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Subject: **Smart ultra-cost-effective LRT System**
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3 Attachments, 156 KB

Smart ultra-cost-effective LRT System: A necessity to help develop a more Sustainably Innovative Culture in our Region and beyond

"An exciting, fast, safe, comfortable, hi-capacity, even educational, ... LRT train that uses in an upgradeable manner proven sustainably innovative IDEAS -- smart technology, hybrid propulsion systems, solar cells, ... -- to realize both an "order-of-magnitude" lower LRT system costs (very approx. $491M in KW & $217M in C) and dramatically increase transit system performance. Not only will this "disruptive" approach model a robust sustainable innovation to the World, it will earn the vote of most citizens."

Only a light rail transit (LRT) system has the potential to utilize proven sustainably innovative IDEAS to make a very significant improvement in cost-effectiveness.

Yes, I support many features of the Region's current plan including much of the track routing and station locations, an electric LRT vehicle, strong emphasis on intensification, etc. But like 95% of the candidates in last fall's municipal elections -- and many others -- I do not support the current LRT plan.

In 3000+ hours of effort on this rapid transit project -- applying a strong background in business systems analysis, science, technology, etc. -- I have tried to balance all community and organizational interests. I have done this by objectively listening to their major preferences and concerns, then researching practicality and validity.

These activities were the basis for creatively innovating in track and vehicle design by incorporating proven innovative technologies towards a minimally altered LRT plan. It would be dramatically less expensive yet achieve all of the benefits desired by community & Region -- and then some.

Perhaps a sufficient number of the IDEAS presented here would merit your support as a good start towards an improved LRT plan that would give taxpayers a significant return on capital investment -- and greatly reduce operating cost

subsidies.

If so, then I hope that you will support/advocate for a motion on June 15th (and reconsideration after that) in which Councillors ask the Provincial and Federal governments for six months for us to collaboratively enhance the LRT plan using a Broad-Spectrum Innovation Team composed of not only innovation-supporting staff and consultants but also proven citizen LRT innovators (from here or elsewhere).

To help inspire you in this direction, let me ask you, "suppose we could creatively use proven sustainably innovative IDEAS to enhance the current light rail transit plan so that it became much more: affordable, road-sparing, disruption-minimizing, technology-leading, time-saving (faster, more direct, just-in-time tech, ...), safety-ensuring, capacity-expansive, comfortable, ... -- and even a means of sustainable innovation (SI) education by example and by on-board interactive e-media?" Let me elaborate.

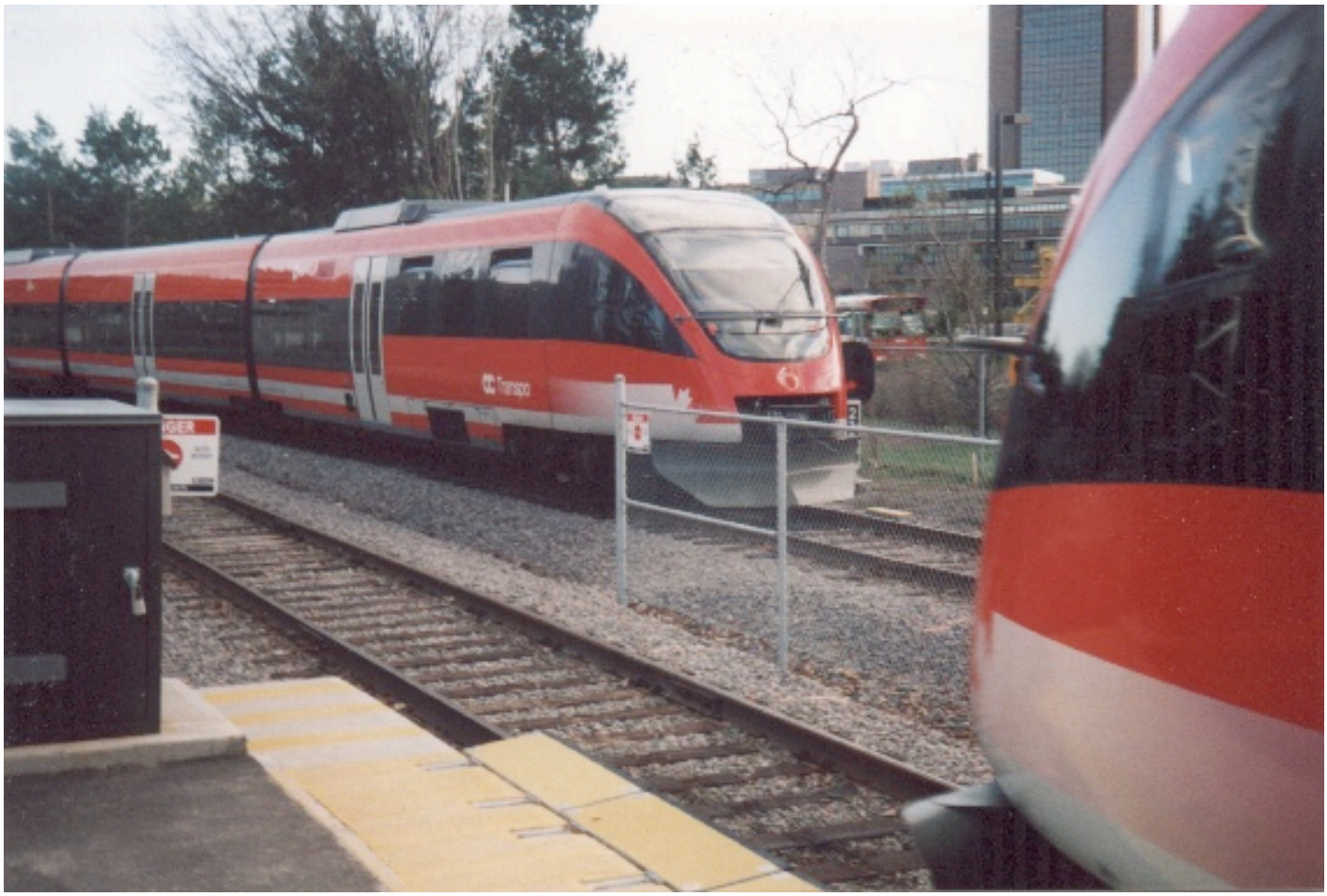
With this SI-type LRT (Sustainable Innovation Express?) as the backbone of our bus-integrated transit system, we would be modeling a robust sustainable innovation to the World and generally point the way towards a more Sustainably Innovative Culture.

Now I will explore how a slightly altered LRT plan could, by performance and as a role model, significantly contribute to expanding our Region's (and more) innovative potential. I refer to this as the Smart ultra-cost-effective LRT System Plan which is designed to greatly exceed all current expectations for ridership, intensification, etc.

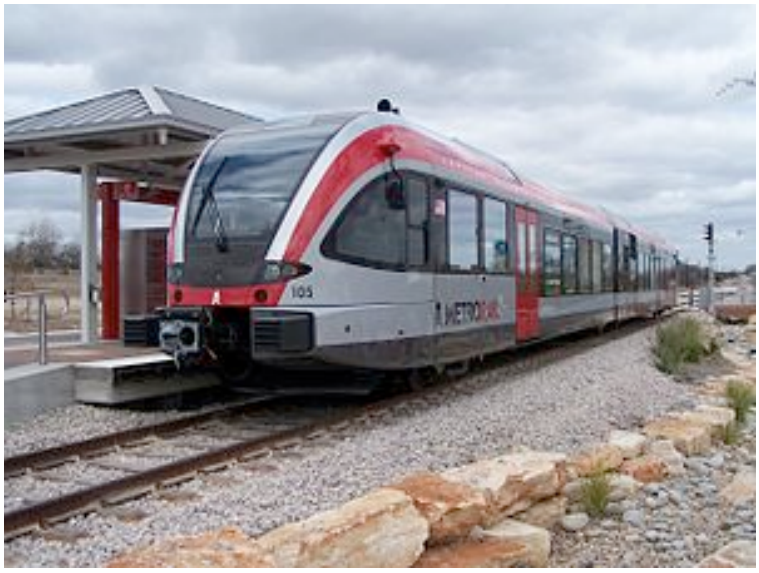
But before I do: Thirty eight per cent LRT support is likely closer to reality. This means that we have a decision dilemma with a majority against all 3 options, **Only an LRT system has the potential to include sufficient sustainable innovative ideas so as to create the Smart ultra-cost-effective LRT System necessary to earn majority voter support -- and World recognition in the process.** This could be the basis for requesting both levels of government for more time to collaboratively innovate such an enhanced plan.

SMART LRT VEHICLE

Ottawa's O-Train -- example of non-catenary LRT but with potentially upgradeable old diesel-electric technology.
http://home.cc.umanitoba.ca/~wyatt/alltime/pics/ottawa-otrain.html



Latest generation Stadler GTW diesel-electric (potentially upgradeable) LRT near Austin, Texas, A different GTW LRT is employed by New Jersey's River Line. http://en.wikipedia.org/wiki/Stadler_GTW



The LRT vehicles would be the most prominent and newsworthy feature of the LRT system. So it is fortuitous that the major sustainable innovative IDEAS would be mostly on the vehicle and not the track system. This will help maximize the likelihood of initial and continuing success -- for ourselves and in the World's eyes.

A strategy of initial best possible technologies and continuously upgrading in a cost-effective manner using new appropriate technologies -- especially a more sustainable off-grid propulsion system -- will help ensure best-possible performance and a perpetual World-class rating.

The Perimeter Institute's recent EQUINOX Conference indicated the necessity to ASAP globally implement reliable, safe, renewable, and non-carbon sources of energy in a conserving manner if we are to continue Humanity's complex advancement. (e.g."A Paradigm Shift Towards Sustainable, Low-Carbon Transport", http://www.itdp.org/documents/A_Paradigm_Shift_toward_Sustainable_Transport.pdf)

The Region's current LRT plan is counter to this objective. It calls for a LRT vehicle that uses very basic electrical technologies that date back to early streetcars -- a DC electric motor and an overhead wire (catenary) for DC power. This approach would use the current electrical grid as a power source which involves mostly carbon-energy and other potentially unsafe means of power generation. And carbon-caused worsening storms will make large generating plants and their transmission lines less stable.

Further, as a power-grid based approach, it is also subject to large rate increases especially during daytime use. And to build a catenary power system would represent about one quarter of the project capital costs.

These electrical power source problems could be solved in an exemplary manner if we used **new smart technologies** -- especially propulsion systems proven in the auto industry. Although lagging auto makers, many LRT vehicle manufacturers are currently using various propulsion energy approaches (including smaller bench-type all-battery LRT's from 2 Japanese manufacturers).

I am suggesting that a combination energy approach is best for the sake of reliability (independence, redundancy, ...), operating costs (self-generate energy), up-grading (exponential advances, modular design) and modeling (SI education

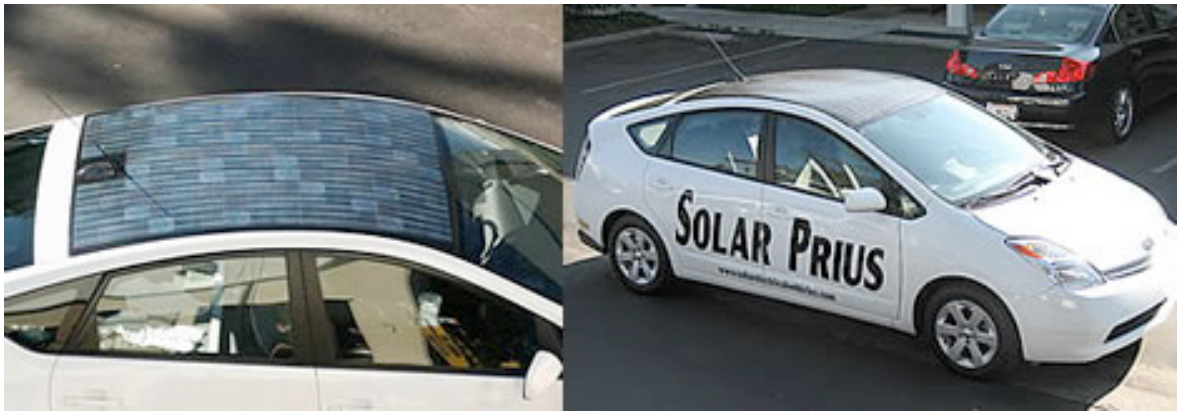
locally and globally). Here are my initial best suggestions:

1. **Batteries** as the primary on-board energy source because they enable grid-independence via charging by large banks of solar cells with stationary vanadium flow batteries at terminals and central maintenance yard. This technology is finally improving rapidly as evidenced by the new Nissan Leaf (lithium ion battery, http://en.wikipedia.org/wiki/Nissan_Leaf#Battery). But now arrives Germany's government-proven extraordinary Lithium-Metal-Polymer Battery (vanadium cathode) whose high-performance design allows for a relatively much smaller and lighter battery, http://gmvolt.com/forum/showthread.php?5538-DBM-s-Lithium-Metal-Polymer-Battery;

2, **Ultra-capacitors** (efficient, fast, light, long-lasting, ...) for capturing braking energy, then releasing it to assist in vehicle acceleration. Suggested use of off-vehicle form so as to conserve LRT vehicle space and to minimize exposure to electro-magnetic fields from high "power" flows. (Note use of on-board form -- and primary grid-dependent energy source -- by Spanish manufacturer CAF, http://www.nesscap.com/news/press_view.jsp?seq=96.);

3. **Hydrogen V-10 combustion engine** used by small Ford in-production buses, http://media.ford.com/article_display.cfm?article_id=20332. When connected to an electricity generator, it could be used for emergency power, topping-up battery, heating, air-conditioning, lighting and other power uses -- as needed. The use of hydrogen in a transit system would help prepare the community for the greater use of hydrogen in fuel cells. The Green Box waste could be used to produce methane, then in cooperation with a new local business, produce hydrogen (and carbon composite-grade carbon feed). This would help familiarize local governments, businesses and citizens with the use and generation of hydrogen -- perhaps catalyzing entrepreneurs to create new hydrogen and carbon composite businesses ;

4. **Solar cells on the vehicle roof**, an in-production hybrid car technology with a 2 to 3 year payback, could be used to spare both the primary battery and hydrogen, http://www.treehugger.com/files/2007/05/solar_hybrid_ca.php.



5. **Control software both on-board** and in a control centre (redundancy for safety) -- with track, vehicle, station and GPS sensors -- so as to optimize: safety (e.g. forced stopping) , speed, energy use, single track use (Cambridge, bridges, tunnels, etc.), passing track use (at-stations & between some).

6. **Carbon composite materials for panels** -- starting to be used by Siemens and other LRT vehicle manufacturers -- would help reduce weight (but retain collision strength) thus requiring less energy to accelerate and maintain speed. Perhaps the support frames might be available in a few years as this Teijin Limited auto application might suggest, http://asiatoday.com/pressrelease/teijin-establishes-worlds-first-mass-production-technologies-carbon-fiber-reinforced-pl

Perhaps PI/RIM might be willing to financially encourage the modeling of these above innovative energy technologies as part of our LRT system. The LRT vehicle could best operate using some of the newest (yet proven) of these sustainable energy innovations -- using (smart) software to optimally control them.

ULTRA COST-EFFECTIVE TRACK SYSTEM

While the very innovative SMART LRT vehicle might be the major focus of the World's limelight, this attention would only happen in a positive sense if it operated on an ULTRA COST-EFFECTIVE TRACK SYSTEM.

The major new strategy suggested for the track system design is use SMART innovative technologies. This would transform existing insufficient infrastructure --

single tracks (with passing tracks added), single track bridges and tunnels --into SMART infrastructure thus enabling their efficient and safe use. Physical up-grading might never have to be implemented.

As with Ottawa's O-Train LRT and Calgary's C-Train LRT, this involves a much more extensive use of the rail right-of-way.

This differs greatly from the Region's questionable strategy -- apparent to many -- of spend-a-lot-now yet greatly underperform, then add-on-later (maybe) if the results are at least mediocre. Let me be specific.

In the Region's current LRT plan, their track (routing) system excessively uses roads in a very disruptive manner -- especially re: existing road infrastructure -- and overbuilds when it uses the rail right-of-way.

The Region's approach here would: 1) be the major cost factor in an unnecessarily very expensive $40M per km. LRT system; and 2) greatly impede LRT vehicle performance in terms of speed (speed limits), time (more delays & circuitous route), safety (road accidents more likely), capacity (length limits and shorter "stations" on streets), ridership (abridged track length), intensification (majority students & working poor discourage investment), ...

To elaborate, our Region's LRT plan uses the rail right-of-way much less than they could and when they do, a much higher capital cost is incurred because they remove existing heavy-rail tracks, re-build them at a side of the rail right-of-way, then build 2 new LRT tracks on the other side with a catenary system. This costs just as much as their approach to 2-tracks on a road.

Also, this Regional LRT plan will not adequately address W-K-C's developing peak-period congestion on our major north-south roads -- even expanded Hwy 8 has bottleneck sections and just a minor accident can make one late for work. And horribly-jammed Hespler Rd. would get even worse.

This Regional LRT plan, even with express bus connections from the east and west suburbs, will not meet sufficiently the key transit-time requirement to compete with a car commute. Gas prices may help, but likely not be a big factor for most potential LRT commuters -- especially as the cost of hybrid and battery-only cars starts to decrease.

If the Regional LRT plan is implemented at very high cost and is mostly considered

unsuccessful in terms of quantity and "quality" of ridership, then it will lose its luster possibly being stamped with a failure stigma. Such an eventuality would make the LRT a much reduced incentive for developers.

As I have implied, along with the SMART LRT Vehicle, the key ULTRA COST-EFFECTIVE TRACK SYSTEM could help make this potential dark cloud of failure blow away. How?

Both Ottawa's O-Train especially and Calgary's C-Train provide excellent examples of ways to increase performance and lower costs. Both use right-of-ways -- exclusively with Ottawa and mostly with Calgary -- thus enabling the LRT vehicles to realize higher speed and capacity, greater safety and much lower cost capital and operating costs.

Similarly, we could build -- double-track to Fairview Mall and single-track with passing tracks to Ainslie Terminal -- on the faster-than-roads, relatively inexpensive and mostly under-utilized W-K-C rail right-of-way corridor (incl. Iron Horse Rail/Trail). As with the O-Train (LRT system cost, $3M/km!), we could very inexpensively upgrade existing track, then add passing tracks (or a second track).

As was done in Ottawa and Calgary, we could cooperate with our railways -- CN/GEXR, CP & GO-Train -- to arrange for our more extensive use of their sections of the rail right-of-way. Their under-utilized track from approx. the Grand River to the main CN line would require some very innovative thinking to achieve time-locked use. (My numerous talks with them have led to good possibilities.)

Also the railways would have to realize significant benefits -- operational &/or financial -- in any such venture.

For example, a new fairly inexpensive 3-track transfer yard could be built by the Region on almost-free MTO land approx. defined by the Grand R., CP tracks, Sportsworld Dr., and Hwy 8.

Then CP could operate during the day but not have to slowly travel to the Courtland transfer yard. GEXR only would have to be financially encouraged to operate at night thus freeing up the only conflicting section of track for regular LRT use.

Where heavy-rail tracks are quite frequently used -- with often very long CP/Toyota car-carrier trains -- space is available along-side their existing tracks. Also rail right-of-way from earlier times, now often trails (Iron Horse, Mill Creek) or roads (only

Caroline St.) can be shared with rail -- with a trail safety fence or an (even artistic) sub-division privacy and noise dampening wall.

This sets the stage for our potential use of the N-S rail right-of-way from a St. Jacob's Stockyard Market Terminal 34 km. to Cambridge's Ainslie St. Terminal. Here Ottawa's very successful 8 km. O-Train also models a great way to proceed not only with the track building but the related LRT vehicle.

To be more specific than previously, the new much lower cost approach would involve upgrading existing single tracks (and signals), adding passing tracks (as currently in Ottawa) or a second track (as planned in Ottawa).

Some currently unused parts of the rail right-of-way would require completely new single or double tracks (Caroline, Iron Horse Rail/Trail, then Hespler Rd. to Ainslie Terminal via at least a Mill Creek Rail/Trail.

And control systems such as Intelligent Transportation software technology would ensure that all the single-track bridges and tunnels -- and passing tracks -- do not degrade speed or safety.

By using a catenary-system-free approach -- a Bombardier Talent diesel-electric vehicle -- the O-Train saved 1/4 on the capital costs and helped simplify the track system building (faster construction) and likely improved the potential for railway collaboration (fewer CN/CP safety concerns). With the proposed SMART LRT Vehicle, we could benefit similarly.

The O-Train plan also involved upgrading the existing track and signals, and a number of new constructions: a passing track, tunnel under a lake, 6 stations, etc. Including the 3 LRT vehicles, the **O-Train's LRT system cost in 2001 was $3M/km** ($23.2M/8km) -- with **15 min. frequency**.

Ball Park Cost for Proposed LRT System including 34km. rail right-of-way backbone (St. J. Mkt. Terminal to Ainslie St. Terminal) and 3 W-K-C Intensification Corridors (by adjustments to both O-Train's $3M/km cost rate for rail right-of-way & Region's current $1550M/39km = **$40M/km** for roads):

1) O-Train LRT System Cost: **$3M/km** (2001) = approx. $5M/km (2011);
2) Cambridge cost: $5M/km x 16km = $90M (16km single track, 15 min freq.);
3) KW cost: $20M/km x 18km. = $360M ($5M/km becomes $10M/km for a second track, then $20M/km for a 7.5 min. frequency)

4) Experimental KW King St LRT Corridor cost: $25M/km x 1.9km = $47M ($40M/km using single LR55 track reduces to approx. $25M/km)
5) LRT Backbone to Kit. HUB cost: $5M/km x 1.75km = $9M
6) Subtotal: $506M (**perhaps best not to proceed further until KW King St. Experimental Corridor results**)
7) Hespler Rd. rail connector cost: $5M/km x 3km = $15M
8) Hespler Rd. cost: $30M/km x 3.75km = $112M ($25M/km becomes $30M/km -- extra work requ'd on blvd. & curbs)
9) Charles/Borden Streets cost: $25M/km x 3km = $75M
Total LRT System Cost: $708M (allows funds for LRT vehicle innovations)
Cambridge total cost: $217M
KW total cost: $491M

What more can we do to move even further towards an ULTRA COST-EFFECTIVE TRACK SYSTEM?

The Region could offer to collaborate with CP in building a 2+-track rail bridge across the Speed River -- instead of 1-track across the road bridge. It might help smooth collaboration with CP, especially since they have unofficially expressed concerns about the safety of the existing bridge relative to limitations on braking as the Shantz Hill is descended.

Besides just-in-time links at stations with cross-connecting express buses during peak periods, we could acquire smaller buses that would be used for computer-scheduled door-to-LRT-to-destination (& return) connections -- similar to an approach used by NJ's River LINE.

Also, the Region could acquire very inexpensive land north of Sportsworld Dr. between the CP tracks and Hwy 8 for a centrally-located LRT maintenance facility.

EXPERIMENTAL INTENSIFICATION CORRIDOR ON KW'S KING ST.

An experimental (pedestrian/cyclist friendly) initial intensification-loop mostly along KW's King St from Alan and Caroline Streets to the Victoria St. HUB. It would include a dedicated bicycle lane (like Montreal) and a single-track (with passing-track at Union Blvd. that could be expanded to a 2nd track) LRT using much less expensive & less disruptive LR55 track [http://www.trampower.co.uk/track.html].

This King St. experimental approach that complements the main LRT (rail right-of-way from St. Jacobs to Ainslie Terminal) corridor --with additional non-peak stops -- would help prove & improve "intensification-by-LRT" IDEAS before we incur great additional expense for Charles/Borden and Hespler Rd. (with CN rail line connector to 401 end?).

Also, because the main LRT corridor (rail right-of way) would make traveling time and use generally less critical on this intensification-loop, **very expensive underground utility upgrading, a CN underpass, etc. could be all done in a later stage when road/rail traffic might demand it.** And perhaps a more pedestrian/bicycyle friendly King St. would make a tunnel never necessary !

This lower cost experimental intensification venture would keep many options open including the possibility of **Aero-Rail** -- if proven successful in Malaysia -- to be used along major KWC streets (KW's King, C's Hespler Rd., etc.) in the future.)

The same part of King St. could also develop into an experimental SUSTAINABLE INNOVATION IDEAS CORRIDOR where there would exist a particularly intense collaborative effort to encourage all existing organizations and individuals operating/living on this corridor to make sustainable innovation an essential part of their strategic direction. If successful, it could be applied further along King in both directions and to Hespler Rd.

CAUSE OF THE LRT INNOVATION DILEMA

Many of the LRT system IDEAS that I propose would be very technologically **"disruptive"**, e.g. the transformative displacement of existing LRT vehicle and track designs. And such innovative technological ideas are what is needed to make our LRT-based transit World-class and thereby World attention grabbing! We would make our research institutes, universities and hi-tech companies proud -- along with our citizens of course.

I have been trying to communicate this technological innovation-potential to the Region over the last two years. Specifically, besides presentations to Regional Council, I have met with Ken Seiling on numerous occasions, CAO Mike Murray, Mayors, staff, (their consultants), ... While some have shown great interest, key players have shown little interest. Why?

The most powerful Regional politician (strongly backed by Carl Zehr, Jim Wideman,

Tom Galloway, Jean Haalboom, Sean Strickland, and Jane Mitchell) has his own agenda that seems to focus on just intensification, especially on King St. between the K & W downtowns.

Part of the why, here, seems to rest on Regional pride in the idea of "intensification by LRT" that we "sold" to the Province as told to me by Ken. Of course with intensification comes an increase in property values -- some politicians apparently didn't realize this before the municipal elections -- with related tax gains. (In these times of growing road congestion, sky-rocketing gas prices and more lower paying jobs, **LRT ridership** -- whose quantity & quality will affect intensification -- must be given a much more urgent priority!).

But mostly I blame the lack of Regional Government of Waterloo interest in proven innovative technological ideas -- and their dearth in the Region's current RTI plan -- on the two most senior RTI project engineering administrators whose natural innovation-averseness (as exhibited also in their previous Regional positions) has been intensified by a gross lack of previous transit system design expertise.

Don't they realize that these types of innovative technological ideas are needed to increase the LRT plan's cost-effectiveness so that the current Regional Council decision impasse (all 3 options have a majority against) and a likely World-reaching LRT embarrassment can be avoided.

To accomplish this, at least Director Nancy Button and Commissioner Thomas Schmidt need to be removed from the RTI project and replaced by more innovation-supporting and transit knowledgeable team members drawn from Regional engineering & planning.

(CAO Mike Murray was alerted to these staff disabilities over 6 months ago and took no action. Nice guys can sometimes avoid necessary tough decisions -- especially when it involves a good friend or a degree that is supposed to signify brilliance.)

Otherwise any LRT "charge" led by Button & Schmidt's current plan would be towards an LRT dramatic failure resulting in an avoidable degradation of the innovative technological climate of our great Region -- and forestall the development of a Sustainable Innovation Culture !

SUSTAINABLE INNOVATION

For Humanity to continue advancing, all significant innovation must be holistically -- economically-socially-environmentally-... -- sustainable.

With our area's long-term success in mind, a SMART ultra-cost-effective light rail transit (LRT) system could have a keystone role in greatly advancing a Sustainably Innovative Culture for our Region by modeling to ourselves and the World the integration of innovation with sustainability -- economically, socially and environmentally.

Certainly appropriate government investment and involvement in sustainably innovative technological ideas for smart infrastructure can encourage not only heightened business enhancement but also the enhancement of society and environment. SMART LRT could enhance Waterloo Region in all 3 ways especially well -- if we are innovativley open enough to consider it.

Our SI World-impact could be greater if Waterloo Region co-created a collaborative network (Waterloo Sustainable Innovation District?) with our also innovatively-unique neighbouring municipalities (G/W, S/P, B/B & W/O) centred by Waterloo Region. Current business and academic links with these municipal areas have set cooperative precedents -- and **they all would benefit from the Waterloo global brand.**

Besides increasing our SI potential, such an area would have almost double the population -- from 535K to over 1M and growing quickly -- further increasing our SI World-impact. WSID could then better support a future NHL team (Waterloo Innovators?), thus adding to our SI World-impact (at least where hockey is popular).

And we could use LRT expansion to increase WSID'S cohesiveness. We could integrate into our W-K-C LRT system a southern CN/GEXR line LRT Cambridge to Guelph (interested) connection. As part of a possible future GO-Train SW Ontario LRT system, we could use old rail corridors and the side of active ones to interconnect with Brantford, Woodstock & Stratford. As with Ottawa's O-Train LRT, New Jersey's River Line LRT, etc., freight trains could run on the new track at night where appropriate.

But WSID would still be a relatively small World Innovative HUB that strives for greater recognition. Our other very strategic move could be to exponentially evolve

our Region's most distinguishing historical and contemporary feature, the uniqueness of our innovative potential.

With the realization in mind that all innovation must be sustainable, perhaps a good first step in evolving our area's innovative potential is to always -- where practical -- qualify innovation with sustainable. For example, sustainable innovative potential sounds fine, but Greater Waterloo Sustainable Innovation District would be too long. (But GWSI could have the motto, "Sustainable Innovation -- economically-socially-environmentally- ... -- necessary for Humanity's future advancement".)

Here's where the new LRT could play a big role. Besides the LRT system itself modeling sustainable innovation, there could be an SI education emphasis on the LRT vehicle -- using social media --that builds on the technologies that the LRT is modeling.

And to build on former UW President David Johnston's Knowledge Capital of Canada project, the Region, UW, etc. could promote us as the SI Knowledge Capital of Canada to help give the LRT system's SI educational emphasis more status and support. And as Governor General he is also encouraging citizen community participation. Could ways be found locally to honour David's wishes perhaps by catalyzing very unique SI projects?

INNOVATIVE BACKGROUND (Motto: "Where there is a will, there is a way"

For over 45 years -- 37 in Waterloo Region -- I've served as an analyst working on difficult and unusual problems -- often defining them in innovative ways and helping to solve them using innovative ideas. This has included work in the private sector, municipal government, private consulting and voluntary community enhancement,

In these situations, an individual, company, government agency or even an educational institution was not serving themselves &/or their community in an optimal manner. This often meant that their current way of operating was somewhat problematic or that I perceived a unique opportunity for them to advantageously innovate.

Often the people involved presented the symptoms of "Willful Blindness" (see book) where they tended to perilouslyignore obvious problems including possible "engineering failures".

Given the potentially very positive impact that an LRT system could have on at least our quality of life, innovative business climate, etc. and given the very large amount of taxpayer money involved, I decided 3 years ago to critically analyze, in a constructive manner, the Rapid Transit Initiative project and the various versions of the current LRT plan.

Gradually I sought out proven innovative technological ideas that could be integrated so as to help overcome perceived weaknesses in the developing LRT plan.

ADDENDUM

Smart technology definition (suggested): refers mostly to new complex technological ideas -- in interrelated categories such as sensors, software, energy conversion, energy storage, materials conversion, materials creation, biomimicry, nanotechnology, etc. -- that enable Humanity to develop a more Sustainably Innovative Culture if applied sufficiently cost-effectively in a viable strategic direction.