WWF

REPORT

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Transportation Revolution: Shifting to Electric Vehicles on Canadian Streets

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WWF-Canada would like to recognize the McLean Foundation and the Ontario Trillium Foundation for their generous support of our sustainable transportation work. The Ontario Trillium Foundation is an agency of the Government of Ontario. Front cover photo © 2012 / WWF-Canada

Published in January 2013 • WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

INTRODUCTION: WHY ELECTRIC VEHICLES ARE KEY TO FIGHTING CLIMATE CHANGE

The science is clear: climate change poses a fundamental threat to places, species and livelihoods across Canada and around the world. Piecemeal efforts are not enough to address a problem of this magnitude. Instead, it's going to take dedicated and significant effort to lower the planet's carbon emissions.

WWF has a bold long-term solution: a 100 per cent renewable energy future by 2050. Our *Energy Report: 100% Renewable Energy by 2050* outlines a pathway to this future that includes changing how we produce, manage and use energy. In Canada, one of the keys to realizing this future will be transforming the transportation sector.

Nearly 30 per cent of Canada's total greenhouse gas emissions come from moving people and goods. In *Road Transportation Emissions Reduction Strategies*, WWF proposed a three-pronged approach to significantly slash carbon emissions in the long-term: better urban planning, better public transit, and electrification of personal vehicles.

Why electric vehicles (EVs)? While better urban planning and better public transit can reduce the need for personal vehicles, many trips will still require cars or minivans. Making them electric represents a tremendous opportunity to reduce carbon emissions. When we compared the full life-cycle greenhouse gas (GHG) emissions of 11 different alternative fuels and technologies with that of conventional gasoline engines, we found that EVs are by far the best alternative fuel option for light-duty vehicles in Canada.[1]

SETTING THE AGENDA

Going electric won't happen overnight. Transforming EVs into mainstream technology will require a robust electricity grid, a national network of charging stations and strong EV production. It will require early adopters - such as public and corporate fleets - and advocates - such as community leaders and corporations - to champion the idea. Finally, it will require a shift in how Canadians think about getting where they need to go.

To achieve all this, WWF plans to change the conversation about EVs. To date, the public discourse on electric vehicles has largely focused on their failure to reach early adoption targets, casting doubt on their viability as a sustainable transportation option.

In contrast, we propose to focus on the environmental potential of EVs, as well as the incremental successes that are happening, and build wide-based support across sectors and between stakeholders.

In this document, we set an aggressive but realistic national goal for electric vehicle adoption: 600,000 EVs on Canadian roads by 2020. We define the conditions that are necessary for aggressive adoption rates. Finally, we have establish measureable objectives so that we can track progress and demonstrate how seemingly small gains today will lead to significant transformation in just two decades.

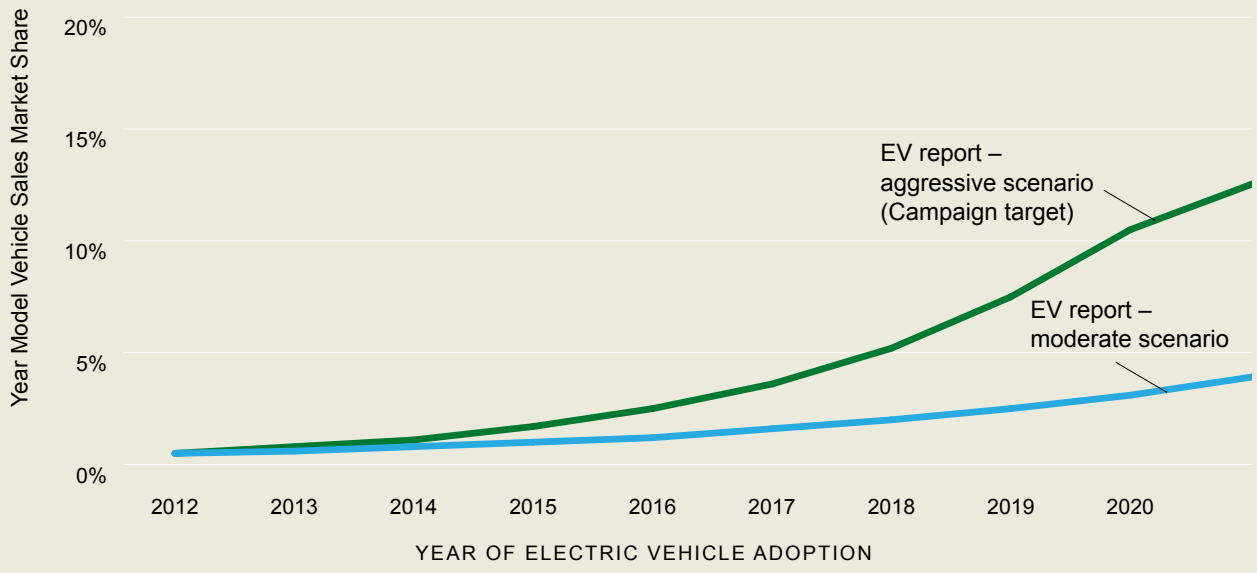
SETTING THE GOAL

To understand the current state of EV adoption and to set a realistic goal, WWF-Canada developed a model that considered three potential market growth scenarios for electric vehicles.[2] Based on this modeling, we have chosen a target for EV adoption that combines the moderate and aggressive growth scenarios we identified.

Given today's infrastructure, technology and behaviour barriers, we expect that to make this more evergreen a moderate growth pattern is most realistic between 2012 and 2014. However, partnerships with and between governments, industry, non-governmental organizations (NGOs) and business can improve the adoption rate over time.

By 2015, we anticipate that mechanisms will be in place to overcome current barriers to EV use, making an aggressive growth scenario possible through to 2020. As Figure 1 shows, this strategy will lead to a far more significant number of EVs than simply pursuing a moderate growth scenario. Thus, we have established an end goal of 600,000 EVs on Canadian roads by 2020, broken down into year-by-year targets (Table 1).

Figure 1. Moderate EV adoption scenario versus campaign target



REAPING THE BENEFITS

To estimate the long-term impact of EVs on carbon emissions, WWF-Canada has developed an in-house simulation model based on Natural Resources Canada's life cycle GHG emissions calculation model (GHGenius) and EV market growth projections (see Appendix A).

Based on this model, our goal of putting 600,000 EVs on Canadian roads by 2020 would avoid a total of 1,200 kilotonnes of carbon dioxide equivalent (Kt CO2-eq) emissions. When we combine aggressive adoption of EVs with current fuel efficiency standards and with initiatives to significantly reduce vehicle use, the model shows significant long-term emission reductions from transportation. For more details on the combined and potential environmental benefits, refer to Appendix A.

Table 1. Annual EV sales targets, 2012–2020

		Combined Target	New Car Sales Share	GHG Emissions Avoided by EVs (Kt-CO_2e)
2012	Moderate growth pattern	8,500	0.5%	17
2013		21,500	0.8%	47
2014		40,500	1.1%	91
2015	Transitional growth pattern	69,000	1.7%	154
2016		112,000	2.4%	246
2017		175,000	3.5%	378
2018	Aggressive growth pattern	269,000	5.1%	566
2019		405,500	7.4%	833
2020		604,000	10.5%	1,208

REACHING THE TARGET

Electric vehicles are a technology that, along with other sustainable transportation initiatives, has the potential to create a low-carbon future. Creating such a significant shift will require collaboration across sectors to address barriers and build opportunities.

ADDRESSING THE BARRIERS

EV stakeholders have identified a number of barriers that hold Canadians back from choosing electric vehicles.[3] Key among these are:

Lack of familiarity

Currently, very few Canadians are familiar with electric vehicles. They see unknown reliability, maintenance and operating costs as key barriers. Canadians also worry that electric vehicles are not versatile enough to be really useful and that owning an EV would force them to make too many lifestyle changes.

Lack of access

Canadians cite lack of access to electrical outlets at home and work for charging as a big concern. Without a visible charging network, Canadians will continue to feel that an EV takes away the sense of spontaneity currently associated with vehicle ownership: the ability to just jump in the car and go wherever you want.

Purchase price

Surveys have shown that the initial cost of purchase is by far the biggest obstacle preventing drivers from considering an EV. Canadians also identified unknown maintenance costs as a significant barrier, especially the cost of battery replacement.

Doubt about environmental benefits

Canadians generally perceive EVs to be quieter and cleaner than conventional vehicles. However, their perceptions of the environmental advantage of EVs are affected by the source of the electricity used to power the vehicle and concerns about the environmental impacts of battery production and disposal.

In order to put 600,000 EVs on the road by 2020, we need to overcome these barriers. WWF-Canada has identified five conditions that must be realized by 2015 to spur an exponentially increasing market interest:

1. **Public experience:** Canadians are increasingly familiar with EVs and actively rent or purchase them. EVs are regularly seen as a component of corporate or government fleets.

2. **Practicality:** Canadians see electric vehicles as a broadly viable transportation option, thanks to better battery range and plentiful charging stations. EV owners may regularly take advantage of other sustainable transportation options (e.g., train) to supplement their vehicle use.
3. **Competitive pricing:** Canadians see EVs as an affordable option. [4]
4. **Clear environmental benefits:** EVs are recognized as part of the solution to climate change.
5. **Availability:** Canadians can choose from a full range of EVs at many access points (e.g., dealerships, car-shares, rental companies, workplace).

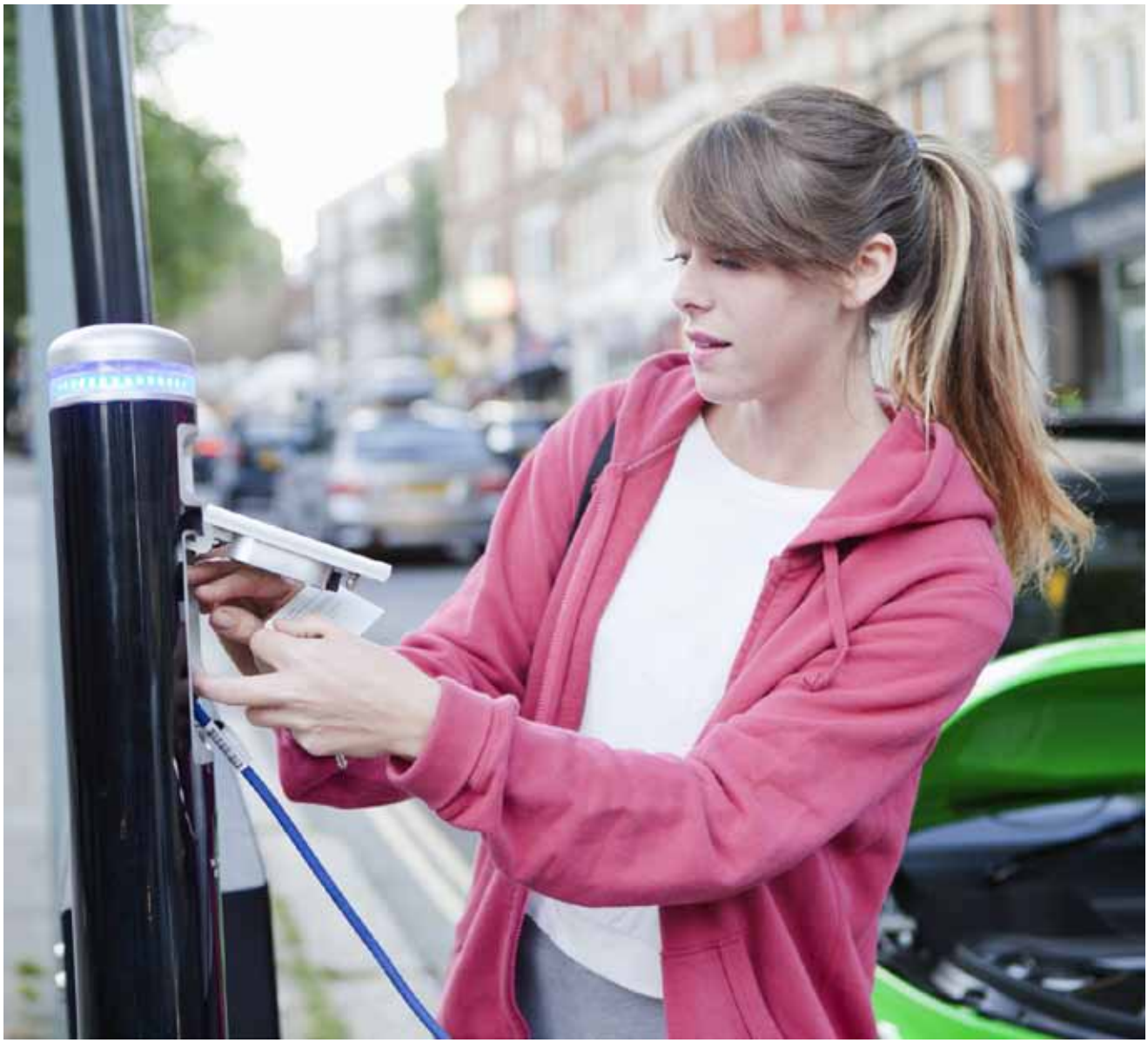
OPPORTUNITIES FOR COLLABORATION

To create the conditions for aggressive EV adoption, WWF has developed strategies, identified stakeholders to be involved and suggested targets for measuring progress (Table 2). These strategies and targets have been informed by reports by EV advocates, NGOs, original equipment manufacturers, and municipalities within Canada and the U.S. By laying out these roles and responsibilities here, and by showing how multiple stakeholders have responsibilities for each action and outcome, WWF will bring attention to the opportunities for collaboration.

Table 2. The WWF strategy

Condition	Outcome	Strategy	Players	Potential metrics
Public experience	Canadians are increasingly familiar with EVs and actively rent or purchase them. EVs are regularly seen as a component of corporate or government fleets	Increase the visibility of EVs through fleet conversions and high-profile spokespeople; encourage Canadians to test-drive or rent EVs	NGOs, original equipment manufacturers (OEMs), utilities, corporations, public fleets (federal, provincial and municipal), colleges and universities	• An increase in awareness, comfort and experience with electric vehicles • A commitment by public, utility and university fleets and most corporate fleets to adopt electric vehicles • An increase in EV rentals and test drives
Practicality	Canadians see electric vehicles as a broadly viable transportation option, thanks to better battery range and plentiful charging stations. EV owners may regularly take advantage of other sustainable transportation options (e.g., trains, buses) to supplement their vehicle use	Reduce current limitations by installing more charging stations and improving battery technology; raise awareness of range and charging options	OEMs, federal and provincial governments, utilities, municipalities, residential and commercial building developers, property managers, corporations, transportation companies	• An increase in EV range and decrease in average charge time • A decrease in Canadians' "range anxiety" • Affordable and reasonable options for all types of residential charging • An increase in public, highway and workplace charging infrastructure • An increase in options for EV owners who need to make the occasional longer trip
Competitive pricing	Canadians see electric vehicles as an affordable option	Reduce the purchase price of EVs through incentives and through fleet conversions that create economies of scale; raise awareness of the operating savings	Federal, provincial and municipal governments, employers, OEMs, banks, insurance companies, retailers, fleet managers, NGOs	• An increase in Canadians who know EVs can save them money • An increase in the value Canadians place on reducing emissions • The presence of charging infrastructure and purchasing incentives across Canada • A reduction in battery costs and premium costs for electric models
Clear environmental benefits	EVs are recognized as part of the solution to climate change	Increase awareness of the environmental benefits of EVs among policy makers and all Canadians; increase the percentage of renewable electricity in provincial grids to boost those benefits	Universities and colleges, NGOs, provincial and federal governments, OEMs, parts suppliers, automotive recyclers, utilities	• An increase in the number of Canadians who recognize the environmental benefits of EVs • The presence of EVs in provincial, federal and municipal government climate strategies • The presence of a clear end-of-life management plan for EVs from each OEM
Availability	Canadians can choose from a full range of EVs at many access points (e.g., dealerships, car-shares, rental companies, workplaces)	Give Canadians more access to EVs at dealerships, in workplace fleets and at rental companies; raise awareness of the options available	OEMs, dealerships, rental companies, employers, NGOs, utilities, governments	• An increase in EV-certified dealerships that offer EV test-drives • An increase in EVs in rental, car-sharing and workplace fleets • The presence of EVs in each vehicle class

In the coming years, WWF will establish baselines for each of the targets listed above, track progress, and report on successes and needs on an annual basis. We will share successes across the country and recognize early EV leaders. As well as tracking and reporting the progress toward our EV penetration goal, WWF-Canada will also work with the stakeholders identified in this report to leverage current actions and initiate new actions in order to create the conditions necessary for EV adoption.



APPENDIX A – THE BIG PICTURE: REDUCING GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION

Electrifying personal vehicles is not the only important strategy for reducing personal, light-duty road transportation-related greenhouse gas emissions. Two other keys are reducing vehicle fuel consumption and avoiding the need for personal vehicle use. Currently, national vehicle fuel consumption standards have been established that will reduce fuel consumption over time, while a number of initiatives are underway that will curb the need for personal vehicles through better land use planning and transit development.

In order to project the collective impact of these strategies on personal road transportation emissions, WWF-Canada created a model based on Natural Resources Canada's life-cycle GHG emissions calculation model (GHGenius). Our simulation shows that under a "business as usual" scenario, GHG emissions from personal road transportation will more than double by 2050 due to a growing number of vehicles on the road.[5] This "no action" scenario provides the baseline against which emission reduction initiatives will be measured.

REDUCING VEHICLE FUEL CONSUMPTION

Regulations currently implemented in North America will significantly improve light-duty vehicle fuel efficiency between now and 2025. According to our simulation, the updated fuel efficiency standards through 2025[6] will reduce the total life cycle GHG emissions of light-duty vehicles by 21 per cent (to 157 megatonnes of CO2 equivalent) by 2050.[7]

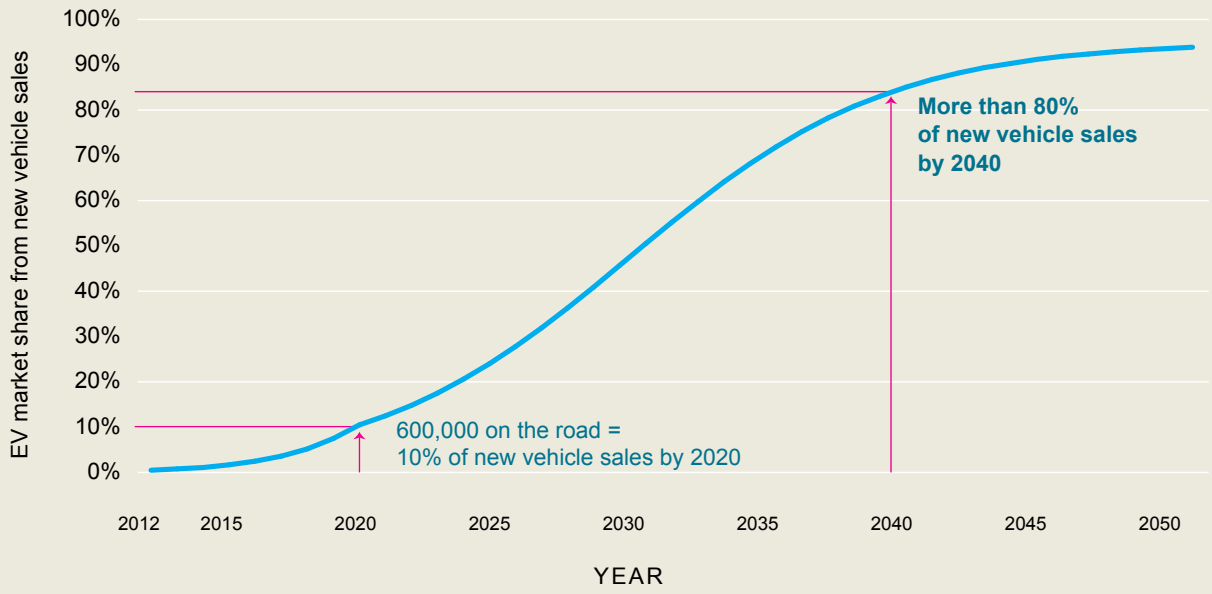
AVOIDING THE NEED FOR PERSONAL VEHICLE USE

In recent years, the average number of kilometres travelled in personal vehicles has continued to increase, although more slowly than in the past. The average annual vehicle kilometers travelled (VKT) in the U.S. shows a 2.4 per cent year-over-year increase between 1971 and 2011, while the average VKT growth between 2000 and 2011 was 0.8 per cent.[8] WWF-Canada expects that with new public transit development and better land use planning, VKT could be reduced by 0.5 per cent each year from 2012 to 2050, for a cumulative reduction of 18 per cent by 2050. According to our simulation, this level of VKT reduction would eliminate 35 megatonnes of carbon dioxide equivalent (Mt CO2-eq) emissions by 2050.

ELECTRIFYING PERSONAL VEHICLES

Even with aggressive improvement of vehicle consumption standards and a reduction in VKT, our model predicts that GHG emissions from personal road transportation will continue to increase due to the growing number of vehicles on the road through to 2050. In order to gauge the long-term emissions reduction potential of EVs, WWF has assumed market penetration of EVs will follow an S-shape growth pattern beyond the 2020 target.[9] Figure 2 (below) shows the potential penetration of EVs by 2020 and beyond.

Figure 2: Predicted adoption of EVs over the long term



The mass adoption of EVs by 2020 and beyond will cut an additional 30 per cent of GHG emissions by 2050 (59 Mt CO2-eq). This reduction is based on Natural Resource Canada's projection for electricity generation mix by 2050.

GOING 100 PER CENT RENEWABLE

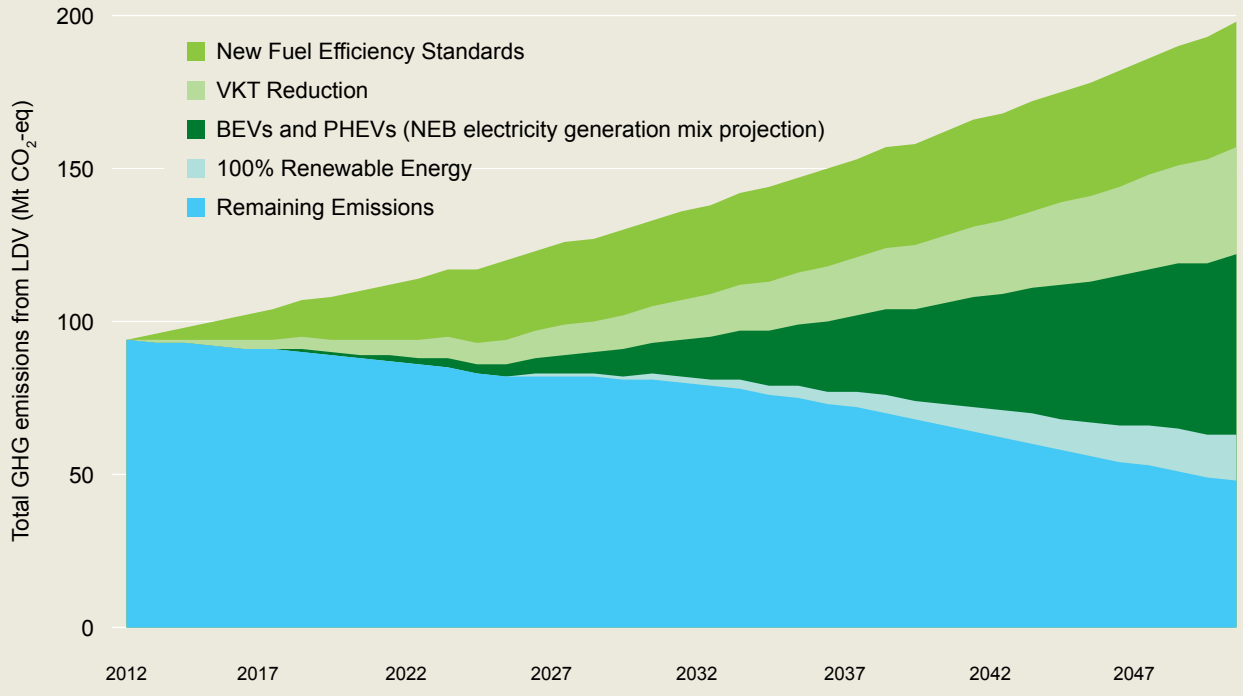
While EVs that run on coal-fired electricity still produced less GHG emissions than their petroleum-fuelled counterparts, the greener the source of electricity, the greater the reduction in emissions. EVs in provinces such as Quebec and British Columbia, where the electricity is generated from renewable sources, create more emission cuts than EVs in Alberta, where coal is currently dominant. Thus, adding more renewable energy to the electricity mix increases the GHG

emissions reduction potential of EVs. In *The Energy Report*,[10] WWF verified that by 2050, the world could acquire all the energy it needs from renewable sources. By transitioning to a 100 per cent renewable energy future, Canada could cut another 15 Mt CO2-eq by 2050, over and above the reductions created by switching to EVs. Since Canada's electricity grid is relatively green, WWF's model shows this will not have a major impact on overall emissions, but it would make a significant difference in coal-powered provinces.

RESULTS

Figure 3 (below) shows the results of WWF-Canada's in-house modeling. By reducing fuel use, reducing vehicle use, switching to electric transportation and increasing the amount of renewable energy in Canada's electricity grid, Canada can slash personal road GHG emissions by more than 50 per cent — and of all the sustainable transportation strategies we include, making the switch to EVs accounts for the single biggest reduction. Clearly, EVs are a solution worth pursuing.

Figure 3: Potential personal road transportation-related GHG emissions reduction of WWF-Canada's 2020 electric vehicle target through 2050



ENDNOTES

1 WWF-Canada. 2012. *Emissions Associated with Various Transportation Technologies.*

2 WWF-Canada. 2012.*Greenhouse Gas Reduction Potential of Electric Vehicles: 2025 Outlook Report.*

3 Electric Vehicle Technology Roadmap for Canada (evTRM). 2010. pp. 49–50

4 evTRM. 2010. p. 50

5 Our model suggests that GHG emissions from personal vehicle use will rise from the current level of 90 megatonnes of CO2 equivalent to 197 by 2050. This model considers the full life cycle GHG emissions of electric vehicles and conventional gasoline engines, from feedstock extraction to automobile manufacturing operation and disposal. By considering the total life cycle GHG emissions from light-duty vehicles, WWF's resulting emissions calculations are approximately 10 per cent higher than the posted numbers in Environment Canada's National GHG Inventory Report.

6 United States Environmental Protection Agency, http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/13f44fb4e2c2d39d85257a68005d0154!OpenDocument

7 Based on the intermittent history of fuel efficiency standard improvements, WWF-Canada has made no assumption in our model of improved standards beyond 2025. However, this is a mechanism that we support.

8 Historical VMT report, Traffic Monitoring Analysis System (TMAS), US Department of Transportation, http://www.fhwa.dot.gov/policyinformation/travel/tvt/history/historicvmt.pdf

9 The model assumes that market penetration never reaches 100 per cent due to a small share of other technologies, including high-efficiency gasoline engines. The model also assumes that 90 per cent of EV sales in the first years would be plug-in hybrids. As we move forward, the majority of sales would be pure battery electric vehicles.

10 WWF International, 2011. *The Energy Report.*

Transportation by the Numbers

19%

Road transportation is the single-most significant contributor to GHG emissions in Canada, accounting for 19 per cent of total emissions in 2009

35%

Road transportation emissions have increased by 35 per cent since 1990, second only to GHG emissions growth from the Canadian oil sands industry

270 grams

The average private automobile emits 270 grams of CO_2-equivalent emissions per passenger kilometre travelled

65%

Light-duty vehicles make up 65 per cent of road transportation emissions