



British
High Commission
Ottawa

Report on the UK-Canada Knowledge Exchange Visit on Zero Emission Vehicles, February 2018

April 2018

Adrienne Yuen

Acknowledgements

The author is grateful to Christina Ianniciello, Nicola Bill, Gaby Yeung and Nicola Scahill for their hard work and support throughout this project. The author also wishes to thank the following individuals for reviewing and providing feedback on the report: Andreas Truckenbrodt, Andy Eastlake, Anete Apine, Ben Grocott, Chantal Guimont, Chris Harris, Eddy Zuppel, Ellie Davies, Jacob Roberts, John Laughlin, Katherine Grieder, Kathryn Bodkin, Ian Neville, Nicola Bill, Peter Weldon, Tim Ward and Warren Ali.

The views expressed in this report represent those of the author and do not necessarily reflect those of the visit participants, participating organisations or reviewers. While care has been taken to ensure accuracy, any remaining errors or omissions are the author's own.

The Author

Adrienne Yuen is a Sustainable Energy, Science & Innovation Officer at the British High Commission in Ottawa. In this role, she works within the Canada network of British diplomatic posts to facilitate UK-Canada relations, increase UK prosperity, and promote the transition toward a low-carbon economy in Canada. Adrienne has a Bachelor of Arts in Public Policy Studies and Environmental Studies from the University of Chicago, and a Master of Arts in Public Administration from Carleton University with a concentration in Innovation, Science and Environment. Previous employers include the Canadian federal government and Carleton University.

Table of Contents

Acknowledgements.....	2
The Author.....	2
1. Executive Summary.....	4
2. Introduction.....	4
3. How This Report is Structured.....	5
4. Costs and Benefits.....	6
5. Infrastructure Readiness.....	8
6. Public Awareness	9
7. Vehicle Supply	10
8. Technological Advancement, Clean Growth and Clean Jobs.....	11
9. Governance	12
10. Connected and Autonomous Vehicles.....	13
11. Lessons Learned	14
OLEV’s Seven Guiding Principles	14
Annex A: Visit Participants.....	16
Annex B: Participating UK Organisations	17
Annex C: Glossary of Acronyms.....	18

1. Executive Summary

In February 2018, the British High Commission in Ottawa, in collaboration with three Canadian federal departments¹, organised a knowledge exchange visit to the UK on Zero Emission Vehicles (ZEVs). The purpose was to understand the UK's approach to ZEV deployment and the nature of the ZEV landscape, make useful connections, and bring best practice and lessons learned back to the Canadian context.

The three-day visit spanned the cities of London, Milton Keynes and Warwick. The programme included meetings with policy makers, industry, urban planners, economists, local authorities, innovation funders, and R&D organisations. Discussions covered issues that are salient in both Canada and the UK, including infrastructure readiness, public awareness, vehicle supply, technological development, clean growth, and employment. The visit also highlighted best practice in ZEV transition governance, and touched on the rapidly evolving Connected and Autonomous Vehicle (CAV) sector.

This report aims to capture key themes, lessons learned and useful information that emerged during these discussions. These include: the value of a cross-departmental unit in coordinating ZEV strategy and programming across government; the importance of creating a safe, non-partisan space to apply rigour to policy ideas and build trust between stakeholders in different sectors; and the benefit of developing a transition plan for the automotive industry. The visit also underscored the value of pursuing local innovation and experimentation, understanding consumer needs and concerns, and preparing for disruptive technologies.

2. Introduction

Addressing the emissions from passenger transport will be essential to transitioning to a net-zero carbon economy by 2050. In 2015, the transport sector accounted for almost a quarter of greenhouse gas emissions in Canada, almost half of which was from cars and light trucks. Transport, the largest emitting sector of the UK economy, represents a similar proportion (26%) of the UK's total emissions. Along with the buildings sector, it is one of just two growing sources of emissions in the UK. With cars accounting for about 54% of domestic transport emissions and vans responsible for a further 15%, switching passenger vehicles over to Zero Emission Vehicles (ZEVs) has the potential to make a significant contribution to climate change mitigation.²

The past eighteen months have been significant for ZEVs in Canada. In November 2016, the Province of Québec passed legislation to introduce Canada's first ZEV mandate, which took

¹ Transport Canada; Innovation, Science and Economic Development Canada; and Natural Resources Canada.

² Committee on Climate Change (CCC). "Meeting Carbon Budgets: Closing the policy gap – 2017 Report to Parliament." June 2017. <https://www.theccc.org.uk/wp-content/uploads/2017/06/2017-Report-to-Parliament-Meeting-Carbon-Budgets-Closing-the-policy-gap.pdf> (p.109).

effect in January 2018.³ In December 2016, federal, provincial and territorial First Ministers released the Pan-Canadian Framework on Clean Growth and Climate Change, which committed the governments to develop and release a Zero Emission Vehicles Strategy in 2018, to tackle emissions from passenger transport and drive clean growth. In the markets, plug-in electric vehicle sales increased 68% from 2016 to 2017, with ZEVs hitting a record high of 1.4% of new vehicle sales in December 2017.⁴

2017 was a big year for ZEVs in the UK as well. The UK Government announced a commitment to end the sale of petrol and diesel cars and vans by 2040; unveiled the £246m Faraday Challenge to drive the research, innovation, and scaling-up of battery technologies; published the Clean Growth Strategy and the Industrial Strategy; and presented £540m in new funding for ZEVs in the Autumn Budget. In October, the Government introduced the Automated and Electric Vehicles Bill, which would give the government powers to set regulations for the installation of smart charge points in all motorway services and large petrol retailers in the UK.⁵ In the markets, sales of plug-in electric cars increased by 31% from 2016 to 2017, climbing to a record high of 2.9% of all new car sales in December 2017.⁶

In light of these developments, the ZEV mission's purpose was to bring policy makers, industry representatives, research institutions, and civil society from Canada to the UK to understand the UK's approach to ZEV deployment and the nature of the ZEV landscape, make useful connections, and bring best practice and lessons learned back to the Canadian context. Over three days, ten participants led by a representative of the British High Commission in Ottawa travelled to London, Milton Keynes and Warwick to meet with policy makers, industry, city planners, economists, local authorities, innovation funders and R&D organisations. The full list of visit participants and participating organisations can be found in Annexes A and B.

3. How This Report is Structured

The aim of this report is not to offer an exhaustive report of the trip, but to capture key themes, lessons learned and useful information that emerged during the discussions. The bulk of the report is organised around the five focus areas of Canada's forthcoming ZEV strategy: costs and benefits, infrastructure readiness, public awareness, vehicle supply, and technological advancement, clean growth and clean jobs. The report also discusses two additional areas: governance, and Connected and Autonomous Vehicles (CAVs).

³ Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques. "The zero-emission vehicle (ZEV) standard." 2018. <http://www.mddelcc.gouv.qc.ca/changementsclimatiques/vze/index-en.htm>

⁴ FleetCarma. "Electric Vehicle Sales In Canada, 2017." 8 Feb. 2018. <https://www.fleetcarma.com/electric-vehicle-sales-canada-2017/>

⁵ Department for Transport (Dft), Office for Low Emission Vehicles (OLEV) et al. "Boost for electric and driverless car industry as government drives forward green transport revolution." 18 Oct. 2017. <https://www.gov.uk/government/news/boost-for-electric-and-driverless-car-industry-as-government-drives-forward-green-transport-revolution>

⁶ CCC. 26 Mar. 2018. Email.

4. Costs and Benefits

As in Canada, costs and benefits are a critical consideration for ZEV deployment in the UK. During the mission, stakeholders consistently cited the upfront cost of purchasing a ZEV, as well as the learning curve of owning and operating a ZEV, as key barriers to individual ZEV uptake. As one stakeholder explained, “you’re asking people to make a change from the familiar, at a higher price”.

“You’re asking people to make a change from the familiar, at a higher price.”

Consumer incentives have been important in driving ZEV uptake, and experience shows that grant levels do influence decisions around ZEV purchases. Stakeholders credited the **Plug-In Car Grant (PICG)**, the UK’s first consumer incentive scheme for ZEVs, as a key instrument in the ZEV policy toolkit. Introduced in 2011, the PICG was originally set at £5,000 for all fully electric, plug-in hybrid or hydrogen fuel cell passenger vehicles. At the end of 2015, the Government announced that the scheme would lower incentives for plug-in hybrids (Category 2 and Category 3) relative to fuel cell and battery electric vehicles (Category 1) beginning in March 2016.⁷ Shortly before the change took effect, the programme saw a spike in orders for Category 2 and 3 vehicles (see Figure 1 on the next page). Today, there are seven categories of vehicles eligible for the PICG, based on the level of CO₂ emissions per kilometer and the distance the vehicle is capable of travelling with zero emissions, with grant levels based on government forecasts of consumer uptake. Cars with a recommended retail price of over £60,000 are excluded.⁸

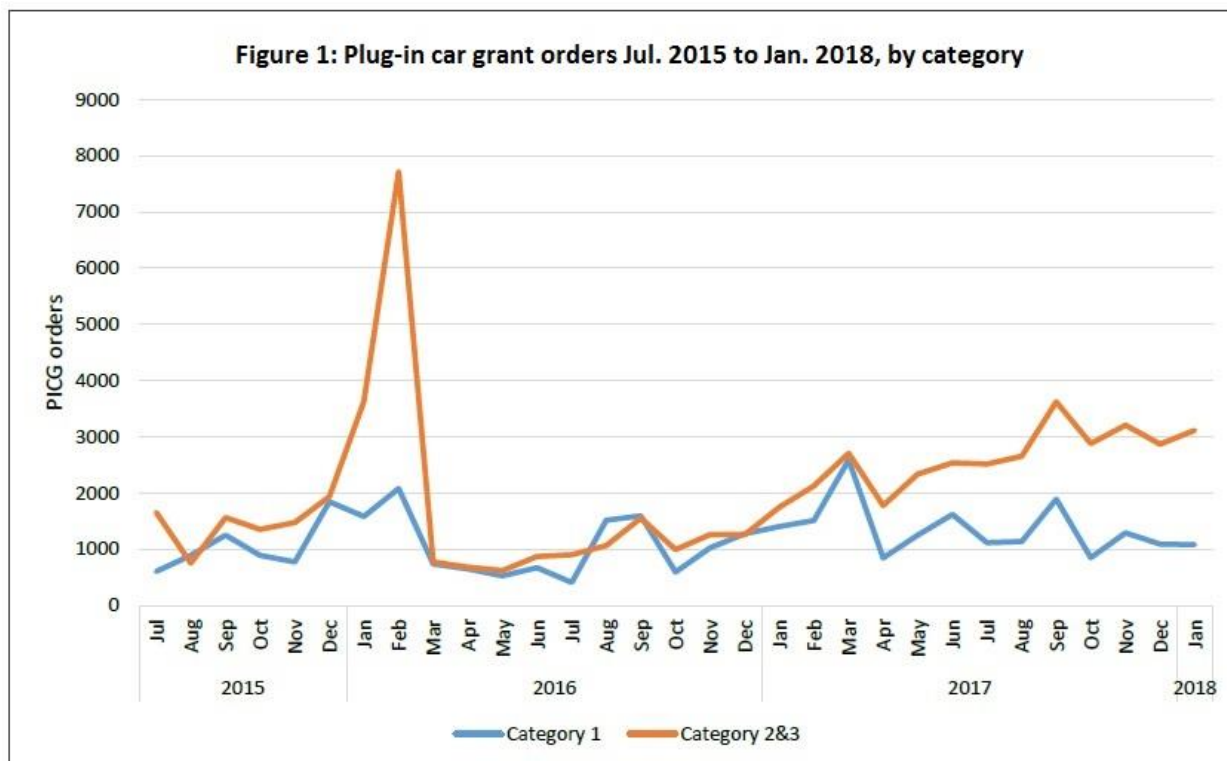
The success of PICG draws from other insights into **consumer behaviour**. According to an official from the **Office for Low Emission Vehicles (OLEV)**, research shows that people prefer to avoid a loss than to realize a gain, even when the amounts are equal. Offering savings therefore can have even more of an effect on consumer behaviour than offering a grant. This approach has worked particularly well in Norway and Sweden, where vehicle taxes are high. Similarly, the simpler it is for people to make a switch, the more likely it is that they will do so. The PICG is designed such that subsidies are built into the price of the car, and it is the manufacturers that shoulder the burden of administration, not the consumers.

According to the social enterprise **Energy Saving Trust**, per-vehicle tax incentives are especially attractive to businesses and other organisations in Britain, which can realise significant tax savings by switching entire fleets to ZEVs. As a result, 65% of new ZEV sales are made to business fleets (compared to 50-60% across all vehicles), according to registration statistics dating back to 2014. ZEVs can make an even bigger impact when they replace “grey fleet” vehicles, which are personal vehicles used for corporate purposes. This is because the use of personal cars for work is typically billed to a company or organisation on a per-mile basis, with UK Government standards enforcing a payment of at least 45 pence per mile. This creates a perverse incentive

⁷ OLEV. “Plug-in car grants: changes to grant level March 2016.” 22 Feb.2016.

<https://www.gov.uk/government/publications/plug-in-car-grants-changes-to-grant-level-march-2016>

⁸ “Low emission vehicles eligible for a plug-in car grant.” <https://www.gov.uk/plug-in-car-van-grants>



Source: OLEV

to employees to inflate salaries by driving more, which in turn contributes to congestion and air pollution and drives up costs to employers⁹.

The **Committee on Climate Change** predicts that the total cost of ownership of battery electric vehicles (BEVs) will achieve parity with internal combustion engine (ICE) vehicles by the early 2020s. Consumers, however, could still be deterred by higher upfront costs and other non-financial reasons, such as unwillingness to change behaviour.¹⁰ Incentives and other policies therefore will continue to play a role. Up-front subsidies will be important, but less expensive initiatives such as allowing the use of priority lanes should be part of the overall package. Costs and benefits to households also matter to the success of ZEV infrastructure. As the **Society of Motor Manufacturers and Traders** (SMMT) pointed out, Vehicle-to-Grid and managed charging might be key to smoothing out the peaks in demand from vehicle charging, but ultimately it will need to be worth the consumer’s while to participate in giving electricity back to the grid.

As for **social costs and benefits**, stakeholders cited several strategic drivers behind the UK’s ZEV ambitions: protecting and boosting the UK economy, mitigating climate change, improving air quality and strengthening domestic energy security. They agreed that there are many challenges

⁹ For further reading on the issues surrounding “grey fleets”, see Energy Saving Trust (EST) and British Vehicle Rental and Leasing Association, “Getting to grips with Grey Fleet”, Jul. 2016, https://www.bvrla.co.uk/sites/default/files/documents/research/bvrla_grey_fleet_final_0.pdf

¹⁰ It should however be noted that around 85% of new cars are leased or financed, so upfront cost is becoming less of a focal point.

from communication and normalization of ZEVs to managing the risks and opportunities of energy demand. They were also unanimous however in understanding that the opportunity costs would be even greater: poor air quality, missed carbon emissions targets and a declining automotive sector unprepared for global changes in technology and demand.

5. Infrastructure Readiness

Infrastructure readiness was a key theme throughout the mission, and stakeholders widely agreed that an **integrated approach** drawing together governments, industry and the research sector is essential to getting it right.

Transport for London (TfL) is making strides in making charging infrastructure available to better support ZEVs and reduce air pollution from passenger transport. Over a period of six months, TfL has worked with suppliers to install 100 rapid charge points across the city, including 51 points for use by taxis. Rapid charge points allow vehicle charging in 20 – 30 minutes compared to the seven or eight hours required by a regular charge point, of which there are approximately 2,000 installed in London. Operated by five different suppliers, the rapid network allows drivers to use all points regardless of the supplier and pay by credit or debit card, without requiring a membership. Another 50 rapid charge points will be added by the end of 2018.¹¹

There is also room for improvement. During the meeting with TfL, officials highlighted the fact that the Greater London Area is comprised of 33 boroughs, each with its own road network and set of parking rules and privileges, including for ZEVs. They acknowledged the need for more **coordinated administration** at the municipal level to harmonise existing regimes and better incentivise ZEV takeup. Another challenge is access to off-street parking, which two-thirds of households in London lack. This has translated into demand for very specific services, such as the conversion of street lampposts into charge points.

Planning for ZEV infrastructure means that getting **electricity people talking to vehicle people** will be increasingly important. As one OLEV official explained, the UK electricity system is transitioning from a 20th century model (fossil fuel based, top-down, predictable and inflexible) to a 21st century model (renewables-based, interconnected, unpredictable and flexible). Vehicle turnover is counted in years, whereas the lifecycle of electricity infrastructure is on the scale of decades. As such, it is important to “get the two systems talking”; “the EV revolution needs to take into account the power revolution”.

Vehicle-to-Grid (V2G) technology will inevitably play an important role, balancing energy use across the grid by allowing ZEVs to function as hubs for energy storage. Opportunities to earn revenue by contributing to electricity grid flexibility could also incentivise customers to switch to ZEVs. Innovative design can make a big difference. In the town of Milton Keynes for example,

¹¹ For further information, see Transport for London, “Electric vehicles & rapid charging”, <https://tfl.gov.uk/modes/driving/electric-vehicles-and-rapid-charging?cid=rapidcharging>

charging pads for electric buses are built into the road where layovers take place, allowing buses to recharge periodically at existing stopping points in their journey.

The principle of **technological neutrality** was mentioned a few times during the mission. Policy could set out ambitious targets, but not dictate technology choice; the market should decide on the winners. Both OLEV and the SMMT agreed on this point. At the very least, government actions should leave doors open for alternative technologies to take hold. For instance, the market for **hydrogen fuel cell vehicles** is much less developed, with just eleven hydrogen fuelling stations in the country. Technological development however could eventually expand the range of applications for hydrogen-powered propulsion.

6. Public Awareness

Although the number of ZEVs on UK roads is rising, the visit highlighted that there is still much work to be done to raise consumer awareness of ZEV incentive programmes, the growing availability of different models and ongoing improvements in battery technology. One stakeholder commented that in terms of “bringing consumers along”, “the mainstream media is just beginning to help us rather than hinder us.”

The SMMT stressed the importance of having agreed **definitions for the different types of ZEVs**. The growth in the market of different kinds of alternative vehicles, as well as Zero Emission Capable Vehicles, risks causing public confusion about what incentives and polices apply to which kinds of vehicles. UK stakeholders agreed that Ultra Low Emission Vehicles (ULEVs) and ZEVs have to be more clearly and consistently defined. It is hard enough for consumers to differentiate between Battery Electric Vehicles (BEVs), Plug-In Hybrid Vehicles (PHEVs) and hydrogen fuel cell vehicles.

Driver education is also needed, even after the purchase of a ZEV. Because they are built differently, ZEVs cannot be driven in the exact same manner as ICE vehicles. To address this issue, the Energy Saving Trust runs a driver behaviour programme funded by the Department for Transport that teaches motorists how to drive ZEVs in the most efficient and effective ways, working with fleets to identify what works well and what does not.

Ultimately, increasing the public’s familiarity with ZEVs has to involve getting “bums in seats.”

The **EV Experience Centre (EVEC)** in Milton Keynes is changing perceptions one visitor at a time (Figure 2). The only one of its kind in the UK, EVEC is a sleek, modern showroom on the ground level of one of the UK’s largest shopping centres. It provides a brand neutral, no-pressure environment for shoppers to stop by, get advice from “EV Gurus” on all areas of EV ownership, and borrow or rent EVs for up to seven days for a test drive.

“We talk them through and get them in a car so they can drive. After the demo, we continue talking: where do you go? Where do your family and friends live? We show them infrastructure maps, a cost calculator. People can borrow a car for a week, and when they return it, we’re ready to lend them another car to try.”

Practical trials can also help raise public awareness. EST for instance **partnered with private car hire company Uber to run an electric vehicle trial** from August 2016 to January 2017. The experiment supplied one of three different EV models to over 50 Uber drivers at no extra cost to the drivers, and used surveys, focus groups and telematics data to identify the practical challenges of using a pure electric vehicle for private vehicle hire in London. An unexpected outcome was that roughly one-third of drivers decided to continue driving EVs after the trial concluded.¹²

Figure 2: The Electric Vehicle Experience Centre in Milton Keynes



Credit: Adrienne Yuen

7. Vehicle Supply

The UK Government has committed to ending the sale of fossil fuel powered vehicles by 2040. The **Committee on Climate Change** recommends that the government go further by setting a 2035 target, pointing out that cars and vans have a turnover of approximately 15 years, and that the UK must have zero carbon surface transport by 2050 if it is to meet its legislated long-term emissions target of 80% below 1990 levels by that year. To keep a 2035 target a possibility would require that ultra-low emission vehicles make up at least 60% of new sales by 2030.¹³ In any case, it is clear that the supply of ZEVs will need to expand rapidly.

¹² For the full report on the Uber EV trial, see EST, "Electric Private Hire Vehicles in London: On the road, here and now", 29 Mar. 2017, <http://www.energysavingtrust.org.uk/UberEVtrial>

¹³ CCC. "An independent assessment of the UK's Clean Growth Strategy." Jan. 2018. <https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf> (p.44).

There are still challenges. As in Canada, where a customer seeking to buy a ZEV may have to wait several months for the vehicle to be delivered, the availability of ZEVs relative to conventional vehicles in the UK continues to pose a challenge to prospective consumers. Dealerships in the UK generally prefer not to place ZEVs in showrooms, citing lack of demand.

Innovative organisations such as the **EV Experience Centre (EVEC)** are working to close the gap. EVEC encourages demand by providing education and advice to prospective ZEV drivers, and then feeds information on that demand back to the sellers. When a visitor to EVEC expresses interest in purchasing a specific ZEV, EVEC will pass on the business lead to dealerships.

While ZEVs are still well outnumbered by ICE vehicles today, **Chargemaster**, a 10-year old company that operates over 44% of the UK's charge points, predicts plug-in car growth to rise from 130,000 today to 1 million by 2022. A company representative compared it to smartphone takeup: "[today] everyone knows someone who has one [EV]. Five years ago there were ten models. There are now well over fifty models on the market. Over one hundred new models are already announced, launching over the next three to five years."

8. Technological Advancement, Clean Growth and Clean Jobs

About half of the cost of an electric car is from the battery; if battery costs can be slashed, ZEVs could become much more affordable. Announced in July 2017, the UK Government's **Faraday Challenge** will invest £246m between 2017 and 2021 for research, innovation and scaling up of battery technologies. **Innovate UK**, a government-funded innovation agency, is responsible for delivering £88m of this funding. Its £30m V2G competition represents a first exploration of the practicalities of vehicle-to-grid technologies in the UK, funding feasibility studies on potential business models, collaborative R&D of physical kit and real-world demonstrators with more than 2,700 vehicles covering different customer types, geographical areas and consumer propositions.

Another example of the UK effort to create scale in battery manufacturing is **Warwick Manufacturing Group's Energy Innovation Centre**, a £60m facility enabling research along all stages of a battery's development cycle, from raw materials to cell components to application integration, through to recycling. Based at the University of Warwick and part of the UK's **Catapult Network**, the facilities can be booked and used for R&D purposes by any business with a presence in the UK.

Throughout the mission, the pursuit of clean growth and jobs was consistently identified as one of the key drivers of the UK Government's ZEV ambitions. Government and industry stakeholders alike described the need for the UK to develop a **competitive advantage in ZEV technologies**, positioning itself to meet domestic and global demand for ZEV-related capabilities. Global market forecasts are projecting a rapid rise in ZEV demand over the coming decades, major automotive companies are shifting R&D investments away from the internal combustion engine, and a growing number of countries are announcing target dates for the phase-out of new fossil fuel-powered vehicles. The UK manufactures 2.7 million engines a year; with markets moving

away from the internal combustion engine, the UK needs to get ahead of the curve. One stakeholder commented that this drive is perhaps boosted by Brexit rather than weakened by it; the bigger the domestic demand for ZEVs, the stronger the incentive would be for ZEV manufacturers to stay in Britain.

One institution that emerged from the Automotive Council was the **Advanced Propulsion Centre (APC)**, a government-industry partnership founded in 2013 to deliver £1 billion over 10 years through competitions to support projects that reduce emissions and create jobs. Projects, which range from £5 million to £40 million, must be collaborative and involve at least one Small to Medium sized Enterprise (SME), develop capability in the supply chain, transfer knowledge, offer new manufacturing processes, reduce carbon emissions and create jobs. The APC is “technology and company agnostic”; as long as a project is innovative, delivers the right key performance indicators and aligns with the APC’s strategic objectives, it is within scope.

Physical constraints can be a driver of clean growth. Located about 80 km north of London, the grid-style layout of **Milton Keynes** resembles that of a typical North American suburb. Half a century ago Milton Keynes was a collection of rural communities with 30,000-40,000 people; today it is a town of 270,000, with ambitions to grow to 500,000. Facing a possible 60% increase in travel demand but only able to build 25% of new highway capacity, and recognising that the growth of the single-use car comes with costs, the town is now charting its own course. As a representative of Milton Keynes Council explained, “we couldn’t afford to just build car parks. We needed to do things differently.” Over the last 4-5 years, Milton Keynes has invested in over 300 charge points, an EV Experience Centre, free downtown parking for ULEVs, and ULEV access to bus lanes. In January 2016 it was named one of four **Go Ultra Low Cities** by OLEV, winning £9m of a £40m pot to realise its vision of becoming one of the most electric vehicle friendly cities in Europe.¹⁴

“We couldn’t afford to just build car parks. We needed to do things differently.”

9. Governance

The **Office for Low Emission Vehicles** is a unique, cross-departmental structure within the UK Government whose purpose is to support the early market for ultra-low emission vehicles (ULEVs). As a joint unit, its staff and funding are drawn from the Department of Business, Energy and Industrial Strategy (BEIS) and the Department for Transport (DfT). It is also supported by staff on secondment from industry and academia. OLEV’s structure consists of eight branches leading on: bills and EU carbon emissions regulations, competitions, R&D, incentives, energy issues, communications, H₂ and supply chain, and infrastructure.

¹⁴ DfT, OLEV et al. “£40m to drive green car revolution across UK cities.” 25 Jan. 2016.
<https://www.gov.uk/government/news/40-million-to-drive-green-car-revolution-across-uk-cities>

Institutions enabling multi-stakeholder dialogue and collaboration are key to a cross-country effort to transition to ZEVs. Originating in 2003, the not-for-profit company **Low Carbon Vehicle Partnership** brings together over 200 organisations representing automotive industries, technology providers, finance and investment communities, governments and others to collaborate on a common goal: mitigating climate change by achieving low carbon transport in the UK. As the group's representative explained, "The LCV Partnership's goal was to gather everyone with skin in the game around the same table. We wanted to identify solutions and put them through the wringer, in a safe and supportive environment."

"The LCV Partnership's goal was to gather everyone with skin in the game around the same table. We wanted to identify solutions and put them through the wringer, in a safe and supportive environment."

Growing out of the LCV Partnership, the nine-year-old **Automotive Council** also represents an important forum for government and industry to build relationships, engage in dialogue, and challenge policy ideas in a safe and constructive environment. One stakeholder mentioned that unions wanted to be part of the plan to ensure employment as the transition away from ICE production begins; the Automotive Council was a place where such a discussion could take place. The Advanced Propulsion Centre, mentioned in the previous section, is an example of the valuable collaborations that result from such dialogue.

10. Connected and Autonomous Vehicles

At the University of Warwick, discussions turned to connected and autonomous vehicles (CAV), a field that is emerging in parallel with the growing ZEV sector. The UK government has recognised the potential benefits and opportunities of CAVs, and in response has committed £250m of funding, matched by industry. A sister company of the Advanced Propulsion Centre, start-up **Meridian Mobility** was launched in September 2017 to help innovators navigate the increasingly complex value chain, aiming to "maximise the collective potential of a cross sector-ecosystem" and to "be a one-stop shop." With £100m of the government's £250m, matched by industry, Meridian Mobility plans to create a testing ecosystem, which so far involves five testing sites, ranging from digital simulations and controlled environment proving grounds in Horiba Mira and Millbrook, to real world public testing infrastructure in the Midlands and in Central London. Additional investments will be made in test infrastructure connecting communities through interurban routes on major roads, motorways and rural routes.

There was no consensus among UK interlocutors on how CAVs would fit in with plans to deploy ZEVs, except for the understanding that ZEV strategy, policy, and infrastructure would need to be flexible in order to accommodate the arrival of CAVs. As one of the visit participants put it, planning for autonomous vehicles is "like trying to design an airport in 1890." According to Meridian Mobility however, Level 4 and 5 autonomous vehicles have the potential to be very disruptive, changing enabling services and creating new business and operating models, so "**the window to look at it is now**".

11. Lessons Learned

Drawing together the themes that emerged during the visit, seven insights could apply to the development of a Canadian approach to ZEVs:

1. The Office for Low Emission Vehicles is a useful model for **drawing together work across government** to accelerate the deployment of ZEVs. While DfT and BEIS retain oversight, efforts are coordinated and focused through OLEV, which represents a single point of contact for ZEV strategy and policy. OLEV's work is underpinned by seven guiding principles (see box).
2. There is value in creating a **safe, non-partisan space** to apply rigour to policy ideas and build trust between stakeholders, while reaching for a common goal. Engaging relevant stakeholders (e.g., original equipment manufacturers, environmental organisations, suppliers, etc.) and bringing them around the same table early on can prevent polarising debates in public later on. The purpose should not be to find the lowest common denominator, but to drive toward a "higher purpose". Collaboration is vital to getting policies and messages for consumer engagement right, and ultimately increasing uptake beyond the innovators.
3. Overall, cross-sector efforts should focus on enabling an **economically and environmentally sustainable transition** from ICE vehicles to ZEVs. Clear pathways, effective communication and a well-defined transition plan are key to successful ZEV uptake. The automotive sector should look to retool and refocus for the ZEV transition, and governments should work with industry to support that transition.
4. Car-oriented, suburban developments can be **labs for innovation and experimentation**. Local governments can leverage central government funds to pursue development that is both fit-for-purpose and sustainable, while carving out their own niche.
5. Consumers do not always make accurate assessments of their own vehicle usage (mileage, fuel needs, etc.). **Brand-neutral services** can help consumers better understand their actual travel patterns and how ZEVs could fit in with their lifestyle. EVEC is a useful

OLEV's Seven Guiding Principles

1. "Securing **maximum possible benefits** to the UK **economy** from the mass market adoption of zero emission vehicles.
2. **Technology neutral**: we will not seek to 'pick winners' in terms of emerging technologies, but follow industry and international consensus.
3. Encouraging a **locally driven approach**: one size fits all solution won't work everywhere.
4. The **consumer experience** underpins everything we do.
5. We will only intervene where the **market alone might not deliver the best outcomes** in the shortest (time) possible.
6. **Consistent communications**: the Government will engage early, openly and proactively with industry on all aspects of the developing zero emission sector and we will support clear and consistent communications with consumers.
7. **Real world impact**: we have learned the lessons of previous Governments. We are focused on real world performance of technology options, not laboratory tests."

model for breaking down barriers for consumers and getting people behind the wheel. Organisations like EVEC can also feed information about demand back to dealerships, encouraging the availability of ZEVs.

6. Consumers respond to subsidies and grants, but **non-financial interventions** are also an important part of the toolkit. These include clear public information about charge points, parking and lane privileges, and services to help drivers make the switch.
7. Governments should prepare for disruptive technologies by engaging with stakeholders early on, and ensure that policymaking and planning are underpinned by **technological neutrality**.

Annex A: Visit Participants

1. Warren Ali – Director of Emerging Technologies Initiatives, Automotive Parts Manufacturer’s Association
2. Chantal Guimont – President & CEO, Electric Mobility Canada
3. Joyce Henry – Director General, Office of Energy Efficiency, Natural Resources Canada
4. Sarah Houde – Directrice générale, Grappe industrielle des véhicules électriques et intelligents
5. Ian Neville – Climate Policy Analyst, City of Vancouver; and lead author for City of Vancouver's EV Ecosystem Strategy
6. Jody Proctor – Director, Environmental Policy Analysis and Evaluation, Transport Canada
7. Andreas Truckenbrodt – President & CEO, Canadian Hydrogen and Fuel Cell Association
8. Paul Wieringa – Executive Director, Electricity and Alternative Energy Division, BC Ministry of Energy, Mines and Petroleum Resources; and Co-Chair of the Canada-wide Zero Emission Vehicle Strategy
9. Gaby Yeung – Policy Advisor, Innovation, Science and Economic Development Canada
10. Adrienne Yuen – Sustainable Energy, Science & Innovation Officer, British High Commission Ottawa
11. Eddy Zuppel – Program Leader – Vehicle Propulsion Technologies, National Research Council Canada

Annex B: Participating UK Organisations

1. Advanced Propulsion Centre
2. Chargemaster
3. Committee on Climate Change
4. Energy Saving Trust
5. EV Experience Centre
6. Innovate UK
7. Low Carbon Vehicle Partnership
8. Meridian Mobility
9. Milton Keynes Council
10. Society of Motor Manufacturers and Traders
11. Office for Low Emission Vehicles
12. Transport for London
13. Warwick Manufacturing Group

Annex C: Glossary of Acronyms

AV	Autonomous Vehicle
BEV	Battery Electric Vehicle
CAV	Connected and Autonomous Vehicle
EV	Electric Vehicle
ICE	Internal Combustion Engine
PHEV	Plug-In Hybrid Vehicle
PICG	Plug-In Car Grant
ULEV	Ultra Low Emission Vehicle
V2G	Vehicle-to-Grid
ZEV	Zero Emission Vehicle