# Vermont IEEE PES Drive Electric Vermont Update

February 19, 2015

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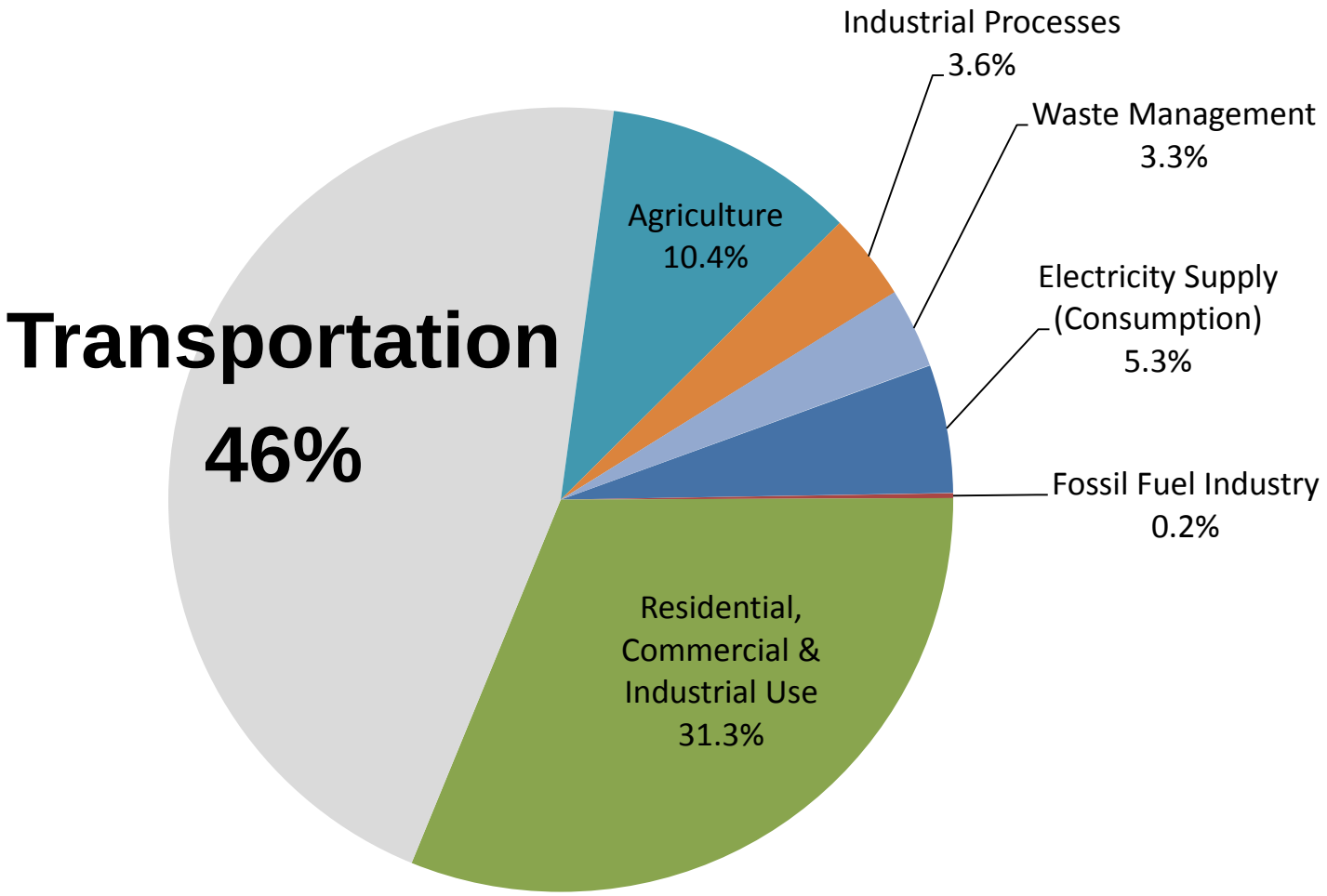
Vermont Energy Investment Corporation

# Agenda

1. Transportation Efficiency Policy
2. Types of EVs
3. EV Characteristics
4. EV Charging
5. Drive Electric Vermont
6. Grid Integrated Vehicles

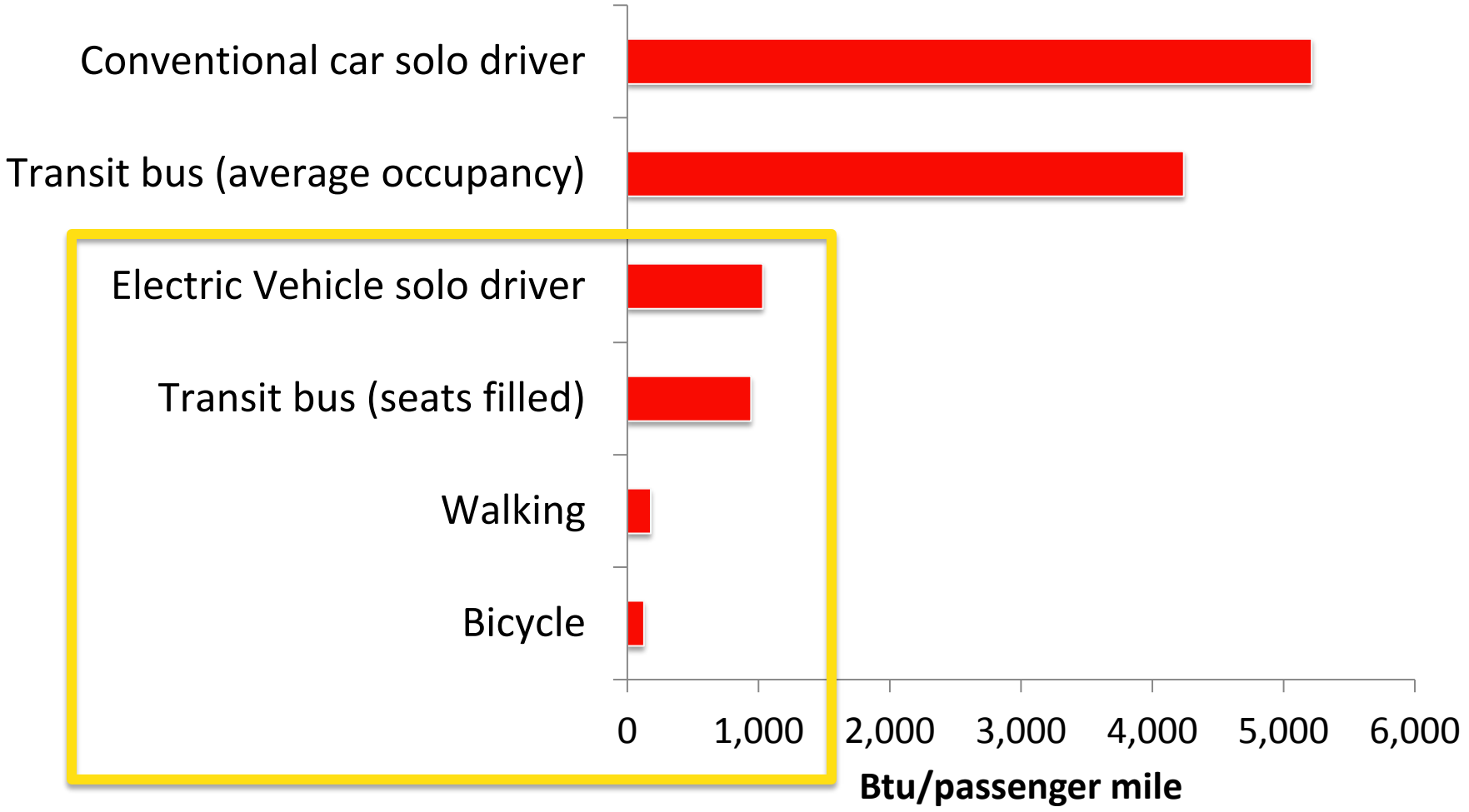
# Vermont Greenhouse Gas Emissions 2011






*Vermont ANR, 2013*

# Transportation Efficiency



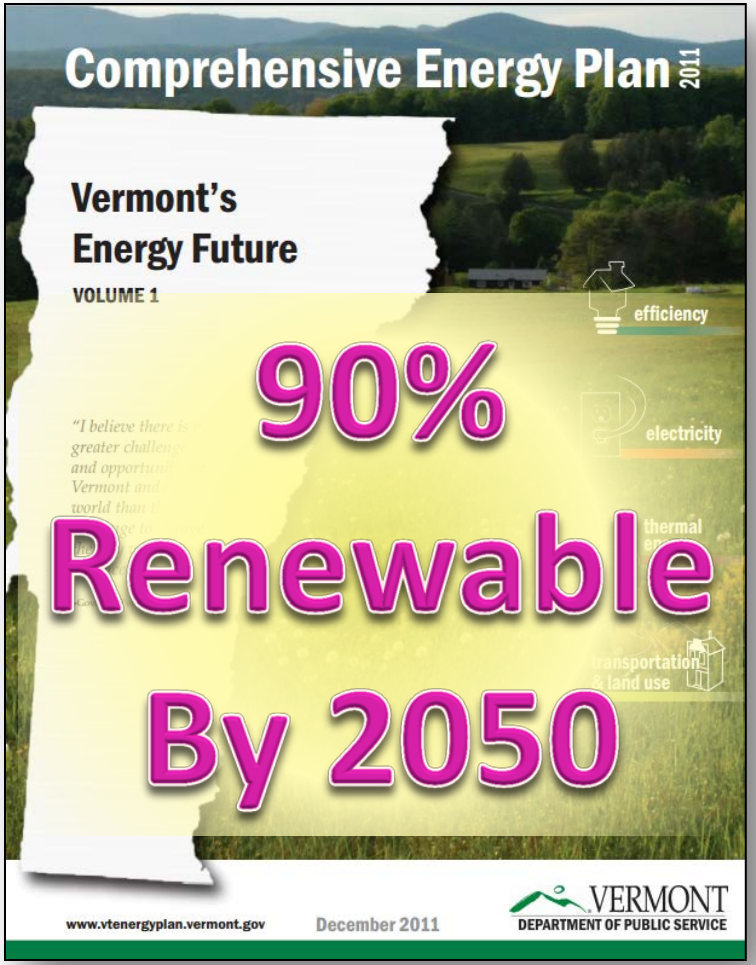



*US DOE Transportation Energy Data Book*

# Comprehensive Energy Plan

## Transportation Strategies

- Increase Consumer Choices
  - Non-SOV travel
- Deploy New Technology
  - Efficient vehicles, including plug-in electric vehicles






http://publicservice.vermont.gov/publications/energy_plan

# Introduction to Electric Vehicles

- All Electric Vehicle

  Powered solely by electric energy stored in a battery


- Plug-in Hybrid Electric Vehicle

  Powered by battery and gasoline for extended range

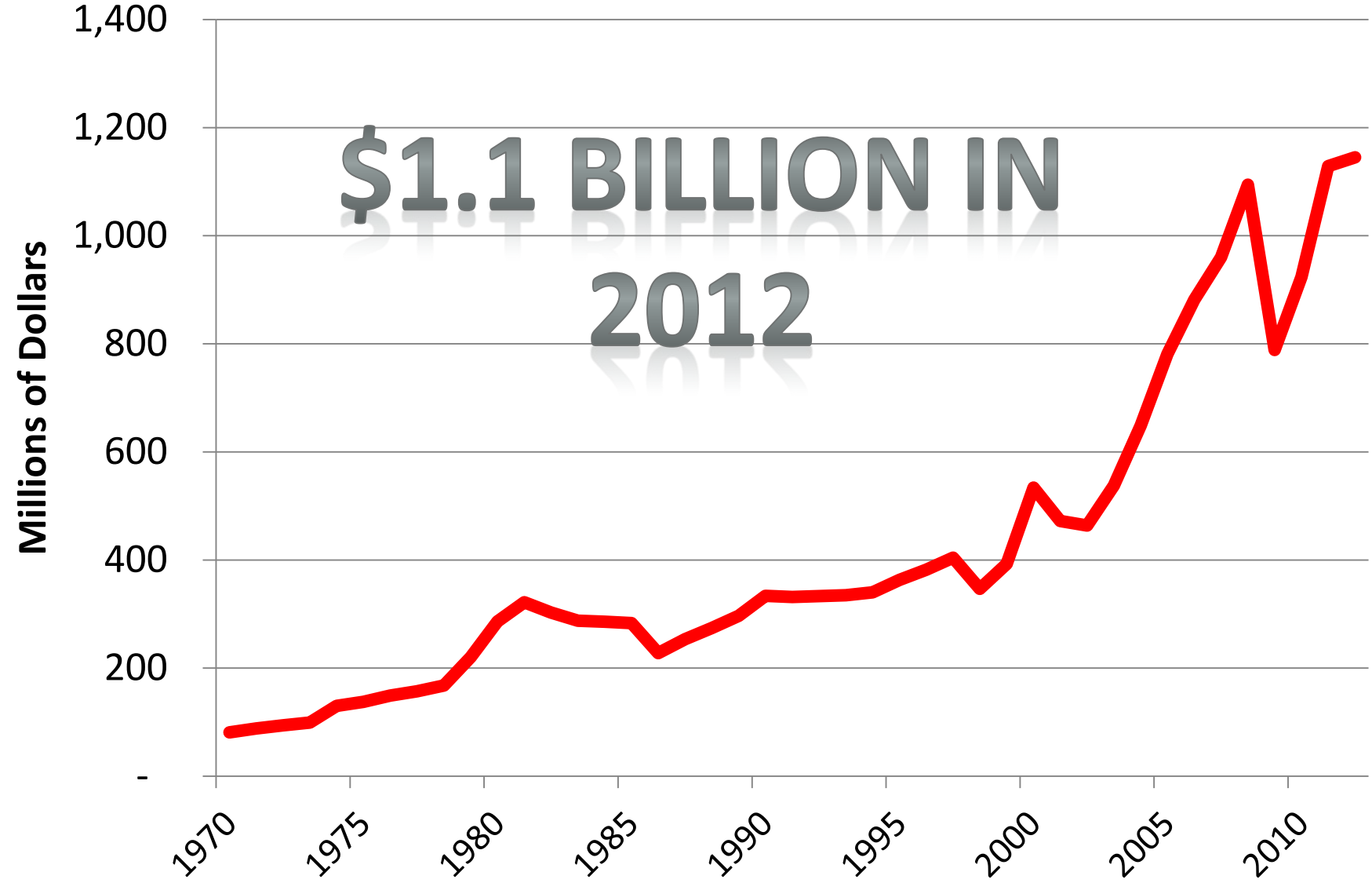
# Automaker Offerings

| OEM | Current EVs | Upcoming Models | Goals/Targets |
|---|---|---|---|
| BMW | **i3** (AEV/PHEV), i8 (PHEV) | X5 eDrive (PHEV) | |
| Chrysler / Fiat | 500e (AEV) | | |
| Ford | **Focus** (AEV), **Fusion** (PHEV), **C-Max** (PHEV) | | 10-25% of 2020 sales electric |
| GM | **Volt** (PHEV), Spark (AEV), **Cadillac ELR** (PHEV) | Bolt (AEV) | 10% of 2020 sales electric, hybrid |
| Honda | Fit (AEV), Accord (PHEV) | | |
| Hyundai | | Sonata (PHEV) | |
| Kia | Soul (AEV) | | |
| Mercedes | **Smart ED** (AEV), B Class Electric (AEV) | S500 (PHEV), C350e (PHEV) | |
| Mitsubishi | **i-MiEV** (AEV) | Outlander (PHEV) | 20% electric and hybrid by 2020 |
| Nissan | **Leaf** (AEV) | e-NV200 (AEV), Infinity LE (AEV) | 10% of 2020 sales electric |
| Tesla | **Roadster, Model S** (AEV) | Model X (AEV), Model III (AEV) | N/A (all electric) |
| Toyota | **Prius Plug-in** (PHEV) | | 30% of 2020 sales electric and hybrid |
| VW / Audi / Porsche | E-Golf (AEV) | A3 E-Tron (PHEV), Q7 E-Tron (PHEV),Panamera (PHEV), 918 (PHEV) | |

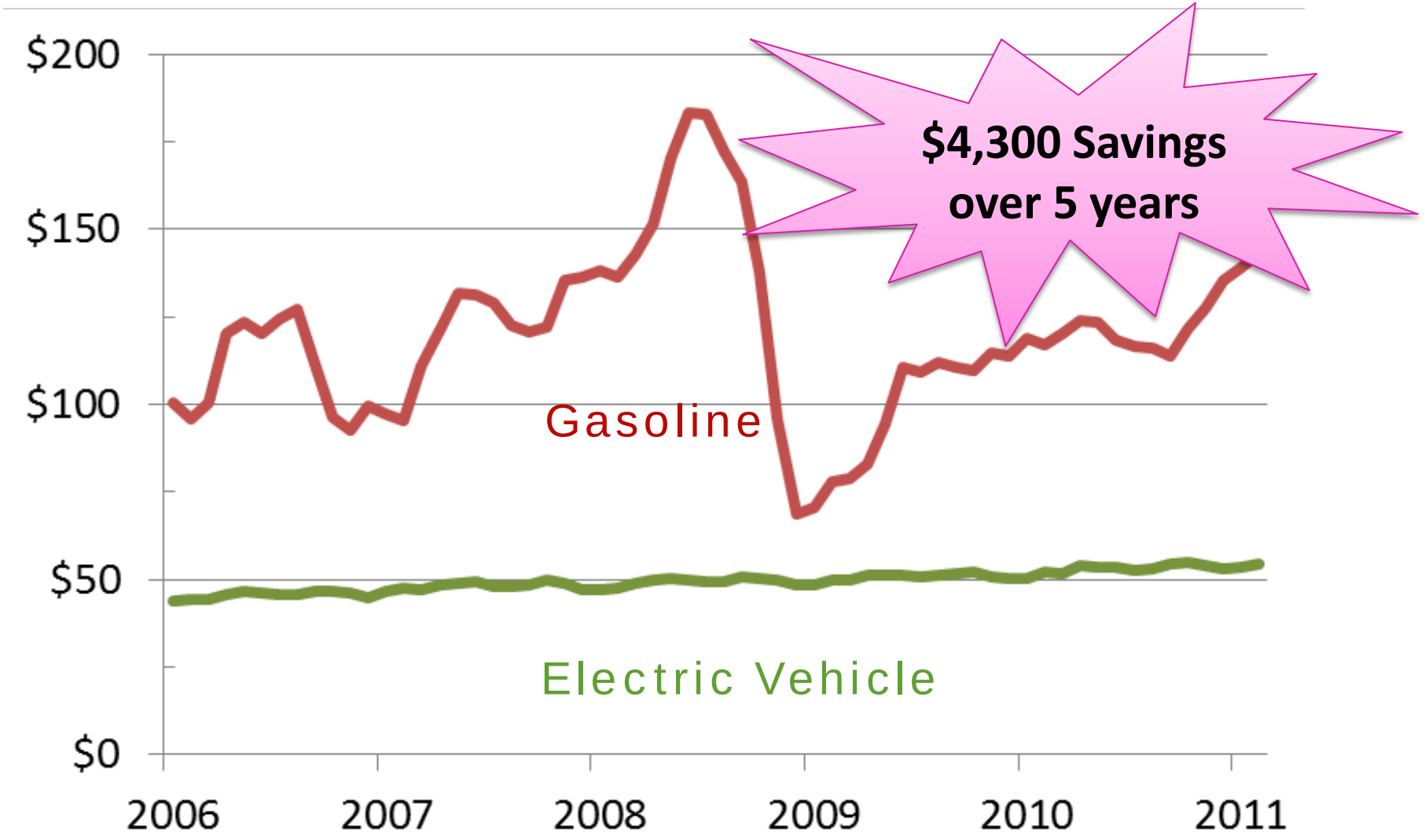
# EV Benefits

- Save money
- Great performance
- Luxury features
- Reduced emissions
  - AEVs have no tailpipe
  - “Well-to-Wheels” Benefits
  - Health Benefits

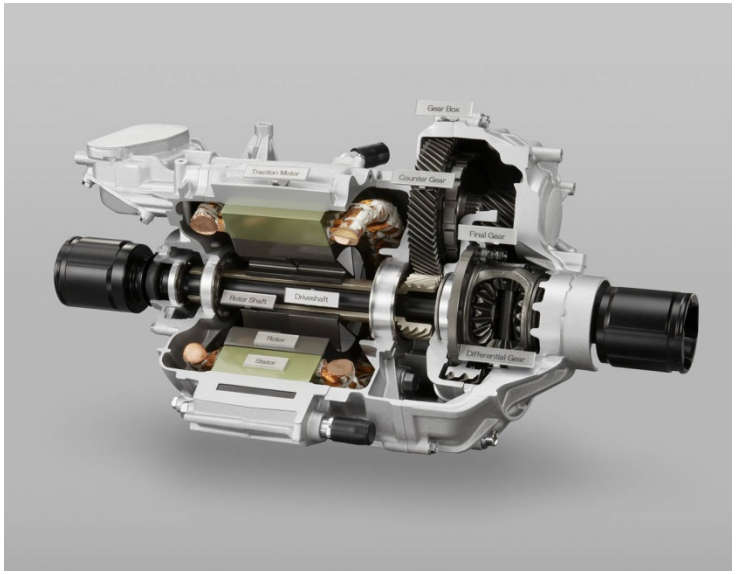
# Vermont Gasoline Expenditures



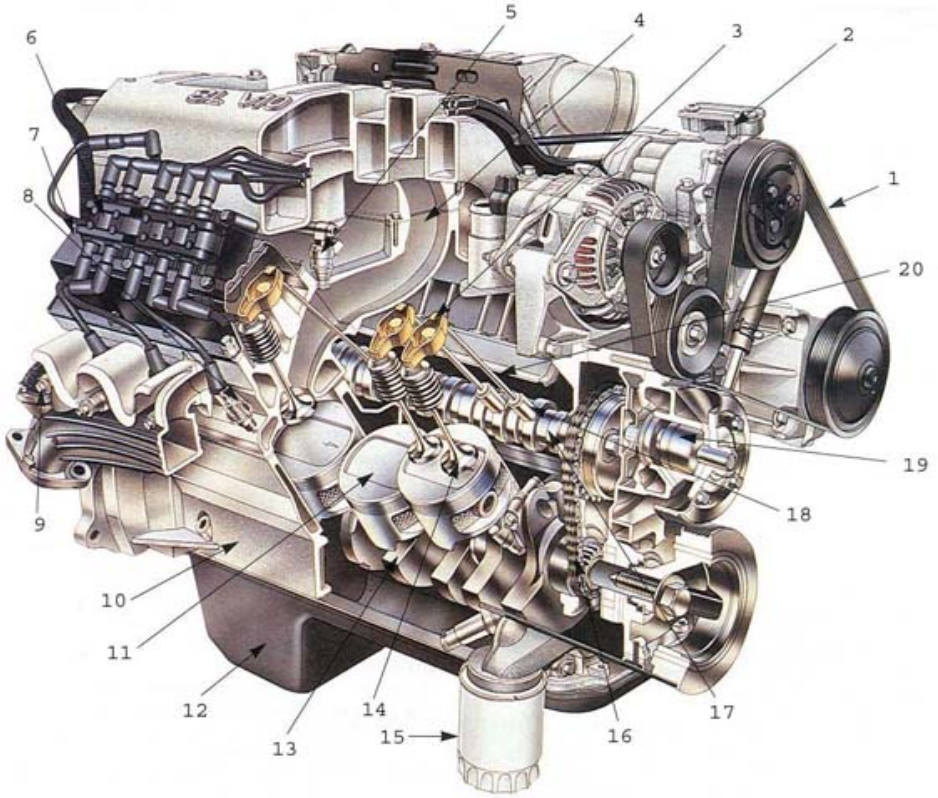
# Monthly Transportation Energy Cost



# Reduced Maintenance



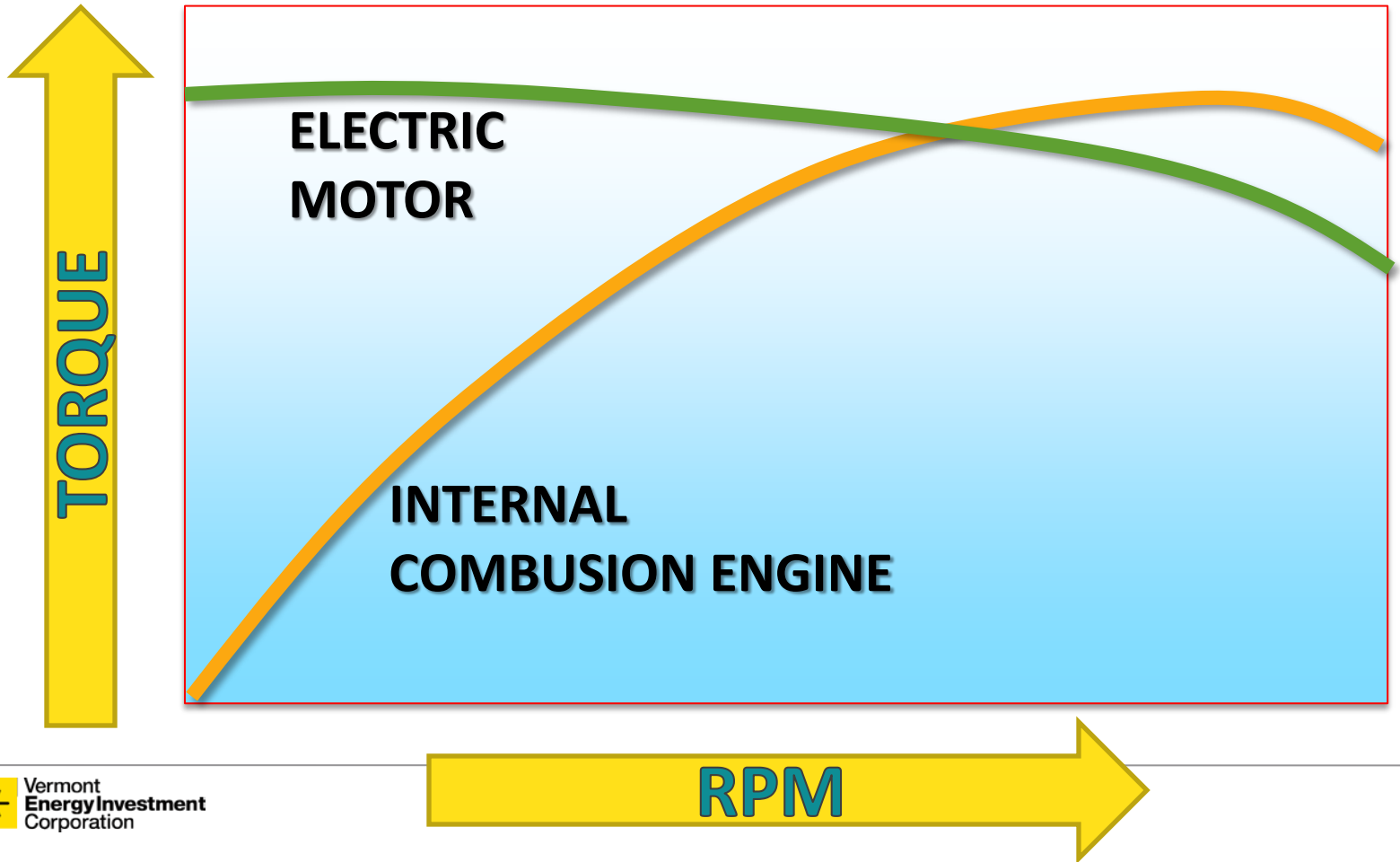

**ELECTRIC MOTOR**




**INTERNAL COMBUSION ENGINE**

# Performance

- Less Gas = More Fun



# Performance – UVM Racing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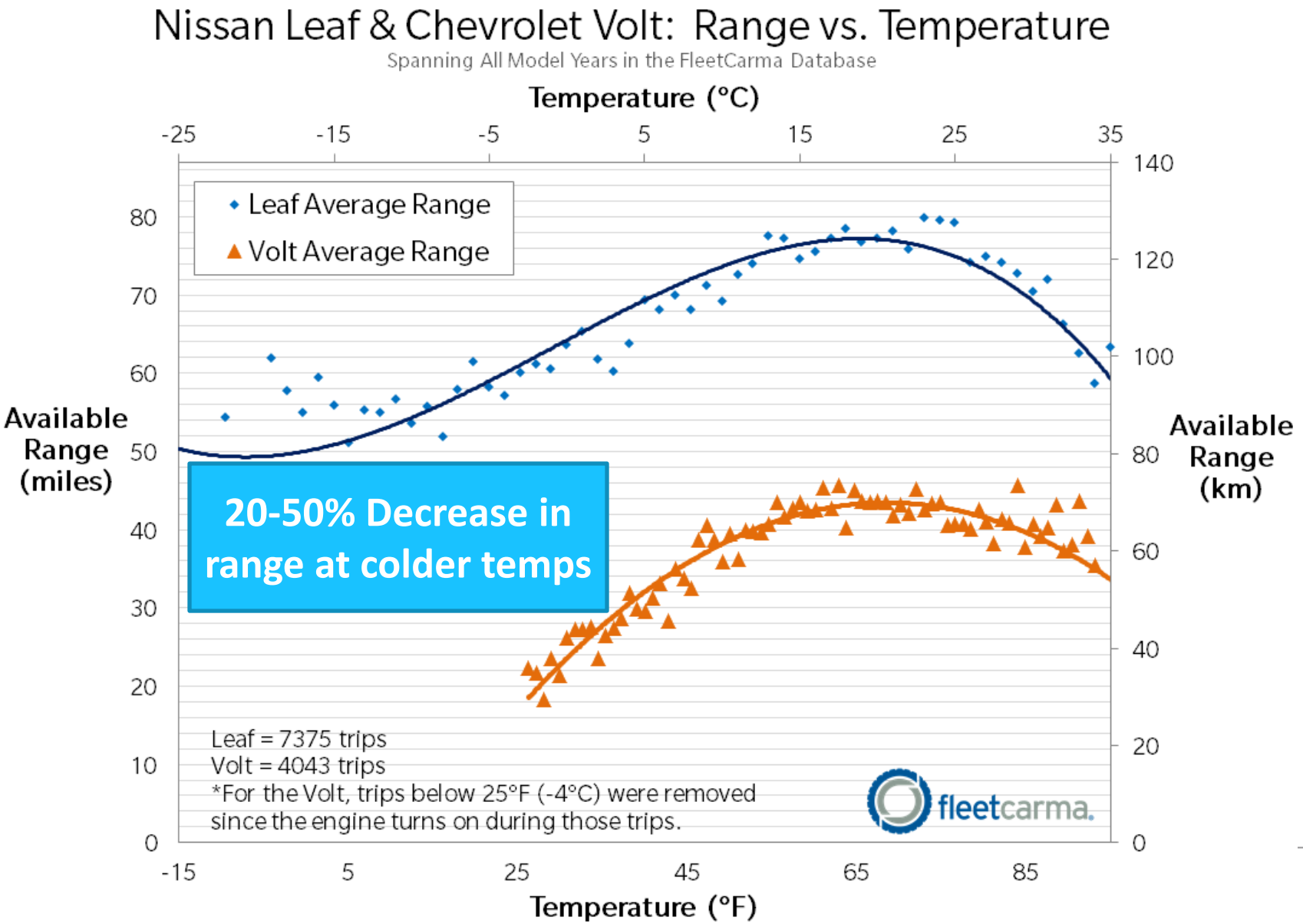
http://www.uvmaero.org/

# Cold Weather Operation



# Safety

- Crash Ratings
- Vehicle fires

187,500 fires in 2011
+5,000 at fueling

< 10 as of Feb 2015

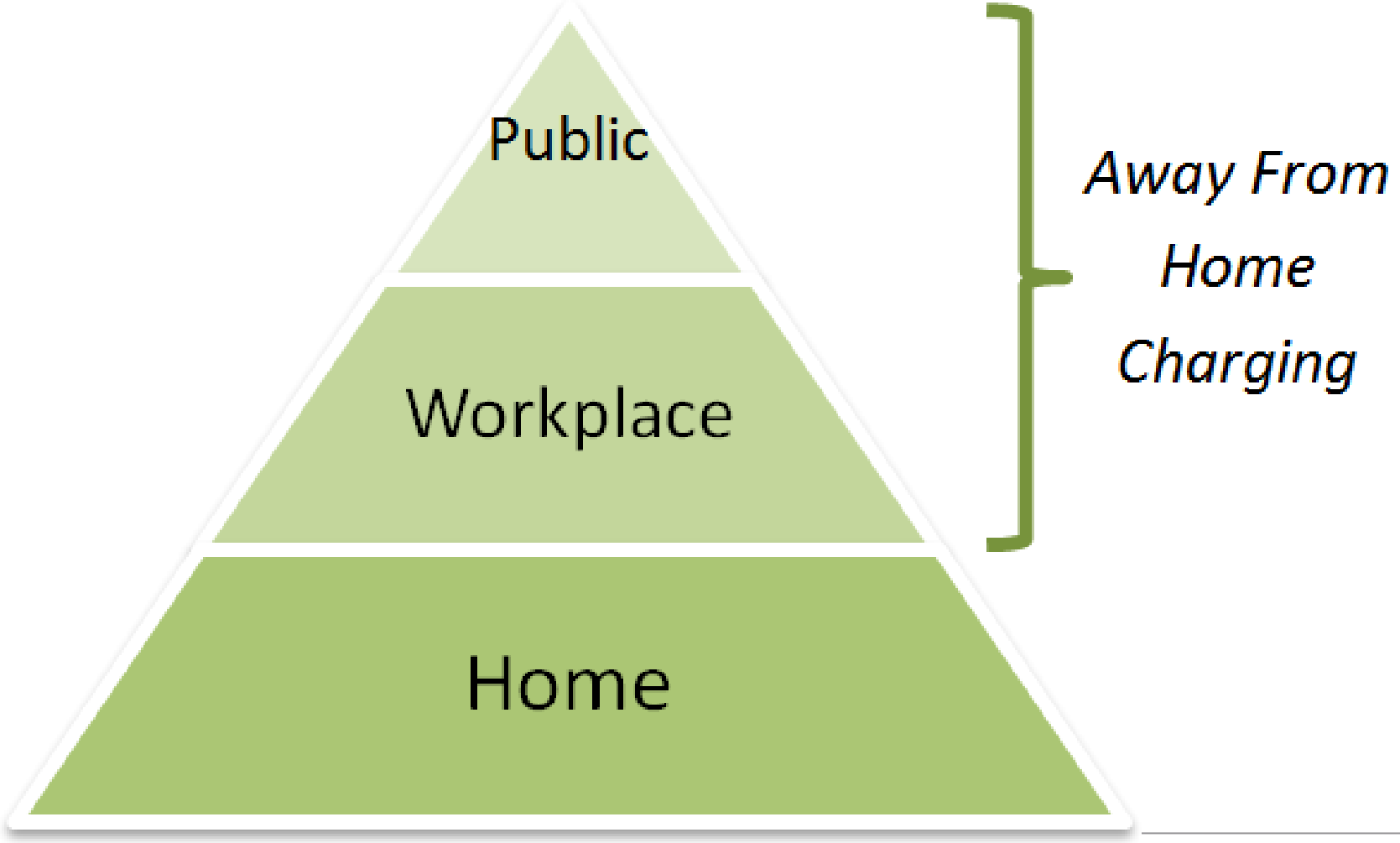
- First responder trainings
  - Decal requirements

# Leasing Options

- 90% of EVs in the USA are Leased
- Federal incentive passed through by leasing company
- Technology is rapidly changing
- Protected from depreciation
- Accelerate used vehicle availability


- High mileage customers may have issues with leasing

# EV Charging



# Charging Equipment

**Level 1 charging**
120V


**Level 2 charging**
208/240V


**DC fast charging**
208-480V

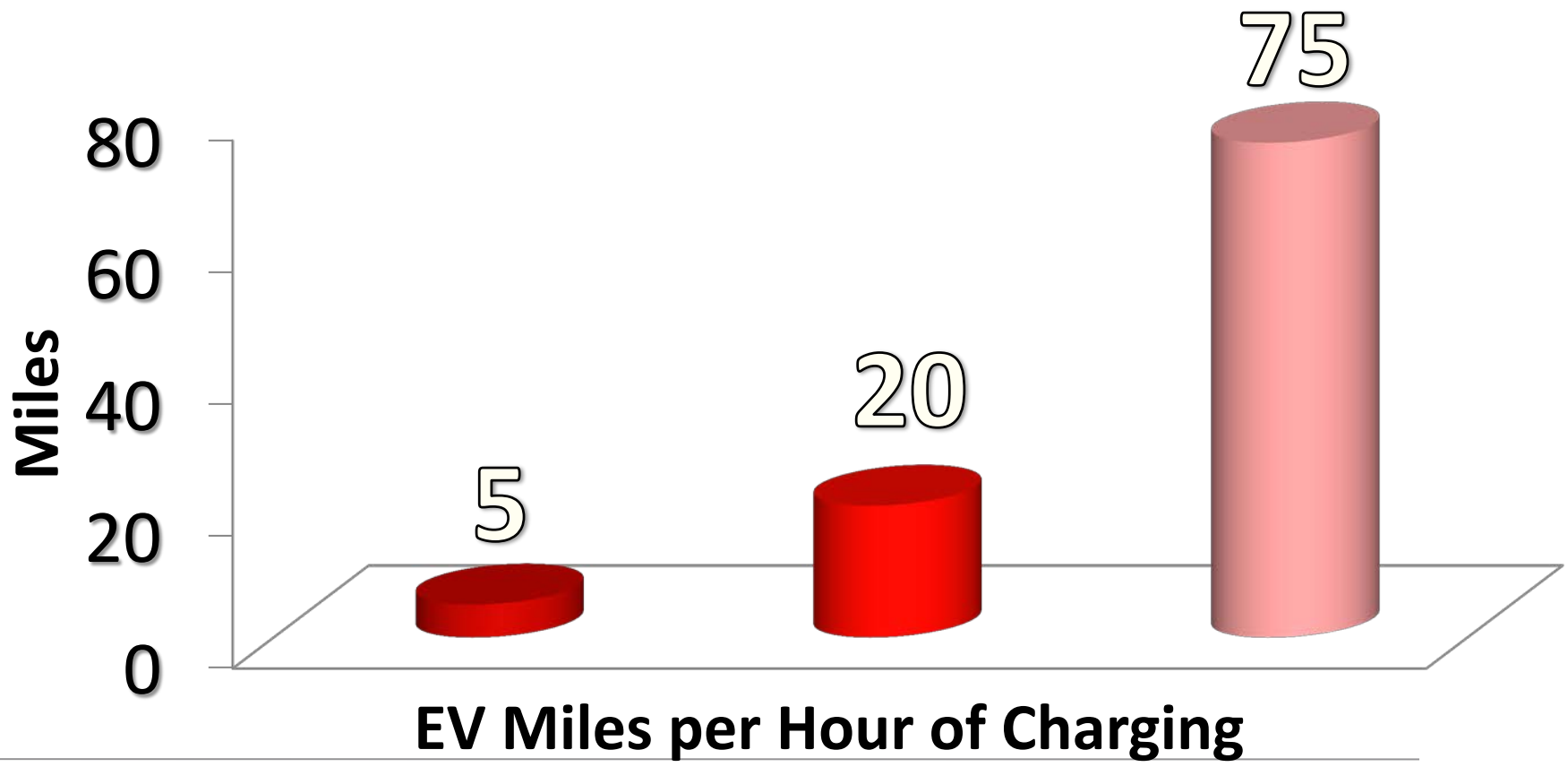
# Brattleboro Tesla Supercharger

# Charging Speed

**Level 1 charging**
120V
20A

**Level 2 charging**
208/240V
15-80A

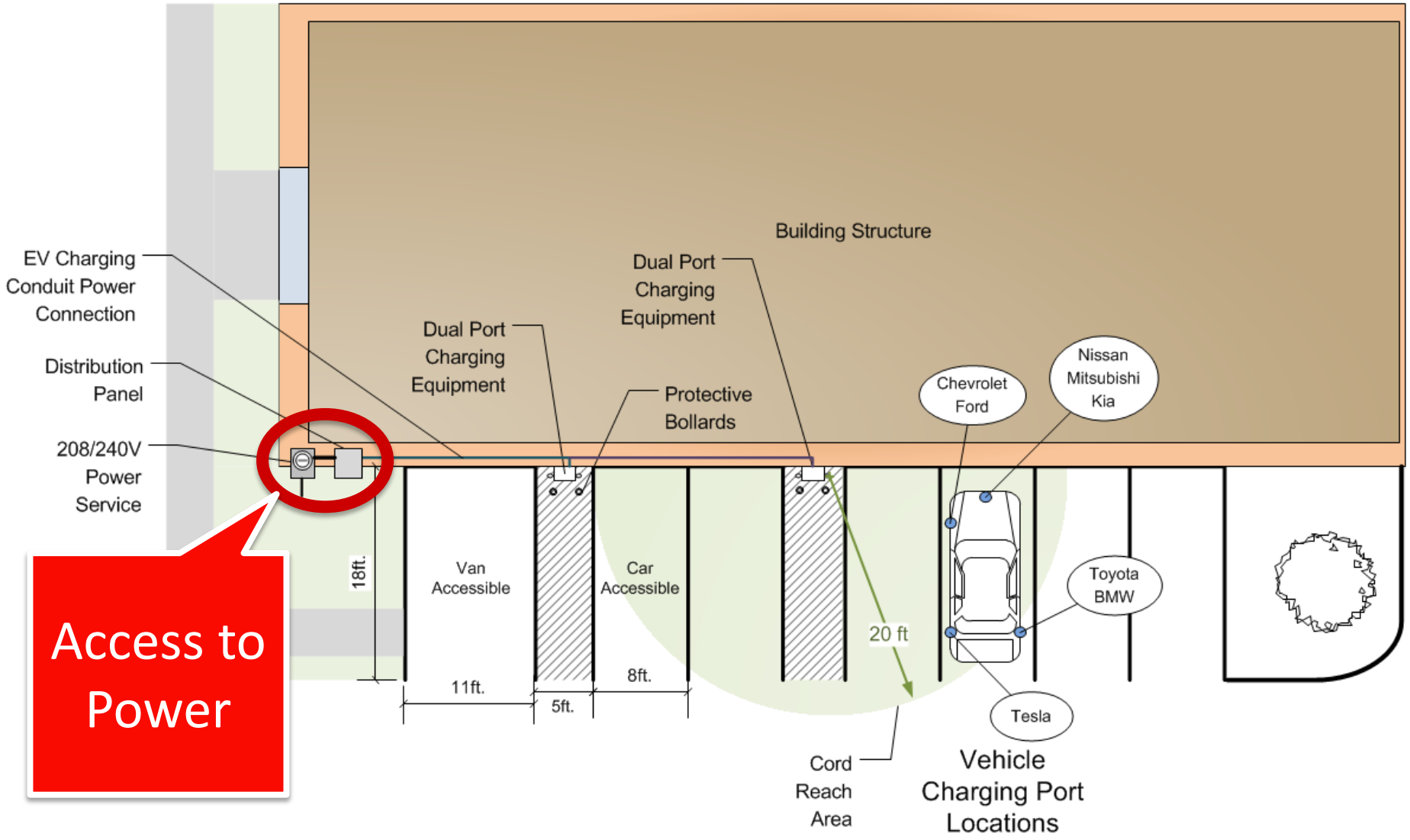
**DC fast charging**
208-480V
Up to 200A



# Charging Station Installation Costs

| | Level 1 | Level 2 | DC Fast |
|---|---|---|---|
| **Charge Duration** | **6-10 hours** | **1-3 hours** | **15-30 minutes** |
| **Equipment** | $30 – 900 | $600 – 9,000 | $15,000 – 60,000 |
| **Installation** | $200 – 450 | $1,000 – 12,000 | $10,000 – 25,000 |
| **Total** | **$230 – 1,350** | **$1,600 – 21,000** | **$25,000 – 85,000** |

# Charging Station Planning



# Public EV Charging Equipment


Waterbury

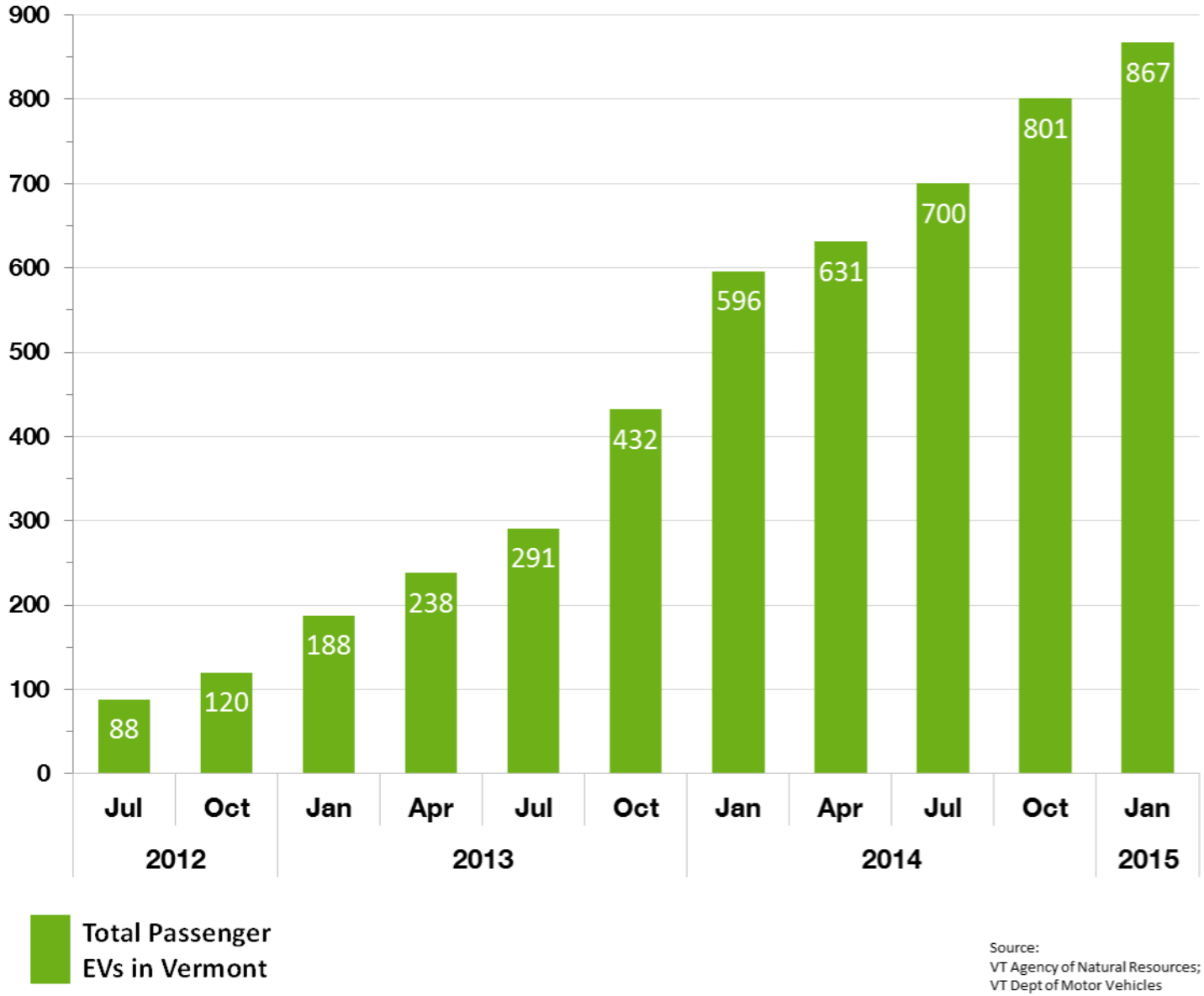
S Burlington

Montpelier

# Vermont EV Policy

- Stakeholder group coordinating public-private investments
  - Vehicle and charging station outreach
- Pilot incentive program at point of purchase with dealer participation
- Downtown charging station grants
- State Infrastructure Bank low interest loans for charging
- Clean Fuels / Fossil Fuel Reduction programs

# VERMONT ELECTRIC VEHICLE REGISTRATIONS




Source:
VT Agency of Natural Resources;
VT Dept of Motor Vehicles

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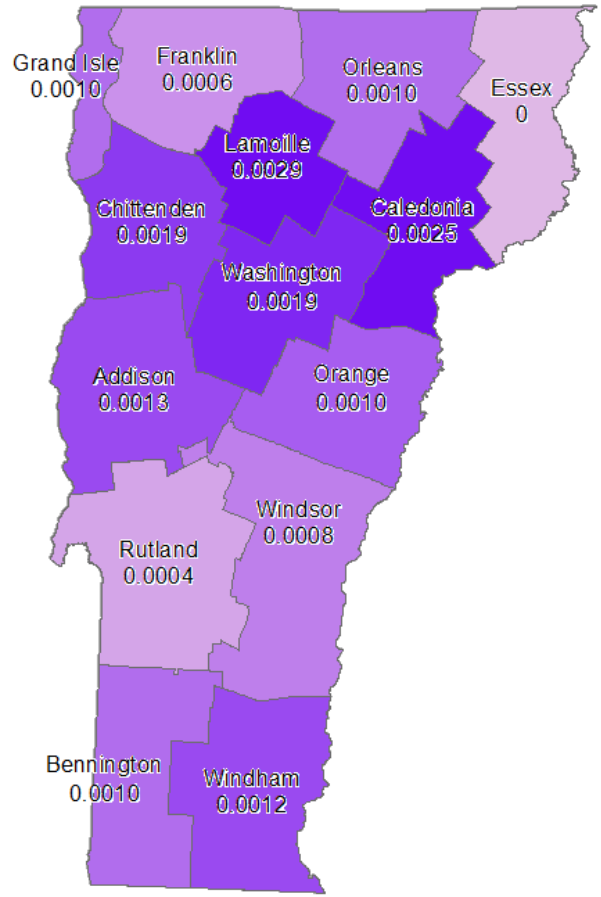
Source: DriveElectricVT.com

# EV Adoption Rates

## Electric Vehicles Per Capita in Vermont Counties

### As of January 2015




| County | Population | All Electric | Plug-in Hybrid | Total EVs | Plug-ins per Capita |
|---|---|---|---|---|---|
| Lamoille | 24,475 | 4 | 68 | 72 | 0.0029 |
| Caledonia | 31,227 | 2 | 77 | 79 | 0.0025 |
| Washington | 59,534 | 17 | 99 | 116 | 0.0019 |
| Chittenden | 156,545 | 99 | 191 | 290 | 0.0019 |
| Addison | 36,821 | 17 | 30 | 47 | 0.0013 |
| Windham | 44,513 | 11 | 41 | 52 | 0.0012 |
| Orange | 28,936 | 9 | 21 | 30 | 0.0010 |
| Grand Isle | 6,970 | 3 | 4 | 7 | 0.0010 |
| Orleans | 27,231 | 2 | 25 | 27 | 0.0010 |
| Bennington | 37,125 | 5 | 31 | 36 | 0.0010 |
| Windsor | 56,670 | 19 | 28 | 47 | 0.0008 |
| Franklin | 47,746 | 6 | 24 | 30 | 0.0006 |
| Rutland | 61,642 | 2 | 22 | 24 | 0.0004 |
| Essex | 6,306 | 0 | 0 | 0 | 0.0000 |

Data Source:
Vermont Dept of Motor Vehicles vehicle registration database as of 12/24/2014.
Data processed by Vermont Agency of Natural Resources Dept of Environmental Conservation. EVs distinguished by fuel type, model and/or VIN.
County data summarized from zip code geography. Population from 2010 US Census.
Does not include 10 vehicles with registrations zip codes outside of Vermont.

This material is based upon work supported by the Vermont Public Service Department, Vermont Agency of Natural Resources, Vermont Agency of Transportation, and the Vermont Department of Buildings and General Services.

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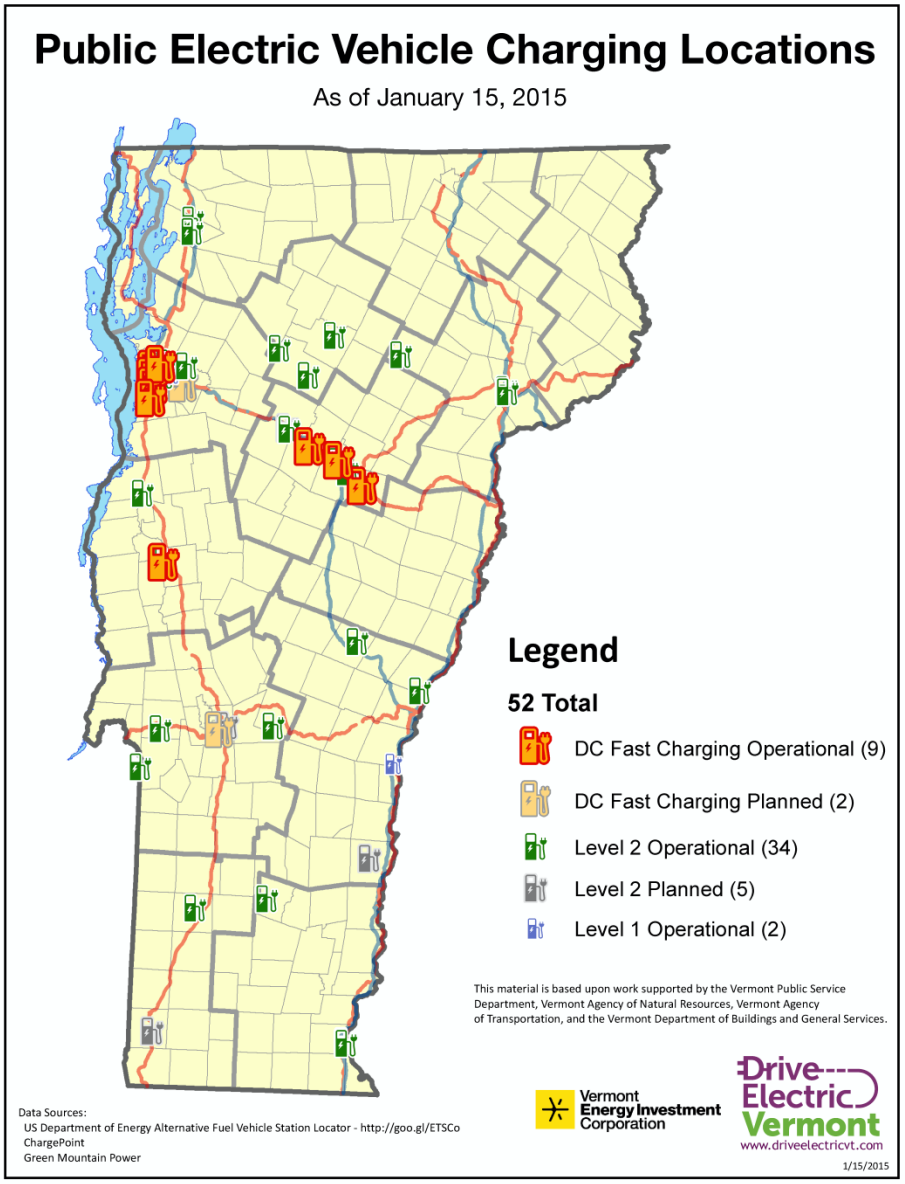
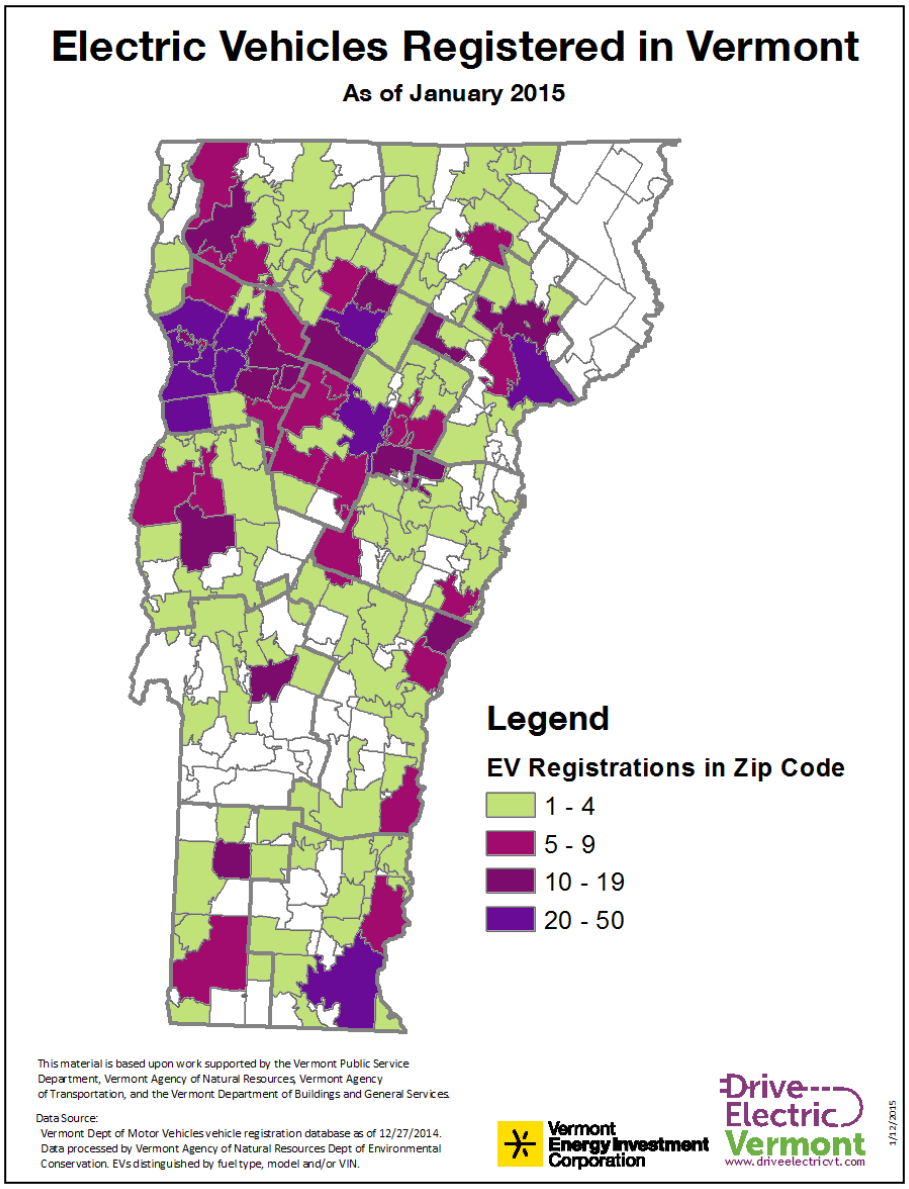
Drive Electric Vermont
www.driveelectricvt.com

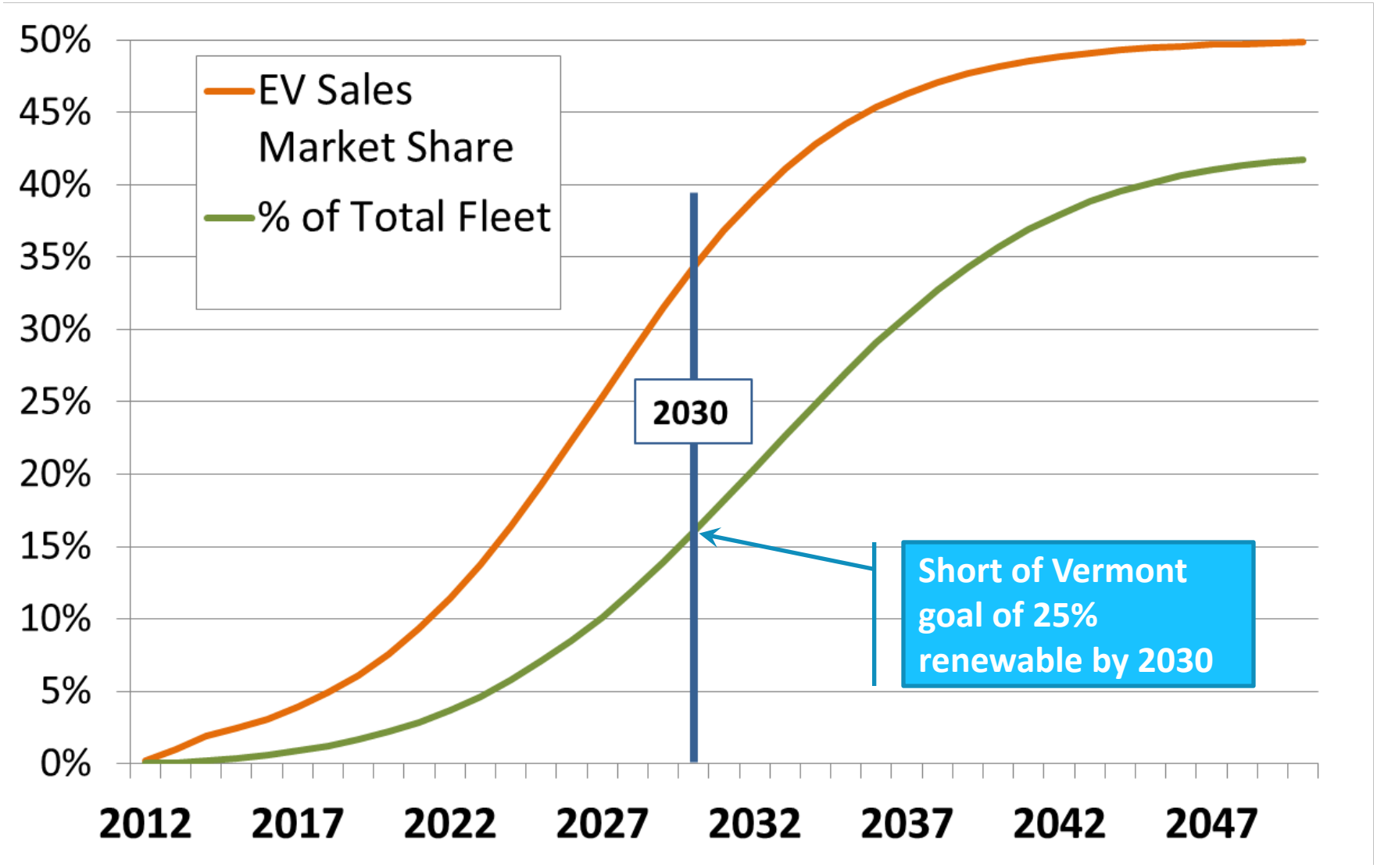
1/22/2015

# EVs in Vermont



# Potential Growth Scenario



# Fleets

- State of Vermont will have more EVs in the fleet
- Several municipalities and CCRPC have leased / purchased
- Utilities and businesses

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Winooski's EV Fleet: https://www.youtube.com/watch?v=W_EKSRYsMVY

# Solar PV and EVs

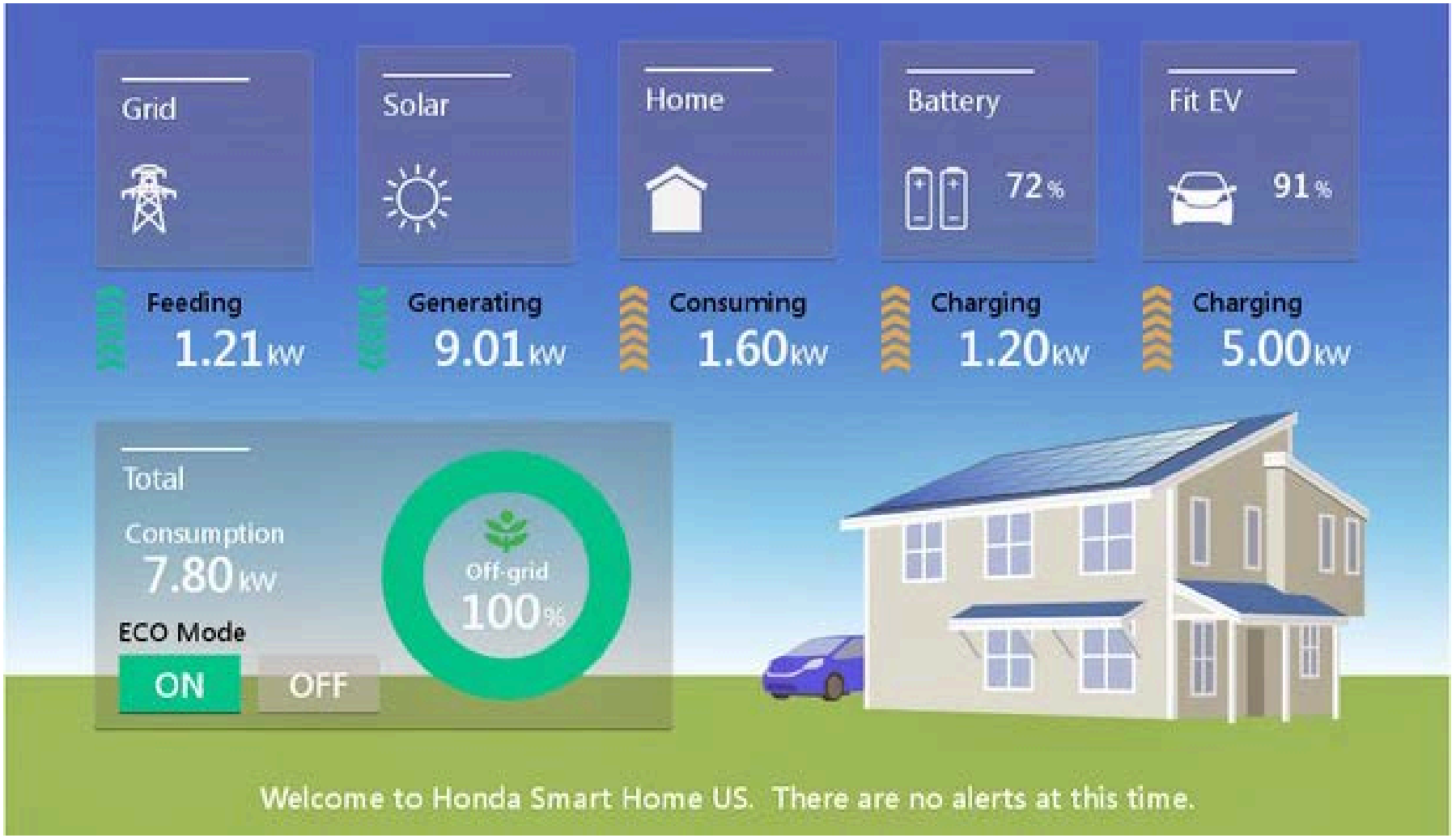
- EVs typically travel 3-4 miles per kWh
- Driving 12,000 miles per year will require 3,000-4,000 kWh

# Vehicle to Grid / Vehicle to Building


Fort Carson, CO
Microgrid Project


Nissan EV Power
Station

# Honda Smart Home Demonstration



# Electric School Buses

LAVALnews.ca

Laval's English newspaper since 1993.
Journal anglais de Laval depuis 1993.

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School Busses

## Quebec pins hopes on all-electric school bus unveiled in Laval

By Martin C. Barry | Fri, 11/14/2014 - 12:45

**Quebec Transport Minister Robert Poëti is seen here connecting the all-electric school bus for recharging with Mille-Îles Liberal MNA Francine Charbonneau and Minister of Sustainable Development David Heurtel.**

Quebec's Liberal government is hoping that a 100 per cent electric school bus unveiled in Laval and which is regarded as a first of its kind in North America will sell briskly to transportation companies and school boards and return at least some of the investment Quebec made in its development.

**A Lion of a bus**

Quebec Transport Minister Robert Poëti joined Sustainable Development Minister David Heurtel and Minister Responsible for the Laval Region Francine Charbonneau with Chomedey Liberal MNA Guy Ouellette at school transportation specialist Chartrand Inc.'s depot on Montée Masson in Laval's east end on Nov. 7 for the official unveiling of the 72-seat C-type E-Lion school bus made entirely in Quebec by Lion Bus

## Google Launches Free EV Shuttle Service in Mountain View, CA

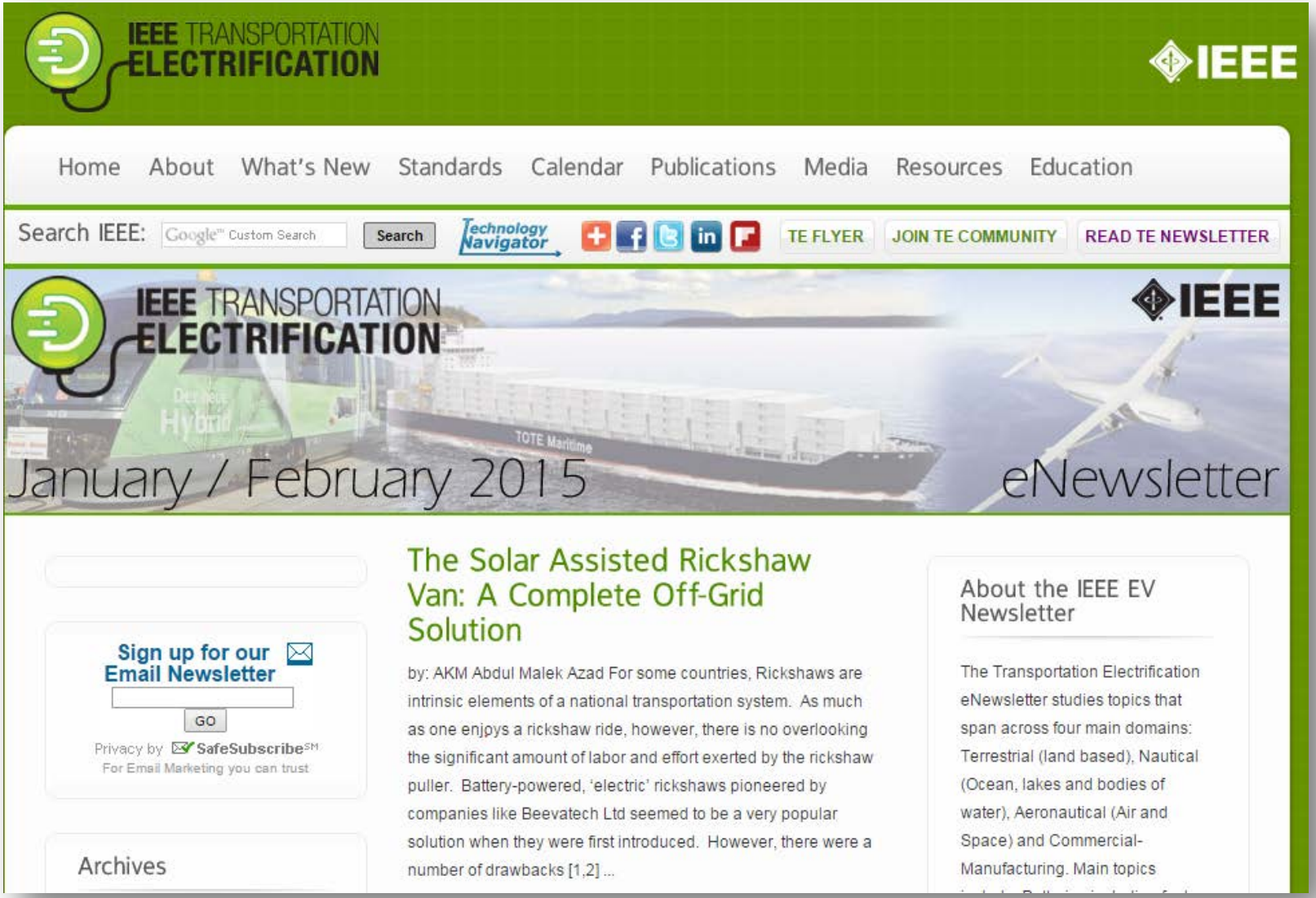
February 5th, 2015 by Aisha Abdelhamid

Four new 100% electric community shuttle buses have hit the road in the beautiful Silicon Valley city of Mountain View, California. The four electric shuttles are free to the public, thanks to Google, and are equipped with seating for 16 passengers, a wheelchair lift, space for two wheelchairs, Wi-Fi connectivity, and bicycle racks on the outside of the shuttle. This sounds more tempting to me than a Tesla.

# Outreach

- Event recommendations for demos
- Newsletters or other outlets
- DEV stakeholder meetings
- EV charging priorities
  - Projects with construction activity in parking areas
  - Major employers
  - Multifamily properties
  - State Infrastructure Bank opportunities

# IEEE Transportation Electrification

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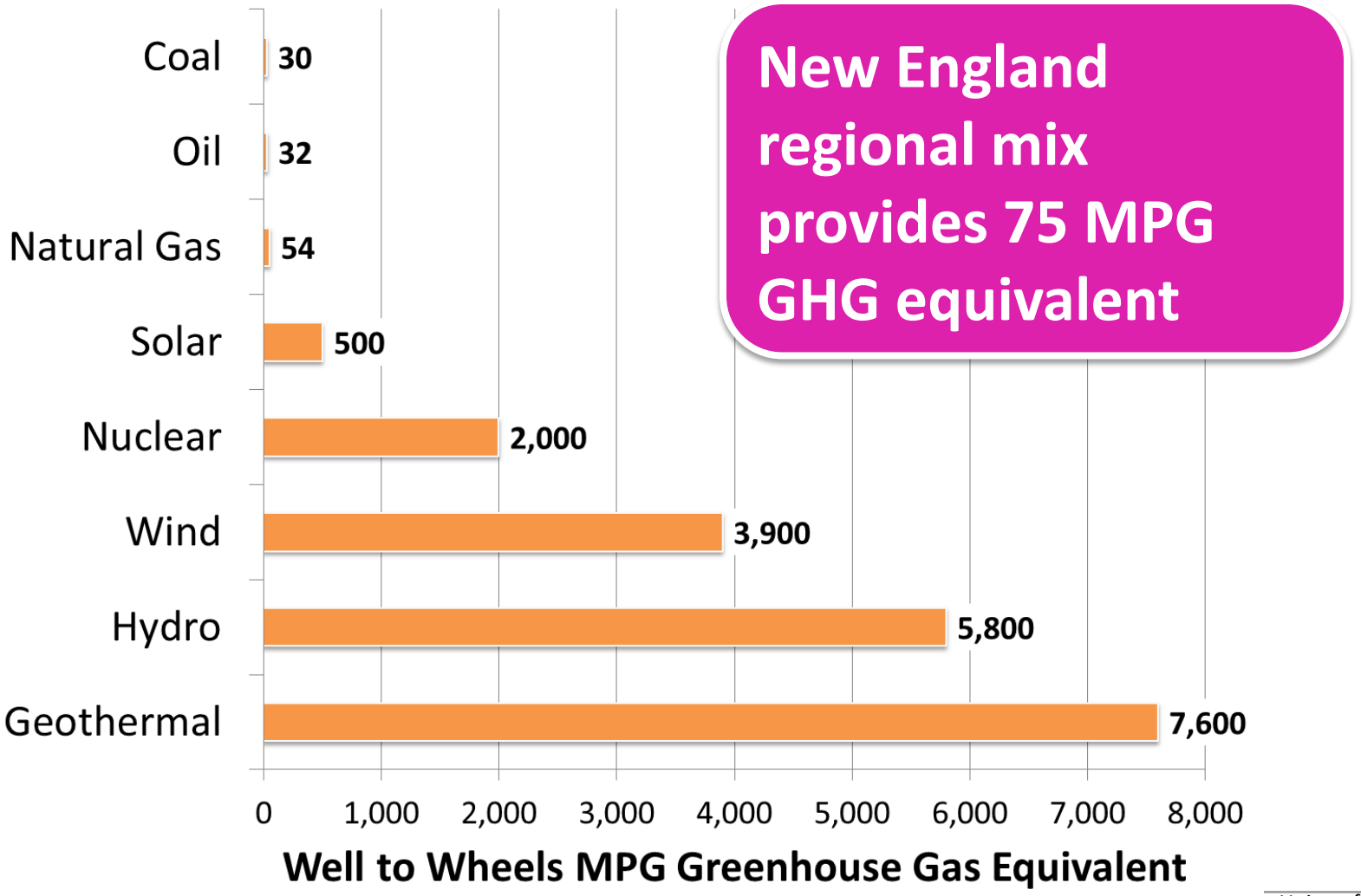
http://electricvehicle.ieee.org/

# Resources

- Drive Electric Vermont
  - http://driveelectricvt.com
  - https://www.facebook.com/DriveElectricVT

- National EV websites
  - http://www.afdc.energy.gov/fuels/electricity.html
  - http://goelectricdrive.com
  - http://www.pluginamerica.org
  - http://www.northeastevs.com
  - http://www.greencarreports.com/

# Electric Vehicle Greenhouse Gas Emissions

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Union of Concerned Scientists, 2012