



# Market Potential Assessment for Alternative Fuels in Connecticut

Findings and next steps for the Connecticut  
Green Bank

*Nick Nigro, Atlas Public Policy*

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# About Atlas Public Policy

- DC-based policy tech firm started in 2015
- **Mission:** equip businesses and policymakers to make strategic, informed decisions through the greater use of technology that interprets publicly available information

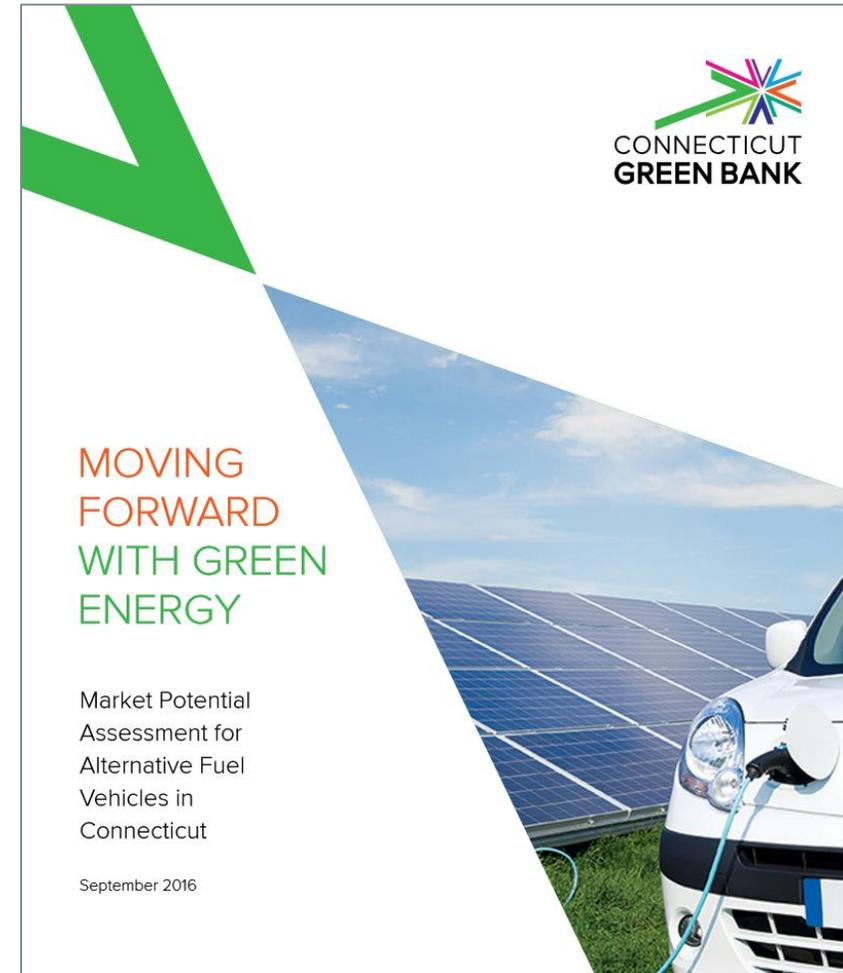
## *Atlas Key Focus Areas*

- **Access:** *Collect and disseminate publicly available information for free.*
- **Interpret:** *Develop open-source apps to spur insights and conduct analyses.*
- **Empower:** *Strengthen policymakers, businesses, and non-profits' ability to meet emerging challenges and identify and seize opportunities.*



# Study Overview

- Available free at [www.ctgreenbank.com/about-us/studies-and-reports](http://www.ctgreenbank.com/about-us/studies-and-reports)
- Comprehensive data collection effort
- Summary of transportation sector in Connecticut
  - State energy and climate goals
  - State of play for conventional and alternative fuel vehicles
- Market potential assessment of alternative fuels
  - Near-term market feasibility
  - Environmental performance
  - Cost effectiveness
  - Local economic impact
- Conclusions and next steps



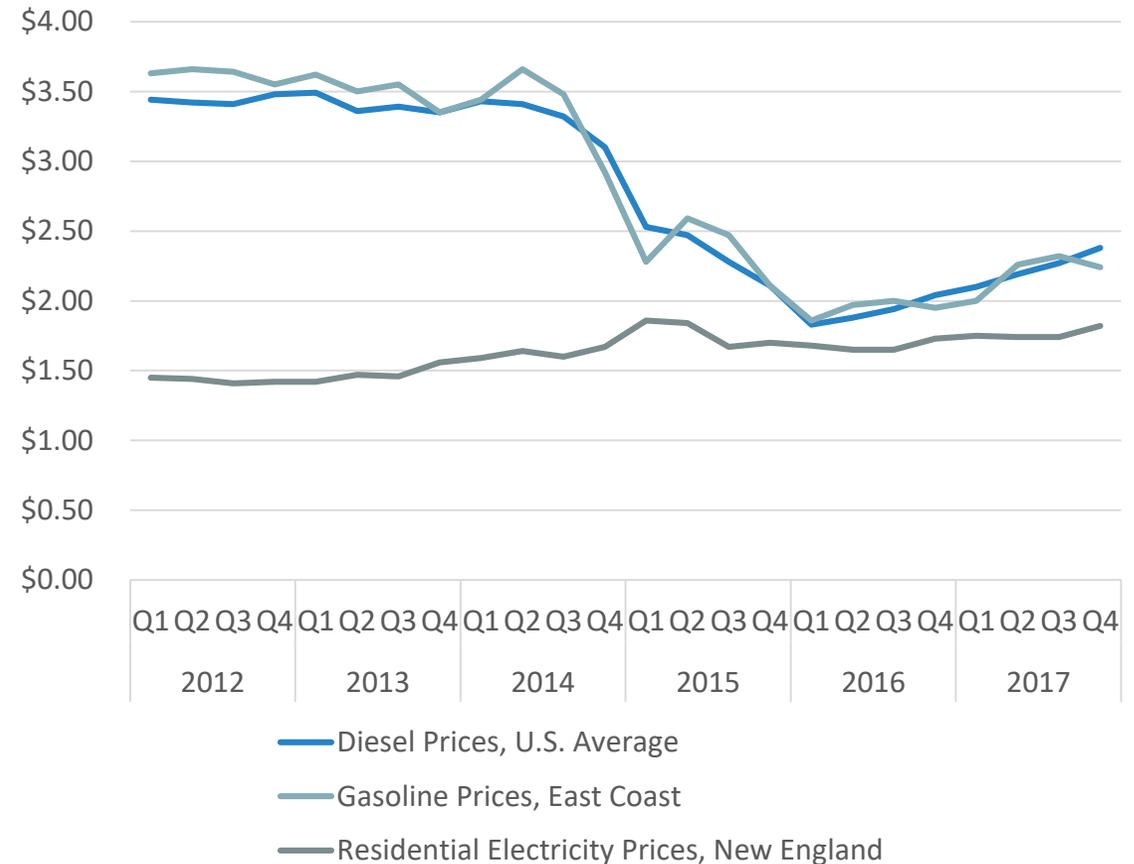


# Study Conclusions

- Electric vehicles are best option for state to meet its goals
  - Automaker investments will introduce variety of EVs in near term
  - Current policy framework in CT supports EV adoption
  - EVs can achieve net cost savings over gasoline vehicles & provide local economic boost

***Stable fuel prices, technological advances, and zero emissions combine to cost-effectively decarbonize transportation***

Near-Term Forecast of Fuel Prices

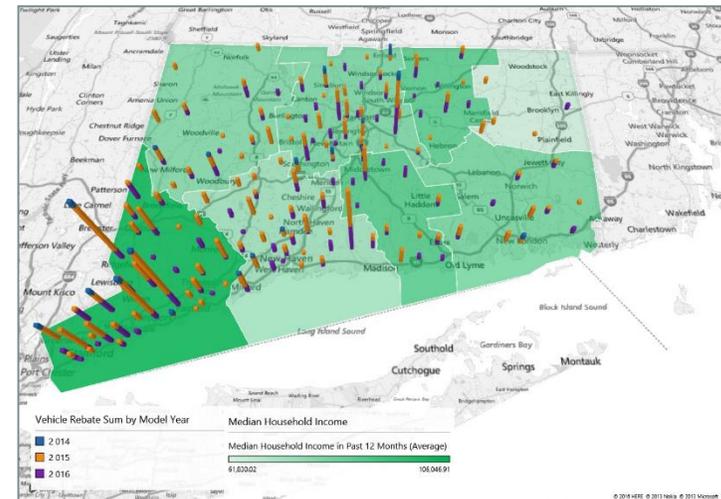
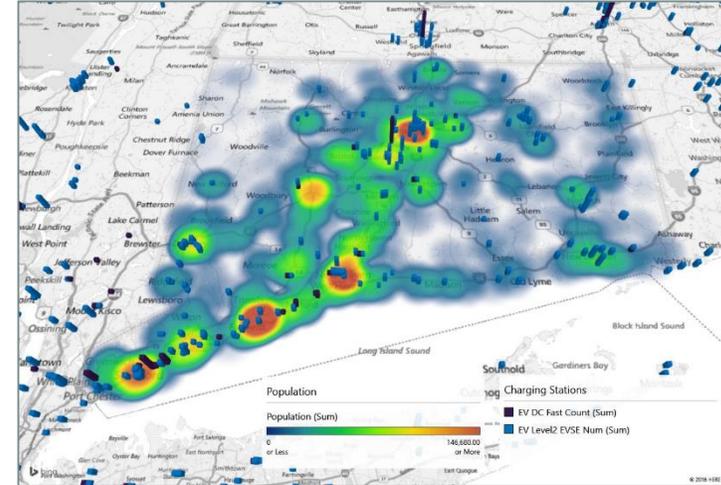


# Relational Database for Connecticut

- Compare multiple datasets at once
  - Create compelling visualizations with Microsoft Power BI and Excel
  - Time series (monthly, yearly) & geolocation (ZIP code)
- Current datasets available
  - Monthly EV sales
  - Alternative fuel/charging stations<sup>1,2</sup>
  - Monthly gasoline & annual electricity prices<sup>1,2</sup>
  - Annual vehicle miles traveled<sup>1</sup>
  - Policies & programs (e.g., CHEAPR)
  - U.S. Census Bureau demographics<sup>1,2</sup>
  - Solar installations<sup>1,2</sup>

<sup>1</sup> Publicly available dataset accessed through web API

<sup>2</sup> Multi-state data available





# EV and Charging Terminology

- Plug-in electric vehicle (EV)
  - Battery Electric Vehicle (BEV): all-electric car only powered by batteries
  - Plug-in Hybrid Electric Vehicle (PHEV) or Extended Range Electric Vehicle (EREV): vehicle that can be powered by either batteries, a gasoline engine, or both
- Charging Levels

**Low – AC 120 V**  
**"AC" LEVEL 1**

- Uses standard outlet
- Power requirements similar to a toaster
- Up to 1.4 kilowatts
- Can use existing power outlets resulting in no cost installation
- Charging rate: 3-5 miles per hour

**Medium – AC 240 V**  
**"AC" LEVEL 2**

- Requires high-voltage circuit
- Power requirements similar to an electric clothes dryer
- Up to 19.2 kilowatts
- Equipment & installation costs vary widely (~\$6,500 in public and ~\$2,000 at home)
- Charging rate: 12-75 miles per hour

**High – DC Fast Charge**  
**"DC" LEVEL 2**

- Power requirements are up to max power for 15 homes
- Up to 90 kilowatts
- Currently, three systems used (CHAdEMO, SAE Combo, Tesla)
- Can have very high equipment & installation costs ( up to \$90,000)
- Charging rate: 100-300 miles per hour



# State of Play Summary

- Transportation is largest source of emissions in CT (40%)
  - Current federal policy and state programs help, but not enough
  - State expected to have 3x more transportation emissions in 2050 than its long-term climate goal
- Light-duty vehicles dominate CT market
  - 95% of vehicle stock, 70% of energy use
- 10 alternative fuel options for vehicles
  - Plug-in electric vehicles most widely available alternative fuel vehicle

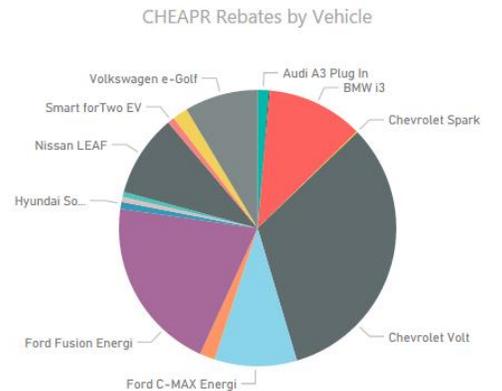
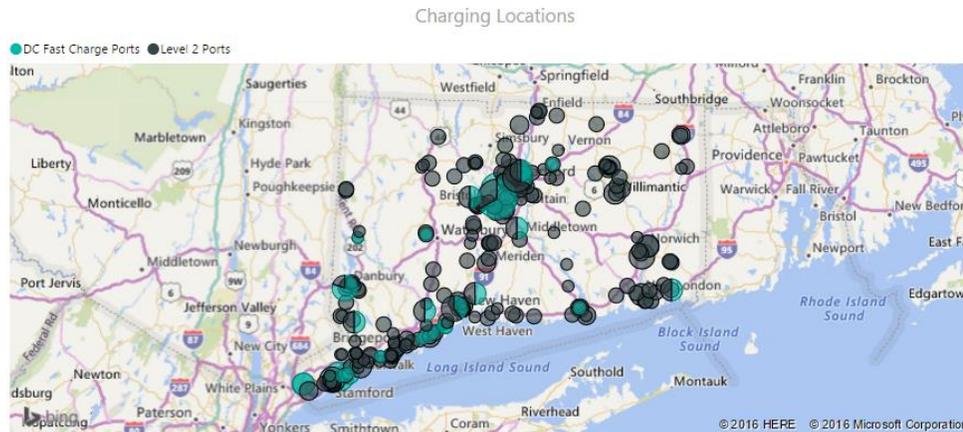
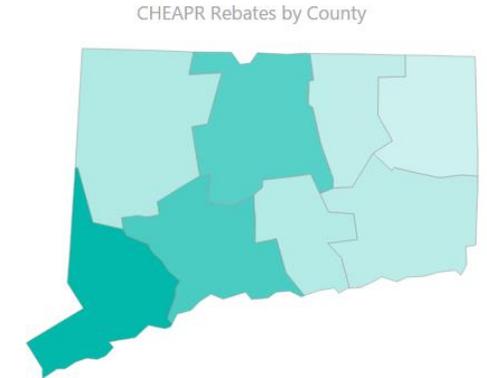
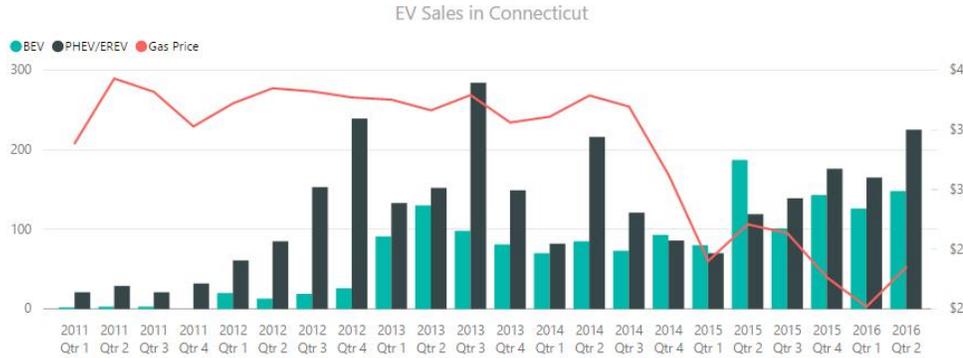


# Near-Term Market Feasibility

Vehicle Type	Alternative Fuel	Key Factors
Passenger Vehicle	Electricity	<ul style="list-style-type: none"><li>• ZEV Program participation</li><li>• Vehicle incentives</li><li>• Available charging infrastructure</li></ul>
Medium- and Heavy-duty Vehicles	Renewable Diesel	<ul style="list-style-type: none"><li>• Drop-in fuel</li><li>• Cost effective compared to diesel</li><li>• Limited supply</li></ul>

# EV Market in Connecticut

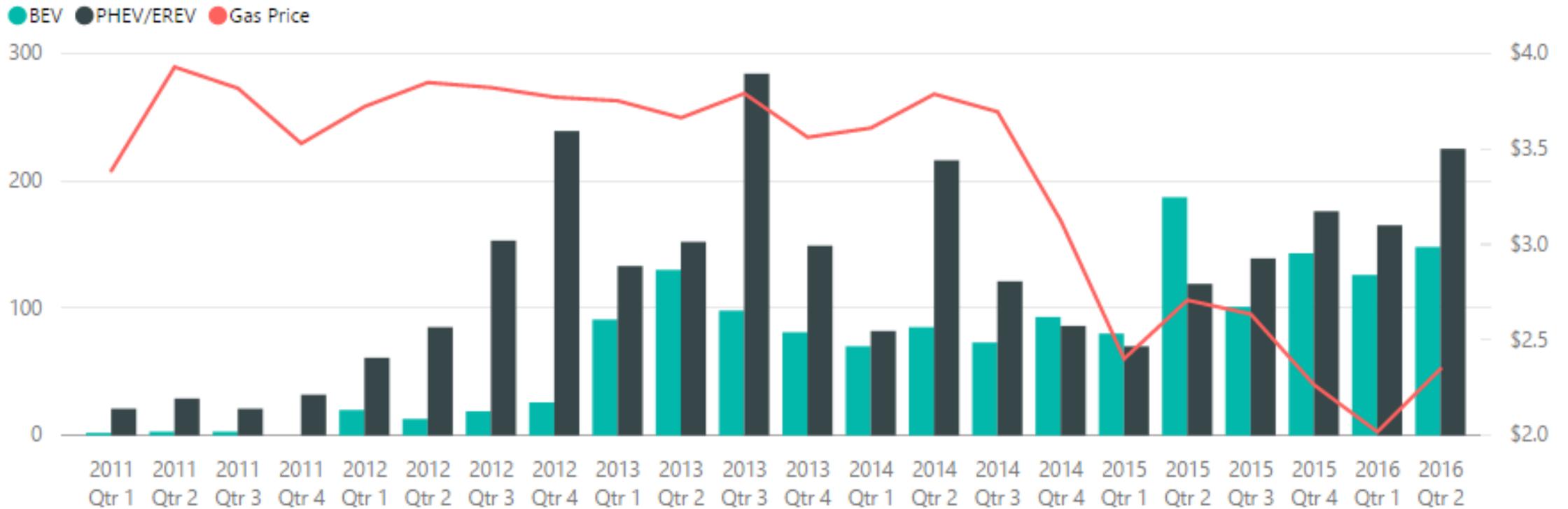
- EV sales resilient in period of low gas prices
- Vehicles concentrated in southwest of state but deployment throughout
- DC fast charging infrastructure not widespread





# EV Market in Connecticut

EV Sales in Connecticut

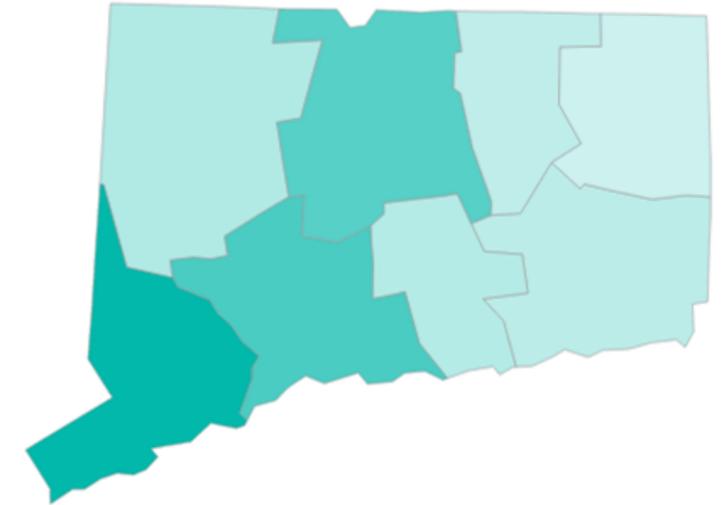




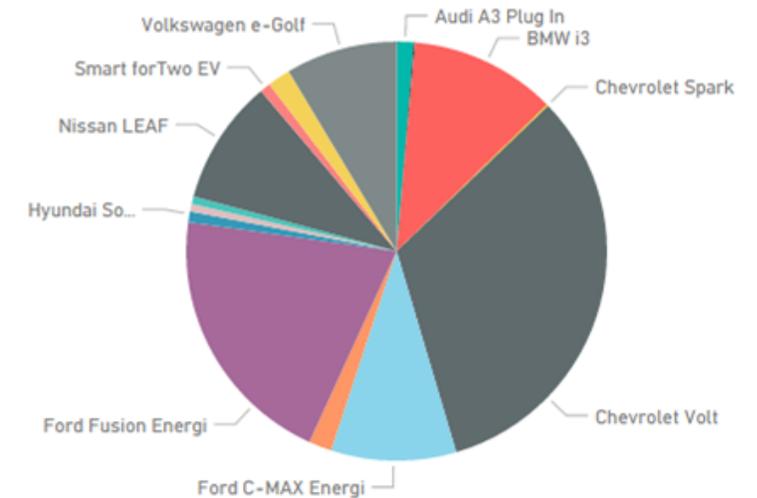
# EV Market in Connecticut

- Program began issuing rebates in May of 2015
- Provided about \$2m towards EV purchases so far
- 568 PHEVs and 284 BEVs
- 15 vehicles, mostly small and mid-size vehicles

CHEAPR Rebates by County



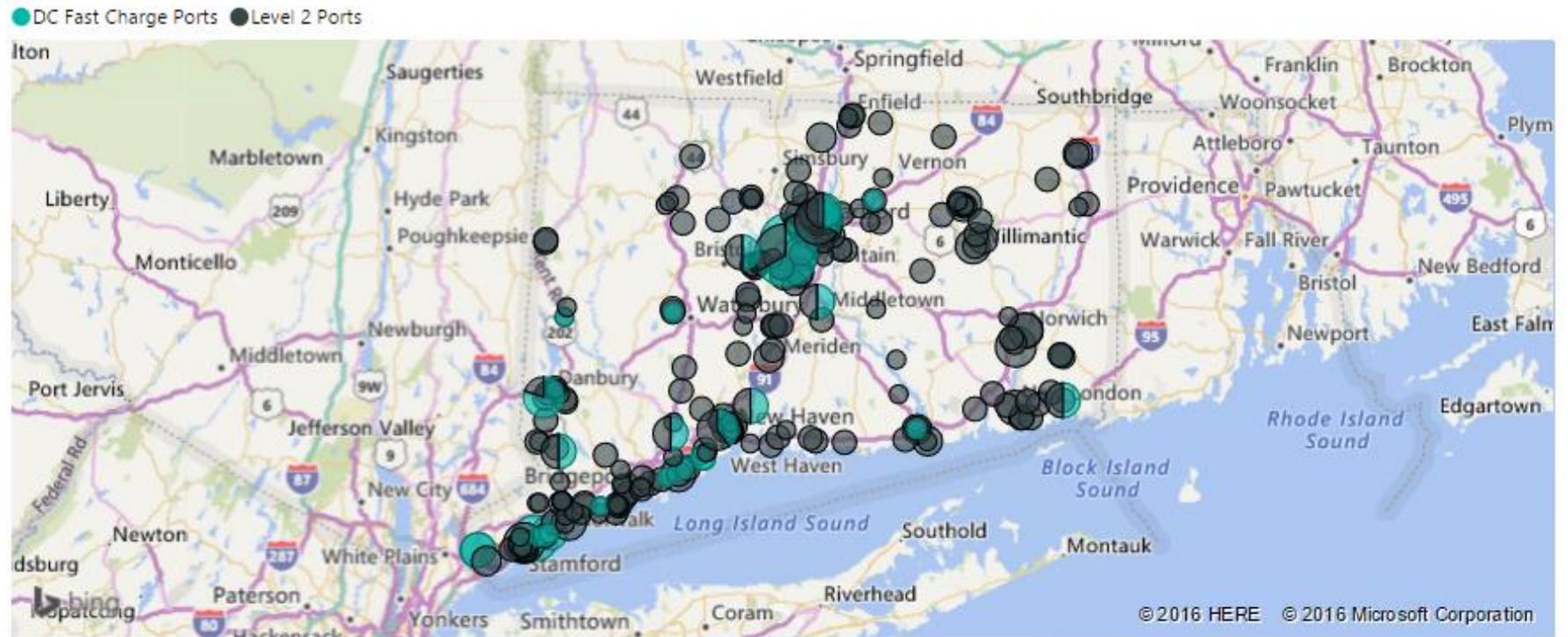
CHEAPR Rebates by Vehicle



# EV Market in Connecticut

- 42 DC fast charging locations
- Many areas inaccessible for BEV drivers relying on DC fast charging

Charging Locations



# Expected Near-Term Availability in CT

Vehicle Class	Vehicle Type	Biogas or Landfill Gas to RNG	Biodiesel (B100) or E85	Renewable Diesel	Electricity	Propane	CNG	LNG	Hydrogen (Gaseous)
Light-Duty	Passenger Cars	Red	Green	Green	Green	Red	Red	Red	Yellow
	Light Trucks	Yellow	Green	Green	Yellow	Yellow	Yellow	Red	Red
Medium- & Heavy-Duty	Beverage, Dump, Tow, Utility, Refrigerated Van	Green	Green	Green	Red	Green	Green	Yellow	Red
	Box Van, School Bus, Step Van	Green	Green	Green	Yellow	Green	Green	Yellow	Red
	Concrete Mixer, Trash	Green	Green	Green	Red	Green	Green	Green	Red
	Tractor Trailer	Green	Green	Green	Yellow	Green	Green	Green	Red
	Transit Bus	Green	Green	Green	Yellow	Green	Green	Yellow	Red

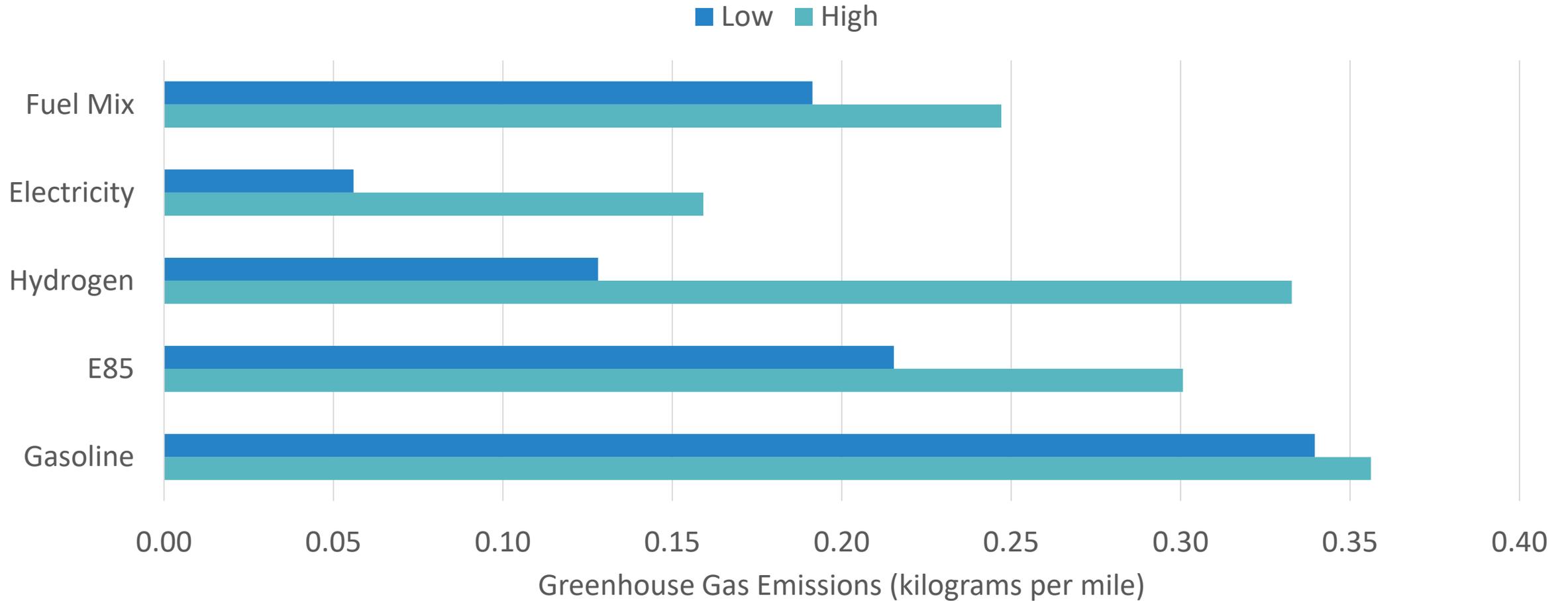
*Green = widely available. Orange = limited availability/demonstrations only. Red = no availability.*

# Environmental Performance

Vehicle Type	Alternative Fuel	Key Factors
<b>Passenger Vehicle</b>	Electricity, Hydrogen	<ul style="list-style-type: none"><li>● Greatest emission reduction potential</li><li>● Requires low-carbon feedstocks</li></ul>
<b>Medium- and Heavy-duty Vehicles</b>	RNG from landfills and dairy farms	<ul style="list-style-type: none"><li>● Greatest emission reduction potential</li><li>● Displaces emissions</li></ul>



# Environmental Performance of Passenger Vehicles

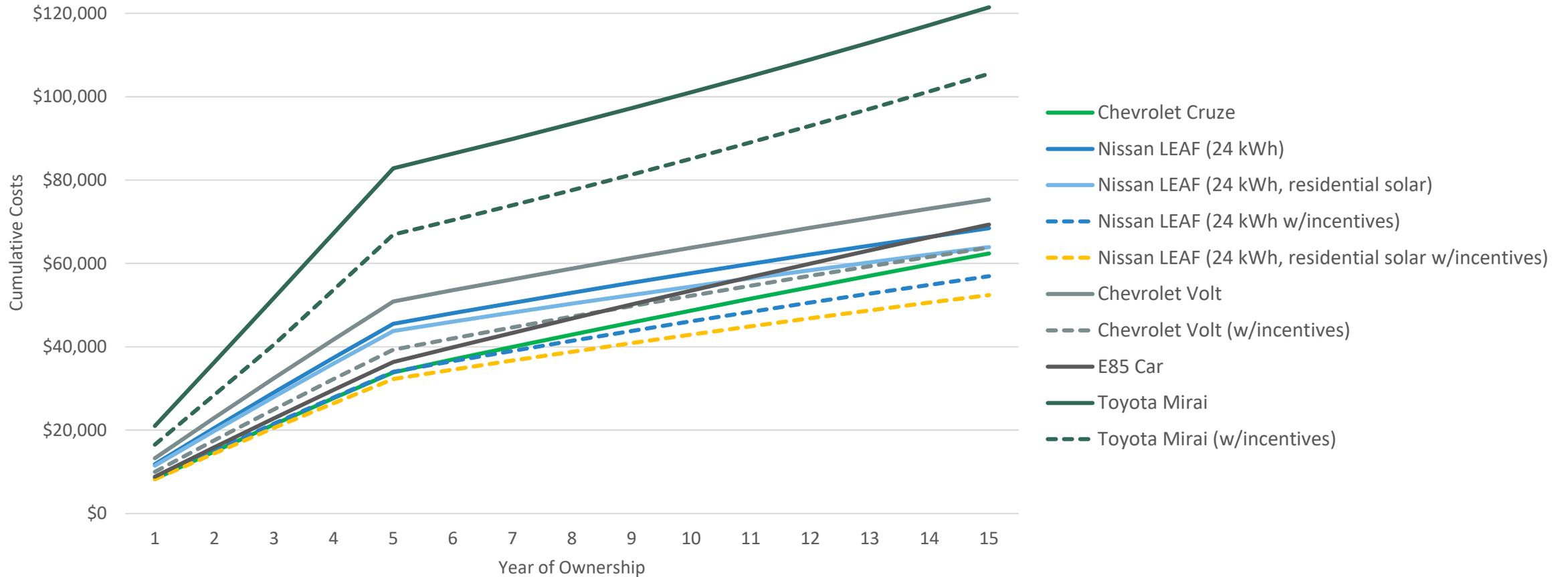


# Cost Effectiveness

Vehicle Type	Alternative Fuel	Key Factors
<b>Passenger Vehicle</b>	Electricity	<ul style="list-style-type: none"> <li>• All-electric vehicles have lower abatement costs than social cost of carbon without vehicle incentives and with solar incentives</li> <li>• Residential solar is least cost option with incentives</li> </ul>
<b>Delivery Trucks, Tractor-Trailers</b>	Electricity (delivery trucks), Biodiesel (delivery trucks, tractor trailers)	<ul style="list-style-type: none"> <li>• Electric delivery trucks cost less than diesel trucks</li> <li>• Biodiesel trucks have lower abatement costs than social cost of carbon</li> </ul>

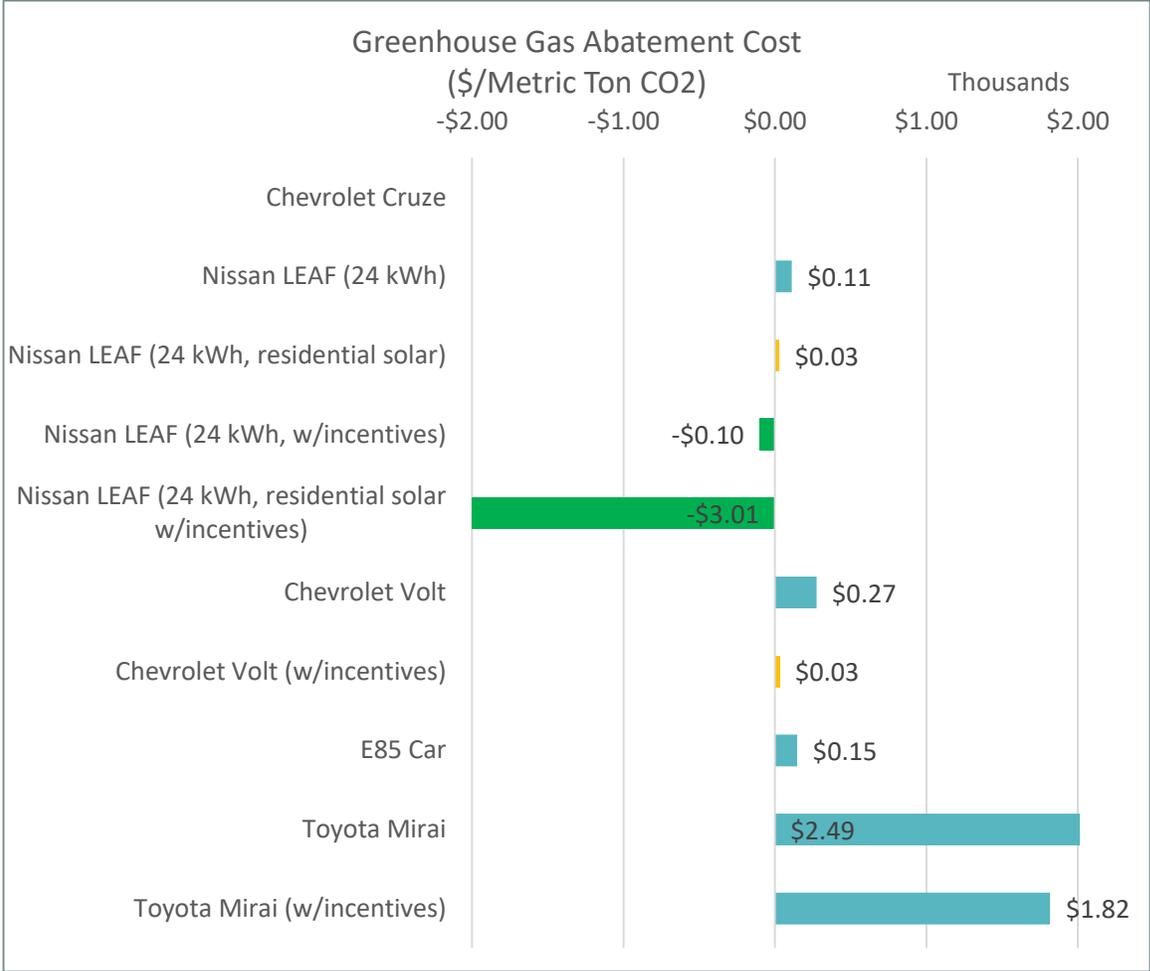
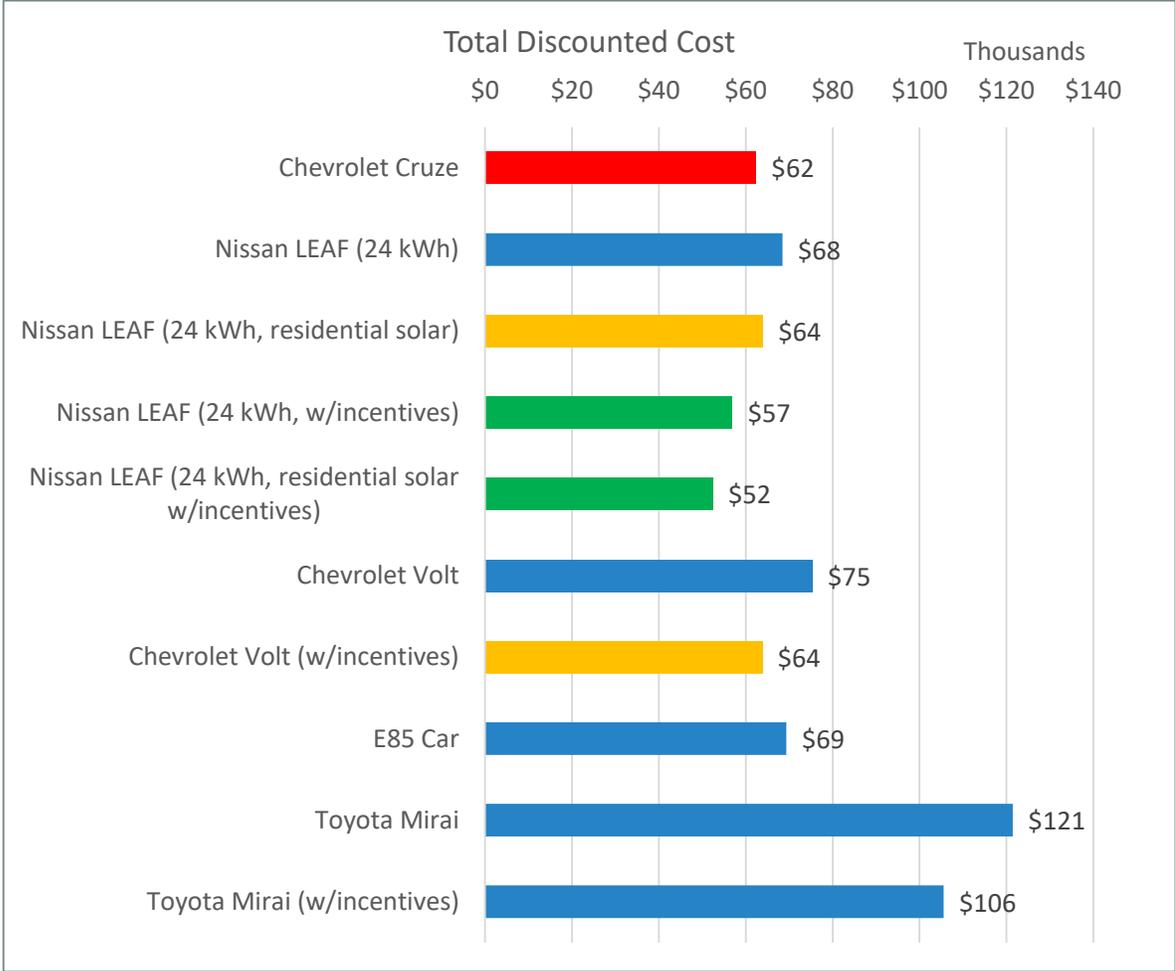


# Discounted Lifetime Cost of Passenger Vehicles





# Passenger Vehicle Discounted Lifetime Cost and Abatement Cost





# Local Economic Impact

Vehicle Type	Alternative Fuel	Key Factors
Passenger Vehicle	Electricity	<ul style="list-style-type: none"> <li>• Sizable power generation capacity keep transportation spending in state's economy</li> <li>• Federal funds exist to support plug-in electric vehicles and charging infrastructure</li> <li>• Electric vehicles can achieve a net costs savings over gasoline vehicles</li> </ul>
Medium- and Heavy-duty Vehicles	Biodiesel trucks	<ul style="list-style-type: none"> <li>• Existing capacity to produce biodiesel and federal tax credit make it best option</li> <li>• CNG could be attractive if oil prices recover to levels seen before summer of 2014</li> <li>• Large portion of commercially-generated waste cooking oil is currently being used for transportation fuel (biodiesel) or heating oil.</li> <li>• Potential to use residentially-generated waste cooking oil for biodiesel.</li> </ul>



# Expected Effects from Increased Discretionary Funds

Vehicle	Alternative Fuel	State Economic Impact from Cost Savings
Passenger Car	Electricity	<b>Positive</b>
Medium-Duty Delivery Truck	Electricity	<b>Positive</b>
Medium-Duty Delivery Truck	Biodiesel (B100)	<b>Neutral</b>
Heavy-Duty Tractor Trailer	Biodiesel (B100)	<b>Neutral</b>
Passenger Car	E85	<b>Negative</b>
Passenger Car	Hydrogen	<b>Negative</b>
Medium-Duty Delivery Truck	CNG	<b>Negative</b>
Heavy-Duty Tractor Trailer	Electricity	<b>Negative</b>
Heavy-Duty Tractor Trailer	CNG	<b>Negative</b>

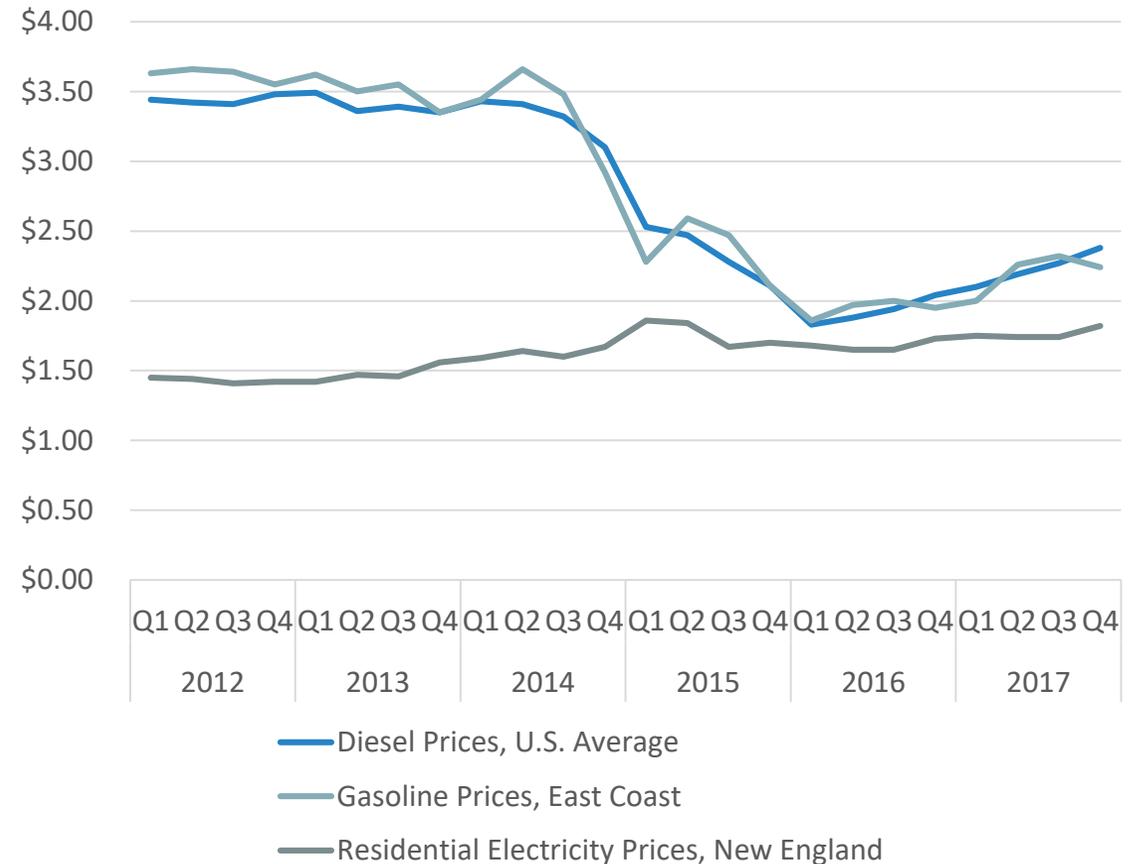


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Near-Term Forecast of Fuel Prices





# Next steps for Green Bank

- Attempt to mirror success of other programs
  - Significant growth in cleantech deployment leading to decreased public investment
- Identified four promising concepts
  - The pairing of electric vehicles and residential solar photovoltaic systems
  - Electric shared-use mobility solutions
  - Advanced publicly available EV charging infrastructure
  - Electrification of the transit fleet



# Transportation Electrification Toolkit

Concept Summaries Objective, Target Locations, Deployment Barriers, Resource Library

## Key Enabling Technologies and Business Models

Barriers addressed

Role of the CTGB, other public agencies, and the private sector

Metrics for program evaluation

## Case Studies from Outside Connecticut

Summary

Target market

Strategy to address barriers

Role of government & private capital

Expected or actual results

## Connecticut Community Spotlight

Monthly blog-style short stories

Highlight transportation electrification opportunities in Connecticut communities

Use data dashboards to educate audience



Nick Nigro

[nick.nigro@atlaspolicy.com](mailto:nick.nigro@atlaspolicy.com)