Association of International Automobile Manufacturers of Canada

L'Association des fabricants internationaux d'automobiles du Canada

Vehicle technology outlook

Passenger vehicle fuel economy/GHG emissions regulations: 2011-2025

Conference of New England Governors and Eastern Canadian Premiers
Montreal, QC
27 September 2012

David C. Adams
President

Overview

1. **Introduction**
   - Membership, mission, economic contribution

2. **Canada's vehicle market in the global context**
   - Domestic sales, production, trade flows

3. **Addressing climate change: The regulatory picture**
   - New fuel efficiency/emissions rules
     Cars: 2011-16 **35.5mpg** (avg); 2017-25 **54.5 mpg** (avg)
   - What's in; what's out?
   - Canada-US regulatory alignment: **One national program**

4. **Innovating solutions: Multiple approaches**
   - Refined internal combustion engines; vehicle down-weighting; BEVs; plug-in hybrids; clean diesel; natural gas; hydrogen fuel cell
   - We're building it now … but will they come?

INTRODUCTION

Members: 15 international companies

Associate members

Mission

We help create and implement public policies and solutions which:

- Enrich Canadian **consumers' choice** of vehicles;
- Demonstrate **environmental leadership**;
- Promote and enable introduction of all advanced technology vehicles (technology **neutrality**);
- Promote **equitable** trade;
- Eliminate trade and regulatory **barriers**;
- Provide reliable counsel to federal departments and provincial ministries on all vehicle safety and environmental **legislative/regulatory/ standards development.**

Economic contribution to Canada

2011 Performance

- Employ **77,000** Canadians (direct and indirect) in sales, service, technical, logistics, warehousing, finance;
- **> 60%** of Canada's 3300+ new car dealerships
- 15 companies sold over **837,230** of **1,585,519** new passenger cars and light trucks in Canada; **52.8% market share** (down from 56% owing to 2011 Asian disaster)
- Toyota and Honda plants accounted for **35%** of Ontario's new vehicle production (reduced owing to 2011 Asian disaster impact on parts supply)
- **> 54%** of the AIAMC member vehicles sold in Canada are assembled in the NAFTA region (Canada, US, Mexico)
- Auto sector % of manufacturing GDP: **11%** (Can); **22%** (Ont)

CANADA'S VEHICLE MARKET IN THE GLOBAL CONTEXT

Canada's market in the global context

Given its market size, Canada is a **technology** (and standards) **'taker'**

- Canada's new vehicle market represents approximately:

  2% of global vehicle production and sales

  12-15% of the US market's annual production and sales

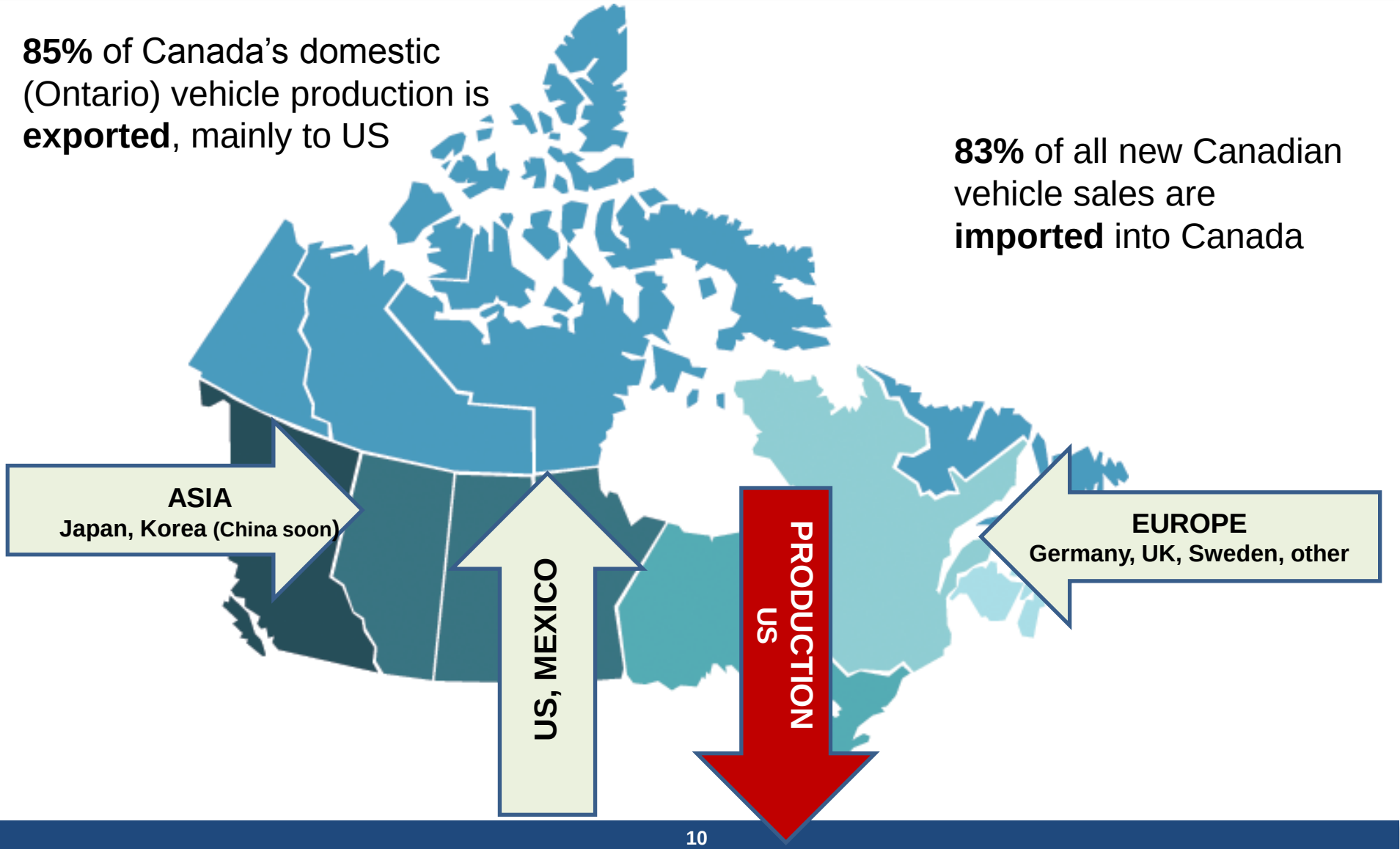
- Unique Canadian environmental and safety standards only increase costs for Canadian manufacturers and **consumers**

- Canada-US regulatory alignment critical on environmental and safety standards, ensuring Canadians have access to newest advanced technology vehicles at lowest costs

Tight regional, global integration

85% of Canada's domestic (Ontario) vehicle production is **exported**, mainly to US

83% of all new Canadian vehicle sales are **imported** into Canada



Canada-US regulatory alignment

Canada-US regulatory harmonization

One product, with common tests, certified for both markets.

- History of bilateral cooperation between Canadian and US federal regulators (EC-EPA, TC-NHTSA, NRCan-DOE) – and some provinces, states
- Similar safety and emissions testing, verification, and targets
- US-Canada Air Quality Committee (2007); US-Canada Clean Energy Dialogue Action Plan (2009); US-Canada Clean Energy Dialogue Action Plans (2009, 2012); provincial-state regional climate change initiatives

Federal-provincial regulatory harmonization

One national fuel efficiency/GHG emissions program for Canada's provinces/territories and US states

- **Québec** recently recognized federal GHG standard; aligned its regulations with Canadian and US program:
- **BC** sees the benefits of the national program

ADDRESSING CLIMATE CHANGE: THE RULES AND REGULATIONS

Addressing Climate Change

- In 2000 there were about **700** million light duty vehicles in the world
  - 2030 – 1.3 billion
  - 2050 – 2.0 billion

- According to the U.S. Dept. of Energy
  - 25% of all oil consumed in the history of humanity was consumed from 2000 – 2010
  - 30% of world's total energy is used for transportation

- Climate change scientists tell us
  - $C0_2$ emissions must be cut by 50% to 80% by 2050 to stabilize the climate

Addressing Climate Change

Problem: **70-80%** of fuel's energy is lost within the vehicle's powertrain and is not transferred to the wheels as motive power

Challenge: Improve fuel efficiency **AND** reduce GHG and CAC emissions **AND** shrink transportation sector's carbon footprint **AND** keep consumers happy **WHILE OFFERING** offer more power, torque, driveability, safety, utility, and legroom.

Key factors

- Size of our target market is unknown (no quotas for new vehicles, just customers)
- Consumer acceptance (US) of smaller engines and alternative technologies is a barrier to market penetration, economies of scale
- Volatility of crude, gasoline and diesel prices
- Near-term vs. long-term regulatory requirements
- Infrastructure, climate and geography (EVs)
- Small improvements <u>now</u> = large improvements <u>later</u>

The rules: 2011-16 and 2017-25

Fuel efficiency/GHG emissions regulations

- Steadily increasing stringency to **2016** and from **2017-25**
- Passenger cars and light trucks have separate footprint-based curves and efficiency/CO_2 emission targets
- Different vehicles have different targets
- Each manufacturer has individual target based on baseline performance: Highly efficient fleets have more difficult challenge
- Ironically, smaller vehicles have more stringent targets
- US Mid-term review mechanism will review 2020-2022 targets due to unpredictability of ATV and electric vehicle sales
- Projected fleet-wide compliance target of 54.5 mpg does not mean the average vehicle in-use will achieve 54.5 mpg (based on test cycles)
- Estimates of approx 40 mpg (avg) for 'real-world' US fleet in 2025

So, Canada-US regulatory alignment remains paramount

One national fuel efficiency/GHG emissions program for Canadian passenger cars and light trucks ► Aligned on a continental basis

The rules: 2011-16 and 2017-2025

So, as currently configured, some sample vehicle targets:

Vehicle Type	Example Models	Example Model Footprint (sq. ft.)	2025 CO_2 Emissions Target (g/mi)	2025 Fuel Economy Target (mpg)
Example Passenger Cars				
Compact car	Honda Fit	40	131	61.1
Midsize car	Ford Fusion	46	147	54.9
Fullsize car	Chrysler 300	53	170	48.0
Example Light-duty Trucks				
Small SUV	4WD Ford Escape	44	170	47.5
Midsize crossover	Nissan Murano	49	188	43.4
Minivan	Toyota Sienna	55	209	39.2
Large pickup truck	Chevy Silverado	67	252	33.0

Source: US EPA

The rules: 2011-16 and 2017-2025

By 2025, most current models will no longer comply: only hybrids/Evs

2025
Mercedes Smart fortwo EV
Nissan Leaf
Chevrolet Volt
Toyota Prius
Honda Civic Hybrid

Hyundai Sonata Hybrid
Ford Fusion Hybrid
Lincoln MKZ Hybrid

2021-2024
Lexus CT 200h
Honda Insight
Toyota Highlander Hybrid
Lexus RX 450h
Honda Civic CNG

Chevrolet Silverado Hybrid (2WD)
Chevrolet Silverado Hybrid (4WD)
Nissan Altima Hybrid
Toyota Camry Hybrid
Lexus HS 250h

Ford Excape Hybrid

2020
Honda CR-Z
Mercedes Smart fortwo
Hyundia Elantra

2019
Toyota Tacoma (2WD), manual

Toyota Sienna
Chevrolet Cruze Eco, manual
Ford Focus SFE
Honda Civic HF
Honda Odyssey 2WD
Ford Ranger 2WD, manual

2018
Toyota Tacoma (2WD), auto
Hyundia Accent
Infiniti M35h
Honda Civic
Ford Focus

2017
Ford Fiesta SFE
Fiat 500, manual
Cadillac Escalade Hybrid (2WD)
Chevrolet Tahoe Hybrid (2WD)

Chevrolet Tahoe Hybrid (4WD)
Volkswagen Passat, manual

Ford Fiesta
Buick LaCrosse
Kia Forte Eco
Mini Cooper, manual
Chevrolet Cruze
Buick Regal

Blue = EV/PHEV
Brown = HEV

Green - diesel
Black = gasoline

No change in vehicles assumed, except improved air conditioning systems

Source: US EPA

The rules: 2011-16 and 2017-25

According to the August 2012 US Final Rule for MY 2017-25,

- US consumers are expected to **save over $US 8,000** at the pump over the life of a new 2025 model year vehicle.

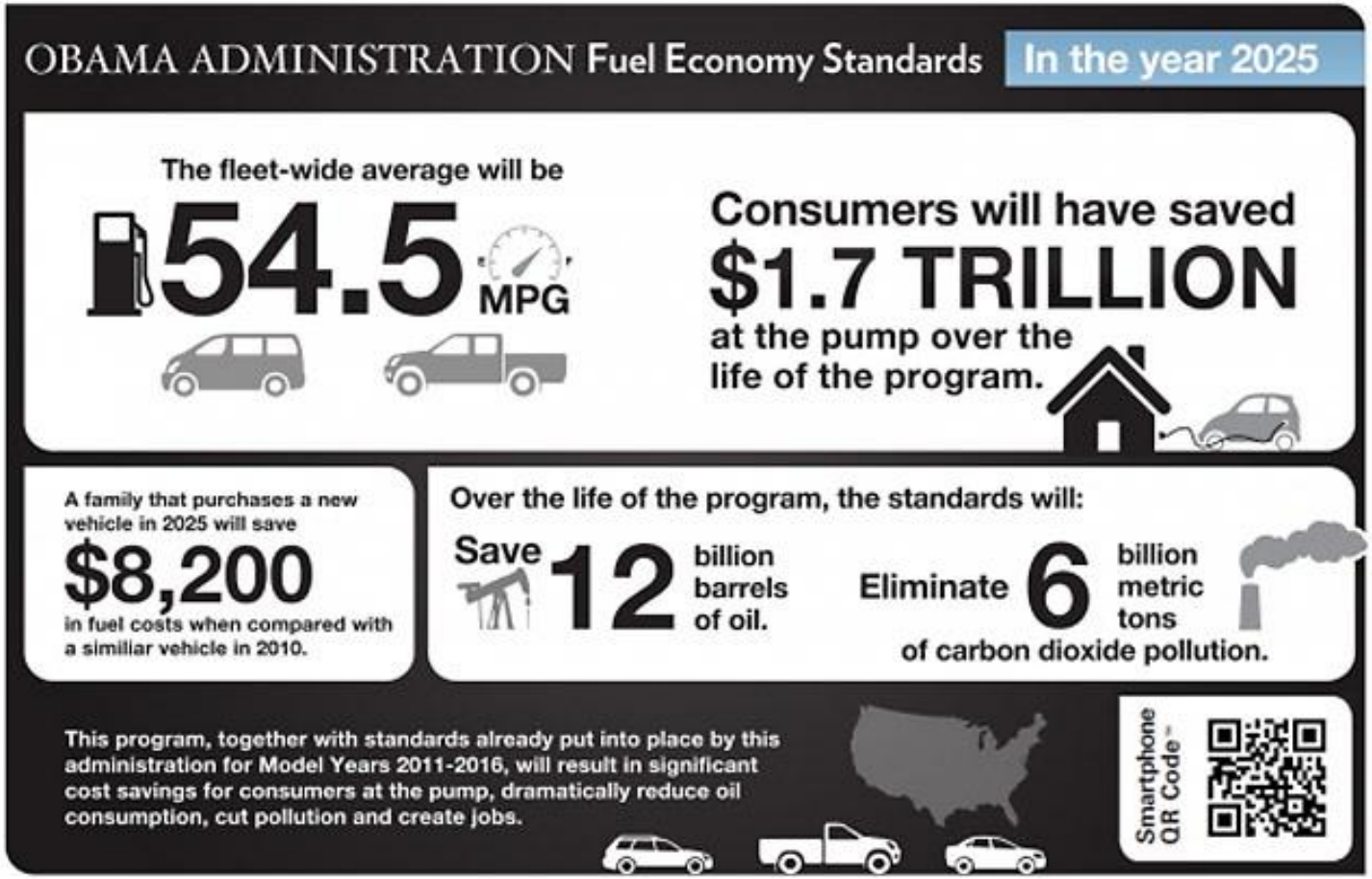
- But that car or truck is also projected to cost approx. **$US 2,560 more** than one of today's vehicles
  (incremental cost of $US 720 by 2016 and $US 1840 by 2025)

In Canada, we expect a similar cost-benefit.

But could be higher owing to smaller fleet, different economies of scale, and consumers' preference for one advanced vehicle technologies vs. another.

The rules: 2011-16 and 2017-25

According to the US Administration:



Source: WhiteHouse.gov

How do we meet the challenge?

INNOVATING SOLUTIONS:
MULTIPLE TECHNOLOGY APPROACHES

Innovating solutions

Several advanced technologies and “alternative” fuels

1. Improved, **refined internal combustion engines**, transmissions and lightweight, rigid chassis (i.e. Mazda SKYACTIV TECHNOLOGY)
2. Advanced high-output **4-cylinder engines** (Toyota Yaris, Honda Fit, Hyundai Elantra, Subaru Outback, Mitsubishi RVR, Suzuki SX-4)
3. Engine **downsizing** and **turbo-charging** (BMW 1, 3 and 5-series, Kia Optima, Land Rover Evoque, Volvo S60, Mercedes-Benz GLK 350)
4. Gas-electric **hybrids** (i.e. Toyota Camry and Prius family, Porsche Panamera, Nissan Altima, Hyundai Sonata)
5. Advanced body, chassis materials: **All-aluminum** bodies (Jaguar, Land Rover); **carbon-fibre** bodies (BMW, Mercedes)
6. Gasoline **direct-injection** (GDI), variable valve timing (VVT), cylinder deactivation, friction-reducing lubricants

Innovating solutions

…still more approaches

7. Advanced **clean diesel** (i.e. Volkswagen TDI family, BMW X5 diesel, Mercedes E, ML, GL classes, Porsche Cayenne, Audi Q7)
8. Pure **battery electrics** (Nissan LEAF, Mitsubishi i-MiEV, smart fortwo EV)
9. Range-extended and **plug-in hybrid** gas-electric (Toyota Prius PHV)
10. Engine **idle stop-start systems**: Now on market (Kia, BMW)
11. Transmission improvements

    Multi-speed 6-, 7-, 8-, (or 9) speeds (All OEMs)
    Continuously variable (Nissan, Subaru, others)
    Dual-clutch (Mitsubishi, Volkswagen, Porsche)

12. Air-conditioning efficiency improvements: Low-leak systems and low GWP refrigerant (**R-1234yf**)

Solutions – Internal combustion engines

Refined internal combustion engines (ICEs), transmissions, chassis

Mazda SKYACTIV TECHNOLOGY

Possible to build a small, fuel-efficient crossover SUV that still delivers ‘Zoom Zoom’. SKYACTIV: An integrated suite of advanced technologies dramatically increases fuel efficiency and engine output – with regular gasoline: 2.0L 155 hp, 6-speed.

CX-5 has highest compression gas engine and may offer the lowest compression clean diesel engine (TBA).

NRCan FE rating 7.8 L/100km city/5.7 L/100 km hwy.

2012 Mazda CX-5

Solutions - Alternative fuels – BEVs

All-electric vehicles (BEVs)

2013 Nissan LEAF™

2013 Nissan LEAF™

Updated LEAF™ gets more efficient motors and better batteries. FE improvement of approx. 25% (roughly 91 mi) expected. Full charge costs approx $2.25 (at Cdn avg $0.0938/kWh). 60% of Canadians travel less than 10km to work, one way.

From ‘empty’ **Level 2**: (240v): approx. 7 hrs. **Level 3** (440): approx. 26 mins to achieve 80% of battery capacity.

Solutions – PHEV gas-electrics

Easing “range anxiety”: Plug-in hybrid gas-electrics

Toyota Prius Plug-in Hybrid

Advantages of an efficient combustion engine and an electric motor. Can travel 18km (11mi) with in all-electric mode. Expected total range of 870 km. Max electric-only speed of 100km/h.

EPA FE rating of 2.5 L/100 km or 95 mpg-e in all-electric mode. Combined city/hwy: 4.7 L/100 km in hybrid mode (same as traditional Prius Liftback).

Lithium-ion battery charges in180 mins at 120 volts or in 90 mins at 240 volts.

2013 Toyota Prius Plug-in Hybrid

Solutions – Natural gas

Compressed natural gas (CNG)

2012 Honda Civic Natural Gas

Honda Civic Natural Gas

Almost no evaporative emissions compared to regular Civic. Very low NO_x and particulate emissions. Fewer impurities in CNG=improved spark plug, oil life.

EPA Hwy FE: 38 MPG-e hwy. CNG engine offers greater fuel efficiency and tailpipe emissions levels lower than any other traditional ICE. 70-90% lower smog-forming emissions and 20-30% lower CO_2.

Fleet usage since 1998; consumer deliveries beginning 2012 in 36 US States. Green Car of the Year 2012 (US).

Solutions – Advanced diesel

Ultra low sulphur clean diesel

2013 Mercedes-Benz GLK 250

Mercedes-Benz GLK 250 Bluetec diesel

2013: New 2.1L twin-turbo 4-cylinder diesel engine. 190hp with 369 lb-ft torque (96 more than outgoing model).

7-speed automatic transmission. EPA/NRCan FE rating: 6.1L/100km (hwy).

ECO start/stop function reduces fuel consumption and emissions by switching off the engine automatically when the car comes to a stop (e.g. in traffic jams or at traffic lights).

Solutions – Vehicle down-weighting

Putting large SUVs and cars on a diet

2013 Range Rover

All-aluminum body and partial-aluminum chassis. Historically, aluminum proved difficult to fabricate and assemble.

Nearly 700lbs lighter than the 2012 steel-bodied model.

Weight reduction permits introduction of smaller, highly efficient 3.0L turbo diesel with acceleration time of 7.9s (0-100 km/h), equal to the 4.4L V8 it replaces.

FE: **7.5 L/100km hwy** (EU test cycle)

2013 Range Rover

Future solutions – Hydrogen fuel cells

Long term: Hydrogen fuel cells

Development, fuel, and infrastructure are very prohibitive.

May be unaffordable until 2030. Sweet spot: 2020?

7 mainline OEMs plan hydrogen vehicle introductions 2014-15 including Honda, Toyota, Mercedes-Benz, Kia, Hyundai.

2008-12 Honda FCX Clarity

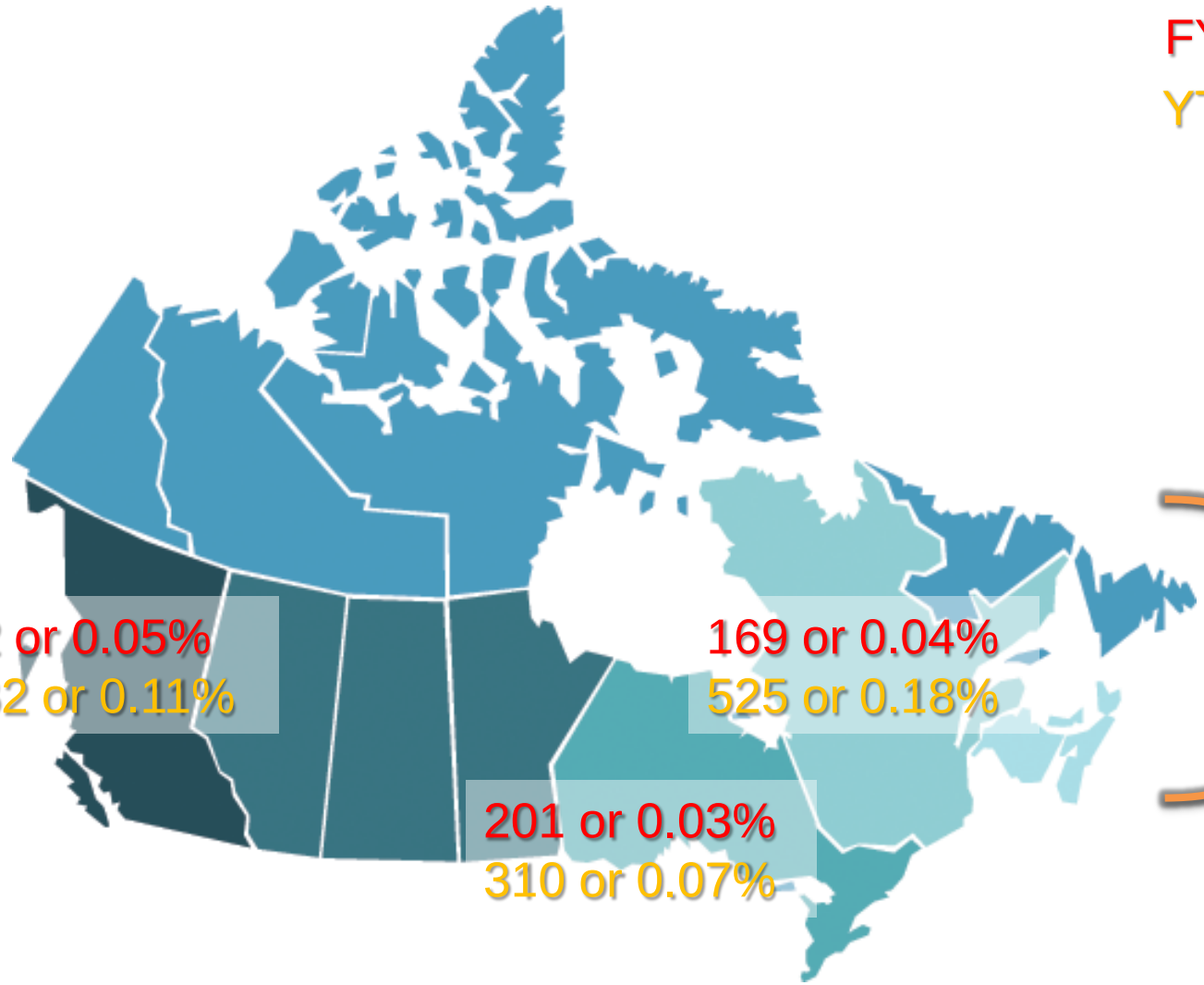
2012 Toyota Highlander FCHV

2007 BMW Hydrogen 7

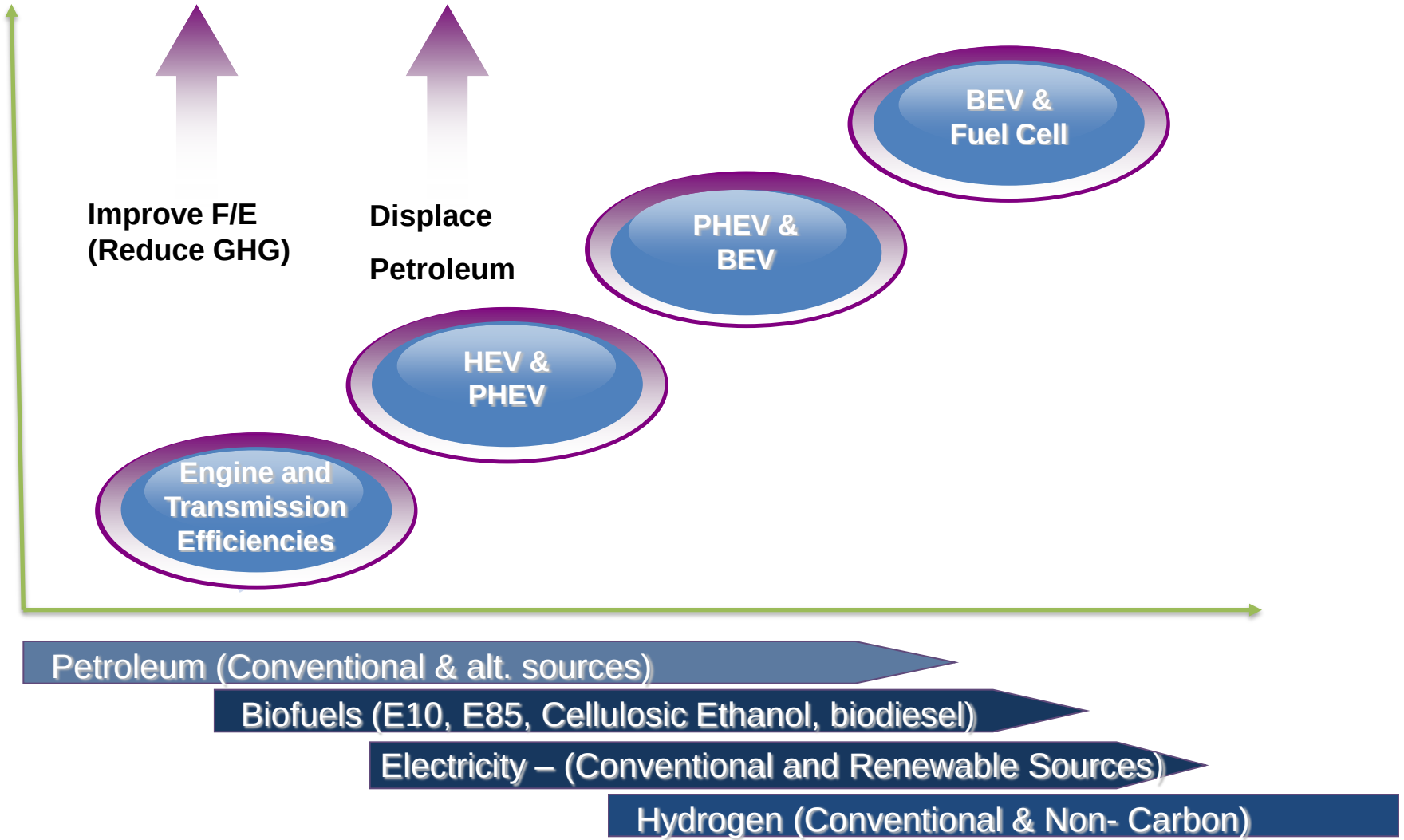
There are barriers…

- **New advanced vehicles and advanced technologies are high risk and high cost**
  - when Toyota Prius first being contemplated in 1995 it was believed to have a 5% chance of success with costs around $2 billion
- **Despite the introduction of more EV's and government support, there is no one "golden" technology that is seen as prevailing**
  - manufacturers hedging their bets by investing in a whole suite of technologies to meet the regulatory challenges
- **A potentially problematic "feedback" loop**
  - If ATV's that rely less on fossil fuels are very successful, logically the price of oil drops sending signals to consumers to stick with tried and true
- **Consumer Acceptance**
  - Higher cost
  - Reduced range
  - Loss of utility
  - Longer refueling time

Where do we stand? Volt, Leaf, IMiEV



Iterative Approach Over Time



Governments have a role to play …

- Setting policy framework **without being prescriptive** to the industry regarding technologies or quotas
- Harmonizing regulations and testing methods
- Ongoing funding of higher risk basic and applied R&D as well as commercialization efforts
- Continued development of infrastructure and attendant codes and standards
- Technology neutral incentives to encourage consumer uptake of ATV's

What do automakers require?

Regulatory certainty: Leadtime is not a ‘nice-to-have’, it’s a necessity.

- 5-10+ year or more design/production cycles
- Impacts manufacturers, importers, parts makers, EV infrastructure
- Short- and long-term durability testing, analysis necessary

N.B.: OEMs have very limited (zero) ability to change technologies ‘on the fly’. In some cases, technologies may not be ready for mass deployment at a reasonable cost (i.e.: high-capacity EV batteries; hydrogen).

Other considerations:

- Safety (mass) and efficiency: Competing priorities and regulations.
- OEMs aim “to do it all” but must also comply with increasingly stringent crash (side, roof, front) standards.
- Additional airbags, stronger bodies typically increase vehicle mass, reduce efficiency
- Some technologies not well-suited to every area of Canada’s geography (remote, rural, urban), climate, vehicle purpose (work vehicles)

Conclusion

- To the extent possible, **Canadian OEMs require regulatory alignment** with US safety and environmental regulations
- Avoid provincial (or state) **regulatory patchworks**
- As a small market, Canada is a standards and **technology "taker"**, <u>not</u> a standards maker
- Deep historical integration of North American automotive production (Auto Pact), distribution, and common products.

  One product, with common tests, certified for <u>both</u> markets.

- Current federal policy of "alignment" enjoys high-level **executive sponsorship** (PM Harper, Pres Obama) and government recognition.

Final thoughts

We're building it now. But will they come?

Factors for success:

- Consumer acceptance
- Cost of technology: Avg vehicle transaction price/affordability
- Volatility of crude, gasoline and diesel prices
- Government policy direction
- Size of OEMs' target market is unknown (no quotas – just customers)
- Consumer acceptance (US) of smaller engines and alternative technologies is a barrier to market penetration, economies of scale
- Small improvements now = large improvements later
- Near-term vs. long-term regulatory requirements
- Infrastructure, climate, geography (particularly for EVs)

Final thoughts

We're building it <u>now</u>. But will they come?

Our companies are spending **billions** internationally to develop advanced technologies and implement production plans to comply with the fuel efficiency objectives for **2011-2016** (right now) and, later, **2020-25**

Largest technology development and transition period in the automotive industry's history

Engineering and development efforts conducted in partnership with Canadian universities, colleges, and centres of excellence (AUTO 21 network in Ontario, Quebec and several other provinces coast-to-coast)

Association of International Automobile Manufacturers of Canada

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President

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History and structure

National industry association representing 15 international companies engaged in manufacturing, importing, distributing and servicing passenger cars and light duty trucks in Canada

- 33 year history in Canada; Incorporated 1999 (Toronto)
- **Scope**: Federal, provinces, territories
- **Committees Structure**: Policy & Government Relations, Technical (safety, environment), Stewardship, Customs, Financial Services, Transportation & Logistics, Legal, Taxation & Finance, Statistical, Aftermarket Parts

Public policy approach

A **trusted source** of industry and policy information

- Cooperative relationships with federal and provincial decision-makers, regulators and stakeholders
- Apply knowledge from companies' **international experiences** in research, design, rulemaking, global best practices

Recognized advanced technology leaders in fuel efficiency, emissions reduction, safety, and environmental stewardship:

- **2012**: AIAMC companies earned **7 of 10** NRCan ecoEnergy awards for most fuel efficient vehicles
- **2012**: Hyundai (**Elantra**), Volkswagen (**Touareg TDI**) awarded AJAC awards for "Canadian Car of the Year" and "Canadian Utility Vehicle of the Year" respectively

Current issues

Ongoing federal/provincial regulatory issues :

- Vehicle safety regulations; provincial highway traffic act amendments
- Driver distraction; integration of telematics
- Vehicle GHG emissions/fuel efficiency standards
- Shipping and logistics: Ports (Halifax, Vancouver), railways (CN, CP); border infrastructure
- Extended producer responsibility, recycling, end-of-life vehicle management
- Chemicals management, toxic substances regulations
- Fuels and fuel quality (engines/fuels are integrated systems
- Charter of the French Language, francization (Québec)
- Motor vehicle dealers' acts; consumer legislation
- Recharging infrastructure for electric vehicle deployment