Technology Road Map for Electric Vehicles in Canada (evTRM)

EVS 24

Report Date

- Slight delay to mid May 2009

A partnership effort between:

- Electric Mobility Canada
- Natural Resources Canada
- Transport Canada

What is Electric Mobility

Mobility is electric when traction is provided by an electric motor.

Three types of mobility system

- **The electricity is generated on board the vehicle (hybrids, fuel cells).**
- **The electricity is generated elsewhere and stored on board the vehicle (batteries).**
- **The electricity is generated elsewhere and delivered to the motor during motion (grid connected).**

What is Electric Mobility Canada?

A National Industry Association with 6 categories of membership:

- **Industry (voting)**
- **Energy Providers (voting)**
- **End Users (Voting)**
- **NGO's (Voting)**
- **Supporters (individuals)**
- **Associates (Gov't agencies)**

Currently 89 members

Our Mission

- To establish electric mobility, in all its forms, as the primary solution to Canada's growing transportation energy issues and to assist its members in the fulfillment of their mandates.

What is a Technology Road Map?

- The Technology Roadmap (TRM) concept is a consultative process that is designed to help industry, its supply-chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. These technologies will be of critical importance to an industry in the next five to ten years.

The Steering Committee

Chair: Azure Dynamics Corporation
Vice-Chair: Unicell Limited

BC Hydro
Canadian Auto Workers
Canadian Automobile Association
Centre national du transport avancé
Delaware Power Systems
Electric Mobility Canada
Electrovaya
Ford Motor Company of Canada
General Motors of Canada
Hydro-Québec
Manitoba Hydro
Pollution Probe
Purolator Courier
University of Manitoba
ZENN Motor Company

Road Map Objectives

- Encourage the rapid adoption of EVs for passenger and commercial transport markets in Canada through appropriate regulations, incentives, infrastructure and education/awareness. We recognize that most EV's will be built by OEMs headquartered outside Canada.
- Develop the EV industry in Canada in areas where Canada has a competitive advantage: parts suppliers, bus builders, niche vehicle builders.
- Power these vehicles with new green electricity

The Process – National Consultation

- Vision meeting – Ottawa – June 26
- User Needs Meeting – Montreal – Sept 11
- Technology Responses – Vancouver – Nov. 4
- Validation – Toronto – Nov. 25

Working Groups

At all three meetings, breakout groups focussed on

- Battery/Energy Storage
- Electric Drive Components
- Vehicle Integration and Efficiency Optimization
- Grid Interface

Draft of Vision Proposed

This vision statement acknowledges the environmental, economic, social and strategic necessity to move from fossil fuels to clean electricity, and the corresponding need that ultimately all new on road vehicles sold in Canada will have electric drive trains.

- **By 2018, in addition to Hybrid Electric Vehicles, there will be 500,000 other highway capable – plug in electric drive vehicles on the road in Canada. These vehicles will have increased Canadian content over current 2008 internal combustion engine vehicles.**

Draft Vision

The vision includes the following boundary metrics:

- **The Most Important Measurements of Performance:**
  - the resulting grams of CO2 equivalent and criteria air contaminants per kilometre traveled.
- **Maximizing the Use of Clean Energy:** Priority to energy from renewable sources.
- **Price:** The total cost of ownership of a grid-powered vehicle will be no greater than that of an internal combustion engine vehicle.
- **Compatibility:** Electric drive vehicles will operate within the current infrastructure on all roads and meet Canadian Motor Vehicle Safety Standards.

Draft Vision

- **Other Measurements of Performance:** Overall vehicle performance will meet or exceed that of current vehicles. Convenience and comfort are part of overall performance.
- **Market Penetration and Industrial Development:** *Canadian fleet operators will be targeted as early adopters of electric drive vehicles*.

Canadian transportation GHG emissions, 1990-2005

GHG by Transportation Mode (Mt of CO_2e) [a,b,c]	1990	2005	Total Growth 1990–2005	% in 2005
Small Cars	25.1	22.4	-10.9%	16.2%
Large Cars	27.1	23.0	-15.0%	16.7%
Passenger Light Trucks	14.9	29.0	94.6%	21.1%
Freight Light Trucks	6.7	11.5	71.2%	8.3%
Medium Trucks	9.4	11.0	17.1%	8.0%
Heavy Trucks	14.9	37.0	147.5%	26.8%
Motorcycles	0.2	0.3	54.9%	0.2%
School Buses	1.0	1.1	8.6%	0.8%
Urban Transit	2.1	1.9	-9.9%	1.4%
Inter-City Buses	0.7	0.6	-8.9%	0.5%
	102.1	**137.8**	**35%**	**100.0%**

Sources:

a) Statistics Canada, *Report on Energy Supply-Demand in Canada, 1990–2005*, Ottawa, May 2007.

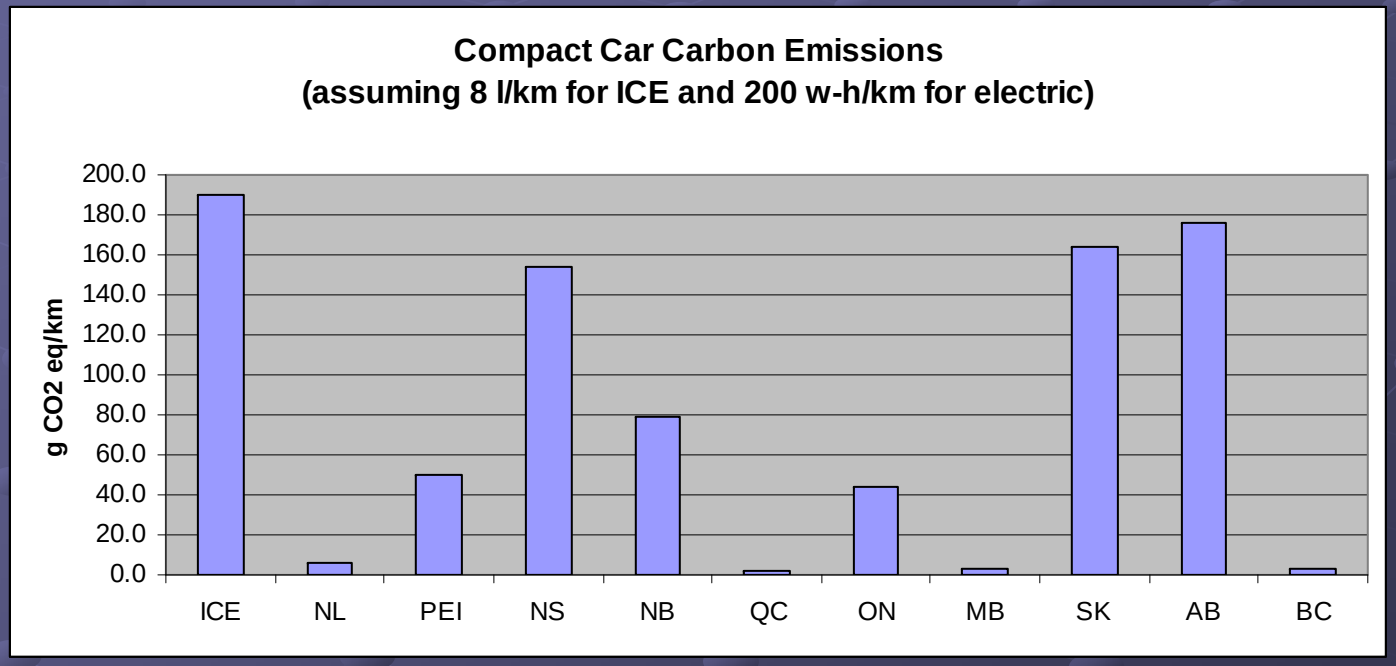
b) Natural Resources Canada, Transportation End-Use Model, Ottawa, June 2007.

c) Environment Canada, *Canada's Greenhouse Gas Inventory 1990–2004*, Ottawa, April 2006 (Cat. No. En81-4/2004E).

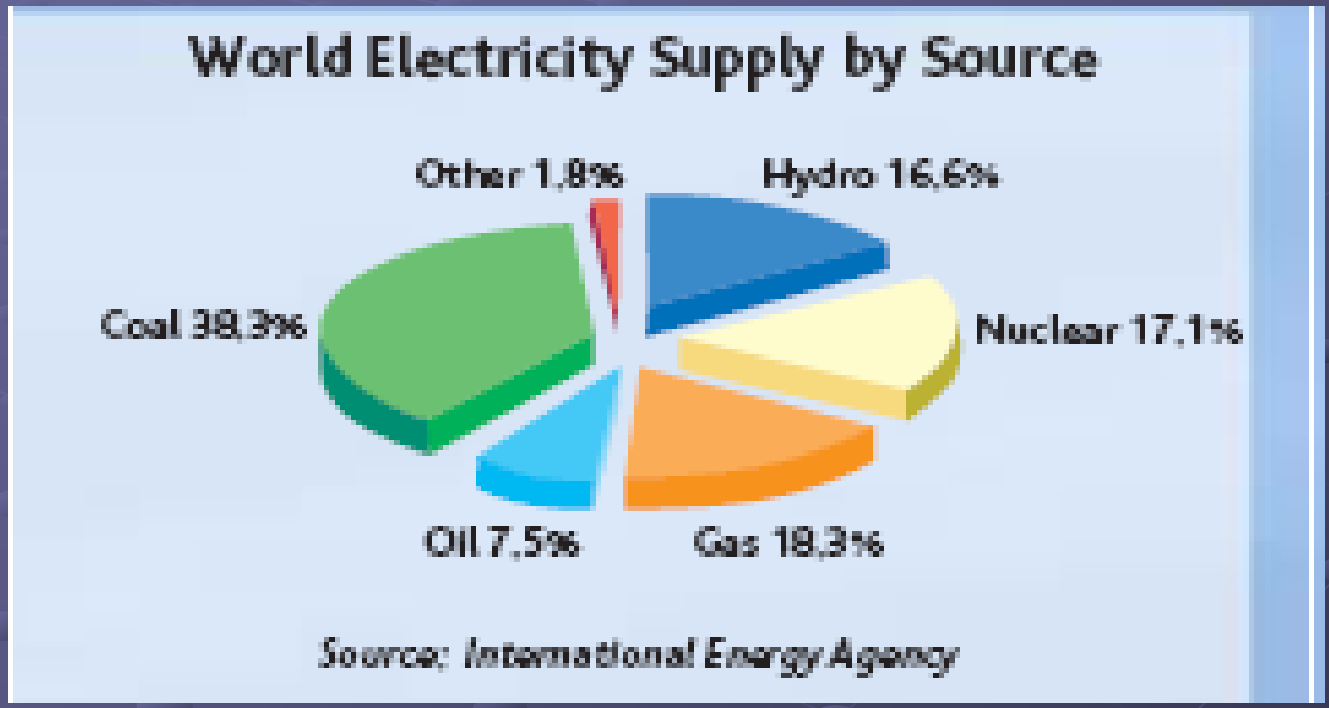
Estimated Fuel Savings

- HEV – 30% to 60%
- PHEV – 60% to 80%
- BEV – 100%

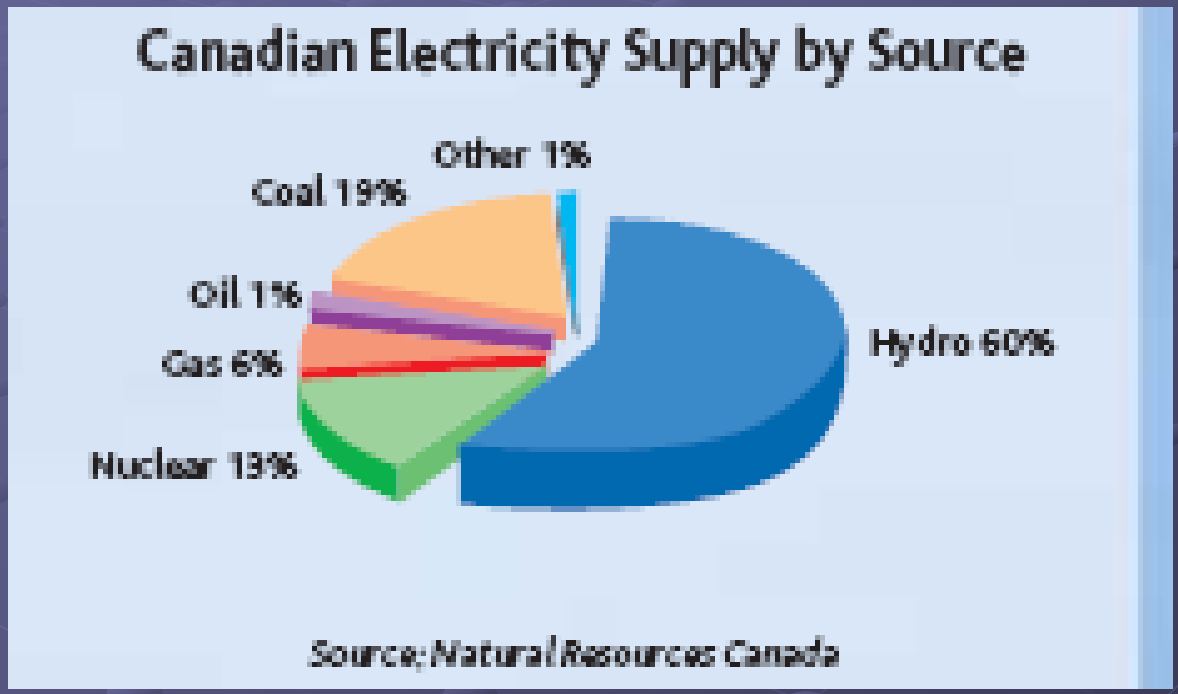
Emission Reductions



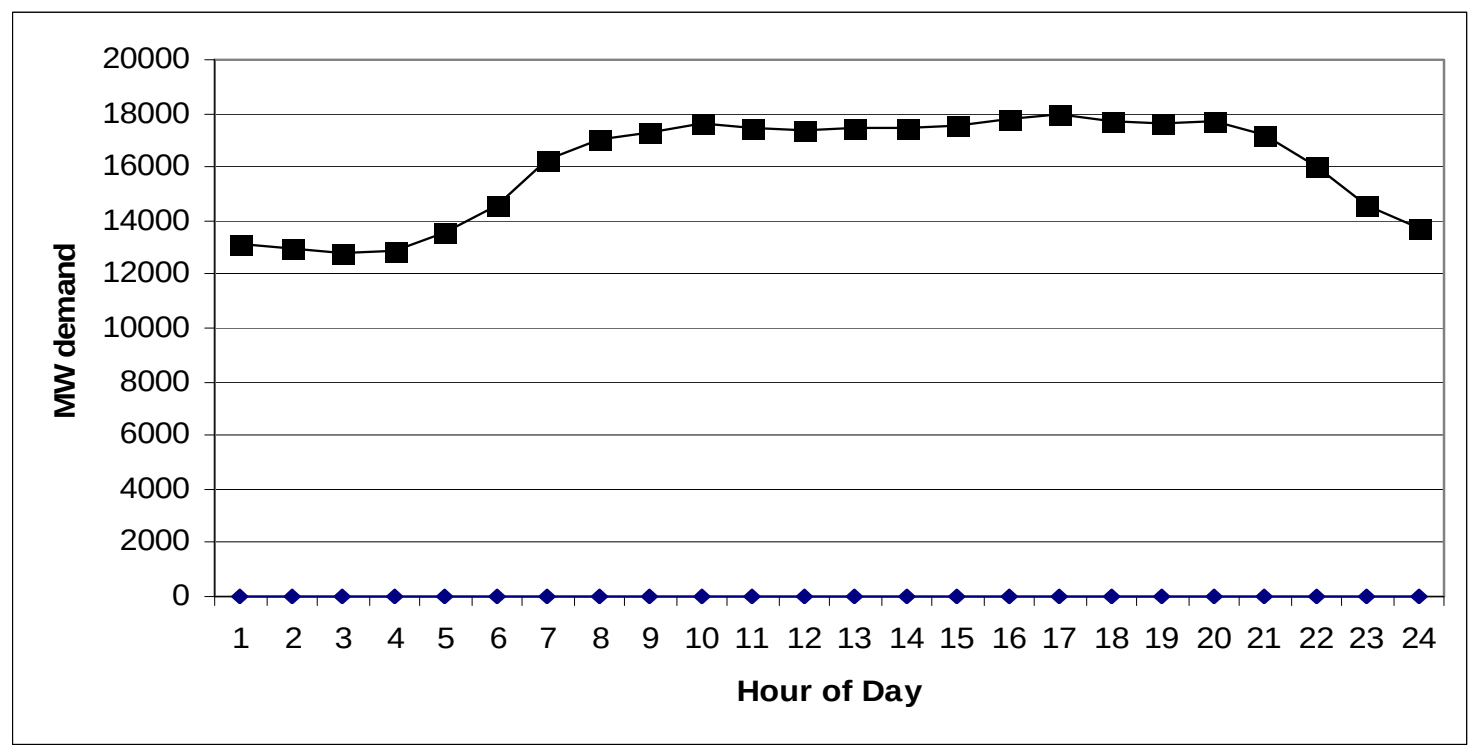
Electricity by Source - Global



Canada's Advantage



Electricity Use by Time of Day



Advantages of EV's

- **Torque** – The high torque of electric motors at near zero rpm provides superior performance in low speed driving, vs. ICEs which require considerable gearing to move the vehicle at low speeds.
- **Efficient Energy Conversion** – Electric motors convert 95 percent of applied power to propel the vehicle vs. up to 30 percent for gasoline ICEs and up to 40 percent for diesels.
- **Regenerative Braking** – Electric motors can capture much of the energy otherwise lost in braking.
- **Power per Unit Weight** – For the same power output, electric motors are smaller and lighter than ICEs.
- **Simplicity** – Electric motors have one or a few moving parts vs. hundreds for the ICE. As a result, they are cheaper to maintain.
- **Pollution** – Essentially zero from the electric motor itself
- **'Fuel' Flexibility** – Electric motors can use electricity from any source (e.g. coal-fired vs. hydro generation) whereas ICEs require significant modification depending on the fuel type.
- **Silence** – Electric motors are near noiseless vs. the ICE which requires muffling that lowers energy efficiency.

Battery/Gasoline Energy Comparison

- **The bottom line: Gasoline has a 15:1 energy/weight advantage. For example, 20 gallons of gasoline weighs about 60 kg: providing the equivalent energy requires a 900 kg. battery. While the electric vehicle dispenses with heavy ICE support systems like exhaust and transmission, it still bears a significant weight penalty.**

Evolution of EV's

- Hybrids – HEV
- Plug In Hybrids - PHEV
- Battery Electric Vehicles - BEV

Challenges Identified

- Technology challenges (batteries,)
- Public awareness of EV's, PHEV's, HEV's
- Infrastructure (capacity, availability of outlets)
- New Financial Models needed

New Procurement Criteria Needed

- To allow for new technologies
- To support Canadian Industry

Road Map Report Content

- **Introduction**
- **Why Electric Vehicles?**
- **Marketing considerations r electric vehicles**
- **Technology Pathway**
- **Institutional Pathway**
- **Summary of Canadian strengths, weaknesses, opportunities and threats**
- Recommendations

Range of Recommendations

- Focused battery research - performance and lifetime
- Grid/EV links
- Codes and Regulations - building codes, safety regulations, electrical standards
- Business Models
- Human Resources Issues
- Public Education and Awareness
- Financial Incentives – expenditures and tax measures

Sept 28 to 30, 2009 – Montreal Conference and Trade Show

Thank You

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