

Pollution Prevention Partnership

Reducing ground level ozone in Nueces and San Patricio counties since 1995



**RESEARCH
ENGAGEMENT**



Why Care About Air Pollution?



Major Toxic Pollutants in Vehicle Exhaust:

VOC— Volatile Organic Compounds, ingredients for **ozone**
Unburned Fuels in Exhaust, Evaporated Fuels and Solvents

NO_x—Oxides of Nitrogen, ingredient for **ozone**

PM—Particulate Matter, lodges in the lungs

CO—Carbon Monoxide, a colorless, odorless, poisonous gas

HCHO—Formaldehyde, a lung irritant and carcinogen

Some Economic Costs of EPA Non-Attainment

(Ozone averages >70 ppb Oct. 2015)

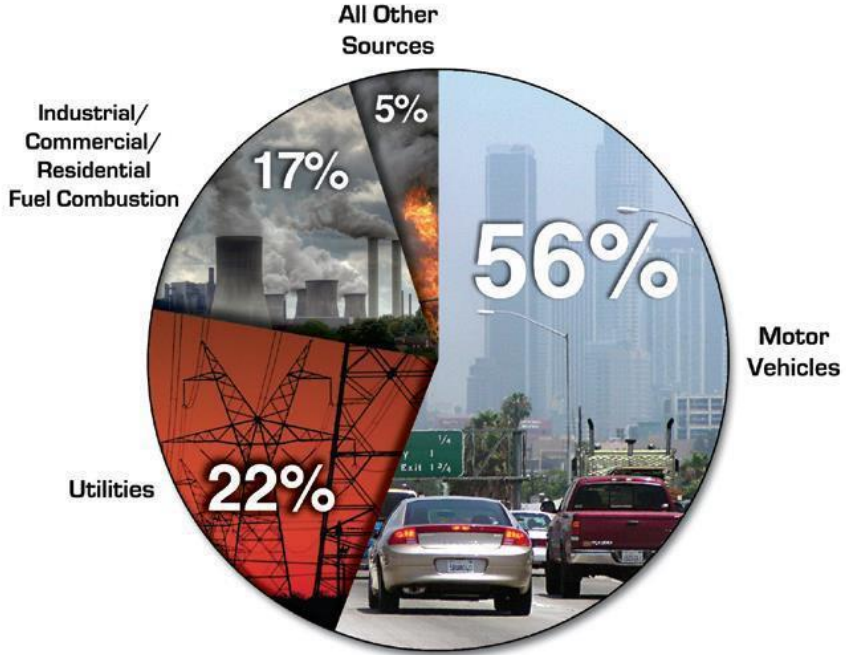
Possible loss of industry and economic development

Possible loss of federal highway and transit funding

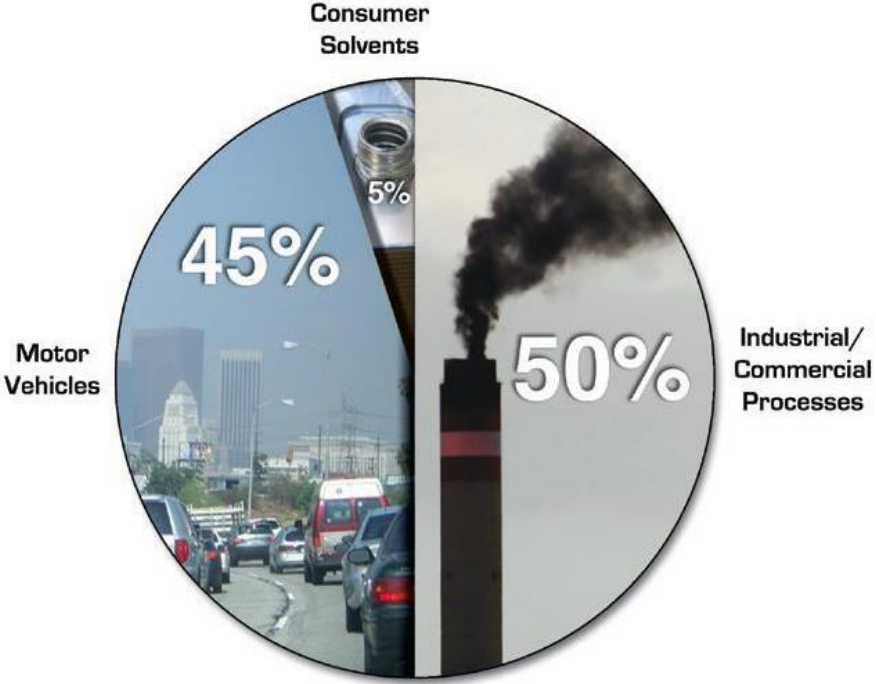
Restrictive permitting requirements not applied in attainment areas

Technical and Formula Changes for product manufacturing

Sources of Primary Pollutants



Sources of Anthropogenic NOx



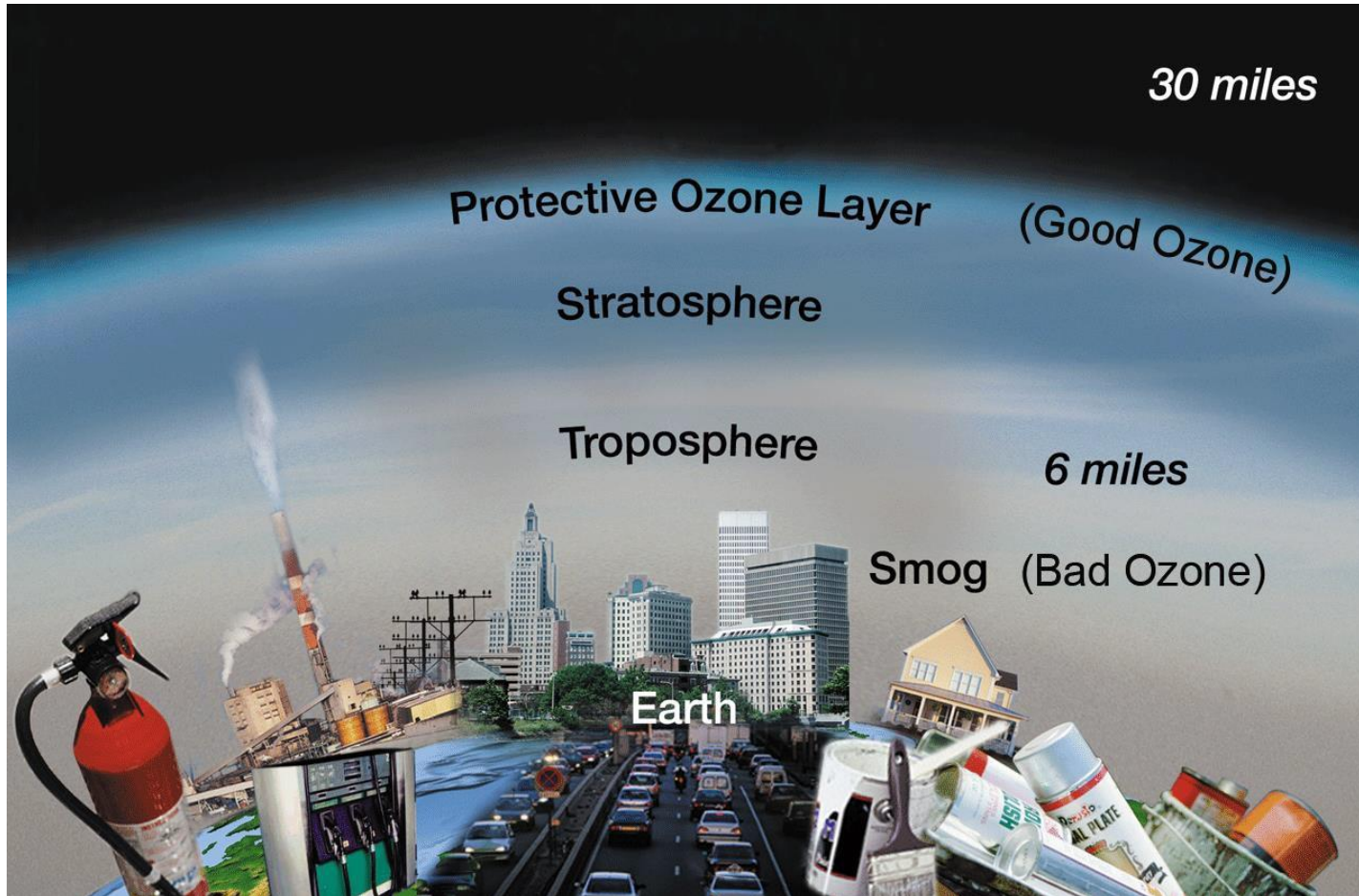
Sources of Anthropogenic VOC



<http://www.epa.gov> From EPA brochure OZONE

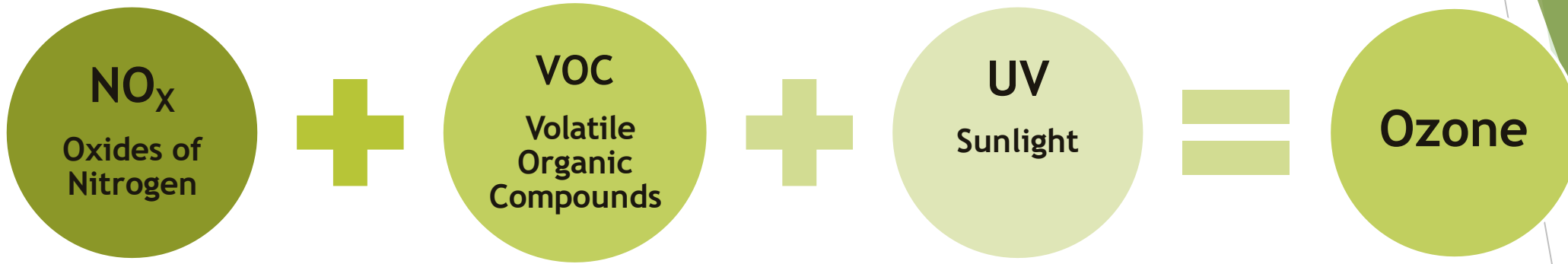
Focus on Ozone

Ozone Good Up High



Ozone Bad Nearby

Ground Level Ozone Formation



**Corpus Christi Region Ozone Season:
April 1 to October 31**

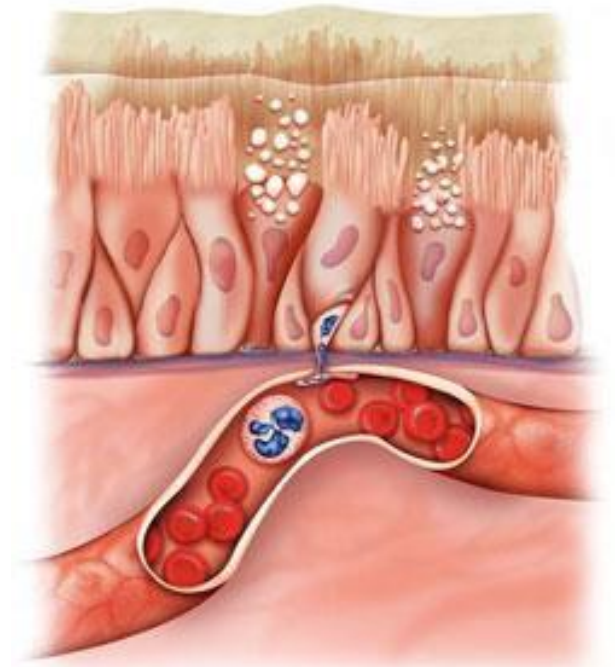
VOC's - Unburned Fuels in Exhaust, Evaporated Fuels, Solvents and

Health Effects

- ❖ Difficulty breathing deeply and vigorously
- ❖ Shortness of breath and pain when taking deep breaths
- ❖ Coughing and sore or scratchy throat
- ❖ Inflammation and damaged airways
- ❖ Aggravated lung diseases: asthma, emphysema, and chronic bronchitis.
- ❖ Increased the frequency of asthma attacks.
- ❖ Lungs more susceptible to infection.
- ❖ Continued lung damage even when the symptoms have disappeared.

Most at Risk

- ❖ Children
- ❖ Adults who are active outdoors.
- ❖ People with respiratory diseases, such as asthma
- ❖ People with unusual susceptibility to ozone



With airway inflammation, there is an influx of white blood cells, increased mucous production, and fluid accumulation and retention. This causes the death and shedding of cells that line the airways and has been compared to the skin caused by sunburn.



<http://www3.epa.gov/ozonepollution/health.html>

The Fix

Reduce Emissions!

**AUTO
CHECK**

Find and Fix
Gross
Polluters

- ✓ Check
- ✓ Fix
- ✓ Maintain

Reduce
Normal
Emissions

- ✓ Alternative Fuels
- ✓ Emission Controls
- ✓ High MPG Vehicles

Change
Habits

- ✓ Ozone Actions
- ✓ Cycling, walking
- ✓ Mass transit
- ✓ Carpool
- ✓ Combine trips

Alternative Fuels: Moving Forward

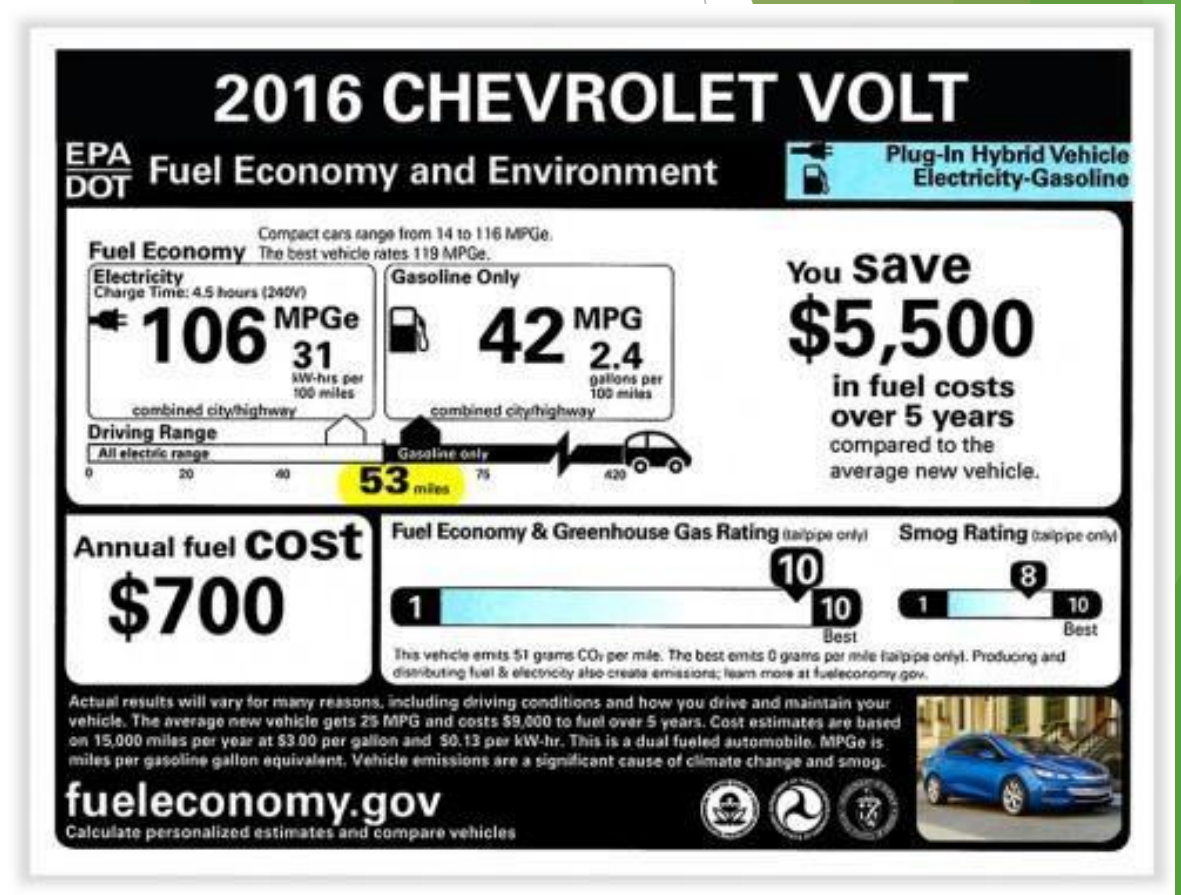
Choosing a Fuel Technology for Health, Ecology and Economy

Common Alternative Fuel Vehicles (AFV)

- ▶ CNG- Compressed Natural Gas
- ▶ E85- 85% ethanol and 15% gasoline
- ▶ LPG- Propane
- ▶ HEV-Gasoline Hybrid Electric Vehicle
- ▶ PHEV- Gasoline Plug-in Hybrid Electric Vehicle
- ▶ EREV- Gasoline Extended Range Electric Vehicle
- ▶ EV- All Electric Vehicle



2016 Chevrolet VOLT - electric vehicle with gasoline powered range-extending capability (EREV).



<https://www.fueleconomy.gov/feg/Find.do?action=sbs&id=34918>

Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. Enter a state to see a station count.

Find Stations | Plan a Route

address, ZIP, or state... **Go**

All Fuels **▼**

[more search options](#)

17,861
alternative fuel stations
in the United States

Excluding private stations

[ABOUT THE DATA](#)

Location details are subject to change. We recommend calling the stations to verify location, hours of operation, and access.

Map data ©2015 Google [Terms of Use](#)

Legend

- Biodiesel
- CNG
- Electric
- Ethanol
- Hydrogen
- LNG
- Propane

[Go to mobile version](#)
[Download iPhone app](#)

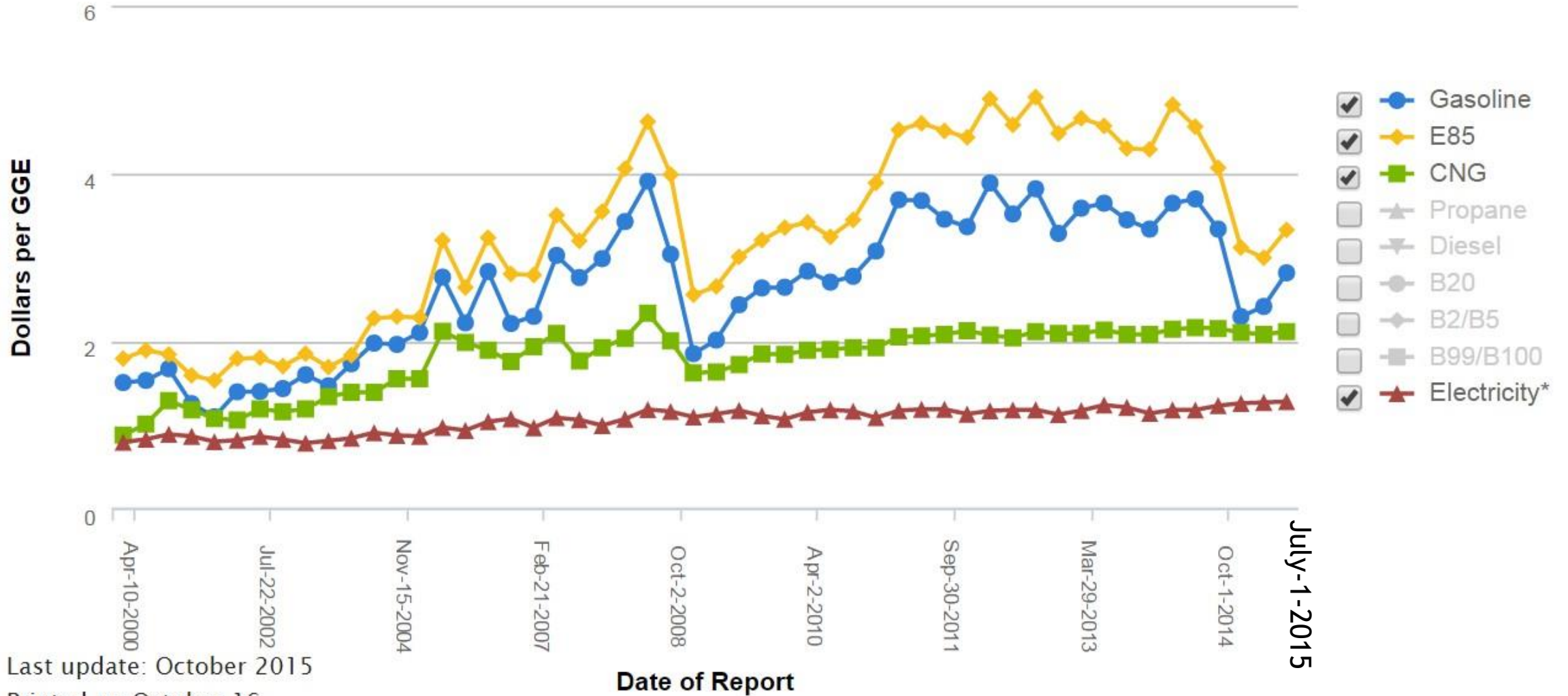
[Download Data](#) | [Developer APIs](#)

Data last updated: 09/16/2015



<http://www.afdc.energy.gov/locator/stations/>

Average Retail Fuel Prices in the U.S.



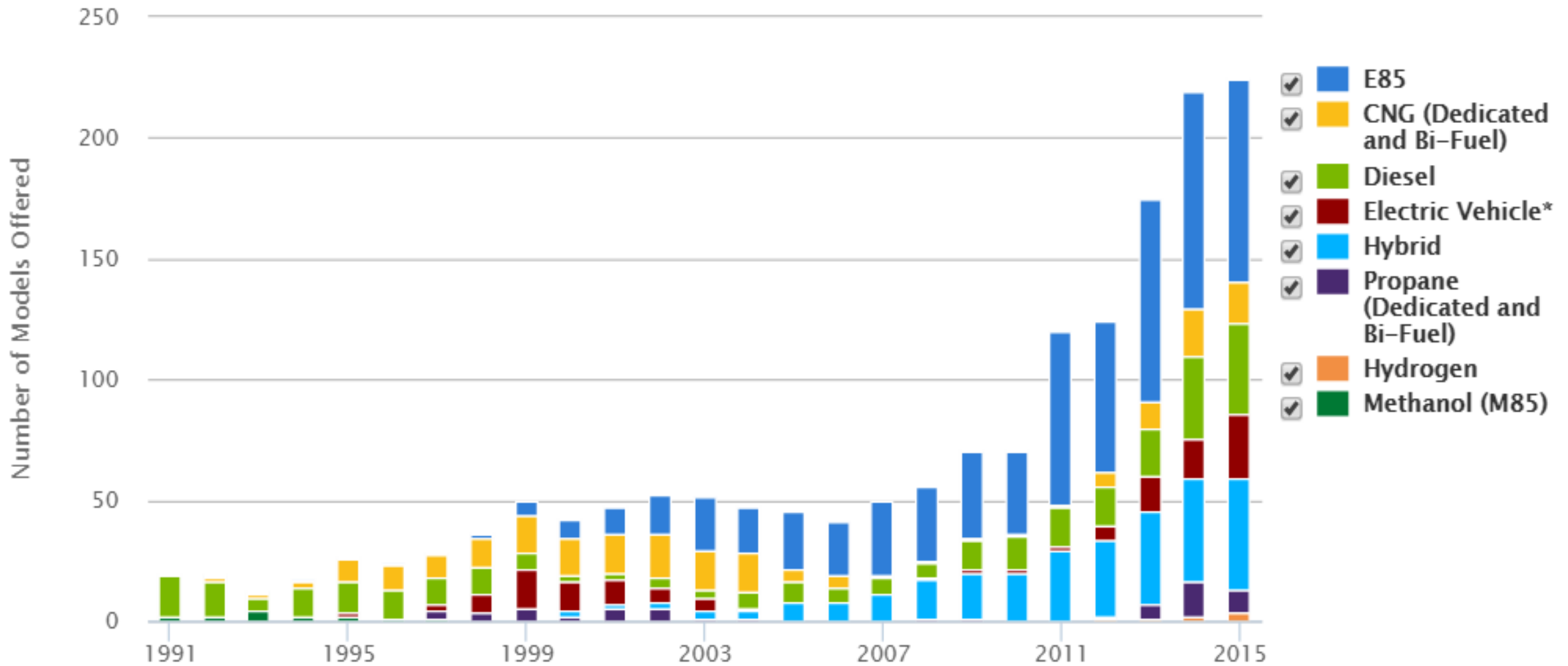
Last update: October 2015

Printed on October 16



<http://www.afdc.energy.gov/fuels/prices.html>

Light-Duty AFV, HEV, and Diesel Model Offerings, By Fuel Type



Last updated: July 2014

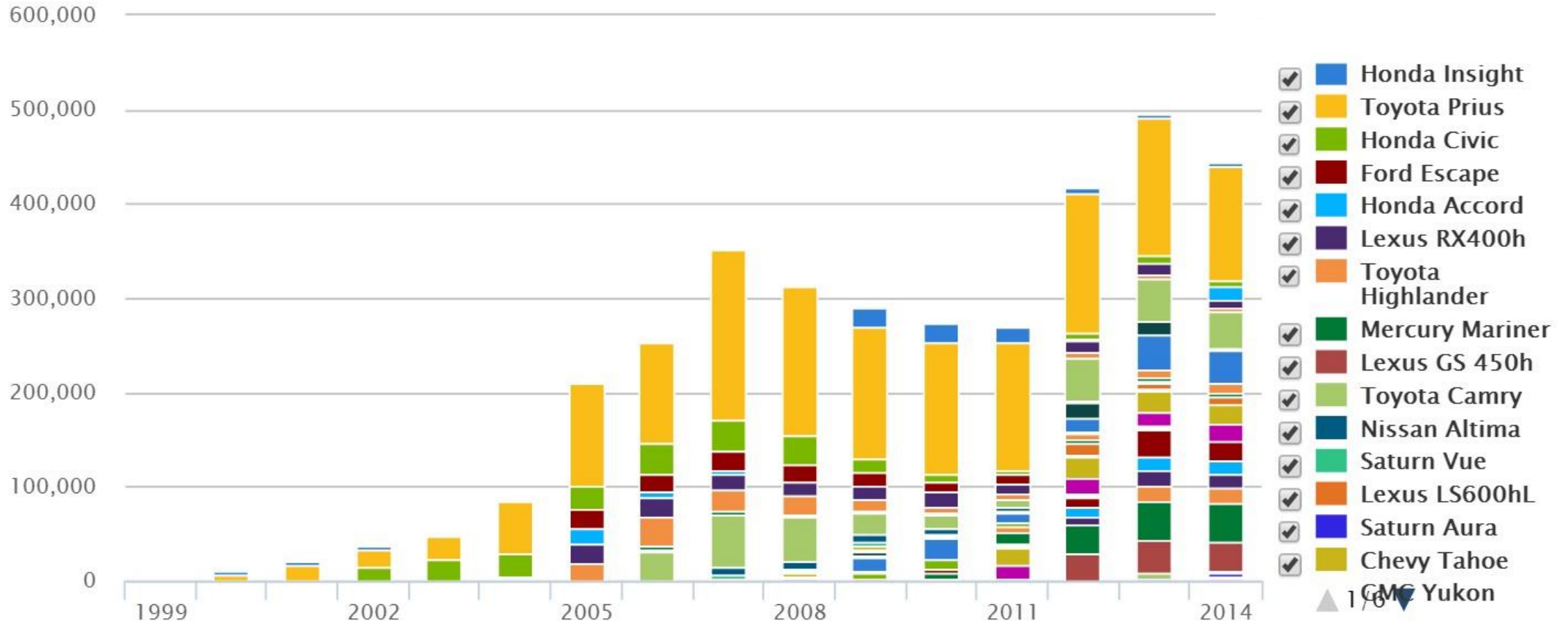
Printed on: October 15



<http://afdc.energy.gov/data/10303>

U.S. HEV Sales by Model

[Download](#)



Last updated: May 2015
 Printed on: October 15

Source: HybridCars.com

Notes: Vehicles are listed in order of introduction into the market.



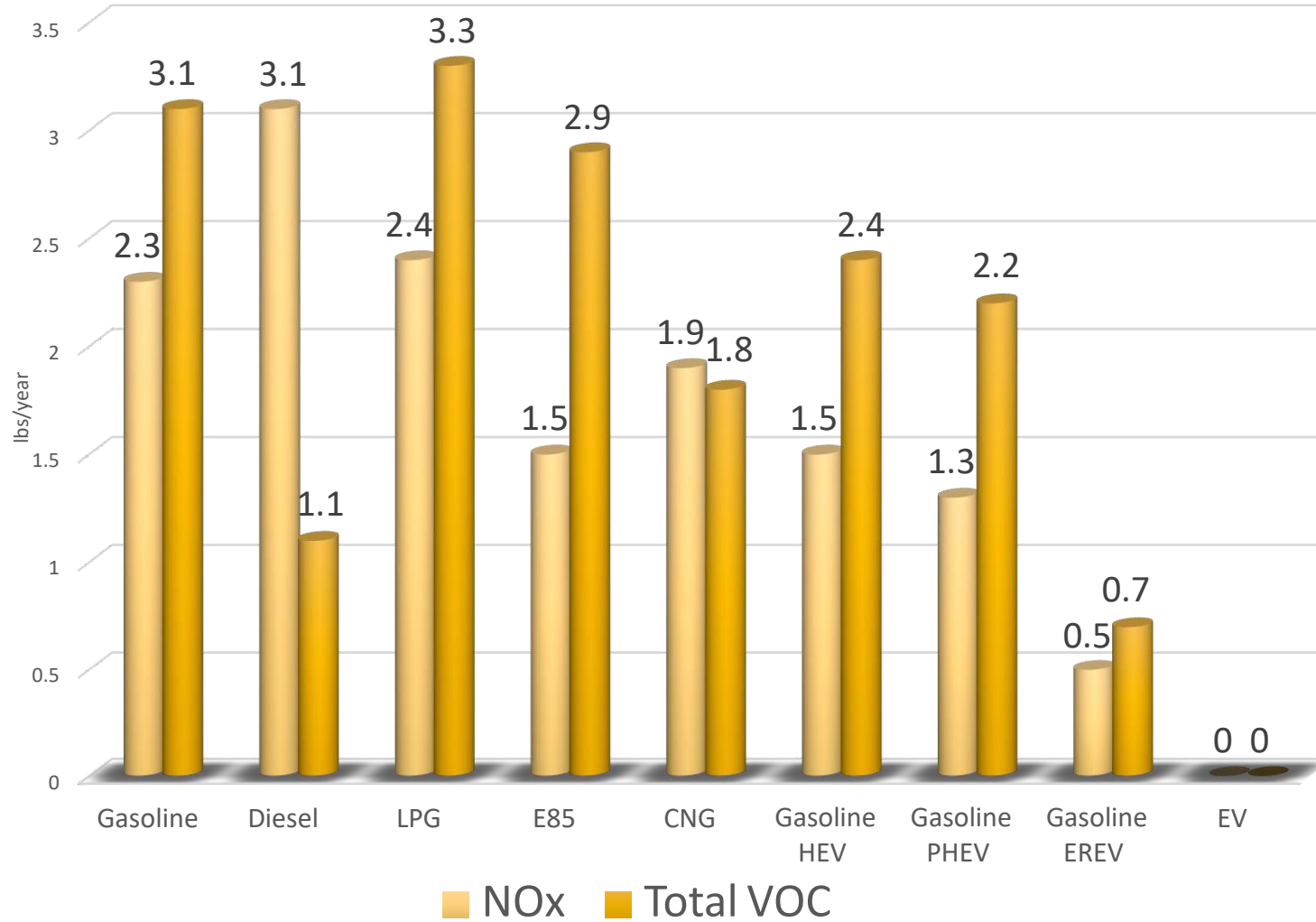
<http://afdc.energy.gov/data/10301>

Emissions Charts

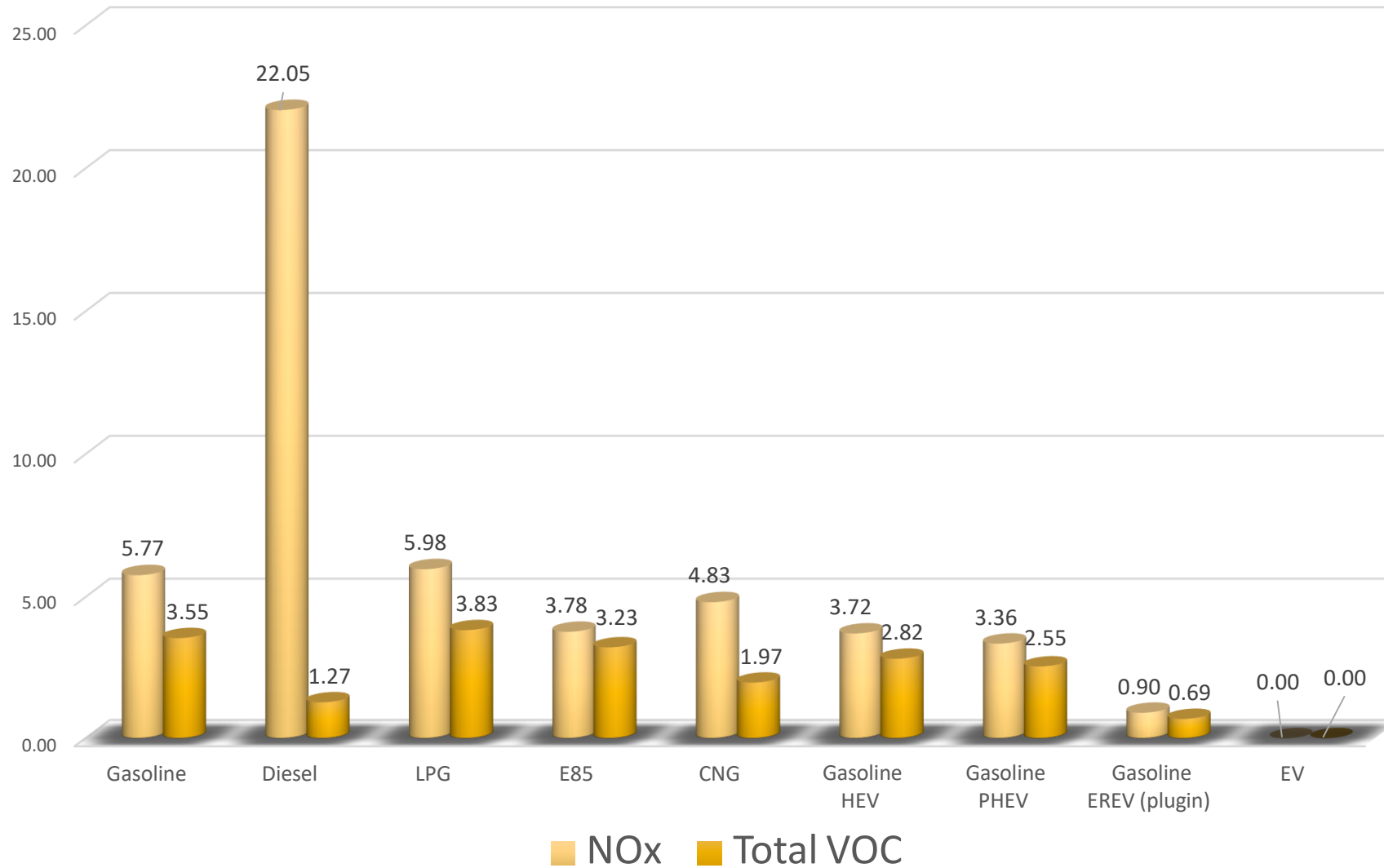
POLLUTION COMPARISON BY FUEL TECHNOLOGY



Annual Pounds of NO_x & Total VOC 1 Passenger Car



Annual Pounds of NO_x & Total VOC 1 Passenger Truck



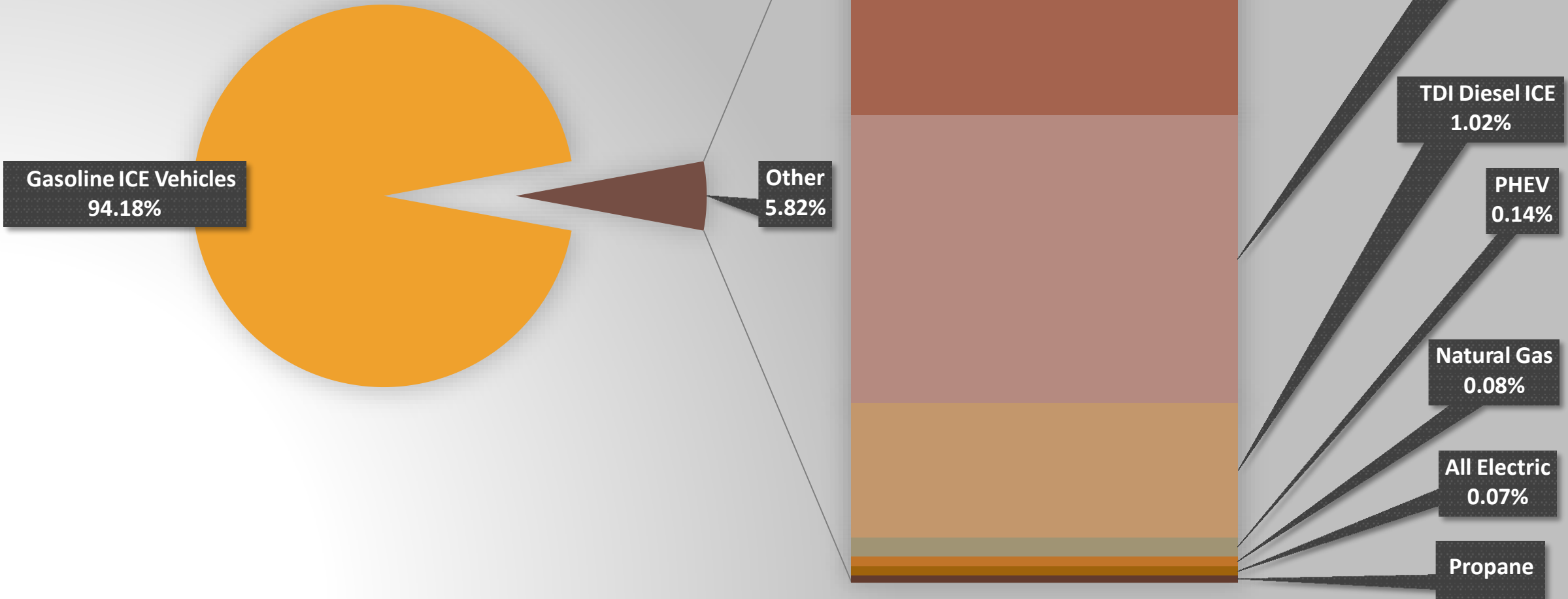
Local Vehicle Stock

NUECES AND SAN PATRICIO COUNTIES (CY 2014)



Passenger Cars by Fuel Type

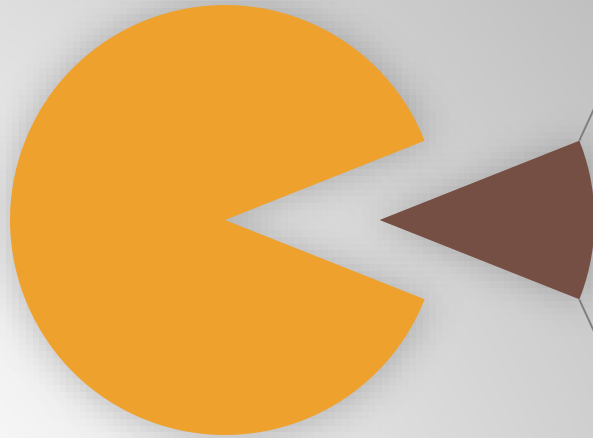
Total count 186,477



Passenger Trucks/SUV by Fuel Type

Total count 98,479

Gasoline ICE Vehicles
87.98%



Other
12.02%



Ethanol-Flex Fuel ICE
10.63%

Propane
0.50%

Gasoline(HEV)
0.43%

TDI Diesel
0.23%

Natural Gas
0.21%

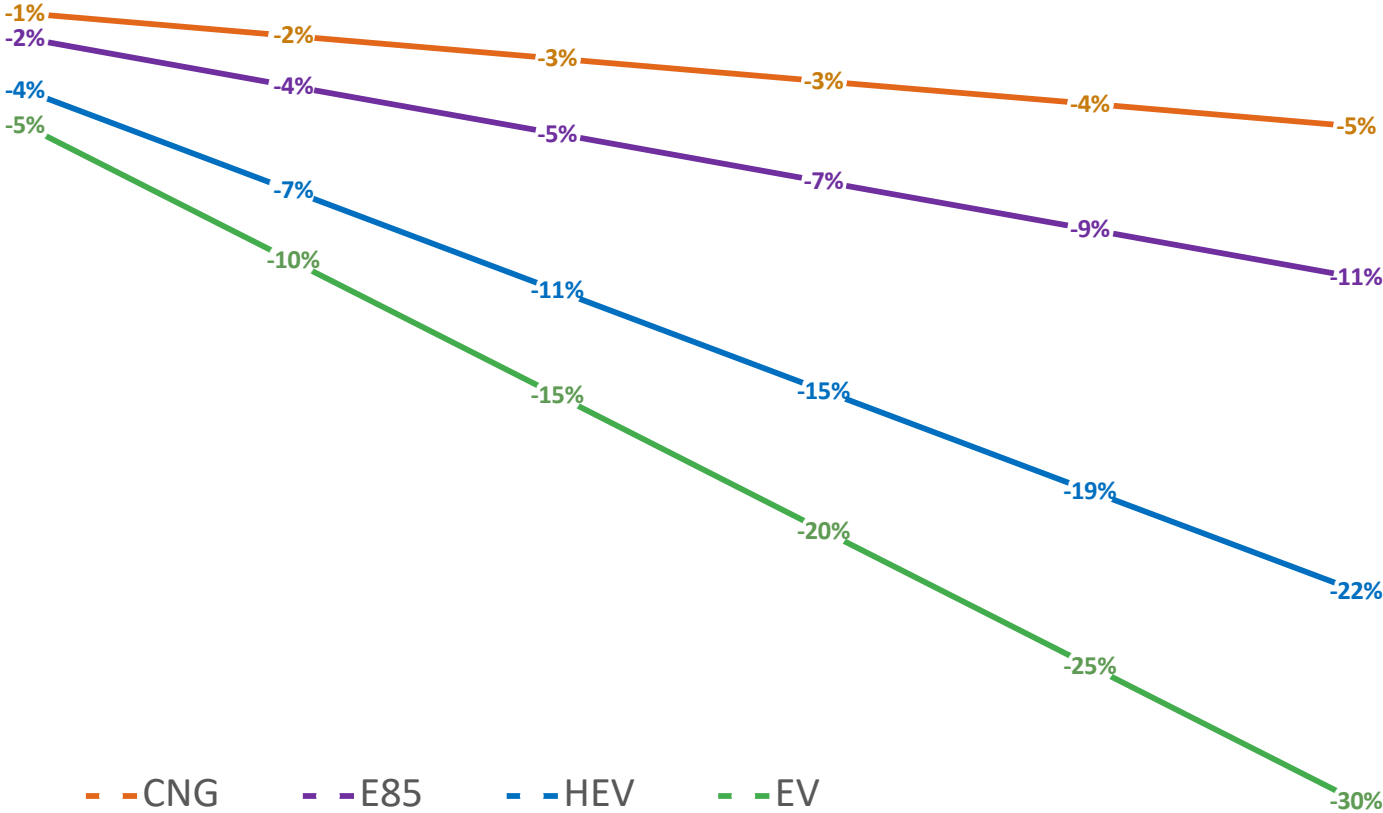
All Electric
0.01%

PHEV
0.00%

% Change from Conventional Fuel Passenger Vehicles to Alternative Fuel: NO_x Reductions

NO_x Emissions

% of Gasoline Vehicles Replaced with AFV
5% Change 10% Change 15% Change 20% Change 25% Change 30% Change



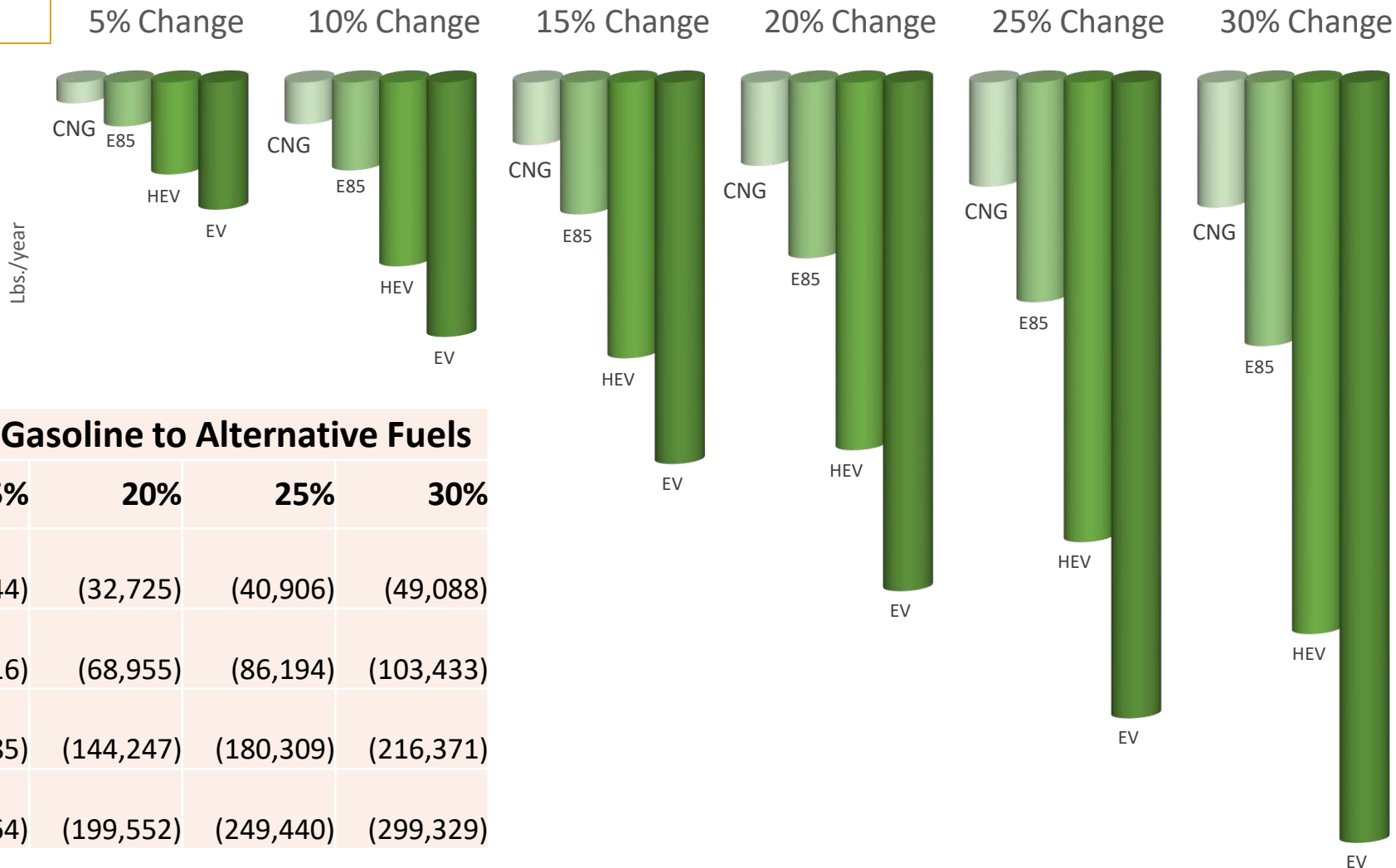
Total Annual Pounds of NO_x Emissions

All passenger cars and trucks
San Patricio and Nueces Counties

973,676

Possible Annual Pounds of NO_x Reduced With % Change from Gasoline to Alternative Fuels

■ CNG ■ E85 ■ HEV ■ EV

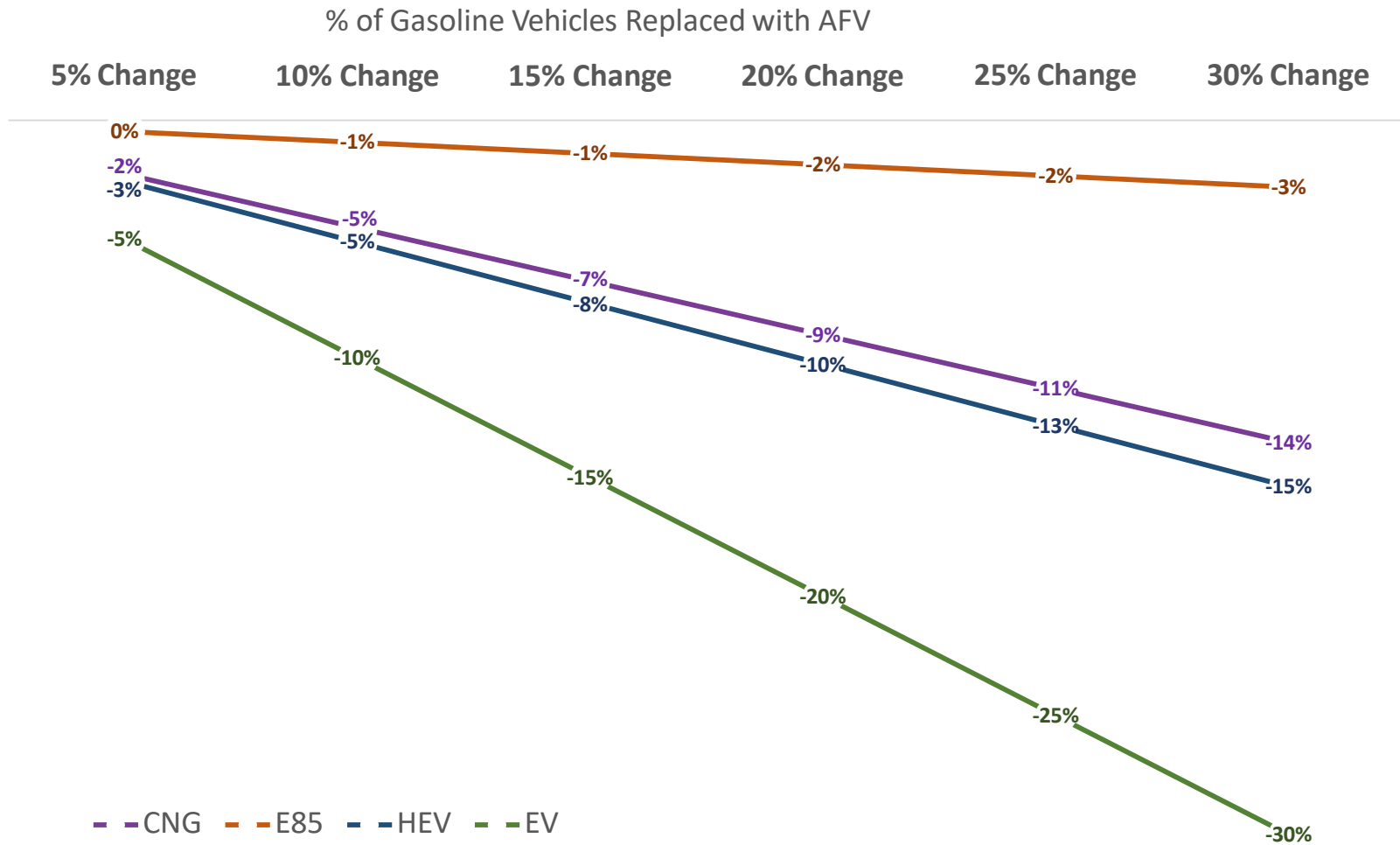


NO_x Reductions with % Change form Gasoline to Alternative Fuels

Fuel Tech	5%	10%	15%	20%	25%	30%
CNG	(8,181)	(16,363)	(24,544)	(32,725)	(40,906)	(49,088)
E85	(17,239)	(34,478)	(51,716)	(68,955)	(86,194)	(103,433)
HEV	(36,062)	(72,124)	(108,185)	(144,247)	(180,309)	(216,371)
EV	(49,888)	(99,776)	(149,664)	(199,552)	(249,440)	(299,329)

% Change from Conventional Fuel Passenger Vehicles to Alternative Fuels VOC Reductions

VOC Emissions



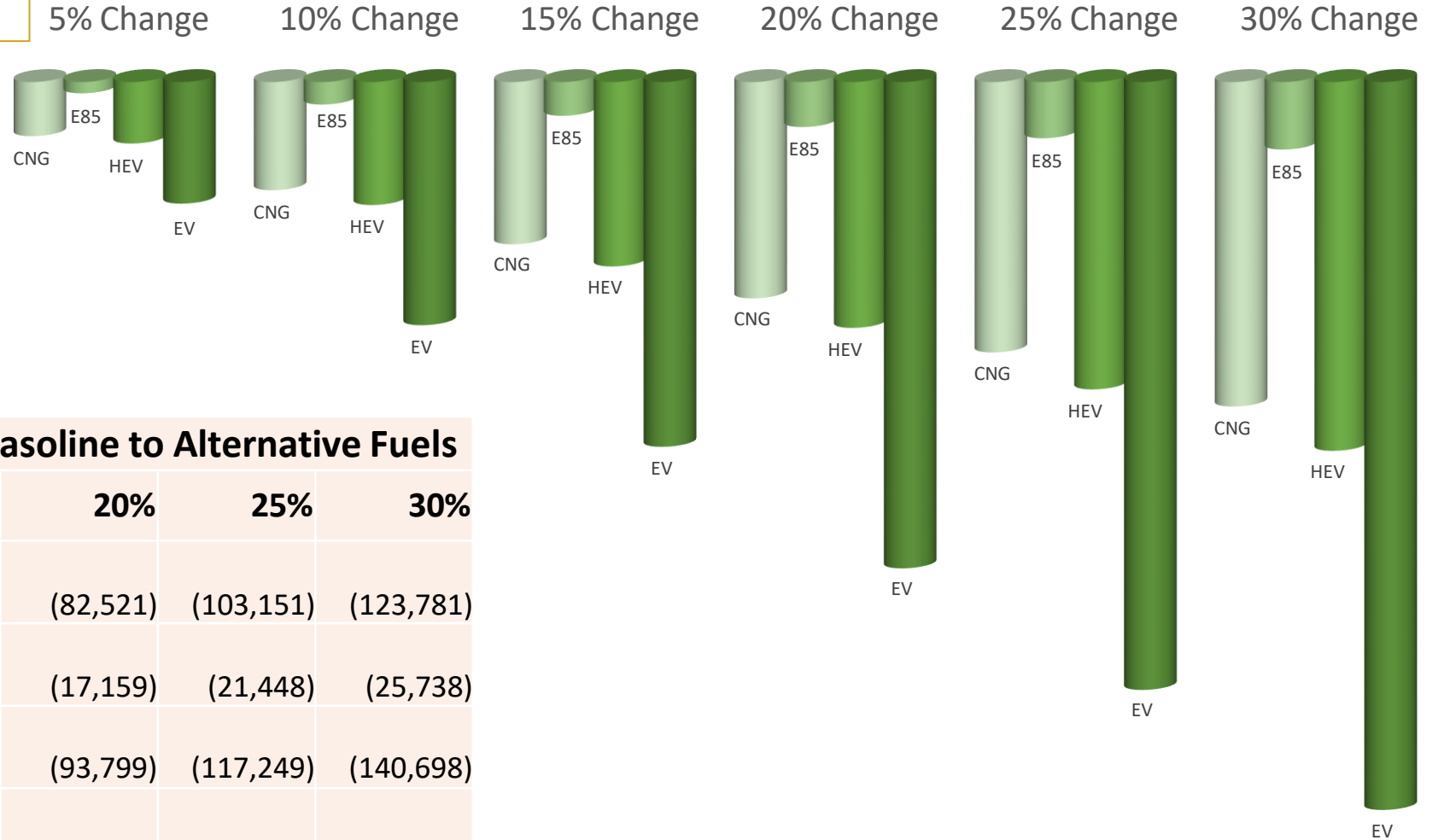
Total Annual Pounds of VOC Emissions

All passenger cars and trucks
San Patricio and Nueces Counties

914,562

Possible Annual Pounds of VOC Reduced With % Change from Gasoline to Alternative Fuels

■ CNG ■ E85 ■ HEV ■ EV



VOC Reductions with % Change form Gasoline to Alternative Fuels

Fuel Tech	5%	10%	15%	20%	25%	30%
CNG	(20,630)	(41,260)	(61,890)	(82,521)	(103,151)	(123,781)
E85	(4,290)	(8,579)	(12,869)	(17,159)	(21,448)	(25,738)
HEV	(23,450)	(46,899)	(70,349)	(93,799)	(117,249)	(140,698)
EV	(46,382)	(92,764)	(139,146)	(185,529)	(231,911)	(278,293)

(

VW Offending Vehicles

✦ Cars registered locally (.1% of local cars) → **313**

✦ NO_x released above certified → **10X to 40X**

✦ Exhaust equivalent of adding cars → **2,817 to 12,207**

✦ % of NO_x from offending cars → **2-7 % of NO_x from cars**

AFLEET Tool - Argonne National Laboratory

AFLEET_Tool_2013Learning Workbook TAT.xlsx - Excel

LDV_type: Passenger Truck

1 Key Inputs

2 Primary Vehicle Location

3 State: TEXAS

4 Light-Duty Vehicle Information

5 Vehicle Type: Passenger Truck

Light-Duty Fuel Type	Number of Light-Duty Vehicles	Annual Vehicle Mileage	Fuel Economy (MPGGE)	Purchase Price (\$/Vehicle)	Default Mileage	Default MPGGE	Default Purchase Price
Gasoline	1	11,400	17.7	\$24,500	11,400	17.7	\$24,500
Diesel	1	11,400	21.2	\$32,000	11,400	21.2	\$32,000
Gasoline Hybrid Electric Vehicle (HEV)	1	11,400	23.0	\$42,000	11,400	23.0	\$42,000
Gasoline Plug-in Hybrid Electric Vehicle	1	11,400	24.4	\$0	11,400	24.4	\$0
Gasoline Extended Range Electric Vehicle	1	11,400	18.1	\$0	11,400	18.1	\$0
All-Electric Vehicle (EV)	1	11,400	60.2	\$0	11,400	60.2	\$0
Biodiesel (B20)	1	11,400	21.2	\$32,000	11,400	21.2	\$32,000
Biodiesel (B100)	1	11,400	21.2	\$32,000	11,400	21.2	\$32,000
Ethanol (E85)	1	11,400	17.7	\$24,500	11,400	17.7	\$24,500
Propane (LPG)	1	11,400	17.7	\$31,000	11,400	17.7	\$31,000
Compressed Natural Gas (CNG)	1	11,400	16.8	\$36,000	11,400	16.8	\$36,000

18 Heavy-Duty Vehicle Information

19 Vehicle Type: Combination Long-Haul

Heavy-Duty Fuel Type	Number of Heavy-Duty Vehicles	Annual Vehicle Mileage	Fuel Economy (MPGGE)	Purchase Price (\$/Vehicle)	Default Mileage	Default MPGGE	Default Purchase Price	User MPGGE
Gasoline	0	0	4.3	\$0	0	4.3	\$0	4.9
Diesel	0	170,000	5.2	\$100,000	170,000	5.2	\$100,000	5.9
All-Electric Vehicle (EV)	0	0	14.7	\$0	0	14.7	\$0	16.7
Diesel Hybrid Electric Vehicle (HEV)	0	170,000	5.5	\$140,000	170,000	5.5	\$140,000	6.3
Diesel Hydraulic Hybrid (HHV)	0	0	5.2	\$0	0	5.2	\$0	5.9
Biodiesel (B20)	0	170,000	5.2	\$100,000	170,000	5.2	\$100,000	5.9
Biodiesel (B100)	0	170,000	5.2	\$100,000	170,000	5.2	\$100,000	5.9
Ethanol (E85)	0	0	4.3	\$0	0	4.3	\$0	4.9
Propane (LPG)	0	0	4.7	\$0	0	4.7	\$0	5.3
Compressed Natural Gas (CNG)	0	170,000	4.7	\$165,000	170,000	4.7	\$165,000	5.3
Liquefied Natural Gas (LNG)	0	170,000	4.7	\$150,000	170,000	4.7	\$150,000	5.3
LNG / Diesel Pilot Ignition	0	170,000	5.2	\$190,000	170,000	5.2	\$190,000	5.9

33 Fuel and DEF Price

Fuel Unit	\$/Fuel Unit	Default GGE	User GGE	User GGE
Gasoline	gasoline gallon \$3.56	\$3.56	\$3.56	\$4.04
Diesel	diesel gallon \$4.11	\$3.56	\$3.56	\$4.04
Electricity	kwh \$0.11	\$3.74	\$3.74	\$4.24
B20	B20 gallon \$4.16	\$3.66	\$3.66	\$4.15
B100	B100 gallon \$4.55	\$4.27	\$4.27	\$4.84
E85	E85 gallon \$3.40	\$4.64	\$4.64	\$5.26
Propane	LPG gallon \$2.91	\$3.84	\$3.84	\$4.36
CNG	CNG GGE \$2.21	\$2.21	\$2.21	\$2.51
LNG	LNG gallon \$1.53	\$2.29	\$2.29	\$2.60
DEF	DEF gallon \$2.80	\$2.80	\$2.80	\$3.18

Instructions | Inputs | Payback | Payback Outputs | TCO | TCO Outputs | Footprint | Footprint Outputs

AFLEET_Tool_2013Learning Workbook TAT.xlsx - Excel






H60: =H5*H6*H8/100*(Background Data!\$C\$881*(1-Background Data!\$C\$896)+Background Data!\$C\$882*Background Data!\$C\$896)*

1 Simple Payback Calculator

	Gasoline	Diesel	Gasoline HEV	Gasoline PHEV	Gasoline EREV	EV	Diesel HEV	Diesel HHV	B20	B100	E85	LPG	CNG	LNG	Diesel Pilot Ignition
21 Number of HDVs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 Annual Mileage	0	170,000	0	0	0	0	170,000	170,000	0	0	170,000	170,000	170,000	170,000	170,000
23 Fuel Economy (MPGGE)	4.3	5.2	14.7	5.5	5.2	14.7	5.5	5.2	5.2	5.2	4.3	4.7	4.7	4.7	5.2
24 Fuel Consumption (GGE/100mi)	23.1	19.2	6.8	18.1	19.2	6.8	18.1	19.2	19.2	19.2	23.1	21.4	21.4	21.4	19.2
25 Fuel Consumption (DGE/100mi)	20.3	17.0	6.0	15.9	17.0	6.0	15.9	17.0	17.0	17.0	20.3	18.8	18.8	18.8	17.0
26 CD Electricity Use (kWh/100mi)			223.4												
27 Share of LNG Fuel Use (energy %)															95%
28 DEF Use (% of fuel consumption)	0%	2%	2%	2%	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	2%
29 Purchase Price (\$/vehicle)	\$0	\$100,000	\$0	\$140,000	\$0	\$100,000	\$100,000	\$100,000	\$0	\$0	\$165,000	\$150,000	\$150,000	\$150,000	\$0
30 Incentive (\$/vehicle)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
31 Maintenance & Repair (\$/mile)	\$0.00	\$0.19	\$0.17	\$0.18	\$0.18	\$0.19	\$0.18	\$0.18	\$0.19	\$0.19	\$0.00	\$0.00	\$0.19	\$0.19	\$0.20
32 Fuel and DEF Price															
33 Primary Fuel Price (\$/GGE)	\$3.56	\$3.56	\$3.56	\$3.56	\$3.56	\$3.74	\$3.56	\$3.56	\$3.66	\$4.27	\$4.64	\$3.84	\$2.21	\$2.29	\$2.29
34 Secondary Fuel Price (\$/GGE)															\$3.56
35 DEF Price (\$/gallon)		\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80	\$2.80
36 Acquisition Cost															
40 Light-Duty (LD) Fleet Cost	\$24,500	\$32,000	\$42,000	\$0	\$0	\$0	\$0	\$0	\$32,000	\$32,000	\$24,500	\$31,000	\$36,000	\$0	\$0
41 Heavy-Duty (HD) Fleet Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$24,500	\$31,000	\$36,000	\$0	\$0
42 Annual Operating Cost															
43 LD Fuel Cost	\$2,293	\$1,911	\$1,764	\$0	\$0	\$0	\$0	\$0	\$1,964	\$2,292	\$2,988	\$2,473	\$1,498	\$0	\$0
44 LD Maintenance Cost	\$1,820	\$2,454	\$1,767	\$0	\$0	\$0	\$0	\$0	\$2,454	\$2,454	\$1,820	\$1,820	\$1,820	\$0	\$0
45 HD Fuel Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
46 HD Diesel Exhaust Fluid Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
47 HD Maintenance Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
48 Annual Operating Savings															
49 Compared to Gasoline LD Fleet															
50 Compared to Diesel HD Fleet															
51 Simple Payback															
52 LD Fleet (miles)	No payback	342,855.7	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	No payback	No payback	No payback	No payback	No payback	164,993.6	No payback
53 LD Fleet (years)	No payback	30.1	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	No payback	No payback	No payback	No payback	No payback	14.5	No payback
54 HD Fleet (miles)															
55 HD Fleet (years)															
56 Life-Cycle Petroleum Use (barrels)															
57 LD Petroleum Use	13.4	11.9	10.3	8.8	3.3	0.2	0.0	0.0	9.7	0.7	2.9	4.5	0.1	0.0	0.0
58 HD Petroleum Use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59 Life-Cycle Greenhouse Gas (GHG) Emissions (short tons)															
60 LD GHG Emissions	7.8	6.7	6.0	5.5	4.9	4.0	0.0	0.0	5.7	1.6	5.8	6.9	6.7	0.0	0.0
61 HD GHG Emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62 Vehicle Operation Air Pollutant Emissions (lb)															
63 Light-Duty Vehicle Type: Passenger Truck															
64 CO	82.2	28.4	61.5	55.0	15.0	0.0	0.0	0.0	28.4	28.4	3.8	85.8	59.5	0.0	0.0
65 NOx	5.8	22.1	3.7	3.4	0.9	0.0	0.0	0.0	22.1	22.1	5.2	6.0	4.8	0.0	0.0
66 PM10	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.2	0.2	0.0	0.0
67 PM10 (TBW)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0
68 PM2.5	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.2	0.2	0.0	0.0
69 PM2.5 (TBW)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
70 VOC	2.3	1.3	1.5	1.4	0.4	0.0	0.0	0.0	1.3	1.3	2.1	2.8	1.3	0.0	0.0
71 VOC (Evap)	1.3	0.0	1.3	1.2	0.3	0.0	0.0	0.0	0.0	0.0	1.1	1.0	0.6	0.0	0.0
72 Heavy-Duty Vehicle Type: Combination Long-Haul Truck															
73 CO	#N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#N/A	#N/A	#N/A	#N/A	#N/A	0.0	0.0

Instructions | Inputs | Payback | Payback Outputs | TCO | TCO Outputs | Footprint | Footprint Outputs

Sources and Resources

-  AutoCheck.cc
-  <http://www.afdc.energy.gov/>
-  <http://www.hybridcars.com/>
-  <https://greet.es.anl.gov/afleet>
-  http://www.eia.gov/forecasts/aeo/tables_ref.cfm