Autonomous and Electric Vehicles Report - Transportation Advisory Committee

Summary

Governments across the world have taken steps to reduce greenhouse gas emissions. How will this be done? Primarily, by phasing out fossil fuelled vehicles. While Electric Vehicles (EV) are already in the city of London, they are small in number. This will change as North American retools their automobile and truck assembly plants this decade.

In the natural evolution of these vehicles, it is predicted that we will also see the introduction of Autonomous Vehicles (AV). The attached report hopes to illustrate how they will be constructed and delve into the issues which the City of London will have to come to grips with in the near term as well as providing some recommendations for the CAV Working Group to consider as they prepare their report to Civic Work Committee later this year.

Proposed Motion for TAC Meeting #4

That the Civic Works Committee receive and refer the attached report to the Connected and Autonomous Vehicles (CAV) Work Group for inclusion in their ongoing review and report to Council in 2021.

Autonomous and Electric Vehicles Report - Transportation Advisory Committee

March 22, 2021

In this report Autonomous Vehicles will be abbreviated to AV, Electrical Vehicles will be EV, Connected Vehicles will be CV.

GENERAL INFORMATION

There have been many reports written that AV will be on the road in twenty years. That is a possibility, the more likely scenario will be a gradual phasing in of EV then AV from fossil fuel vehicles. Electrical vehicles are already in the city, they are small in number. They will grow in number after the renovation of the Detroit area assembly plants. Two major economic powers, United States and European Union, want to reduce greenhouse gas emissions by 2030. How will this be done? This will be done by phasing out fossil fuelled vehicles and introducing electric vehicles. In this report there will be more about the assembly plant. The report will give you some idea of how they will be constructed.

The London Free Press ran a series of articles on the future cars dated Dec.12, 2019. The car of the future will be powered by four small motors, this will free up storage space in the chassis for lead acid and lithium ion batteries. The heart of the car will be its information centre, also known as the dashboard, the vehicles will be purpose built around their electrical architecture. The vehicle will have embedded sensors, cameras and other electronics, the information centre will automatically give you a route that will give you a faster commute home. The information centre could and probably will be used to remind you of appointments and other daily activities.

Cybersecurity will be extremely important for everyone who uses a vehicle, cell phone, tablet as these devices can now be connected to your vehicle. QNX an operating system by Blackberry is going to be used in Hyundai vehicles that feature advanced driving and autonomous vehicle platforms. Hyundai is using the QNX system right now, they are being advertised on television since late 2019 and early 2020.

HISTORY

Now for a little history about EV/AV. A Scot's man, Robert Anderson develops the first crude electric car about 1832. In 1859 rechargeable batteries were invented. During the 1870's the manufacture of electric cars became practical. In 1887 in Des Moines, Iowa a patent for electric car was issued. The electric car was in a parade in Des Moines, Iowa in 1888; the car appeared in the 1893's World Fair. In the 1920's there were articles about a "Phantom Car" or AV Testing continued on this car. In the 1980's promising results from came from testing at Carneige Mellon University's NAVLAB. The technology caught on, many people thought that the results were science fiction, with many reference to the television series "The Jetsons". Different companies worked on technologies whose main theme was to drive down a municipal road, interact with other vehicles, citizens, infrastructure and natural elements. In 2014 a professor at New York University wrote a book called "ReProgramming Mobility, The Digital Transformation in the USA". He envision a do nothing or delayed approach to AV. He envisioned four scenarios: Growth, Collapse, Constraint, Transformation for more information go to HTTP://reprogrammingmobility.

WHAT OTHERS ARE DOING: A WORLD VIEW

Japanese automakers are teaming up to develop technologies and infrastructure strategy for AV. This is done out of fear that European and American automakers are taking the lead and establishing “global standards”. Another Asian country Singapore has an ongoing project called “Future Urban Mobility”. This project has been active since 2010 and has completed several sub projects. Germany plans to upgrade the Autobahn for AV use and allow vehicle to employ infrastructure communication. The Province of Ontario has created an ecosystem for success that featured the following:

- Population
- Local weather patterns
- Terrain
- Types of dominant road networks (examples Gravel Roads, Paved, Etc)

HOW IT WORKS

When on the road self-driving vehicles rely heavily on capturing the “live” built environment around them. The eyes of the system are 3D laser scanners that are constantly scanning everything around them to a millimetre accuracy. The acquired data is run through different algorithms, the vehicle’s algorithms looks at the acquired data and tries to make sense of what is going on around the vehicle. The algorithms help the vehicle make sense and the vehicle follows the rules of the road. Every second the vehicle is on the road it collects a tremendous amount of data, anything the vehicle can see generates data and that data is stored in real time.

WHAT HAPPENS TO THE DATA?

The data is available to automakers now, it can be used by who may be using the data to test AV with or without government permission. The AV will have an enhanced system that will be able to read and respond to our needs. The type of personal data that could be used by the automakers includes: Voice patterns, names, home address, place of employment, schools, etc. Some of the data will be useful for traffic management. The Federal and Provincial government must clearly define what is sensitive data and what data can the municipality use.

Here is an example of how it could be done. Uber and the city of Boston plan use the data which will manage growth, reduce pollution and reduce congestion. The data captured by 3D scanners on buildings, highways, rivers etc. could easily study changes over a period of one day, one month, one year or more.

DEFINITIONS BY TRANSPORT CANADA 2019

AUTOMATED VEHICLE: -uses a combination of controllers and on board computers along with sophisticated software which allows the vehicle to control at least some driving functions, instead of humans. Examples: steering, braking and acceleration, checking and monitoring the driving environment.

CONNECTED VEHICLE: -depends on the features installed a connected vehicle may be able to communicate with:

- its occupants such as through their mobile devices

- with other vehicles and road users
- with surrounding transportation infrastructure such as roadways and traffic lights
- internet based applications and entities

The province of Quebec has defined autonomous vehicles: to a vehicle equipped with an automated driving system that can operate a vehicle at driving level 3, 4, 5 as defined by SAE International Standard 3016. Further research at the Society of Automotive Engineers website needs to be undertaken so that the city can determine the level it is at. In addition, further research will assist London in identifying its future infrastructure needs. The Province of Quebec defines AV this way "can be operated without human monitoring or intervention. They may, also, be called driverless vehicles or intelligent vehicles.

ELECTRIC VECHICLES: -a vehicle that is partially or entirely powered by electricity

WHAT IS HAPPENING NOW?

All AV/CV are now at SAE level 2. These vehicles feature adaptive cruise control, park assist and automatic emergency braking. AV/CV vehicles use radar, Lidar(light detection) and possibly thermal imaging. These technologies enable real time positioning through GPS. The technologies use complex machine learning algorithms to process and respond to their surrounding environment, traffic and obstacles. CV technology often appears in tandem with AV technologies.

Vehicle to vehicle communication technology is available in Canada. The vehicle to vehicle communication enables two way data that provides information to the driver. The Vehicle to Vehicle (V to V) technology enables the vehicle to communicate with other vehicles and road infrastructure. This technology can improve situational awareness through the use of Dedicated Short Range Communication (DSRC).

This is what London can do. We must ask ourselves many questions about AV. The city needs to ask the province about the results of tests done in Stratford, ON. These tests have implications for safety, road infrastructure, mobility and land use planning. The city needs to know if there are any updates to the regulations and the city needs clearly defined regulations.

The city needs to start collecting data about anything related to AV/CV/EV. This means the city needs to ask questions, create working groups, hold workshops and educate the public. Here are some examples. How do the new technologies compliment public transit? How does the adoption of these technologies support the first and last kilometre of travel for urban transit users? Data and research will be needed to determine the life span of bridges and road infrastructure. This can be done by using sensors in bridge structures, along with working with Western University Faculty of Engineering Science. Perhaps there is a project at Western that could benefit both parties.

More questions to consider. How does the data from AV/CV change the design infrastructure and use of mobility services? AV/CV will disrupt human drivers, another huge impact will come in the employees who repair, service and use the AV/CV. They will need to upgrade their skills, retrain for another type of job. Who and how will this be done? Will it be in house or will the local college and university do the training. The city will need to redefine the skill set required for many jobs involving AV/CV.

QNX Platform made by Blackberry asked the City of Ottawa to assist them, they asked Ottawa to help construct a site with specified features. These features were a traffic light, roundabout, an on ramp, railway crossing, stop sign, yield sign and parking area. The site was, also, equipped with the latest communication technology. The site was designed as a miniature city. Blackberry was able to do more advanced testing in a lower risk environment. Other companies were able to test wireless networking technologies, advanced sensor car to car technology and car to infrastructure communication, and they were able to test a first responder scenario. These are examples of the use of 5G wireless technology.

The tests revealed that AV do not respond well as human drivers in extreme weather. There will be more information about extreme weather testing later in this report. Future plans include more testing in extreme weather conditions. The installation of 5G antennas to facilitate various 5G testing. AV will depend on the advances in technology. They will be incremental additions to today's technology.

WHAT CITIES CAN DO

It is possible that cities might have a dedicated lane for manually operated vehicle. The challenge will be how quickly will the consumer purchase AV/EV/CV. What will be the mix of privately owned, public transit mix? Future vehicle fleets will be EV so that cities can become greener. AV and EV along with bike paths, motor scooters and improved public transit needs to happen, this needs to be an integrated approach.

The challenges that need to be addressed are the accuracy of GPS map how up to date are they, teaching Artificial Intelligence how to function in extreme weather, ethical and legal challenges in a collision that might cause an injury are who is responsible: the driver, the manufacturer or the software developer. AV have to learn under extreme weather conditions. Rain makes it more difficult for the sensors to "see" their surroundings. The city might be required to find better or upgrade road markings. Snow covers the road markings. AV use Radar and Lidar to drive on the roadway, in extreme weather events cities may have to plow sooner, use more road salt, and other means to uncover road markings.

SNOW and AUTONOMOUS VEHICLES

In 2017 Finland conducted a test to see if a car could successfully navigate a snow covered road. They used two vehicles, Car A had three forwarding looking lasers, a mix of cameras, antennas, sensors, GPS and detailed positioning information to navigate its route. Car A reached a speed of forty kilometres per hour. A second car was built for urban driving. Car B had in addition to the technology in Car A two forward looking LIDARS sensors and one rear looking LIDAR. Car A was tested near Munio, in northwest Finland. The car was tested on an intelligent road the road was specifically built to be compatible with intelligent transportation systems. The road had 5G connectivity and relayed road conditions such as friction data and precise positioning. However Car A was not equipped with the ability to communicate with digital infrastructure. No information about the test was available on the internet.

Just recently, data was released by the University of Waterloo and the University of Toronto. The Canadian Adverse Driving Condition data set. The data set is based on actual scans of icy snow covered roads. It acts as a virtual training course for computer algorithms that allow AV to drive themselves. They wanted to see the worst driving conditions possible. The universities used a Lincoln MKZ hybrid that had a full suite of sensors, eight on board cameras, a LIDAR (Light detection and ranging) scanner, and GPS. The car had a recording mode that captured images at the rate of ten images per second.

During the two year study the vehicle drove over 1,000 kilometres of which 33 kilometres were in snowy harsh conditions.

The Universities teamed up with Scale AI a San Francisco, USA based Artificial Intelligence infrastructure company to label the data. Scale used a combination of computer and human imaging recognition. The company tagged more than 178,000 instances of passing vehicles. They,also, tagged more than 83,000 instances of humans and many other objects. This data was necessary as no one had any idea how AV would perform in a Canadian winter. The team did a statistical analysis, process validation and placed the data into a format that can be looked at. In the future both universities want to create technologies that can locate and track objects in adverse weather.

AV CV EV PROJECTS 2017-2020

- Scarborough, ON. Rouge Hill automated shuttle trial for six to twelve months starting fall 2020. The shuttle will take residents to GO station from under serviced area by public transit.
- Hamilton, ON. A connected and autonomous vehicle test bed will start in spring 2020. The test bed will be on five main streets in a two kilometre stretch of residential, commercial and eight industrial developments. The purpose of the project is to explore emerging autonomous technologies to consider future integration into traffic systems.
- Candiac, QC. Navya Shuttle Pilot was a fifteen passenger autonomous electric vehicle, it was done over a two kilometre route in a light industrial area of the city from Oct. 2018 –Oct. 2019. Its purpose was to improve transportation service in an area that was under serviced by public transit, its secondary purpose was to inform and help future planning. No information about the test results are available on the internet.
- Stratford, ON. AVIN TECHNOLOGY DEMONSTRATION ZONE (AVIN) It started in 2017 and is ongoing.
- Toronto, ON. UBER Self Driving Lab. The project stated in 2017 and is ongoing. The purpose was to improve automatic mapping to make the roads safer.
- Ottawa, ON. L5 Project The project started in 2019 and is ongoing. It has a sixteen kilometre test track with a five point two kilometre high speed test loop. The purpose of the project is to test cybersecurity, adverse weather conditions and interoperability of systems.
- Alberta The project is called ELA Pilot Project in Beaumont, AB. and started in 2019. It is a twelve passenger autonomous electric vehicle on various routes for short periods of time. It is a project of Pacific Western Transportation CO. it purpose is to allow the public to experience AV. A secondary purpose was to position the company the regional transportation industry as a technology leader and promote research.
- Montreal, QC. The project was a two year study using a twelve person shuttle between Olympic Stadium and Metro (subway) along with other stops along the way. The project had a dedicated route, the project lasted from Aug.2018 to Aug.2019, within several months they added a second shuttle. There is information about this electric bus project on the internet.

AV/CV/EV PROPULSION SYSTEM

There are several types:

- BEV or Battery Electric vehicle. They are vehicles that run on batteries and plug into an external source of electricity. These vehicles use regenerative braking to charge the battery. Regenerative braking was used by electrified railways between 1900 to 1970. It turns heat from braking into electricity to recharge the batteries.
- PHEV or Plug in Hybrid Electric Vehicles. They are hybrid vehicles that are internal combustion engines and plug into an external source of electricity.
- HFCV or Hydrogen Fuel Cell Vehicles. These vehicle derive their energy by converting chemical energy into electrical energy. These vehicles can refuel in five minutes and release no harmful tailpipe emissions. First responders will need to be very careful when responding to a vehicle involved in an accident. Hydrogen when enclosed in a cylinder can explode and burn if the cylinder is damaged. There is only a hand full of public hydrogen filling stations. These vehicles have a range of 500 kilometres.

RECHARGING BATTERIES

BEV takes about fourteen hours at home or eight hours at work to recharge. PHEV needs one to four hours to recharge. There are two types of charging stations: Standard and Fast.

Standard supplies 240 volts to the vehicle being charged. In Ontario the cost can be a flat rate of $4.00 regardless of the length of charge or at an hourly rate per minute based on the amount of time the vehicle is plugged in.

Fast charging stations supplies 400 volts to the vehicle being charged. Fast rate charging station charges $17.00 per hour and is billed by the minute. The bill is based on the total time at the station.

ONLY one vehicle at a time can be charged at a fast rate charging station, the other vehicle will charge at the standard rate. At Fast Rate Charging the manufacturers have designed the batteries to be charged up to 80 to 83 of a full charge before switching over to standard charging to complete the recharging.

AV,EV,CV will most likely be powered by a rare earth metal type of battery. Although North America has an abundance of rare earths the ore is shipped to China for processing. There are several companies planning on extracting the earths from mineral sands in the southeastern US and the tailings from Alberta oil sands. Rare earths are used in magnets that are used in electric motors. As society is moving towards a low carbon emission vehicle rare earths will become more valuable.

Battery materials will be made out of Lithium, Graphite and nickel, and rare metals. The price of these materials will increase. Lithium is expected to increase by 965%, Graphite 383%, Nickel 108% by the year 2050. The batteries will become the target of thieves. Cobalt is also used in EV, the EV battery is moving to nickel to increase the range an EV can drive before recharging. Eventually these new batteries will not be able to hold a recharge and will need to be replaced. The European Union and China now have regulations that require battery manufacturers to finance the cost of collecting and recycling these new types of batteries. Ontario is moving in this direction.

EV and PARKING.

An owner in Toronto wanted to install a parking pad on his property as he planned to purchase an EV. The City of Toronto said NO, the homeowner appealed to TLAB. TLAB agreed with the owner. The city of Toronto again said NO and banned the installation of parking pads. The city cited the following. The pads create an environmental concern, they increase the amount of storm water runoff, and increase the amount of sewage that flows into the lake. In addition the city cited lack of clarity in provincial regulation surrounding parking. In 2017 Toronto Hydro was supposed to install parking pads in select locations around the city of Toronto.

Toronto Hydro did not install the pads, they had been granted permission by TLAB. TLAB said the parking pads were allowed because they meet the following criteria: minor in nature, desirable appropriate use of the site and in keeping with the general intent and purpose of the zoning bylaw and the city's official plan. It is possible that once approved and built by Toronto Hydro the City of Toronto does not have a way to enforce what type of vehicle parks on the pad.

THE LATEST NEWS CONCERNING AV/EV

GM announced a major renovation to Detroit area assembly plant. The plant will produce an electric pickup truck in late 2021. The pickup will be a battery operated Hummer pickup. The plans call for the plant to produce multiple electric pickups and sport utility vehicles, they will have different prices on the vehicles. At the same time GM introduced "Origin" a passenger like vehicle.

The "Origin" has been plagued with technical challenges and uncertainty around regulations about self driving vehicles. The article was not clear when GM would receive permission to use the "Origin". National Highway Traffic Safety Administration require vehicle to have mirrors and other safety devices attached to vehicles. However this has changed. A company in Mountain View, CA. called NURO has received permission to use a low speed autonomous vehicle. There will be no humans in the vehicle.

National Highway Traffic Safety Administration (US) do not require safety devices on vehicles that do less than forty kilometres per hour, NURO received temporary permission from NHTSA. The company can control the vehicles remotely if needed. The company will make safety reports in real time. The company will be reaching out to the communities where the vehicle will operate. Along with this the company will be meeting with NHTSA on a regular basis. The company has plans to use less than 100 vehicles but has permission to use 2,500 vehicles. The vehicles will be equipped with cameras, lasers, radar sensors and will travel in regular traffic.

Concerns were raised about the electrical grid being able to handle the number of EV recharging. London Hydro was asked to develop a peer to peer charging network to remove barriers to rapid adoption of EV. EV PLUG the name of the project is designed to convert chargers into block chain nodes, enabling public and private owners to share charging stations. Another part of the project is to provide consumers with more information on charging behaviour and give electrical providers the capacity to manage electrical loads.

Recent television advertisement by Ford signals their intent to assemble electric vehicles. The recent awarding of a contract to CAMI to assemble electric vehicles strongly suggest that some of these vehicles will be on London's roads in the near future. The CAMI vehicles will most likely be produced for a very large parcel delivery company.

AN EASY PROJECT

Should you go to Toronto in the near future you may encounter this sign “10 Minutes to Eglinton”. These signs appeared on certain streets in Toronto and indicated how long it would take to get to a subway stop. The signs were generally accurate and some people wanted to know what these signs were all about. See the accompanying photo these signs have devices that capture the signal a cellphone sends out so that the cellphone can uplink and downlink. When the cellphone is put in search mode, it is trying to find the nearest cellphone tower. This will, also, occur when you turn the ignition to the on position, most cars late model are equipped with WiFi or Blue Tooth.

When two devices are in sequence along a route, a reading can be matched up and estimate the travel time. When your Bluetooth or WiFi is in search mode a signal is transmitted, the signal is encrypted and stored. MAC ID stores the information until a match is found at a downstream location. Once the system finds a match, the information is deleted. A record is generated on the time stamp and segment travel time. Signs are updated every minute.

MAC ID is not traceable to any individual device there are no data base linking device. Even when the system is looking for a match the data is encrypted. The system cannot be used to identify a specific user’s speed or travel time. This system is a common approach to detecting general traffic conditions by road authorities. More information about this system can be found on the City of Toronto’s web site.

FUEL TAX REVENUES

As consumers switch to EV how are municipalities going to deal with the loss of revenue? The gas tax is used to fund infrastructure, sport facilities and broadband connectivity in Ontario. Two cents per litre from the gas tax fund goes into public transit. Vehicle efficiency has caused the demand for fuels to go in a downward trend The more EV are sold the trend will continue to a point that municipalities will need to find a new way to generate funds to offset the decline in funding from senior levels of government.

Infrastructure needs to be replaced, repaired and renewed during its life span. Another question to be asked is how to ensure EV pays their fair share of taxes and not get a free ride. The Residential and Civil Construction Alliance of Ontario suggest as downtown cordon pricing and congestion parking taxes. A similar idea is being tried in London England. These ideas will be politically challenging. The article from the Toronto Star published on Feb.22, 2020 has another idea.

Their idea is to charge a small user fee on all drivers. The fee MUST go to infrastructure building and maintenance. The State of Oregon is trying a user fee system called OReGo. The system charges 1.8 cents per mile. It is hoped that this fee will replace all state fuel taxes. The project has only 1,600 vehicles enrolled at the moment.

Another user pay as you drive mileage system is the IFTA. The next time you are out and about look for an eighteen wheeler with a sticker that says IFTA on the tractor. IFTA stands for International Fuel Tax Agreement. It was set up for truckers that cross the international border, it measure the mileage, route and fuel purchase details. The information is reported quarterly, IFTA uses this information to calculate the fuel taxes owing in each state or province. A user fee system such as IFTA could be set and use the amount of kilometres you drive inside and outside the province to determine how much you should pay in user fees. The user fees MUST go to infrastructure building and repair fund.

RECOMMENDATIONS AND POLICY CHANGES

In ten to fifteen years the city will need to replace the present traffic signals with “Smart” traffic signals. This will allow the city to manage traffic flow more efficiently. “Smart” traffic signals will receive a significant amount of data that will need to be sorted or stored. “Smart” traffic signals will probably include photo radar, vehicle plate readers and other Software Designed Networks (SDN). Thus the city will need a Chief Technology Officer and Chief Privacy and Data Officer.

If council decides not to have a Chief Technology Officer, they should establish a working group consisting of a civil engineer, mechanical engineer, electrical engineer and anyone they feel is appropriate to the group. The purpose of the group is to review all new technology as it pertains to civic operations. The following questions need to be addressed:

- What will be the new regulation pertaining to data be?
- How will the data be stored?
- Will the data be stored in cloud computing?
- Will it be in a secure physical structure?
- Who will determine how the data is segregated into public or private?
- If the data is public, will the city be able to turn the data into a profitable venture?

(Note: The data that referred to in this paragraph is from vehicles to “smart” traffic lights.)

The city will need to reach out to Western University School of Engineering to get the latest updates on sensors in bridge infrastructure. The city will need to determine if there are any projects that could be sent to Western to be evaluated. These projects could be designed to improve the overall transportation system. Any project sent to Western should be mutually beneficial and should be designed to give students real life projects. A project such as what is the best paint for road markings that can be picked up by sensors or cameras during rainstorms and good weather.

The city needs to determine what type of future engineering students they will need. What will be the future trends? How can Western and Fanshawe teach and train the engineering student of the future? What is happening at the GM research facilities in Canada, how can London partner with this test facility? What are the latest research and applications being done in software and can they be used and applied by the city?

The city will need to get a copy of the Canadian Adverse Driving Data Set. This is available online at U of T or Waterloo. The data set needs to be examined, studied and how can it be applied in London. The question to be determined is how will the data set affect the city’s snow removal budget. Will the city still follow provincial guidelines or will the city put new guidelines in place, in addition what will be the cost to the taxpayer?

There are a number of ongoing and complete projects involving AV/CV/EV completed, can any data be shared with the city. The data needs to studied, evaluated and can the information used in London. Will there be any new projects emanating from the completed projects that London could be involved with? There are several projects underway involving regional transportation between London and surrounding communities. What type of data is going to be generated by these projects, can the projects be sustainable. If these projects are sustainable, will the vehicle be AV/CV/EV?

Charging stations will be necessary for electrical vehicles, in parts of the city where there are single dwellings an Electrical Safety Permit will be required. The charging station should be at the side of the house. Here are some challenges: in Heritage conservation districts will a Heritage Alteration Permit be required in addition to the ESA permit. If the homeowner in a HCD cannot install a charging station beside the residence, where will the owner be allowed to put the charging station? Another question what type of materials will be consistent with the character of the HCD, will the look of the charging station be modern or will it be something else. The heritage planner and heritage groups must be consulted to help determine the answers to these questions.

Townhouses, apartment buildings public spaces and public buildings will pose unique challenges for the city. Council first must determine what level EV's are at, and when that is established what will be the minimum number of charging stations required. The advice of a civil engineer, mechanical engineer and ESA should be used to set policy and determine regulations. ALL future construction MUST include detailed plans for the minimum number of charging stations with the provision of increasing the number of charging stations. This should be done with the cooperation of the developer before any permits are issued. Before any charging stations are installed the following questions must be answered:

- Does the building code need to be changed?
- Who does the inspection the city or ESA (Electrical Safety Authority)?

These questions can best be answered by examining the charging site at TD Call Centre on York Street and further enquiries may need to be done to get answers, insight or problems that may have arisen.

As the City of London is the largest shareholder in London Hydro what is the status of the Peer to Peer charging project. The data from this project or any other project should be reviewed by the Chief Data and Privacy Officer or Working Group. They will be able to determine whether the data conforms to provincial and federal laws and regulations, and can advise on council on any options.

IN terms of legal challenges:

- what is the acceptable risk to society, government and the legal system if a city owned AV/CV/EV is involved in an accident? Who is responsible? Is it the vehicle manufacturer, the company that designed and built the software, or somebody else?
- "Smart" traffic lights may possibly have software designed networks how do we integrate them into our car dominated urban planning in the future. Will the SDN be of use to law enforcement, can they be used to determine if the offence is serious or minor? If the offence is serious in nature how does law enforcement respond to the offence?

Earlier in this report we referred to an ongoing trial in Mountain View, CA. Council should monitor the progress of the project and expect periodic reports from staff.

Ontario is finalizing regulations concerning Lithium ion and other rare earth batteries. Council's policy should alignment with province. Lithium ion batteries will need to be replaced, when they are taken to a salvage operation photo id should be produced and strictly enforced for individuals. There needs to be a system in place to trace the ownership of all Lithium ion and rare earth batteries. These batteries could, also, be used to power alternative sources of energy as an example solar power farms.

Parking pads should not be allowed, someone will suggest this for charging stations. The LPAT will want to approve them citing the reasons earlier in this report. The city MUST say no because they cause more runoff during rainstorm and snow melt. In addition provincial regulations are poorly written and need to be clearly defined and understood by the city and general public.

Under the heading An Easy Project here is something the city can do. Should council decide this a worthwhile project, the project can be an easy way for council to introduce the concept of a CV. The public will feel like they are part of the process to integrate AV/CV/EV in the city. Where can this project be used? Many motorists are frustrated by delays at construction on major arterial roads this would be an excellent place to encourage motorists to seek alternate routes. The signs could be used on major arterial roads to indicate how long it takes to get from point A to Point B.

The trend for sharing fuel tax is trending down. What can council do? It can contact Residential and Civil Alliance of Ontario to get their suggestions. Council can contact the state of Oregon and ask questions about the challenges of OReGO. Council can enquire how IFTA works and the funds can be shared with the city. The CITY needs to articulate clearly that the province and federal government need to do something about fuel taxes in the future or else EV will get a free ride.

Some more final thoughts: the city will face many challenges in regards to AV/CV/EV information and data must be collected now and failure to do so will lead to chaos and a failure of leadership. Tough decisions will have to be made if carefully thought out and well explained to the public, the public will accept them.