Stuttgart S-Bahn	2009	$2.1
Bombardier SMU260	Queensland Rail	2009	$2.5
Siemens Desiro	First ScotRail	2008	$2.0
Stadler FLIRT	NSB Oslo S-Rail	2008	$2.7
BI-LEVEL			
Stadler KISS	BLS Berne	2010	$4.6
Alstom-Bombardier TER-2N	SNCF/CFL	2009	$4.6
Reliance Rail "A" Set	Sydney CityRail	2006	$4.8
Skoda CityElefant	Czech Railways	2006	$3.9
Siemens Desiro	SBB Zurich S-Bahn	2003	$3.7

Q. Why can't a more rapid transit-style "surface subway" operation, with additional station stops, be part of the ARL/Georgetown South Service Expansion plan, especially if the line is being rebuilt with four tracks?

Participants in the Metrolinx workshops asked that such a service be seriously considered, especially in light of the fact that the ARL project is now being funded totally by the taxpayers of Ontario. There is no evidence that an exploration of this option has been undertaken by Metrolinx. Given that the area served by the GO Weston Subdivision, especially north of Bloor Street West, is poorly served by public transit, this would make perfect sense.

Q. Is it really necessary to inflict more than $400 million in extra infrastructure costs on the ARL electrification plan?

The electrification study revealed that GO intends to build a fourth track on the Weston Subdivision and a tunnel under Highway 401 in order to protect for the construction work required to implement electrification after ARL diesel service begins in 2015. This is a large price to pay for what GO says is necessary track capacity during construction. GO has no experience in electrification and is not yet fully aware of the techniques employed by other railways to minimize track occupancy time for construction and keep the existing rail services moving. This $400 million-plus decision is especially questionable and it needs to be investigated thoroughly before such a large commitment of public funds is made.

Q. If this additional, expensive infrastructure is so necessary to the conversion of the ARL after its launch as a diesel service in 2015, why not just delay the project until it can be done properly?

Members of the CTC and Transport Action Ontario have asked this question repeatedly. The answer they have received is that the ARL is a requirement of Ontario's bid for the Pan Am Games. The fact that the current government tacked this requirement on to the original bid has been curiously forgotten. There is no reason to believe that not delivering the ARL in time for the games would in any away affect or jeopardize Ontario's successful bid if an adequate and environmentally friendly alternative were to be substituted. The CTC has suggested that a fleet of Ontario-built "green" hybrid or biodiesel buses providing express service from Pearson International Airport to Union Station and other points across the GTHA would more than fit the bill for a two-week sporting event. This suggestion has fallen on deaf ears at Queen's Park and Metrolinx headquarters.

Nor have Metrolinx and Premier McGuinty been willing to heed the advice of seemingly more influential outside parties. A motion on this issue went before Toronto City Council on March 8, 2011, moved by Councillor Frances Nunziata (Ward 11 – York South-Weston) and seconded by Councillor Doug Ford (Ward 2 – Etobicoke North). The recommendations were:

1. That City Council request that the Minister of Transportation consult with international rail experts to determine whether electrification of the Airport Rail Link can be completed by 2015.

2. That City Council request that if rail electrification experts are of the opinion that the Air Rail Link cannot be built to operate as electric in time for the Pan Am Games, alternative transportation plans be made to transport people from the airport to Union Station for the duration of the Games to avoid the added costs of converting from diesel operation to electric.

This motion was passed by City Council on March 9. Still, the Province refused to consider altering its diesel-first stance for the ARL.

Obviously, the Premier's directive to Metrolinx to deliver the ARL in time for the Pan Am Games is unstoppable. The result is that taxpayers will pay for a service that is far less than it could be at the time of its launch. They will also pay a high price to later convert it into something that will still fall short of delivering the maximum transportation benefits to the greatest number of users.

5.0 Conclusions and Recommendations

"Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will not die."

Daniel Burnham

The public perception is that the battle for GO electrification has been won and its advocates can rest easy. That's far from the truth.

The Government of Ontario and Metrolinx were highly successful in their public relations efforts following the January 26, 2011, approval of the two-line electrification plan. The media reported the decision in positive terms and the public generally believed it. But the Metrolinx board decision was little more than a paper victory for the advocates of electrification. As with many other Ontario transit projects that were supposedly assured, there has been far too much talk and too little action. The fact that this plan calls for the construction of the ARL as a diesel-first service provides ample reason for cynicism and concern.

This is not a new situation. Throughout the citizens' campaign for GO electrification, the advocates faced both political and bureaucratic intransigence. Anyone who has campaigned for improved transit or rail service knows this situation all too well. Transportation planner and former Toronto City Councillor Howard Levine has gone so far as to describe it as "rigid incompetence cloaked in know-it-all arrogance."

True, Metrolinx did conduct a public consultation process that was extensive (and no doubt expensive), but it often appeared to be window dressing. The revelations in 2009 of an internal Metrolinx report spotlighting the need to co-opt and control the public consultation process did little to reassure those who were attempting to make the case for electrification.

It is, therefore, understandably difficult for these citizens to accept the provincial government's commitment to electrify portions of the GO system as firm. At best, it is loose enough to provide many opportunities to bail out before it is implemented.

Nonetheless, the authorization to proceed with the electrification of the ARL/Georgetown and Lakeshore corridors has been received and preliminary work in preparation for the Environmental Assessment process has begun. This is more than has ever been accomplished in the past, when it appeared on numerous occasions that GO electrification was imminent.

Still, this is a far different situation than the one facing Ontarians back in the mid-1960s. Then, Premier John Robarts applied his own sense of logic and fairness to the issue of mobility in what was then known as the Metropolitan Toronto Region. He not only spoke sincerely in favour of, but fully committed his government to what became a landmark in North American transportation: the creation of GO.

Now, it remains for another premier to honour a commitment to a plan just as momentous. If GO electrification is going to be implemented as promised, there are measures that must be taken – and soon.

5.1 Accelerated and Expanded Electrification Program

It has been eight years since some residents of Weston proposed electrification as a solution to the neighbourhood-disrupting problems that would arrive with a diesel-powered ARL. Even using the luxurious timelines proposed by Metrolinx today, had a positive decision been rendered back in 2003, an electrified ARL could be in service now. That obviously didn't happen.

Worldwide experience proves the timelines for GO electrification are unreasonably lengthy. It is true that foreign railways with extensive experience in electrification can do it much faster because of the expertise they have acquired from previous projects. These railways have assembled teams of planners, designers, suppliers and builders who can swing deftly from one project to another, all of them experienced in bringing about electrification collaboratively in the swiftest and most cost-effective manner.

Still, the one element that is present in those electrification projects elsewhere and lacking at Metrolinx is commitment and enthusiasm. It is imperative that the political masters who command the bureaucrats who will be entrusted with making GO electrification a reality should now hold their feet to the fire. Ways must be found to expedite the process and even expand it. There is still a case to be made for electrification of more of the GO system, especially the Milton and Richmond Hill lines, the latter as part of a long overdue realignment and expansion of the route. With a proper approach, there is reason to believe there are strong operating, financial and environmental benefits to be gained by including other lines in the project.

Above all, this must be done with alacrity. Past experience proves that delaying or stretching out a GO electrification plan only provides opportunities to kill it further down the way.

5.2 International Peer Input

One of the key failings of the Metrolinx study process was the absence of international expertise in the construction, implementation and operation of electrified railways, especially commuter lines. Metrolinx and Minister of Transportation Wynne have argued otherwise and pointed to consultants ARUP and LTK as proof. However, these two firms – while headquartered outside Canada – do not have the real-world manufacturing, implementation and operating experience to qualify them as international experts capable of making meaningful contributions to the implementation plan.

The input of professional railroad manufacturers and operators who have dealt with electrification on functioning railways in Europe, the U.K. and elsewhere is very much needed if the Metrolinx-approved plan is going to be advanced in the most expeditious and cost-effective manner possible.

In recent conversations this writer has had with senior GO operating personnel, it has become apparent that part of their reluctance to embrace and accelerate electrification is largely based on fear arising from a lack of knowledge of how electric railroading works and how it can be undertaken without seriously disrupting current operations. One senior GO staffer admitted he wasn't aware most of the world's electrified railway infrastructure had been built to convert existing lines previously operated with steam or diesel locomotives and the work had been carried out without shutting down these railways. This is common knowledge in the railway world.

The way to quell this GO managerial fear and resistance is through the involvement of those professionals elsewhere who implement electrification programs regularly. The engagement of these real-world electric railroaders is vital if the approved GO program is going to occur as promised.

5.3 Freight Railway Consultation

Throughout the consultation and study process, Metrolinx chose to portray electrification as high risk and Tier 4 diesel as low risk, while the opposite is true. However, there is one risky element of the plan and that is the approval of the freight railways, which own large segments of the GO routes to be electrified.

GO is a tenant of CN, CP and the American-owned Goderich-Exeter Railway on about 40 per cent of its current route network. But of the 243.4 route-kilometres included in the approved Option 3 plan, only 93 route-kilometres are owned

by GO. That means the ownership ratio is reversed and about 60 per cent of the trackage earmarked for electrification remains completely under freight railway control.
As a result, the involvement and approval of the freight railways is critical to implementing four phases of the seven-phase electrification program. Past anti-electrification statements by two of these railways should be of considerable concern. As well, the freight railways have in the past insisted that any works erected on their rights-of-way become their property, even if constructed by and for government passenger agencies. This cannot be the situation today if electrification is to proceed.

Metrolinx does have recourse to the amended *Canada Transportation Act,* which could compel the freight railways to cooperate with a passenger-driven electrification program and under fair financial terms (see Attachment H). However, it would be preferable if they were willing partners, avoiding a lengthy and antagonistic legal battle before the Canadian Transportation Agency.

Metrolinx needs to resolve any conflicts with the freight railways now, before any serious implementation work is undertaken. A failure to do so could not just delay, but ultimately kill some portions of the current GO electrification plan.

5.4 The European Urban Rail Concept

In *The Big Move*, much was made of the plan to evolve GO beyond its traditional morning-in/afternoon-out weekday service primarily focused on moving suburban commuters in and out of Union Station. What is desperately needed is the transformation of GO into a day-long service with higher speeds and frequencies on all routes, emulating successful urban railways such as the more than 30 S-Bahn systems of Europe, the Parisian RER network, London's recent Overground project and similar operations in cities such as Sydney, Melbourne and Sao Paulo. Electrification is a crucial element in such a plan, along with the use of high-performance EMUs, full fare integration and numerous connections with other transit lines.

The positive implications of such a transformation and expansion of GO's rail system are massive, as has been proved in those urban centres that have taken this route. Even Metrolinx's own studies have validated this approach. This should be a prime objective of Metrolinx, the Government of Ontario and the municipal and regional governments throughout the GTHA.

The implementation of a GO urban rail strategy should especially be accelerated within the boundaries of the City of Toronto. With the cancellation of Toronto's Transit City LRT plan and the reduced coverage to be provided by the subways proposed under the current civic administration's transportation plan, a fully-integrated GO rail system providing above-ground, subway-like service on existing and selectively realigned rights-of-way is one of the few options available. A failure to embark on such a project will only condemn Toronto and the entire GTHA to yet more gridlock, lost productivity, environmental degradation and excessive automotive dependency. It will also leave us uncompetitive with those regions in North America and overseas which are moving or have already moved in this direction.

5.5 Public Scrutiny and Oversight

GO electrification only became an issue because of public scrutiny and advocacy. There is ample proof that this issue wouldn't be on the table now if not for the efforts of the residents in Weston who placed it there eight years ago and then maintained a vigil, never taking "no" for an answer from politicians and bureaucrats who seemed determined to derail the issue. If implementation is to occur, these same members of the public are going to have to remain vigilant and even aggressive in their pursuit of GO electrification.

As those who participated will attest, the Metrolinx public consultation process frequently seemed hollow. This was not helped by the revelation of the *Globe & Mail* of the internal document that encapsulated the agency's views on how to co-opt and control all of its consultation processes. Though its author has departed Metrolinx, nothing that has occurred since has convinced many members of the public who have participated in various consultations that the situation has changed.

What remains now for those citizens who have fought so hard to make GO electrification happen is a level of scrutiny and activism equal to that which they have applied to the issue since it began in earnest with the announcement of the ARL eight years ago. Various organizations that advanced this cause – especially the CTC – proved adept at building bridges to the public, key members of the media, transportation professionals worldwide and politicians of all stripes at all three levels of government.

If GO electrification is to be implemented as promised by the current government and even expanded to provide greater benefits to residents of the GTHA – benefits this government has repeatedly said it seeks to achieve – then the public will need to keep up the campaign. And if this government is sincere in its oft-stated desire to involve citizens in this process, then the least it can do is maintain and improve the stakeholder workshop process that was in place throughout the one-year GO Electrification Study.

Appendix A: The European Urban Rail Concept

The history of commuter railroading may be divided into three eras of development. The first began as soon as the original steam-powered railways of the 19th century connected the central business districts of large cities with the surrounding countryside. Intercity trains scheduled to arrive in a city in the morning and depart in the late afternoon allowed workers to live in towns outside the crowded cores of the business capitals of the industrialized world. Soon, trains dedicated to this sole purpose appeared. The era of the pure suburban or commuter train began.

The next era arrived with the implementation of electric service early in the 20th century. Electrification improved the speed and efficiency of the original steam-powered services dramatically, but it didn't significantly alter the service pattern, which usually remained a morning-in, afternoon-out weekday operation linking the growing suburbs with the central business districts of major cities in the U.K., Europe, the eastern U.S. and elsewhere.

The third era of commuter railroading began in 1924 with a sea change in the operation of the heavily-used suburban system in Berlin. This new approach gave rise to the concept of the urban railway, known in Germany as the Stadtschnellbahn ("fast city rail") or S-Bahn.

A.1 German S-Bahn Systems

Berlin's railway system was developed in the 19th century by eight separate companies. All operated suburban service on the usual morning-in/afternoon-out service pattern, but using six separate and disconnected main terminals on the edge of the city's core. The first improvement came in the 1870s with the construction of the Ringbahn, a loop line encircling the city. Commuter, intercity passenger and freight services all used this connection between the main terminals and yards. The line's commuter service was electrified with a third rail DC system in 1926 by the state-owned Deutsche Reichsbahn, which unified the disjointed national rail system after the First World War.

To provide a more direct route through the city, the 14-km. Stadtbahn was opened in 1882, cutting east-west across the city's core. Built as a four-track line on a viaduct, the Stadtbahn handled through passenger and freight trains connecting between the eight different rail systems, as well as high-frequency commuter service to a number of new intermediate stations within the city. Two tracks were dedicated to this commuter service and electrification was completed in 1928.

In 1924, the commuter services on the Stadtbahn, the Ringbahn and other routes radiating out of the city were unified as the Berlin S-Bahn to provide a high-frequency service connecting seamlessly at numerous points with the city's extensive subway (Űntergrundbahn or Ű-Bahn) and streetcar (Strassenbahn) systems, as well as regional and intercity trains. A new north-south tunnel route through the city's core was completed in two stages between 1936 and 1939.

The Berlin S-Bahn progressively established principles and concepts that converted key lines of the city's commuter rail system to increase inner city transportation benefits. These characteristics include:

- High-frequency, fixed-interval service, usually 5-10 minutes in the city centre and 15-20 minutes beyond;
- Extended service hours, running from approximately 5 a.m. until after midnight;
- Numerous stations within the city's boundaries, allowing for intra-city journeys;
- Often a central ring line around the city's core and connecting with other rail services radiating outward;
- A central east-west and/or north-south section through downtown, often underground or elevated;
- Dedicated tracks when running alongside main lines used for intercity and regional rail service;
- Elimination of all grade crossings;
- Dedicated rolling stock, usually larger than but similar to that used on city metro or subway lines;

- Integration with other urban transit services in terms of ticketing and physical connectivity; and
- A distinctive and readily-identifiable logo at every station, such as the green “S” used in Germany.

Disrupted by the severing of some routes and a complicated operating arrangement during the Soviet partition of the city between 1961 and 1989, the S-Bahn has since been reunified and placed under the management of the city’s public transportation authority, the Berliner Verkehrsbetriebe (BVG), and operated under contract by Deutsche Bahn (DB), the government-owned national rail system.

The separate double-track lines of the Deutsche Bahn regional system (left) and the S-Bahn service at the Hackescher Markt S-Bahn station in Mitte, Berlin.

The Berlin S-Bahn now consists of 15 routes with a 331-km. route network serving 166 stations connected with the city’s web of 10 Ű-Bahn, 22 streetcar and 149 bus lines, as well as the extensive network of regional commuter, regional express and intercity passenger trains operated by DB. Daily ridership on the S-Bahn exceeds one million, accounting for 26 percent of the 1.4 billion annual public transportation journeys within Berlin.

The S-Bahn is fully integrated with all other BVG services and fares are charged on the basis of a three-zone system encompassing all the modes. The S-Bahn’s Ringbahn around the city’s core forms Zone 1 of this system.

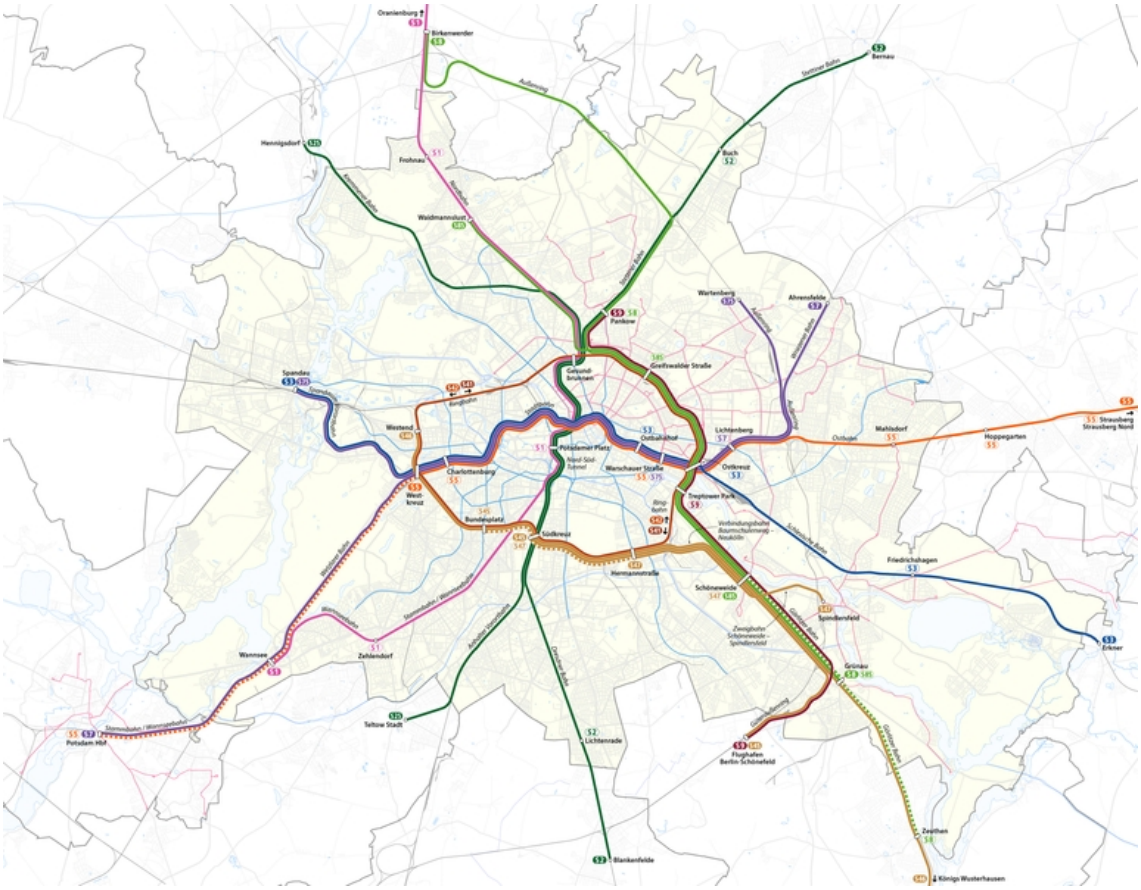
The creation of the Berlin S-Bahn was followed closely by the successful 1934 application of the concept to the dense commuter operation in Hamburg, where electrification of the component lines began in 1907. The Second World War and post-war reconstruction delayed the implementation of other planned S-Bahn systems in Germany, but the movement resumed in the 1960s and continues today. S-Bahn systems are now in operation or soon will be launched in 15 major German urban regions.

As well, the success of the German systems inspired the creation of urban rail networks in other European cities, all of which have adopted some or all of the S-Bahn principles. These include Vienna, Zurich, Paris, Copenhagen, Milan, Budapest, Prague, Warsaw, Madrid and Barcelona. The S-Bahn influence is also apparent in urban rail systems in London, Liverpool, Dublin, Melbourne, Sydney and Sao Paulo. All of these systems are electrified, although a few lighter density diesel-powered lines temporarily remain on some of the systems. In each case, electrification is planned in the near future.

CITY/REGION	ROUTES	ROUTE-KM.	STATIONS
Augsburg (under construction)	8	266	76
Berlin	15	331	166
Bremen	4	259	56
Dresden	3	103	38
Hamburg	6	144	68
Hannover	8	385	74
Leipzig-Halle	3	33	47
Magdeburg	1	39	18
Munich	10	442	148
Nuremberg	4	229	75
Rhine-Main (Frankfurt-Mainz-Wiesbaden)	9	303	108
Rhine-Neckar (Ludwigshafen-Mannheim-Heidelberg-Karlsruhe)	6	290	77
Rhine-Ruhr (Cologne-Ruhr Metropolitan Region)	13	676	124
Rostock	3	58	24
Stuttgart	7	190	75

Deutsche Bahn Class BR 485 EMU train at the Ostbahnhof on the Berlin S-Bahn's Route S9 to Schönefeld International Airport. Other DB regional commuter routes also serve the airport. Photo by Johannes Fielitz.

Berlin S-Bahn



Map courtesy of Maximilian Dörrbecker

The newest trains on the Berlin S-Bahn are the Bombardier Class 481 EMUs, shown here at the Hauptbahnhof (Central Station), which is also served by numerous DB intercity and regional routes, as well as the Berlin Ű-Bahn.

A.2 Paris Réseau Express Régional

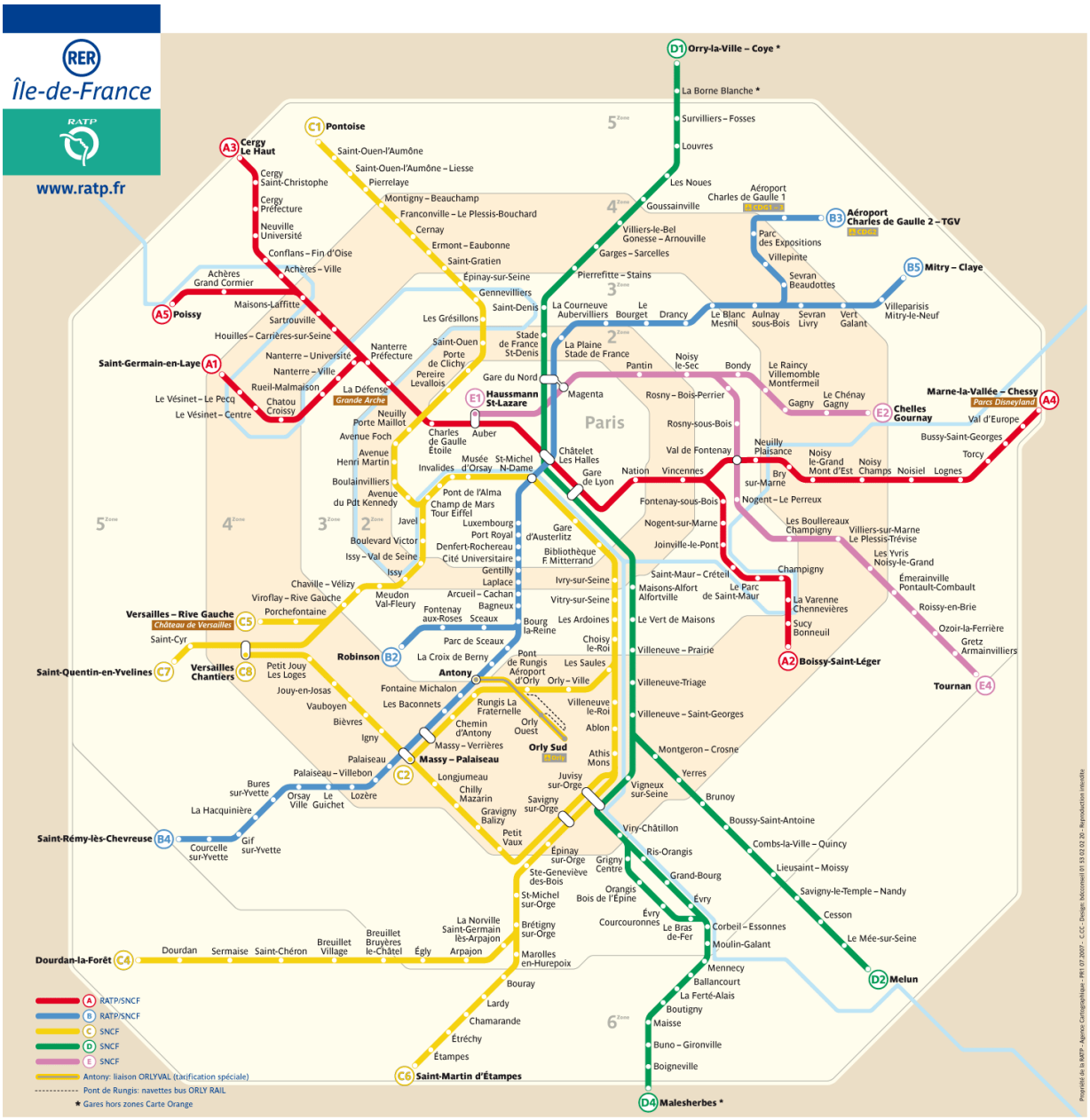
The Réseau Express Régional (RER) of Paris has been used as a touchstone for North American commuter rail improvement proposals ranging from the Caltrain 2025 electrification plan to Metrolinx's regional transportation blueprint, *The Big Move* – and for good reason. The RER is considered by many rail and transit professionals to being the fullest flowering of the urban rail concept pioneered in Germany.

The RER's roots go back to a 1936 plan by the Parisian transit authority to build a fast and frequent railway equivalent of its Métro or subway system, but using higher-capacity equipment built to main line railway standards. Like the underground Métro, this system's lines would pierce the heart of the city and it would operate on tracks isolated from the main line system of the Société Nationale des Chemin de Fer français (SNCF). As in Berlin, the Second World War and post-war reconstruction delayed this plan until the 1960s, when it was revived by the Île-de-France's transit authority, the Régie Autonome des Transports Parisiens (RATP).

The first line to be completed was the east-west Line A. This involved the RATP's takeover of the disconnected SNCF Saint-Germain-en-Laye and Vincennes commuter lines, which terminated at stub-ended stations on the western and eastern fringes of the business district on the Left Bank. The two lines were electrified and stitched together via a new line partially in a tunnel with six underground stations. Construction from both ends extended the two old lines toward each other station by station, with the final connection made at the underground station in the city's core at Châtelet-Les Halles. Line A opened on December 9, 1977.

At the same time, the southern leg of the north-south Line B was added to the operation, initially connecting Châtelet-Les Halles with the Gare du Luxembourg to the south. The line was progressively extended north under the Seine to the Gare du Nord and beyond to Paris-Charles de Gaulle Airport, not only creating numerous additional connections to the RATP transit system and the air terminal, but also with other SNCF commuter, regional and intercity rail services.

A dual-voltage bi-level EMU train arrives at the underground Haussmann St-Lazare station on the RER's Line E.



Standards were set in the construction of the first two RER lines that have been maintained throughout the network's growth. First and foremost has been the size of the tunnels, which are much higher and wider than those found on the RATP Métro system, allowing for both the overhead catenary system and the use of high and wide bi-level EMU rolling stock. Advanced train control systems have also been employed to provide an extremely high peak frequency service.

One complication was the electrification. The first phase of SNCF electrification prior to the Second World War was generally undertaken with 1,500 volt DC catenary. But the French pioneered the use of 25 kV AC catenary after the war and that has become the standard for both their high-speed TGV lines and recent electrification of conventional lines. Consequently, the RER has from the start used a fleet of EMUs known as *Materiel d'Interconnexion*, which has been built as both single-level and bi-level variants. The trains are equipped to automatically switch from one traction power system to the other while running at speed.

The RER has been progressively expanded by making use of dedicated and electrified tracks on existing SNCF rights-of-way and additional new line segments, largely tunnelled, to connect all the lines into a seamless and comprehensive system serving large sections of the Île-de-France that were previously transit deficient or served by overloaded RATP Métro and bus lines. The RER now consists of:

Number of lines:	5
Number of stations:	257
System length:	587 km.
Annual ridership:	782,900,000

It should be noted that the five RER lines include numerous branches at their outer ends and some alternate routes within the core of the city. Line E is a likely candidate for further extension and the building of a new Line F has long been considered. However, Parisian transit expansion is now focused on a substantial expansion of the RATP tramway system, three Métro extensions and the long-planned Tangentielle Nord line of the SNCF's 30-route Transilien commuter rail system, which serves points beyond the Île-de-France.

The RER is operated by both RATP and SNCF, with the former owning and operating Line A and Line B south of the Gare du Nord. The other lines are owned and operated by SNCF, but completely integrated physically and through the fare structure with the rest of the RER and the RATP Metro, tramway and bus systems. Nine of the stations on the RATP-owned RER lines A and B provide direct connections with other SNCF-operated RER lines and its Transilien commuter rail network, which carries more than 600 million passengers annually.

The main hub of the RER is the deep underground station at Châtelet-Les Halles, which serves three of the system's routes and four Métro lines. It is reputedly the largest and busiest underground railway station in the world, handling a daily average of 750,000 passengers every weekday, of which 493,000 are RER users. At peak period, it serves as many as 120 RER trains per hour.

A bi-level EMU train at Mèe-sur-Seine on the southern end of the five-route Paris RER's Line D. Photo by Romain Martin.

One striking feature of the RER has nothing to do with its grand scale and technical excellence. The RER's construction was a key factor in the passage of a funding measure that continues to fuel the public transportation system of the Île-de-France. It is a small fee levied on all Parisian businesses and employers as a regional transport contribution, the rationale being that these firms benefit directly from the vast labour market they can tap thanks to the RER and other RATP services. This levy came into force in June, 1971, and has been a permanent source of revenue for transport investment ever since. Incredibly, there was very little public debate or opposition to this funding tool when it was introduced. Nor has it ever been seriously challenged since.

The impact and success of the RER cannot be understated. Its introduction slashed journey times, particularly on east-west and north-south routes. As well, it has made suburb-to-suburb trips of a diagonal nature easy and fast, thanks to the cross-platform connections between lines at Châtelet-Les Halles and other stations. This ease and directness of travel has led to the RER exceeding its planners' traffic forecasts. Ridership of 55,000 or more passengers per hour in each direction on Line A make it the busiest transit line in the world outside of East Asia. This traffic volume has led to a frequency of more than one train every two minutes during the rush hours, as well as the installation of digital signalling in 1989 and the use high-capacity bi-level EMU trains since 1998.

The RER has also wrought a social revolution, bringing residents of the suburbs into central Paris for shopping and leisure activities and aiding in the re-integration of the core with its outskirts. This is most evident in the Châtelet-Les Halles neighbourhood, which is crowded with suburbanites on evenings and weekends.

The success of the Paris RER has inspired the current construction of a sister system in Brussels.

Number of lines:	9
Number of stations:	120
Length:	350 km.
Projected ridership:	25 million annually
Frequency per line:	15 minutes maximum
Cost:	€2.173 billion.

The objective of the Brussels RER is to create a high-frequency electric service within a 30-km. radius of the city's core and improve cross-city journey times. Additionally, the new service will cut the journey time between the European Quarter neighbourhood and the city's international airport, which already possesses an electrified rail connection.

The Brussels RER will open in 2016 and make use of single-level EMU rolling stock drawn from a new fleet of 305 three-car Desiro ML trains purchased from Siemens by the publicly-owned Société Nationale des Chemins de fer Belges for use on this system and other regional passenger services.

Among the numerous components of this ambitious project are:

- Quadruple-tracking of sections of existing lines to segregate RER and intercity trains;
- Construction of a 1.25-km. double-track tunnel in the city's northeastern sector;
- Reconstruction of 28 existing stations and widening of numerous road overpasses;
- Construction of park-and-ride lots at most stations; and
- Construction of noise barriers along several sensitive line segments.

The Brussels RER is scheduled to open in 2016.

A.3 London Overground

Although it is the newest addition to the growing global family of urban rail systems, the London Overground makes use of some of the world's oldest commuter rail routes, including a 142-year-old tunnel line formerly operated as part of the London Underground subway system. Its launch as a new, improved and integrated operation within the City of London in 2007 occurred largely out of desperation resulting from the misguided privatization of the nationalized British Railways by Prime Minister John Major's government in 1994, which U.S. transportation commentator Yonah Freemark has accurately described as "a racket designed to transfer profits into the private sector and force the public sphere to absorb losses."

The privatization scheme established a separate infrastructure owner, Railtrack (now Network Rail), and franchised all the former British Railways commuter, intercity passenger and freight services to an initial collection of 23 concession operators. The subsequent service, safety and funding disaster this scheme wrought is well known to those in the railway industry, not to mention British users who had to suffer through it. Some improvement has occurred in recent years, but it has taken tremendous effort and even more public funding than formerly flowed to the publicly-owned British Railways.

One of the initial franchise operators was Silverlink, which took over a rag-tag collection of lines radiating out from and encircling London, which it designated as its County and Metro routes, respectively. These were part of a misguided approach to franchising that distributed the plethora of London commuter services among several private operators . It was far from satisfactory, doing little to improve service frequency or quality.

In 2003, the City of London's transportation agency, Transport for London, implemented a scheme to market these diverse and disjointed services under one umbrella. This led to the agency's proposal to the infrastructure owner, Network Rail, and the Association of Train Operating Companies (National Rail) to take over the Silverlink services within London. The city's plan was not to just improve the services and integrate them seamlessly with its subway, bus and tram lines, but to build new links – often on long abandoned railway rights-of-way – to create a whole new service that would plug gaps in the city's public transportation system. The London Underground's East London Line would be part of this new sub-system, reconstructed to accommodate electric railway equipment of higher capacity.

The objective was to serve 20 of London's 33 boroughs, placing 30 per cent of Londoners within a walk of less than 15 minutes from an Overground station. The new system would have 17 direct connections with other commuter and intercity rail services, 14 with London Underground, two with the London Docklands Railway and one with the Croydon Tramlink, as well as numerous connections with bus services throughout its wide service area. To do this, Transport for London created a five-route system consisting of the East London, West London, North London, Watford DC and Gospel Oak-Barking (or Goblin) lines. All except the latter would be electrified using the two different traction power systems already in place on portions of the network. The Gospel Oak-Barking Line remains operated with self-propelled diesel multiple unit (DMU) equipment, although the plan calls for its electrification.

Only the Watford DC Line enters the city's core, terminating at Euston Station, which is an important terminus for electrified intercity, regional and commuter trains. Euston is also directly served by London Underground's Victoria and Northern subway lines, and is within a five-minute walk of the Metropolitan, Circle and Hammersmith & City lines. It is slated to become the London terminus of the High-Speed 2 intercity passenger line, which will provide electrified 400 km/hour service to the Midlands, the North of England and Central Scotland.

Much of the Overground passes through less affluent areas around the fringe of London. A key objective was to assist in regenerating these neighbourhoods by providing a frequent, affordable, high-quality transit service. The neighbourhoods along the North London and Goblin lines were particularly transit deficient.

There has been substantial investment in London Overground since Transport for London took over and re-launched service on November 12, 2007. These include:

- New high-capacity, air conditioned trains;
- New and extended lines;
- More frequent service (four trains per hour minimum in each direction);
- Refurbished stations; and
- Better customer information.

Some of these improvements are being delivered as part of the Olympic Transport plan, which was a condition of London's winning bid for the 2012 Olympic Summer Games. These investments will leave an important transport and regeneration legacy to East London.

In 2012, an extension of South London Line will be opened between Clapham Junction and Dalston Junction via Surrey Quays, providing a quick link between southwest and southeast London. This extension will link the new route to the existing London Overground and National Rail networks, with trains running in both directions every 15 minutes. Trips to West Croydon and Crystal Palace will also be possible with a cross-platform connection between trains at Surrey Quays. The extension will complete the London Overground orbital railway around the Capital.

The former Underground station at Shadwell on the Overground's East London Line, refurbished and branded with Art Deco signage identical to that found on Transport for London's Underground system.

The Overground's fare system is shared with all of Transport for London's other services and is based on a seven-zone structure. Fare payment may be made with cash, conventional paper tickets, multi-ride passes (daily, weekly or monthly) or the Oyster pay-as-you-go smart card.

Canada's Bombardier Transportation has been a major contributor to the success of the London Overground. The company built the fleet of 57 four-car Class 378 Capitalstar EMU trainsets at its Litchurch Lane Works in Derby, England, as well as the eight two-car Class 172 Turbostar DMUs used on the Gospel Oak-Barking Line. This new equipment provides a level of performance and comfort unheard of with the older equipment it replaced. The dual-system EMUs are equipped to operate on both the 750 volt DC third rail and 25 kV AC catenary lines of the Overground.

The Capitalstars are part of Bombardier's Electrostar family of EMUs. The company has built nearly 500 sets of these trains in various configurations of up to five cars for service in the U.K. As well, the Electrostar design was used for the production of the 24 four-car EMU sets for use on South Africa's new Johannesburg-Pretoria-OR Tambo International Airport electrified rail service, the Gautrain, which opened in 2010 in time for the Fédération Internationale de Football Association World Cup.

Built on the bones of several deteriorated and generally unloved railways, the 78-station London Overground now carries about 30,000 passengers daily. Further expansion is planned.

A Bombardier Class 378 Capitalstar EMU train calls at the new London Overground Imperial Wharf station on the West London Line on opening day, September 27, 2009.

Interior of a Bombardier Class 378 Capitalstar EMU with longitudinal seating similar to that found on the "tube" trains of the London Underground. Photo by Peter Skuce.

London Overground geographic map 2012