FleetWise EV300

Plugging fleets into electric vehicles

Partners in Project Green Webinar. December 2011.

Toronto Atmospheric Fund 20 Years

About the Toronto Atmospheric Fund

TAF is the City of Toronto's climate change agency, dedicated to helping the City, its residents and businesses reduce their climate impact.

TAF leverages its own endowment to incubate, test & accelerate solutions with the potential to result in significant greenhouse gas emission reductions.

www.toronto.ca/taf

FleetWise EV300

TORONTO Atmospheric Fund 20 YEARS

Grants to non-profits

Investments in for-profits & social enterprises

Direct program delivery through fundraising & partnerships

FleetWise EV300

Public and private fleets jointly procure, drive, charge, evaluate and promote 300 electric vehicles in the GTA by 2012.

1. Deployment of EVs

2. Advocacy for EV-friendly policies & programs

3. Education & outreach on the business & environmental case for EVs

FleetWise EV300 Strategic & Fleet Partners

TORONTO

toronto hydro corporation

hydro one
Partners in Powerful Communities

Ontario
MINISTRY OF TRANSPORTATION

bullfrogpower

Hamilton

Toronto District School Board

Richmond Hill

EMC NEC
Electric Mobility Canada
Mobilité électrique Canada

OAKVILLE

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

MISSISSAUGA
Leading today for tomorrow

AutoShare

ONTARIO POWER GENERATION

GTAA TORONTO PEARSON

DSEA
www.dsea.ca

Natural Resources Canada
Ressources naturelles Canada

UNIVERSITY OF TORONTO

MARKHAM

METROLINX
LINKING PEOPLE TO PLACES • ON Y VA
An agency of the Government of Ontario

FleetChallenge ONTARIO

TORONTO AND REGION Conservation
for The Living City

FleetWise EV300 OEM Partners

NISSAN

AZD
AZURE DYNAMICS
part of the solution

GM
Canada

MITSUBISHI
MOTORS

15 Fleet Partners representing over 5,000 light-duty vehicles

Demand projections:
2011: 73-168 EVs
2012: 79-170 EVs

60 EVs on the road by end of 2011

FleetWise EV300: Helping fleets make the right choices

1. Determine the best fit
2. Business case development
3. Procurement assistance
4. Customized driver training
5. In-service performance monitoring

FleetWise EV300: Helping fleets make the right choices

FleetCarma

EValuation Calculator

eDriver Training

FleetCarma

How do EVs fit into your fleet?
How will they perform based on your real-time usage pattern?
What's a realistic solution for your fleet?

CrossChasm

FleetCarma: sample report

fleetcarma
vehicle selector tool

FleetWise EV300
Toronto Atmospheric Fund

Current Vehicle

Rav 4

Fleet:	Name
Vehicle:	2003 Toyota Rav 4
Unit:	53-0310
Log Dates:	4/8/2011 11:29:33 AM - 5/25/2011 2:46:35 PM
Log Time:	47 Days 3 Hours
Operation Hours:	25.07 Hours

Consumption:	9.9 L/100km 925 Wh/km
Carbon Emissions:	233.1 g CO_2/km
Total Distance Travelled:	1045.26 km
Longest Single Day:	185 km

		Toyota Rav 4	Ford Transit Connect EV	Nissan LEAF	Mitsubishi i-MiEV	Toyota Prius Plug-In	Chevrolet Volt
Energy & Emissions	Total Energy [Wh/km]	925	191	160	130	287	275
	Fuel Consumption [L/100km]	9.9	0	0	0	2.3	1.5
	Fuel Consumption [Wh/km]	925	0	0	0	212	141
	Electrical Consumption [Wh/km]	0	191	160	130	75	134
	Tailpipe CO_2 Emissions [g CO_2/km]	233.1	0	0	0	53	36
Capability	Range Capable [% of days]		93%	93%	93%	100%	100%
	Range Capable [# of missed days]		2	2	2	0	0
	Charge Capable [% of days]		100%	100%	100%	100%	100%

Summary

Of the 30 active days, the TransitConnect-EV was range capable on 28 days, the Leaf was range capable on 28 days, and the i-MiEV was range capable on 28 days. All vehicles were charge capable. The vehicles evaluated would reduce energy consumption by 69%-86%. Tailpipe CO2 emissions would be reduced by 77-100%.

This report does not reflect the impact that driver behaviour training will have on EV range capability.

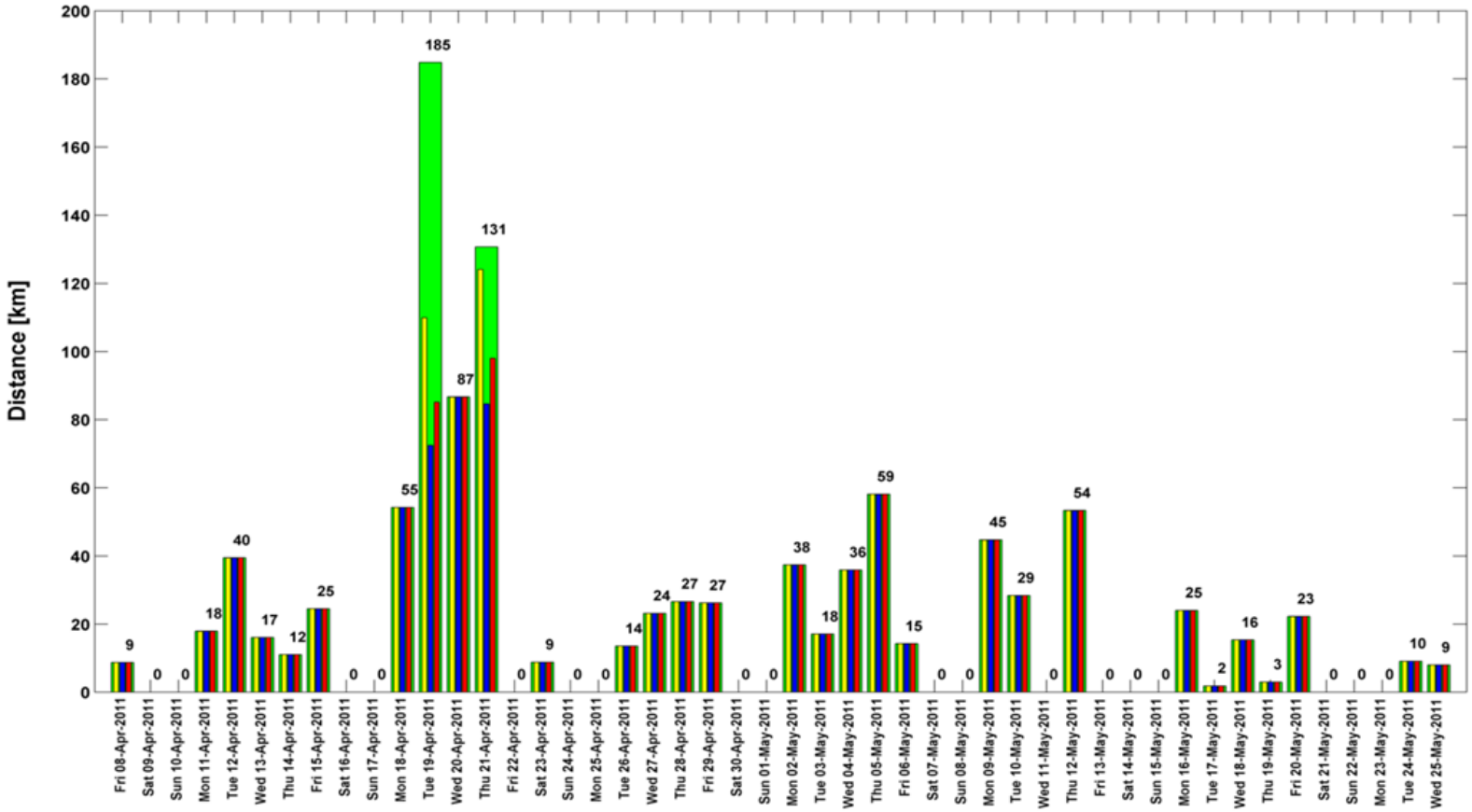
fleetcarma vehicle selector tool

FleetWise EV300

Daily Range Capability

LEAF: 28/30 days
Transit Connect EV: 28/30 days
iMiEV: 28/30 days

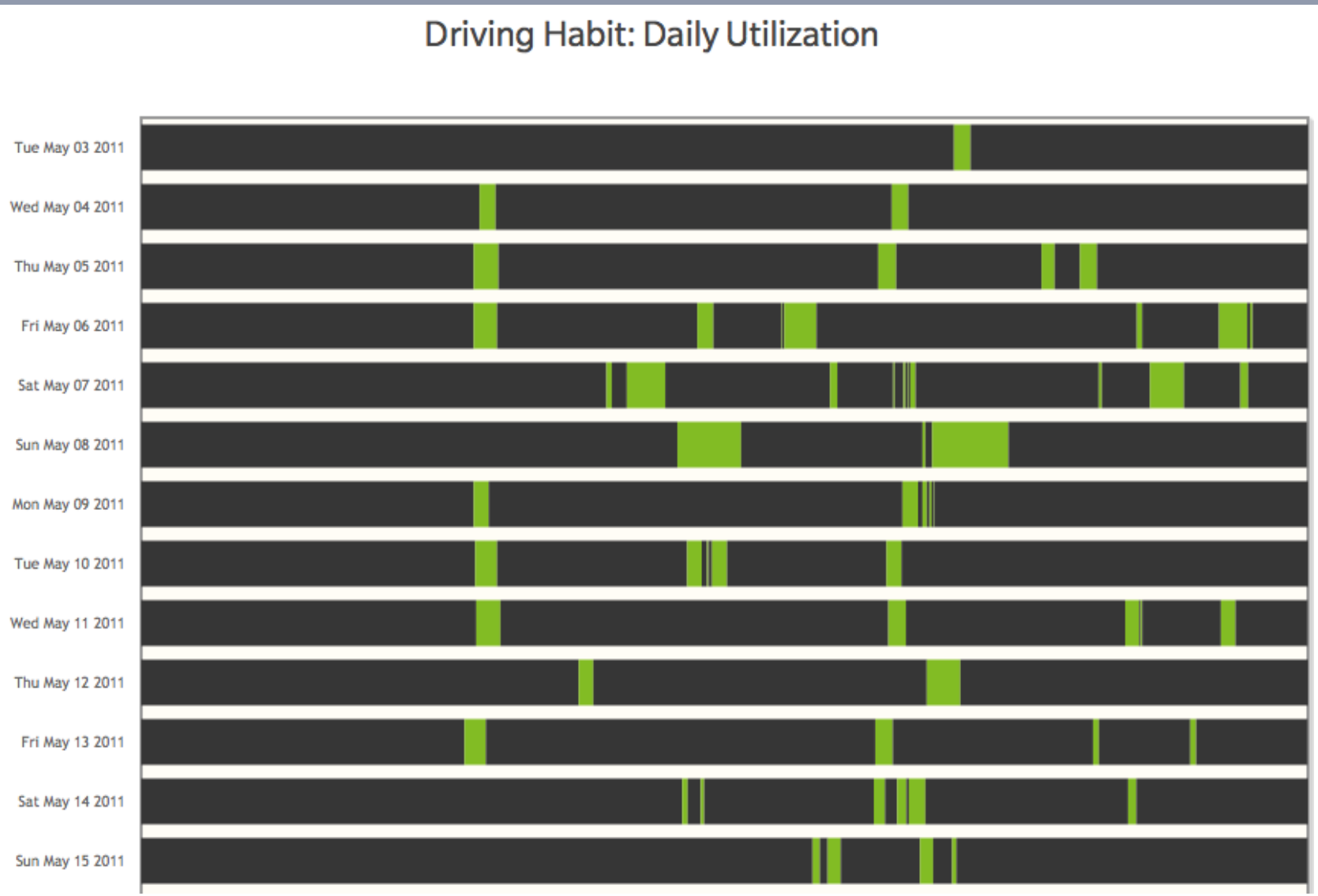
Vehicle not used on 18 of 48 total days logged.



FleetWise EV300

TORONTO Atmospheric Fund 20 YEARS

FleetCarma: sample report



FleetWise EV300

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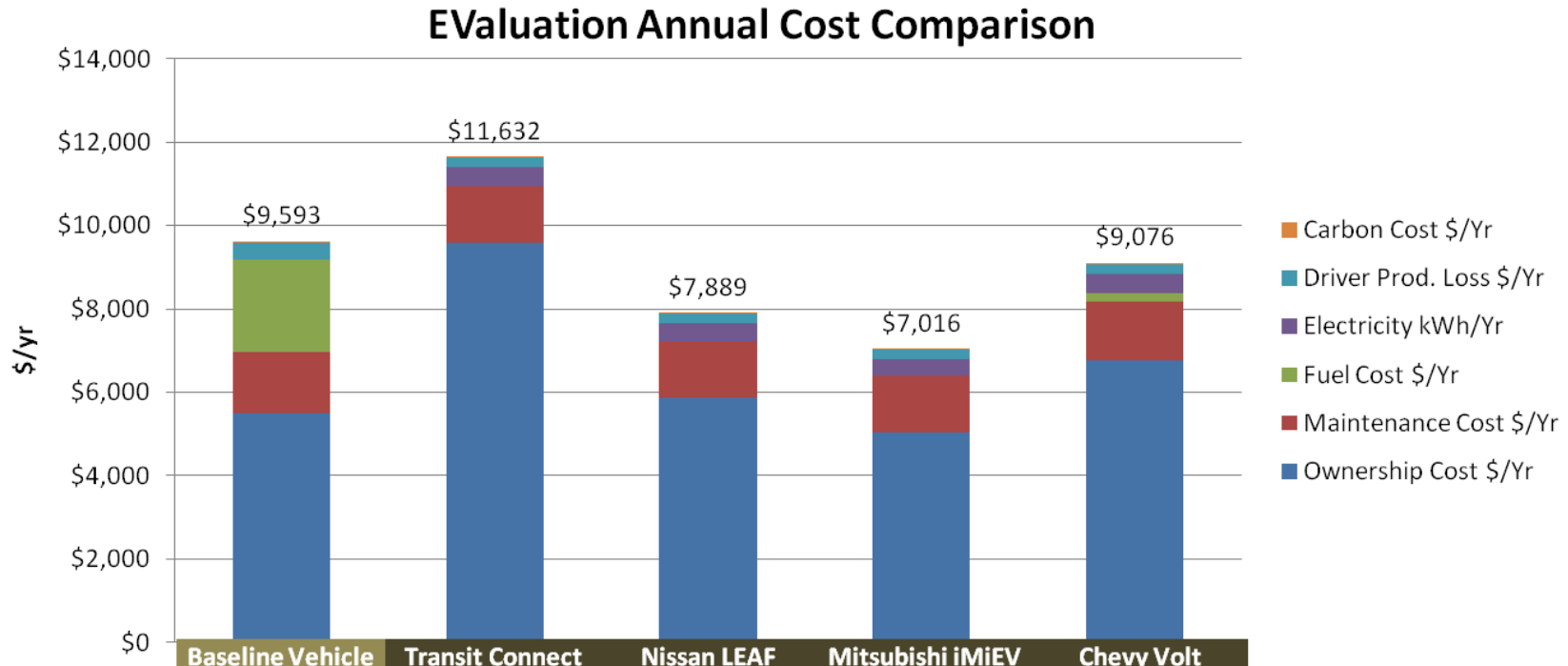
EValuation Calculator

What is the total cost of ownership?
How does this compare to a conventional vehicle?
What's the anticipated business case for an EV?

EValuation Calculator sample report

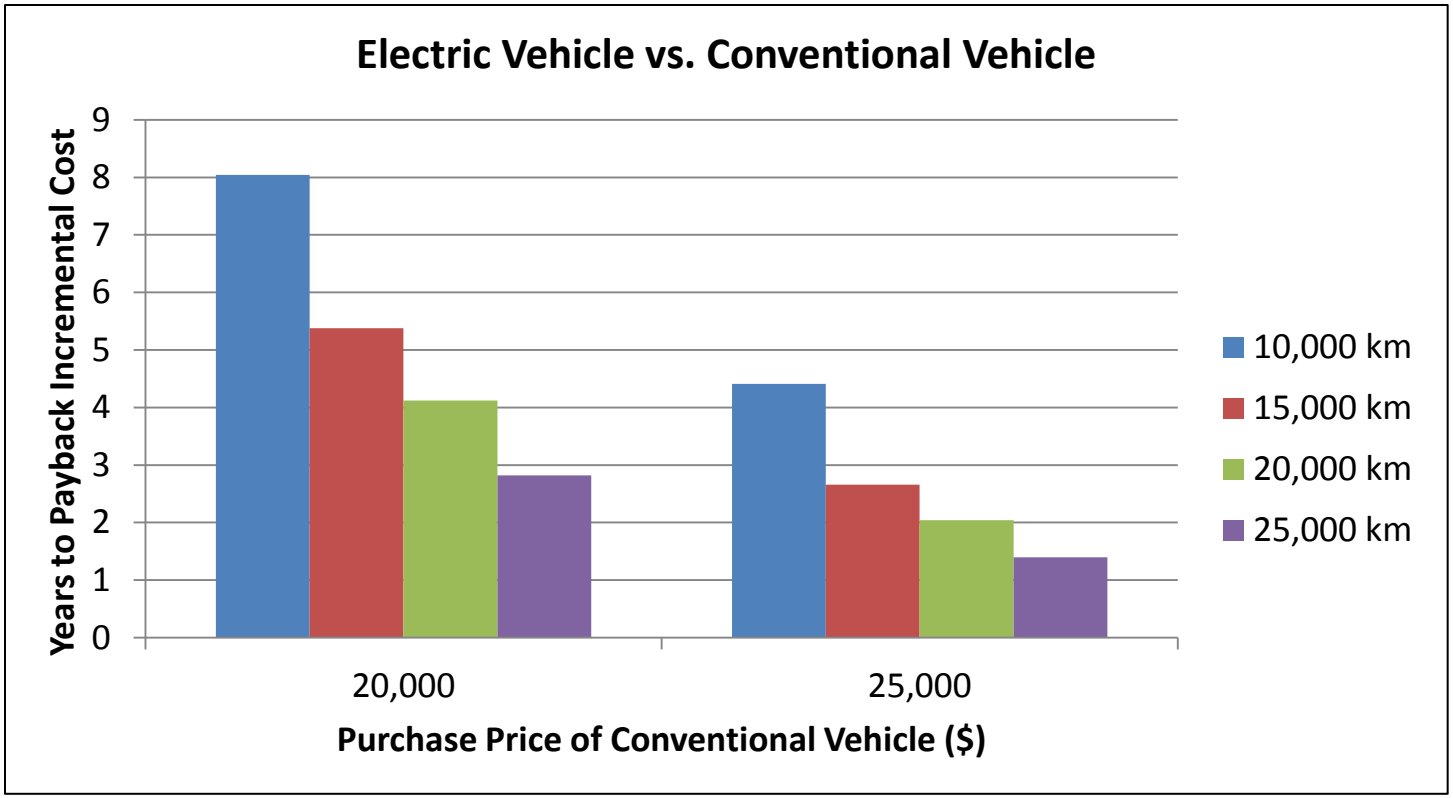


	Baseline Vehicle	Transit Connect	Nissan LEAF	Mitsubishi iMiEV	Chevy Volt
Ownership Cost $/Yr	$5,492	$9,581	$5,867	$5,031	$6,769
Maintenance Cost $/Yr	$1,463	$1,357	$1,357	$1,357	$1,506
Fuel Cost $/Yr	$2,238				
Electricity kWh/Yr		$472	$443	$140	$163
Driver Prod. Loss $/Yr	$392	$222	$222	$222	$222
Carbon Cost $/Yr	$7.65	$0.52	$0.61	$0.49	$1.45
Total Cost $/Yr	**$9,593**	**$11,632**	**$7,889**	**$7,016**	**$9,076**
Net Purch. Cost $	$31,[illegible]	$[illegible]8	33,787	27,988	39,245
Incremental Purch. Cost $		29,098	2,147	-3,652	7,605
Operational Savings $		2,050	2,079	2,116	1,795

SAMPLE FIGURES

Payback is calculated as the incremental purchase price divided by annual savings

EValuation Calculator – sensitivity analysis



FleetWise EV300

Toronto Atmospheric Fund 20 YEARS

A customized two-hour training course

What is the environmental impact of transportation?

Primer on plug-in solutions

Benefits & concerns about EVs

Tips for maximizing the performance of EVs

Real-world scenarios & examples

eDriver Training

Km/charge

80 90 100 110 120

Range Reducing	Condition	Range Extending
High acceleration, speed	Driving style	Low acceleration, speed
Air conditioning on	Air conditioning usage	Air conditioning off
Highway	City / Highway	City
Heavy payload	Payload	Light payload
Windy, wet	Weather	Calm, dry
Uphill, rough	Road conditions	Flat / Downhill, smooth
C-mode	D-mode	B-mode

Source: Mitsubishi Motors Canada

* Figures reflect unofficial testing.

Our experiences to date

Overwhelmingly positive

Some challenges w/ EVSE

Educate mechanics & drivers

Range anxiety – aware of it but not impeded by it

"There's a line up to reserve our EVs"

"Range anxiety is mitigated with proper planning & training"

"We have yet to have a negative experience – but we're ready"

Moving forward

Ongoing recruitment of EV300 Fleet Partners

- Establish an MOU
- Submit your fleet demand projections
- Deploy the FleetCarma selection tool

Assistance with procurement of EVs

- Liaise between OEMs & Fleet Partners
- Delivery of eDriver Training

In-service performance monitoring

-Datalogger installation
-Individual + aggregated results
-Sharing of experiences amongst fleets

Telling our story

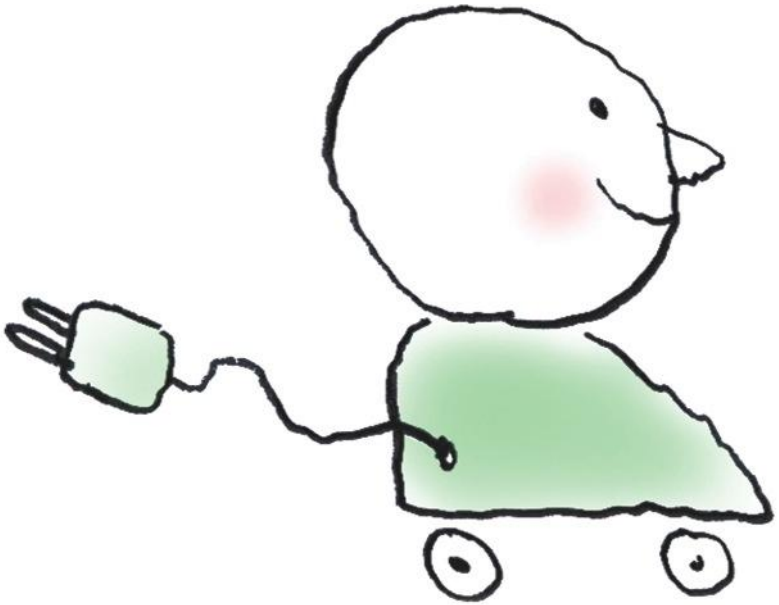
- Media releases
- Press events
- Green Ambassadors

What's next?

Ben Marans
Manager, Social Innovation & Transportation
bmarans@tafund.org
416-393-6367

TORONTO Atmospheric Fund

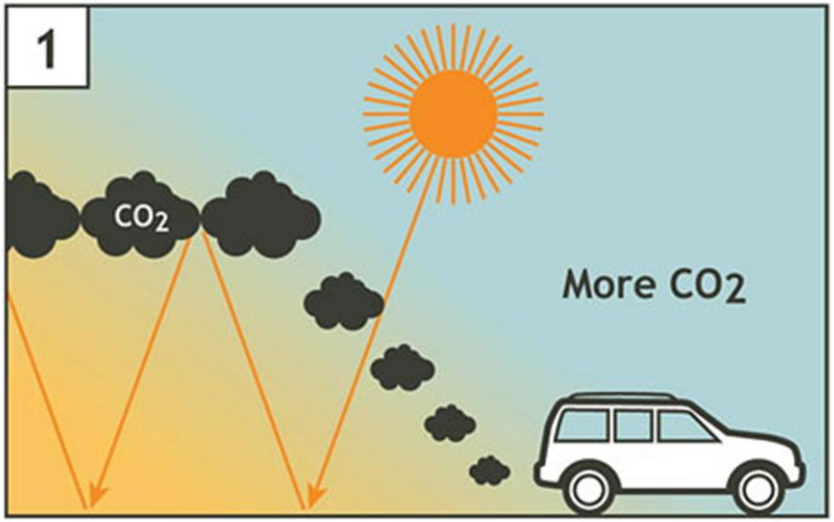
www.toronto.ca/taf



DRIVING ONTARIO'S CLEAN ENERGY FUTURE

December, 2011

- **6.7 million** light vehicles on the road
- Almost **12 billion** litres of gasoline/year
- Emitting **7.4 million** tonnes of CO^2/year



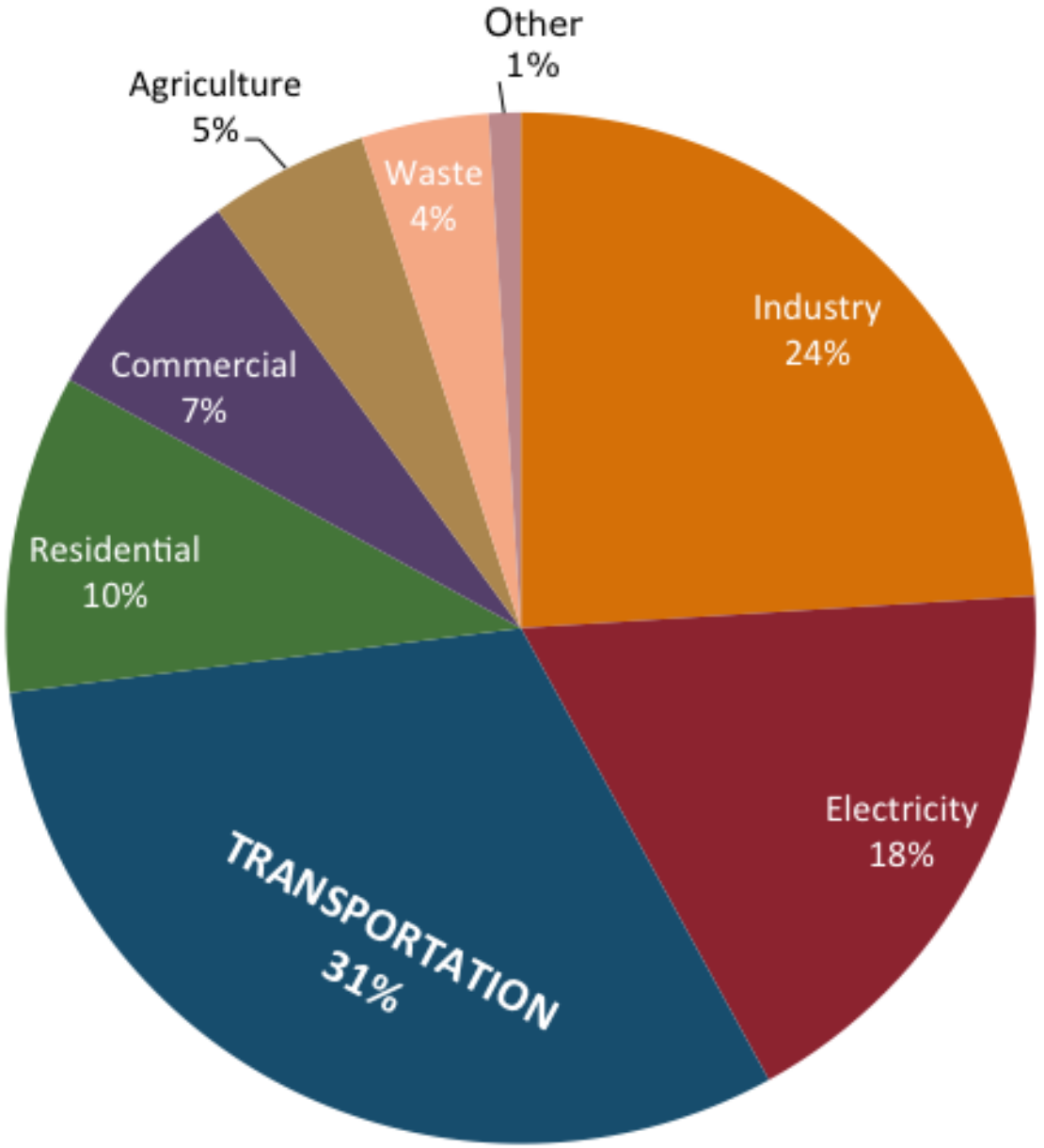
Plug'n Drive Ontario

Source: Statcan

Average vehicle uses 16.4 barrels of oil per year

100% of Ontario's oil is imported

Ontario GHG Emissions by Sector

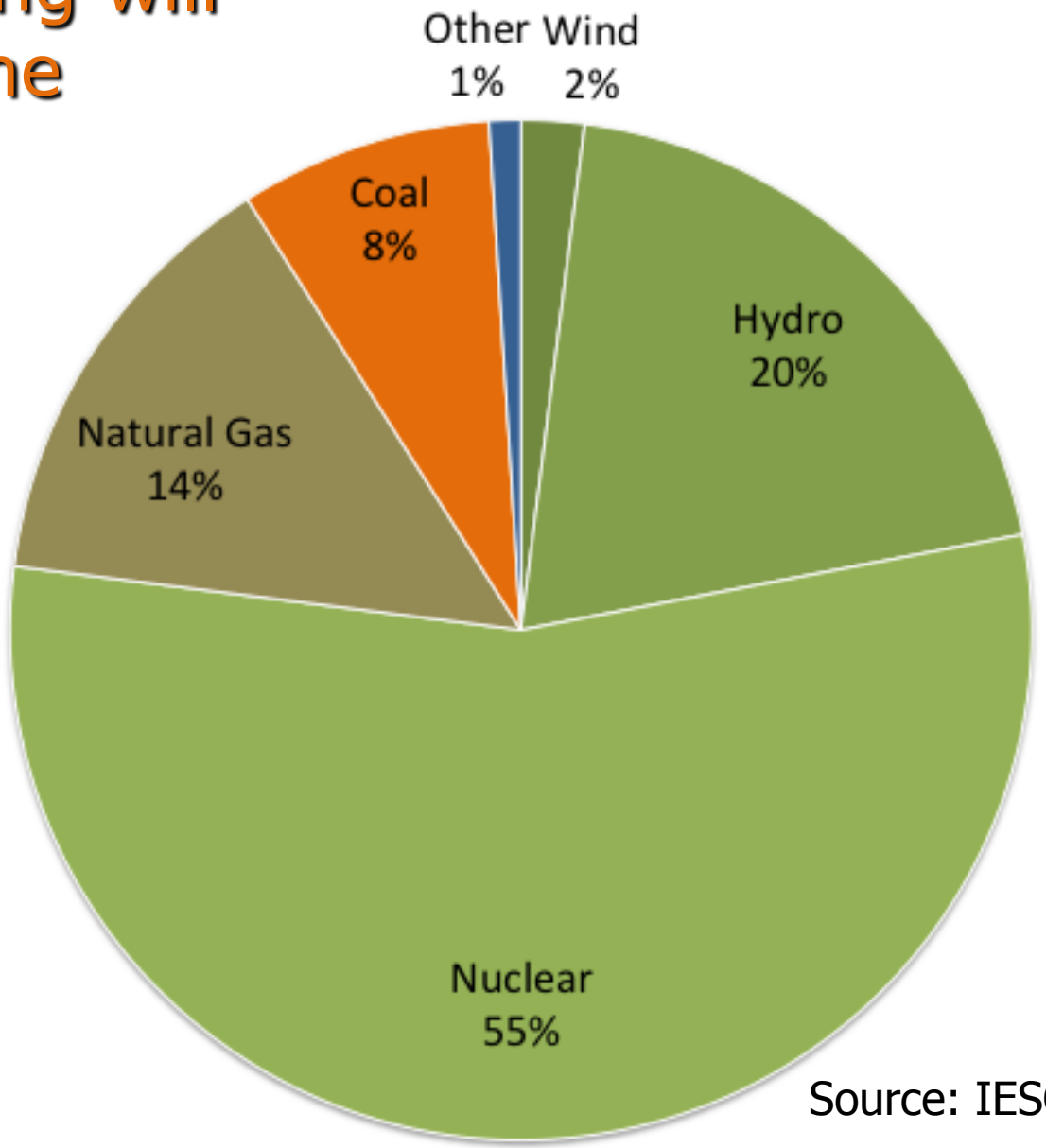


Source: Ministry of Energy

Ontario Energy Mix

Majority of charging will occur at night in the home

Almost zero CO2 emission driving!



Source: IESO

POWER. SMARTER.

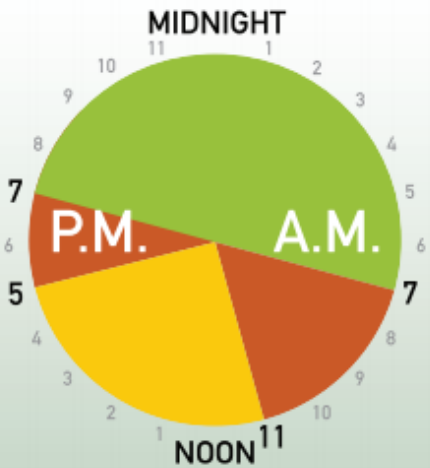
Shift from on-peak to off-peak periods when possible to help manage electricity costs, reduce strain on the electricity system, and help the environment.

Use this removable decal as a reminder of Time-of-Use (TOU) price periods.

Ontario Electricity Time-of-Use Price Periods

Summer weekdays
(May 1 - October 31)

Weekends and
Statutory Holidays



Winter weekdays
(November 1 - April 30)

¢ **Off-peak**

¢¢ **Mid-peak**

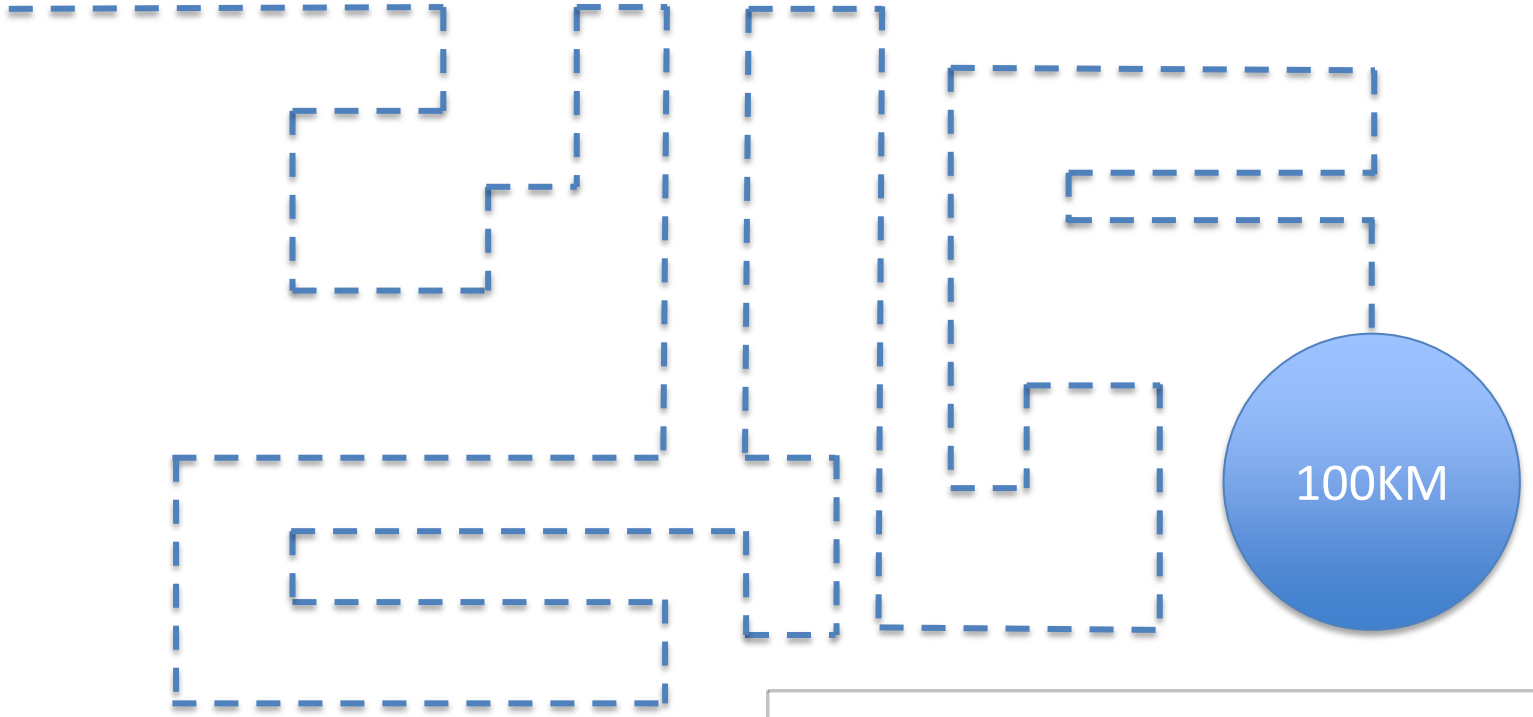
¢¢¢ **On-peak**

For current TOU pricing, please go to www.oeb.gov.on.ca.

Ontario

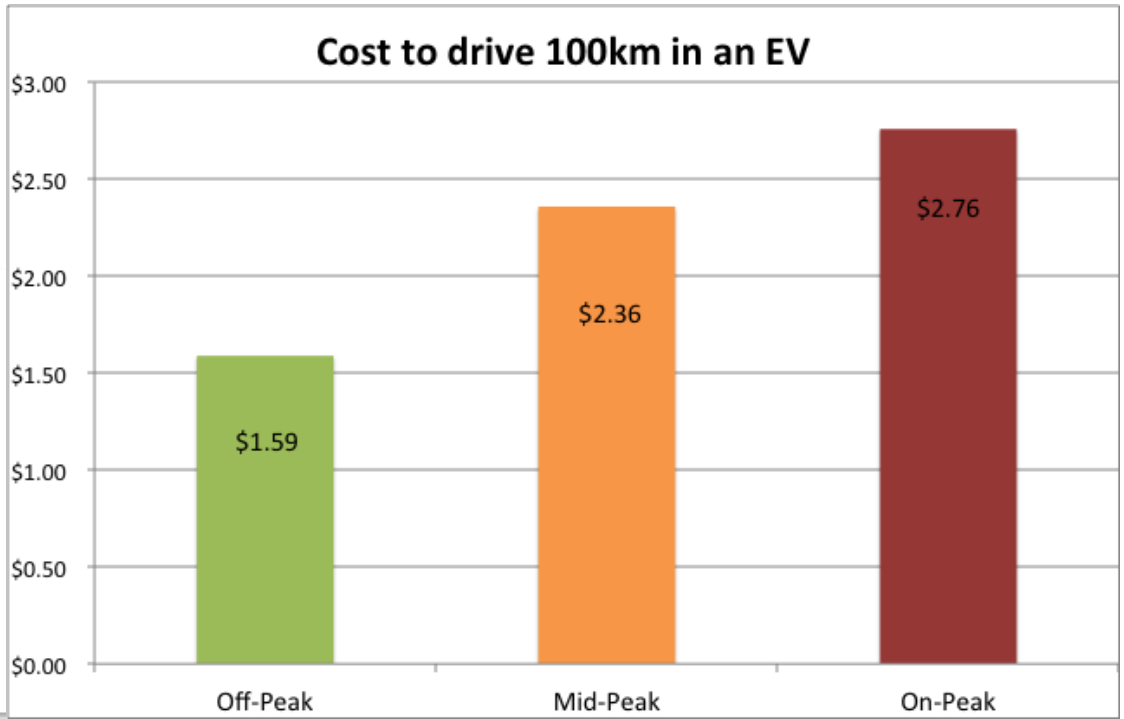
hydro one

Plug'n Drive Ontario

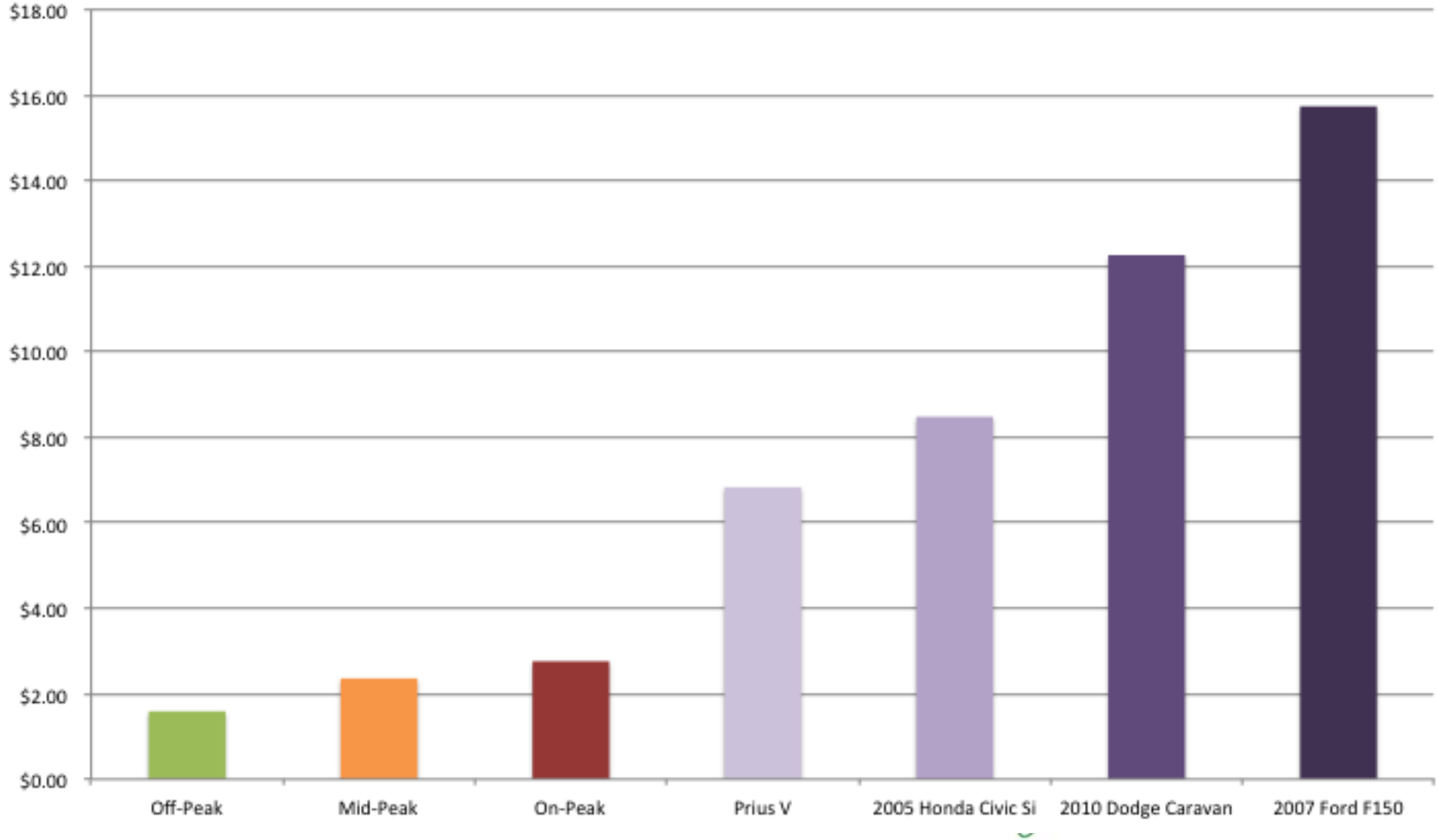


An EV can travel

100 km for $1.59



Comparable cost of driving 100km in an EV and other popular vehicles



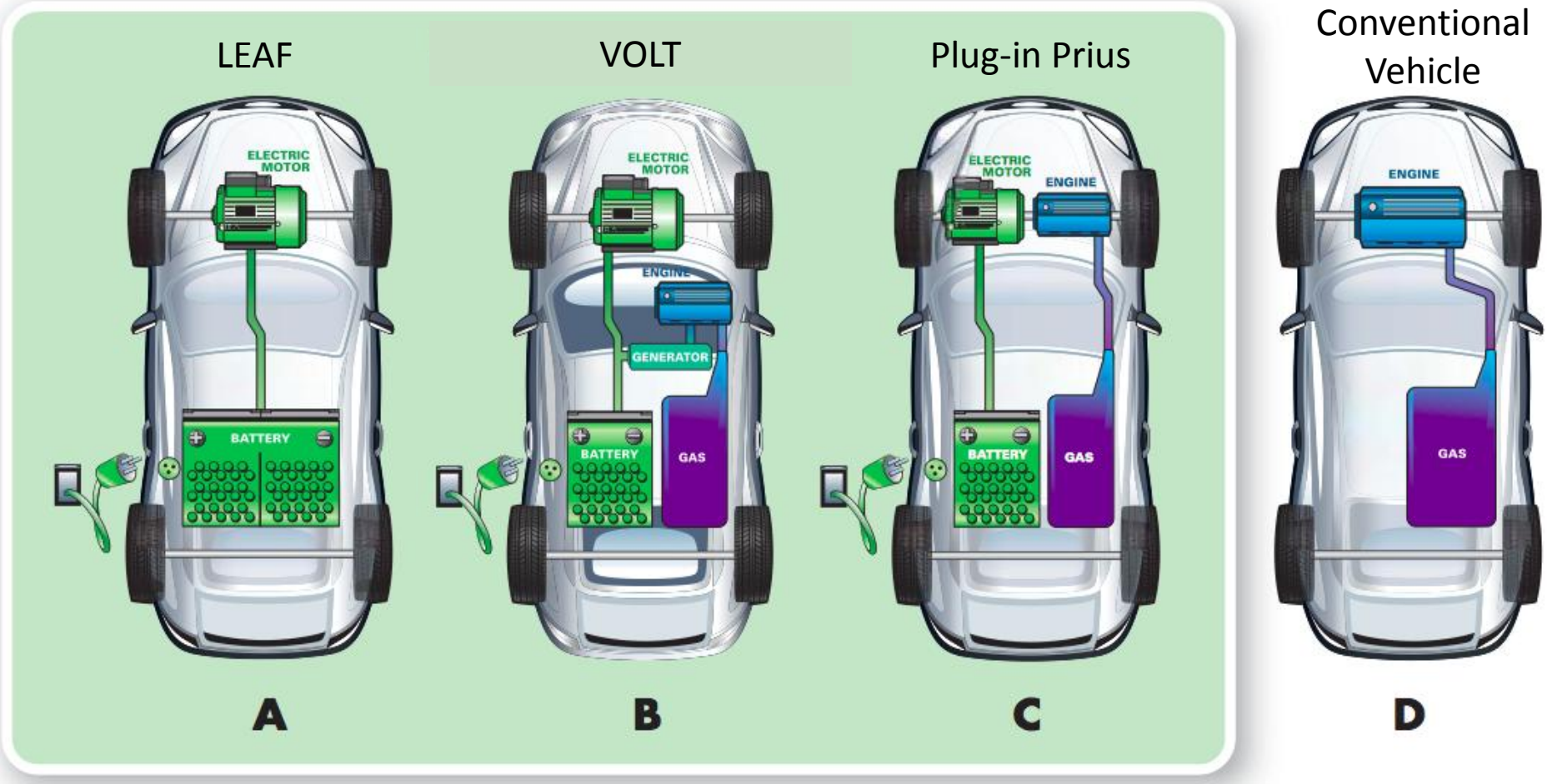


Figure 2. *A comparison of PEV and conventional vehicle configurations. (A) battery electric vehicle, (B) series plug-in hybrid electric vehicle, (C) parallel plug-in hybrid electric vehicle, and (D) conventional internal combustion engine vehicle. (Courtesy Southern California Edison)*

Plug'n Drive Ontario

2011 Mitsubishi i-MiEV

2011 Ford Focus Electric

2011 Nissan LEAF

2010 Tesla Roadster

Prius Plug-in Hybrid

2012 Smart ED

2011 Chevrolet VOLT

2011 BMW ActiveE

VEHICLE	MANUFACTURER	VEHICLE TYPE	ELECTRIC RANGE	BATTERY SIZE	MODEL YEAR
LEAF	Nissan	BEV	161 km	24 kWh	2011
VOLT	GM	PHEV	64 km	16 kWh	2011
ActiveE	BMW	BEV	193 km	32 kWh	2011
Transit Connect Electric	Ford	BEV	128 km	28 kWh	2011
Focus Electric	Ford	BEV	161 km	24 kWh	2011
i-MiEV	Mitsubishi	BEV	120 km	16 kWh	2011
Prius Plug-in Hybrid	Toyota	PHEV	23 km	5.2 kWh	TBA
Smart ED	Daimler	BEV	112 km	16 kWh	2012
RAV4-EV	Toyota	BEV	161 km	~35 kWh	2012

NEW MARKET ENTRANTS

VEHICLE	MANUFACTURER	VEHICLE TYPE	ELECTRIC RANGE	BATTERY SIZE	MODEL YEAR
Roadster	Tesla	BEV	394 km	53 kWh	2010
Karma	Fisker	PHEV	80 km	20 kWh	2011
Coda Sedan	Coda	BEV	161 km	37 kWh	2011
F3DM	BYD	PHEV	100 km	13.2 kWh	2011
e6	BYD	BEV	400 km	72 kWh	2011
Think City	Think!	BEV	193 km	24 kWh	2012
Model S	Tesla	BEV	357- 480 km	42–95 kWh	2012

BEV = Battery Electric Vehicle
PHEV = Plug-in Hybrid Electric Vehicle

Level 1 – 120v

Charge to 80%: 12-18 hours

Cost: ~$2,000

Voltage: 110v

Amperage: 16-30A

Power: 1.9-3.6kW

Level 2 – 240v

Charge to 80%: 6-8 hours

Cost: ~$3,000

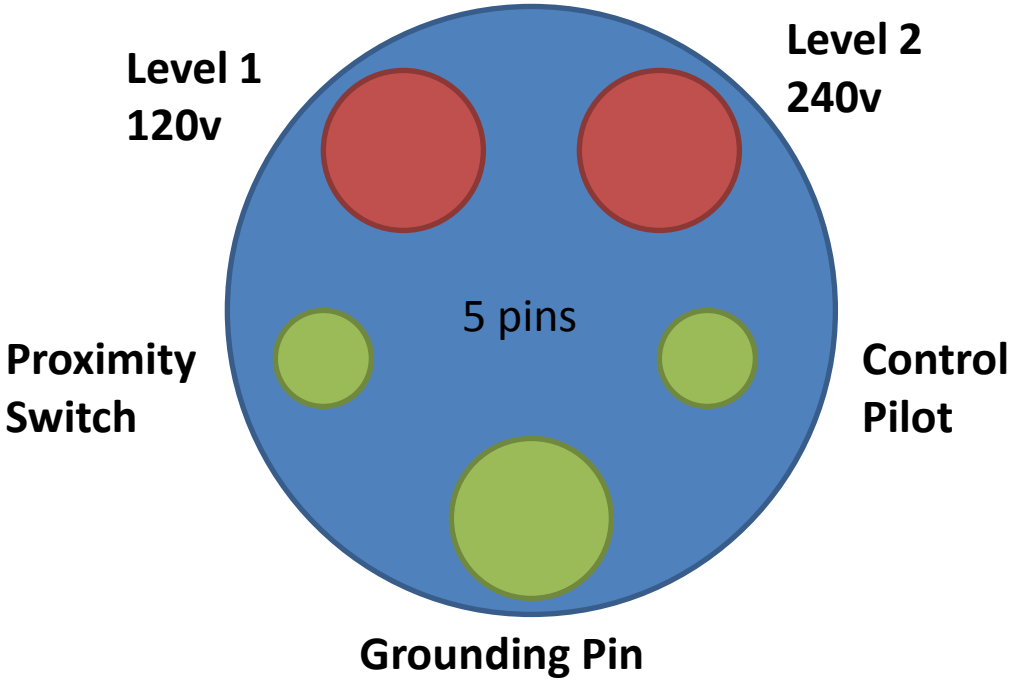
Voltage: 240v

Amperage: 30-70A

Power: up to 6kW

J1772 EV Plug

- Standard EV Plug for North America, Europe and Japan
  - Level 1 and Level 2 Chargers



DC Level 3 – 400v

Source: Eaton

Voltage: 400v
Amperage: 125A
Power: up to 50kW

Charge to 80%: 20-30 minutes
Cost: $50,000+
Installation: $10,000+

CHAdeMo (Level 3) Plug

- A coalition of Japanese industry:
  - *Toyota, Mitsubishi, Nissan, Fuji Heavy Industries and Tokyo Electric Power Company to form 'CHAdeMO'*
  - *Standard in Japan & Europe*
    - *North America?*

Plug'n Drive Ontario

CHAdeMO

J1772

Plug'n Drive Ontario

What is Plug'nDrive Ontario?

A not-for-profit coalition engaging in activities that will accelerate the adoption of electric vehicles (EVs) and maximize their environmental and economic benefits for consumers and businesses in Ontario.

Board of Directors to date:

- David Collie – CEO, Electrical Safety Authority
- Dennis Edell – CEO, Rain 43
- Len Griffiths – Partner, Bennett Jones Law Firm
- Jim Keech – CEO, Kingston Utilities and Chair of EDA
- Don MacKinnon - President, Power Workers' Union
- Tom Mitchell – CEO, Ontario Power Generation
- Gerry Smallegange – CEO, Burlington Hydro
- Lawrence Zimmering – CEO, RedBud Capital Corporation

Business Priorities

1. Education and Awareness

- Create a one-stop shop for information on EVs in Ontario;
- Road show to educate and excite consumers on benefits of EVs;
- Movie screenings "Revenge of the Electric Car" .

2. Research

Engage in research that help fill the gaps needed to advance EV deployment and influence consumer behaviours.

3. Infrastructure

Promote the development of EV infrastructure, particularly home charging and off-peak charging solutions as well as critical public infrastructure.

Plug'n Drive Ontario

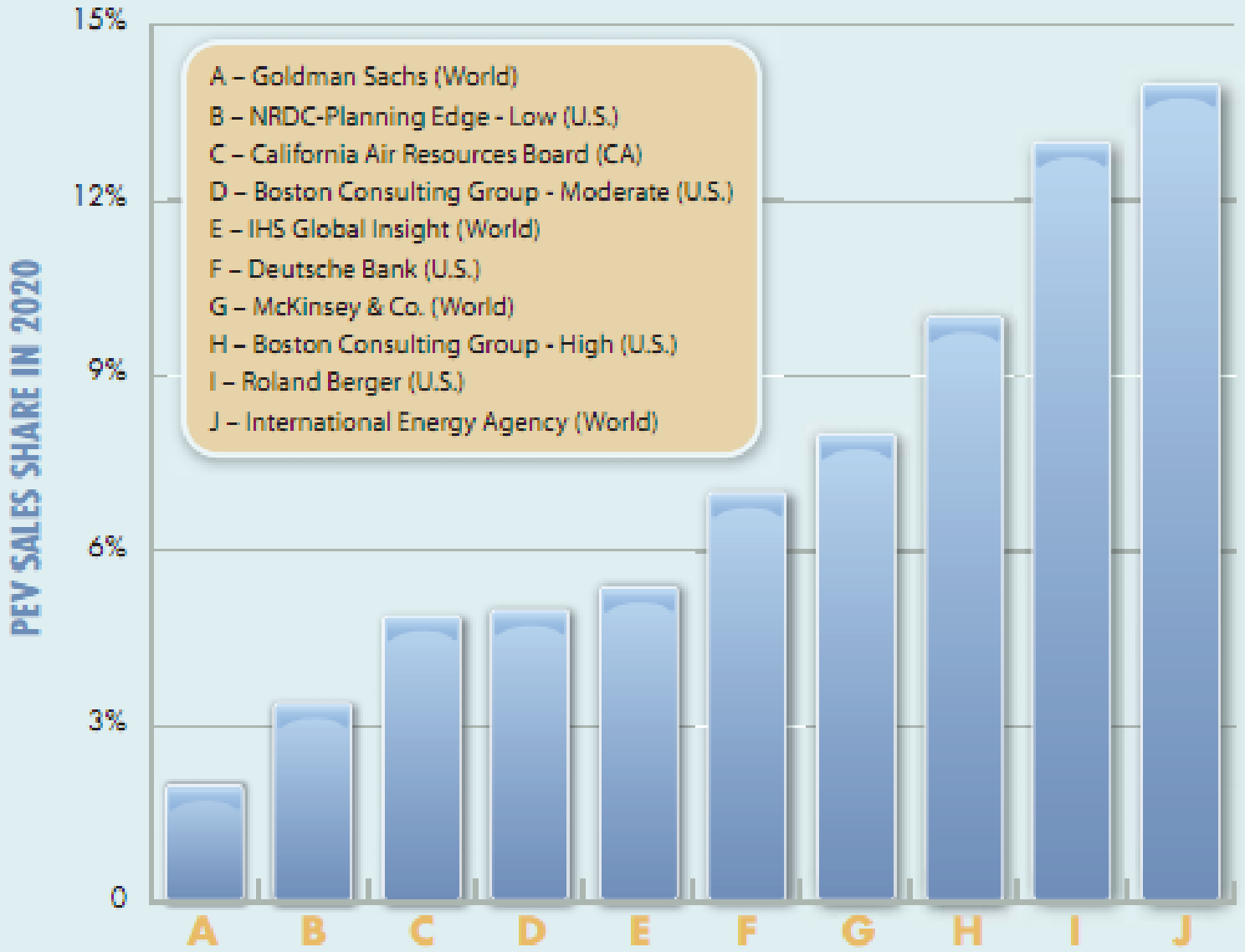
Proposed Road Show Stops

Barrie, Guelph, Hamilton, Kingston, Kitchener-Waterloo, London, Niagara, Ottawa, Toronto

Meetings/Consultations/Networking with stakeholders

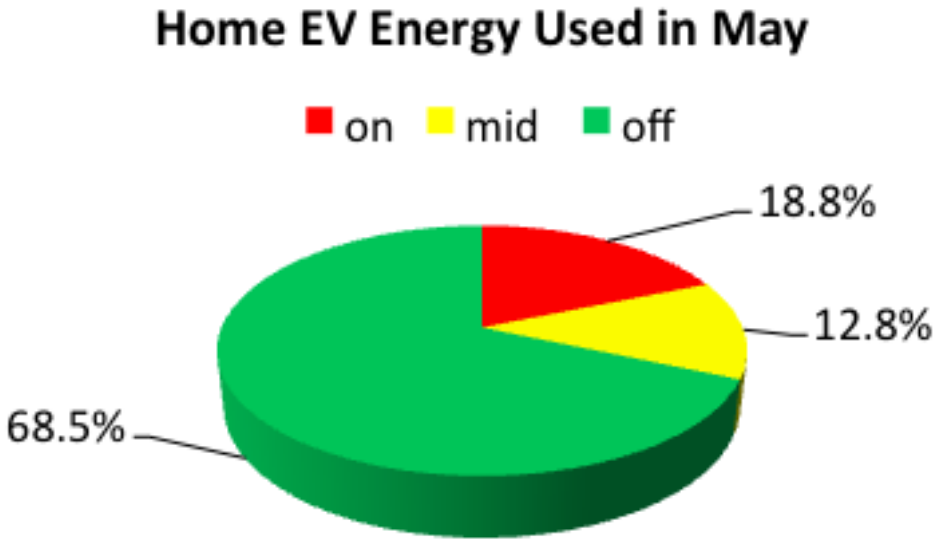
EV Adoption is Unpredictable

California Example

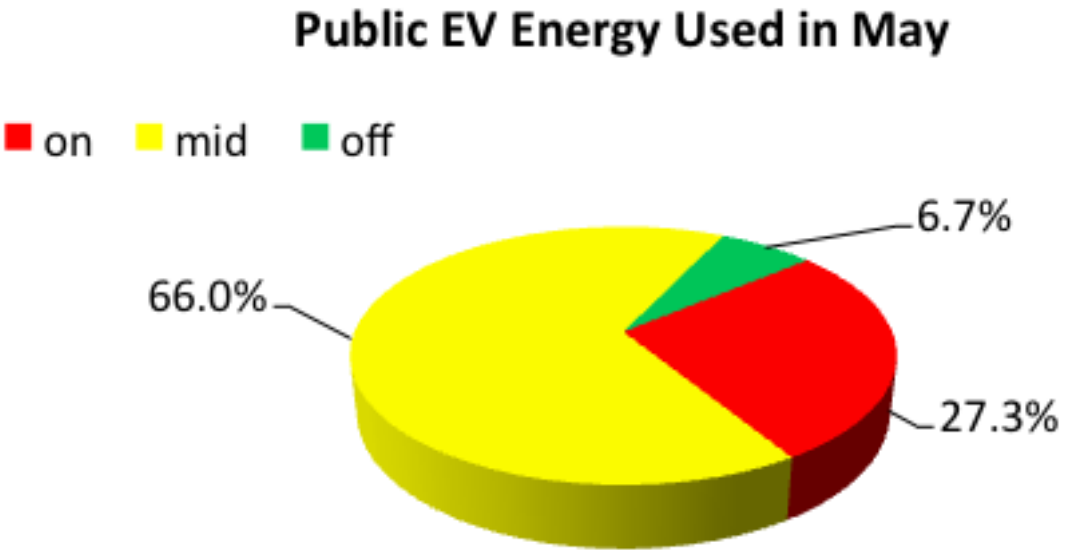


Source:
PEV Collaborative

Charging Behaviour:
Time of Charge in Absence of Cost



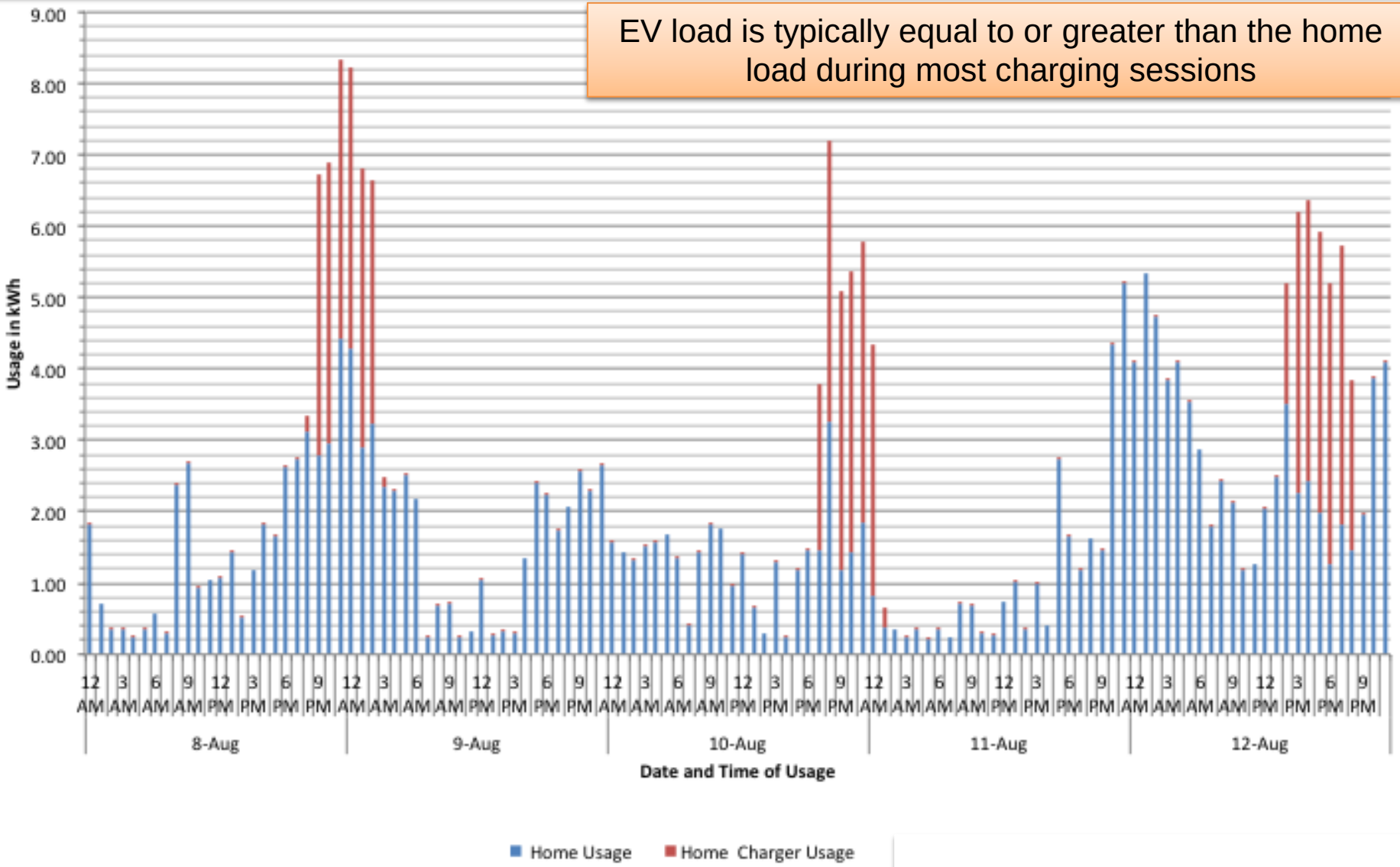
EV user charged off-peak at home in absence of cost driver



Source: Toronto Hydro

Grid Impact: *EV Load Equals Home Load*

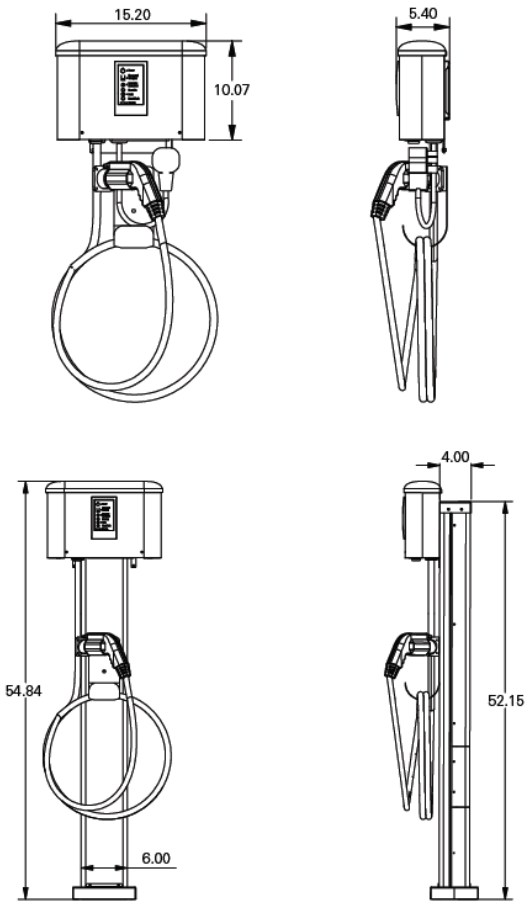
EV load is typically equal to or greater than the home load during most charging sessions



Source: Toronto Hydro

Conclusions: Charging Behaviour

1. Range anxiety lessens over time - skipped charge days and shorter charge cycles
2. Charging typically does not commence with home arrival
3. Charging does not approach full discharge (8 hrs)
4. Public charging availability impacts charging behaviour significantly
5. Other incentives play a dominant role in the use of public charging
6. Charge time may not be significantly impacted by TOU rates



Dimensions
(Shown with Advanced Cord Management)

Plug'n Drive Ontario

Conclusions: Grid Impact

1. EV adoption is more of a distribution issue rather than transmission or generation
2. Need a system to inform utility companies of EV installations to allow greater management
3. Average EV load is approximately 182% of the home load while charging
4. EV charging energy and costs are low relative to home energy and costs
5. Battery thermal management is an additive load that should be analyzed

Key Challenges and Opportunities

- Vehicle emissions are Ontario's largest source GHG emissions
- Plug-in vehicles are an important solution, allowing people to switch from gasoline to clean electrons
- Charging at night at night when emissions are lowest and prices are lowest maximizes both the economic and environmental benefits to Ontario
- Ontario has a unique combination of a clean generating mix, time of use pricing, smart meters and a vibrant auto sector, creating the opportunity to be a world leader in the commercialization of plug-in electric vehicles
- Some distribution challenges but not insurmountable.
- LDC's need to be 'in the loop'!

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