



Engines and Transmissions



## Legislazione USA

Limiti CARB ed EPA per emissioni, gas serra e consumi

-----  
PRODUCT ENGINEERING  
EAMS

Marzo 2010



EPA = Environmental Protection Agency



CARB = California Air Resources Board



NHTSA = National Highway Traffic Safety Administration




- I costruttori sono classificati in gruppi in base alle vendite annuali

<b>EPA - Manufacturer Classification</b>	
Small (SM)	< 15'000 vehicles/year (*)
Large (LVM)	> 15'000 vehicles/year (*)

<b>CARB - Manufacturer Classification</b>	
Small (SM)	< 4500 vehicles/year (*)
Indipendent low volume (ILVM)	Up to 10'000 vehicles/year (*)
Intermediate (IM)	Up to 60'000 vehicles/year (*)
Large (LVM)	> 60'000 vehicles/year (*)

(\*) Cars + Light Duty Truck

- Programma California è chiamato **Low Emission Vehicle Program (LEV)**
- Attualmente è in vigore la fase due del programma  **LEV II**
- La normativa CARB prevede un **limite Corporate per NMOG** (Non Methanic Organic Gases)
  - Limite corporate (media ponderata emissioni sul venduto)
  - Ad esempio

Manufacturer	NMOG Corporate at 50kmi (g/mi)
Small	0,075
Intermediate & Large	0,035

- Large Volume Manufacturer Target → NMOG Corporate = 0,035 g/mi
- Per raggiungere questo target il costruttore si avvale di:
  - **ULEV II**      Ultra Low Emission Vehicle      NMOG = 0,040g/mi
  - **SULEV II**      Super Ultra Low Emission Vehicle      NMOG = 0,010g/mi
- Inoltre:
  - **PZEV**      Partial Zero Emission Vehicle
  - **ATPZEV**      Advanced Technology PZEV
  - **ZEV**      Zero Emission Vehicle

- LEV II – Ciclo FTP(\*) – Limiti di Emissione

		NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	Aldeidi (g/mi)	PM (g/mi)
<b>ULEVII</b>	50'000 mi	0,05	0,040	1,7	-	0,01
	120'000 mi	0,07	0,055	2,1	0,011	0,01
<b>SULEVII</b>	120'000 mi	0,02	0,010	1,0	0,004	0,01

- Emissioni evaporative

0,50 g/test HC    Diurnal (72h) + hot soak (1h)

0,65 g/test HC    Suppl. diurnal (48h) + hot soak (1h)

(\*) Federal Test Procedure

- Caratteristiche PZEV

- Emissioni SULEV II

NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	Aldeidi (g/mi)	PM (g/mi)
0,02	0,010	1,0	0,004	0,01

- Evaporation test 0 g/test (\*)

- Durability 150'000 mi

(\*) 0,35 g/test w/o complete fuel system + 0,054 g/test w fuel system

## Vehicle Categories



**Fuel Cell Electric Vehicle**  
**Battery Electric Vehicle:**  
Type 0 (0 – 49 mile range)  
Type I (50 – 75 mile range)  
Type 1.5 (75-100 mile range)  
Type II (100-200 mile range)  
Type III (>200 mile range)



**Silver:**

- Conventional Hybrid Electric
- CNG

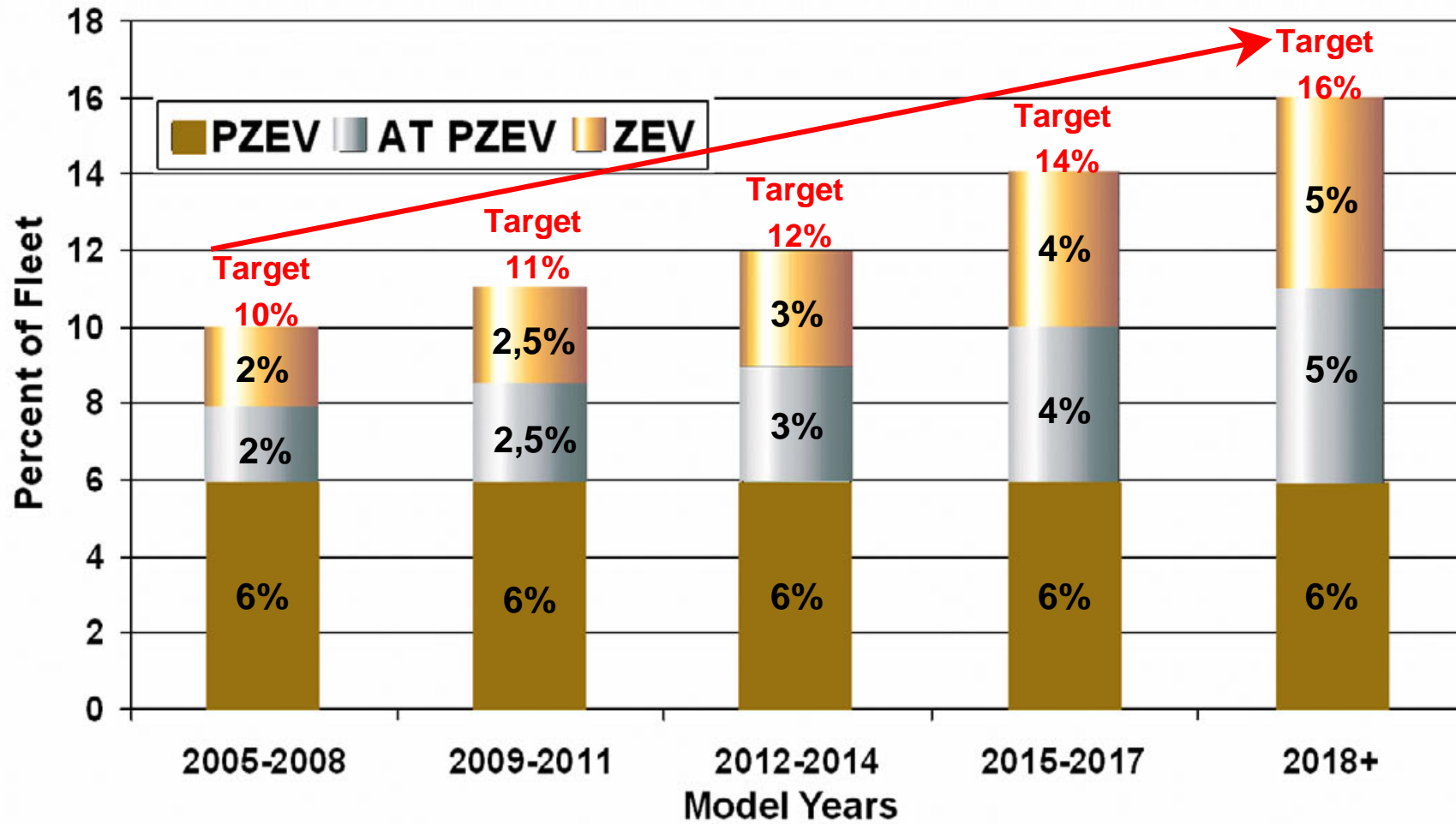
**Silver+:**

- Hydrogen




**Gasoline/diesel Internal Combustion Engine**  
**Partial Zero Emission Vehicle Requirements**

# CARB – ZEV Mandate – Phase-in

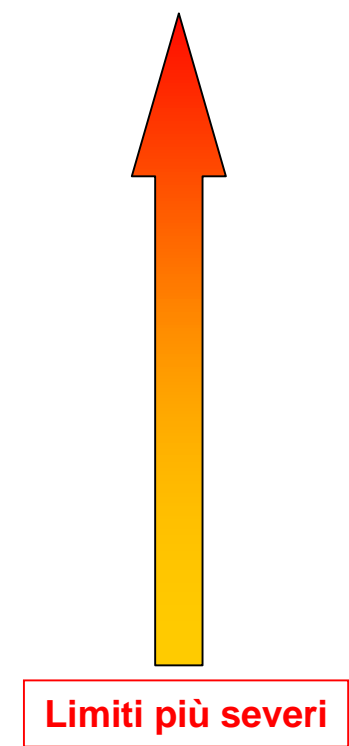


- Large Volume Manufacturer deve rispettare pienamente lo ZEV Mandate, ossia MY 2012 – 2014 → 6% PZEV + 3% ATPZEV + 3% ZEV
- Intermediate Volume Manufacturer può raggiungere le percentuali previste dallo ZEV Mandate solo con veicoli PZEV
- Small Volume Manufacturer non deve rispettare lo ZEV mandate

- Programma EPA  **Tier 2 Regulation**
  - Strutturata in **Certification BIN**
- La normativa CARB prevede un limite Corporate per NOx
  - Limite corporate (media ponderata emissioni sul venduto)
- **NOx Corporate** = 0,07 g/mi @ 120'000 mi

- Limiti Emissione EPA Tier 2 – Ciclo FTP

	mi	NOx (g/mi)	NMOG (g/mi)	CO (g/mi)	Aldeidi (g/mi)	PM (g/mi)
BIN1	120'000	0,00	0,00	0,00	0,00	0,00
BIN2	120'000	0,020	0,010	2,1	0,004	0,01
BIN3	120'000	0,03	0,055	2,1	0,011	0,01
BIN4	120'000	0,04	0,070	2,1	0,011	0,01
<b>BIN5</b>	<b>50'000</b>	<b>0,05</b>	<b>0,075</b>	<b>3,4</b>	<b>0,015</b>	<b>0,01</b>
	<b>120'000</b>	<b>0,07</b>	<b>0,090</b>	<b>4,2</b>	<b>0,018</b>	<b>0,01</b>
BIN6	120'000	0,10	0,090	4,2	0,018	0,01
BIN7	120'000	0,15	0,090	4,2	0,018	0,02
BIN8	50'000	0,140	0,100	3,4	0,015	n.a.
	120'000	0,200	0,125	4,2	0,018	0,02



- Evaporation test 0,50 g/test Diurnal (72h) + hot soak (1h)  
0,65 g/test Suppl. diurnal (48h) + hot soak (1h)

- GreenHouse Gases = **CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O**
- GreenHouse Gases sono ritenuti responsabili del riscaldamento globale
- GreenHouse Gases sono normati sia in ambito CARB che in ambito EPA

- Legislazione CARB sui GHG si basa sul calcolo della **CO<sub>2</sub> equivalente**:

$$\text{CO}_2 \text{ Equivalent} = \text{CO}_2 + (296 \times \text{N}_2\text{O}) + (23 \times \text{CH}_4) - \text{Air Conditioning}$$

- CO<sub>2</sub> and CH<sub>4</sub> sono in g/mi (dati dai test di emissione)
- N<sub>2</sub>O è fissato a 0.006 g/mi
- Air Conditioning: valore dipende dall'efficienza del condizionatore

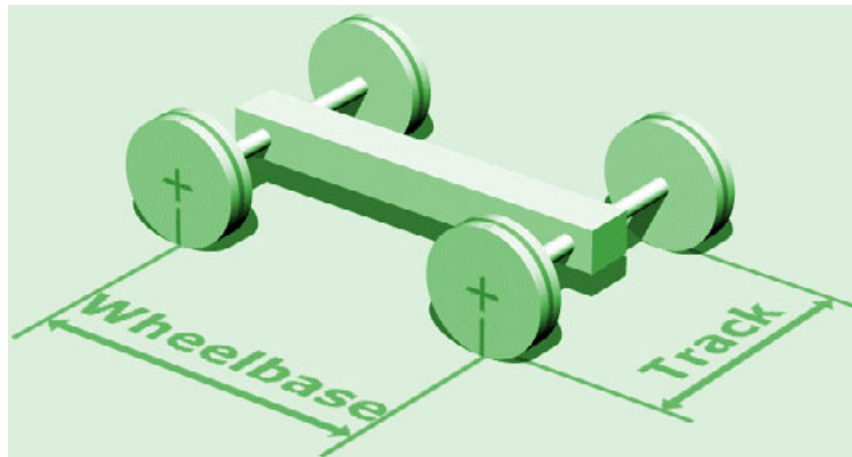
- Emissioni GHG Corporate per la **California**

Year	GHG Std (gCO <sub>2</sub> /mi)	
2010	301	420
2011	267	390

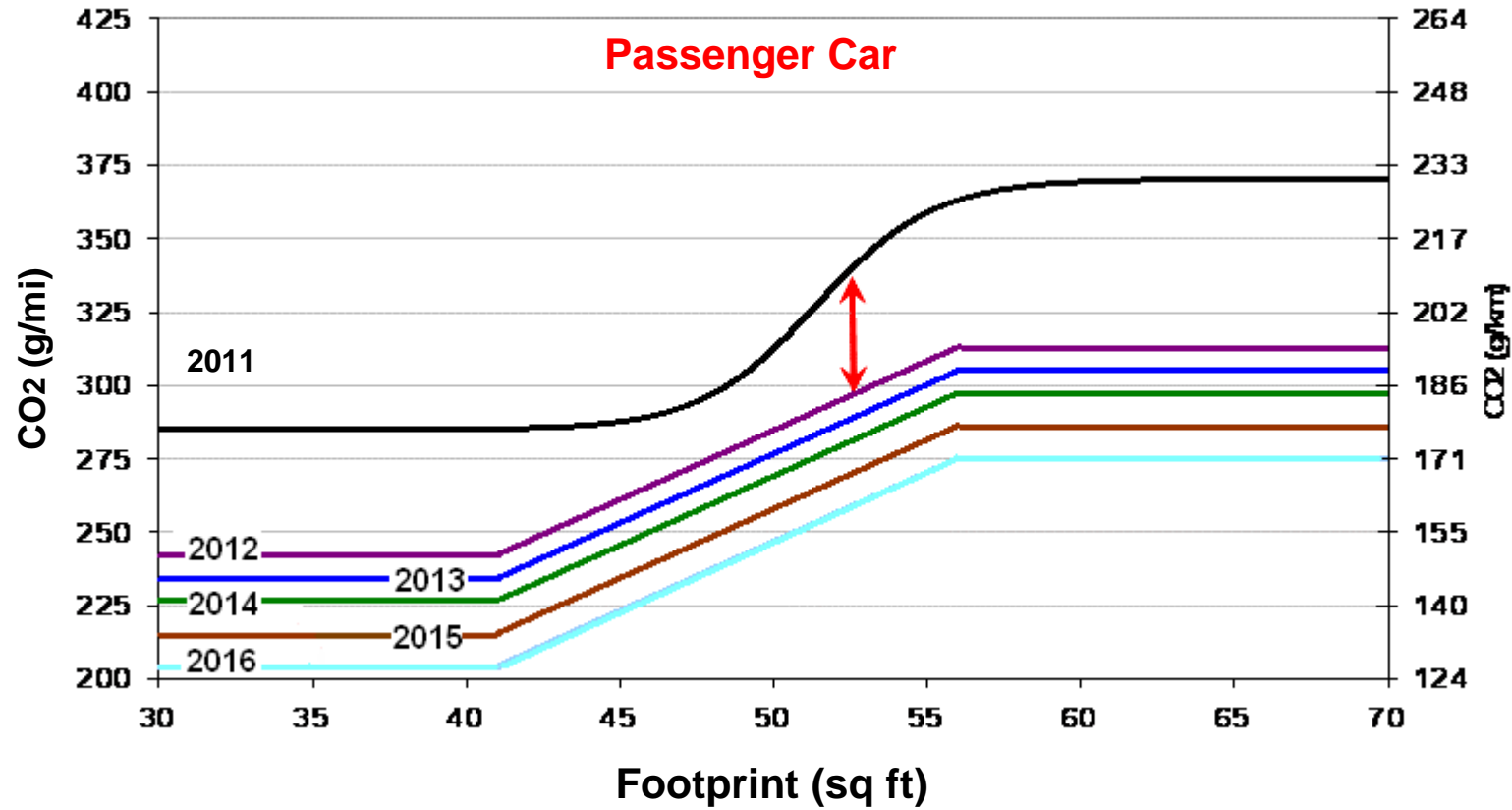
**Da MY2012 CARB accetterà la legislazione EPA**

- Il calcolo della CO<sub>2</sub> nella legislazione EPA è basata su **footprint**

$$\text{Footprint (sq ft)} = \frac{\text{Wheelbase} * \text{Track}}{144}$$



- La legislazione EPA entrerà in vigore dal MY 2012

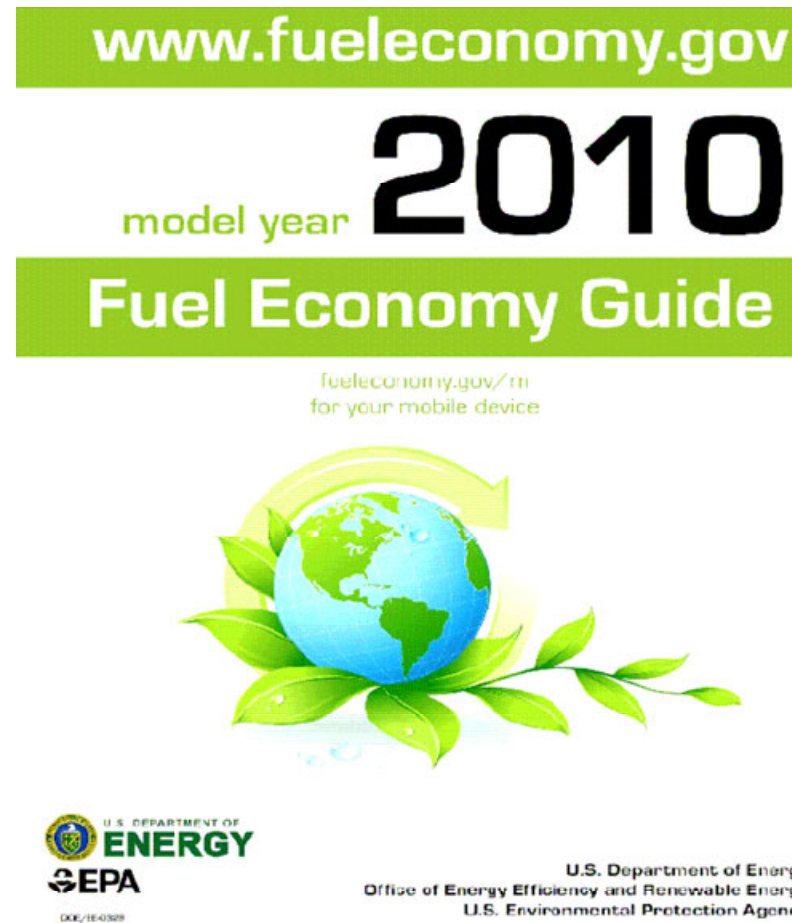


- Emissioni CO<sub>2</sub> Corporate dovranno seguire la seguente tabella:

	2012	2013	2014	2015	2016
Passenger cars (g/mi)	261	253	246	235	224
Light Trucks (g/mi)	325	341	332	317	302
Combined cars&trucks (g/mi)	295	286	276	263	250

- Fuel Economy Guide
- Fuel Economy Label
- CAFE

- Ogni MY US Department of Energy/EPA pubblica la **FUEL ECONOMY GUIDE**



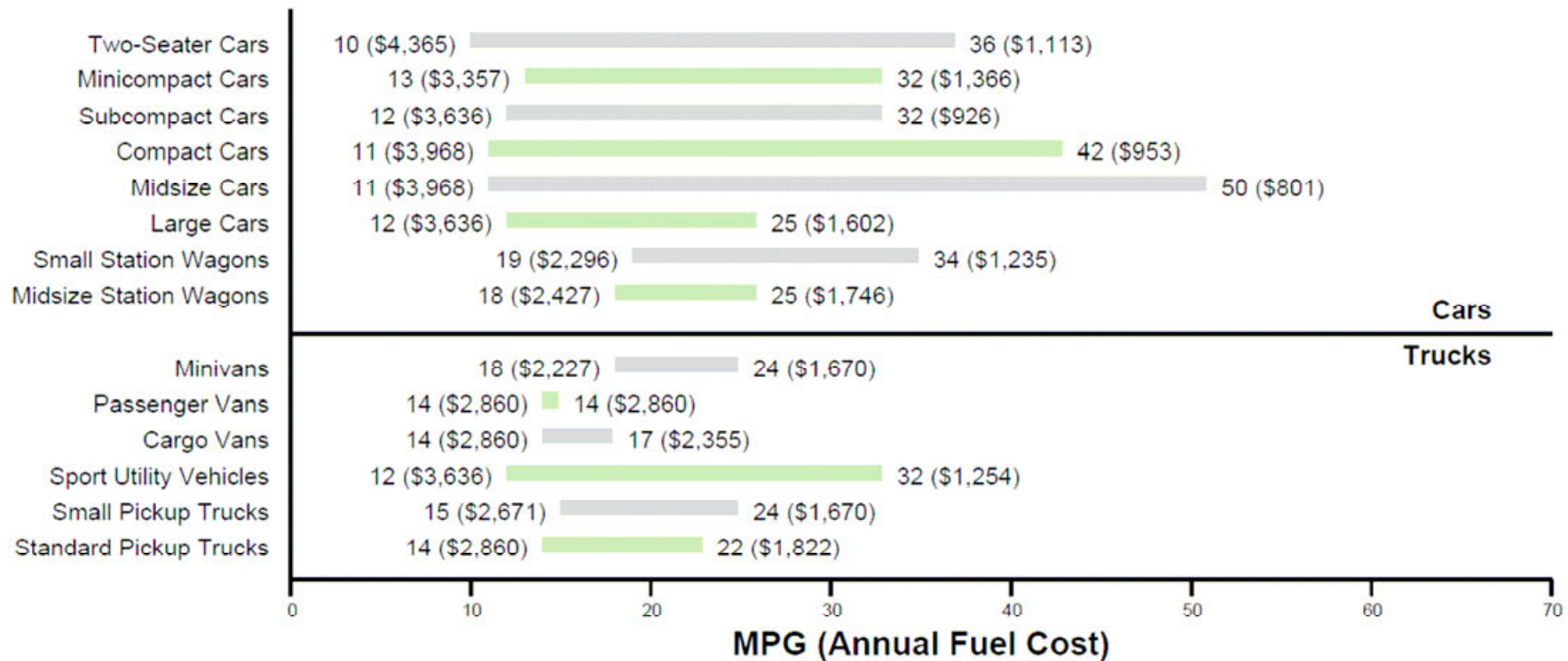
- Nella Guida i veicoli sono suddivisi in base al volume

Cars		Trucks	
Class	Passenger and Cargo Volume (cu.ft)	Class	Gross Vehicle Weight Rating(*) (pounds)
<b>Two-Seaters</b>		<b>Pickup Trucks</b>	
<b>Cars</b>		Small	<6000
<b>Sedans</b>		Standards	6000 - 8500
Minicompact	<85	<b>Vans</b>	
Subcompact	85 - 99	Passenger	<8500
Compact	100 -109	Cargo	
Midsize	110 -119	<b>Minivans</b>	<8500
Large	>120	<b>Sport Utility Vehicles</b>	<8500
<b>Station Wagons</b>		<b>Special Purpose Vehicles</b>	<8500
Small	<130	(*) Gross Vehicle Weight Rating = Vehicle weight plus carrying capacity	
Midsize	130 -159		
Large	>160		

# FUEL ECONOMY – Guida

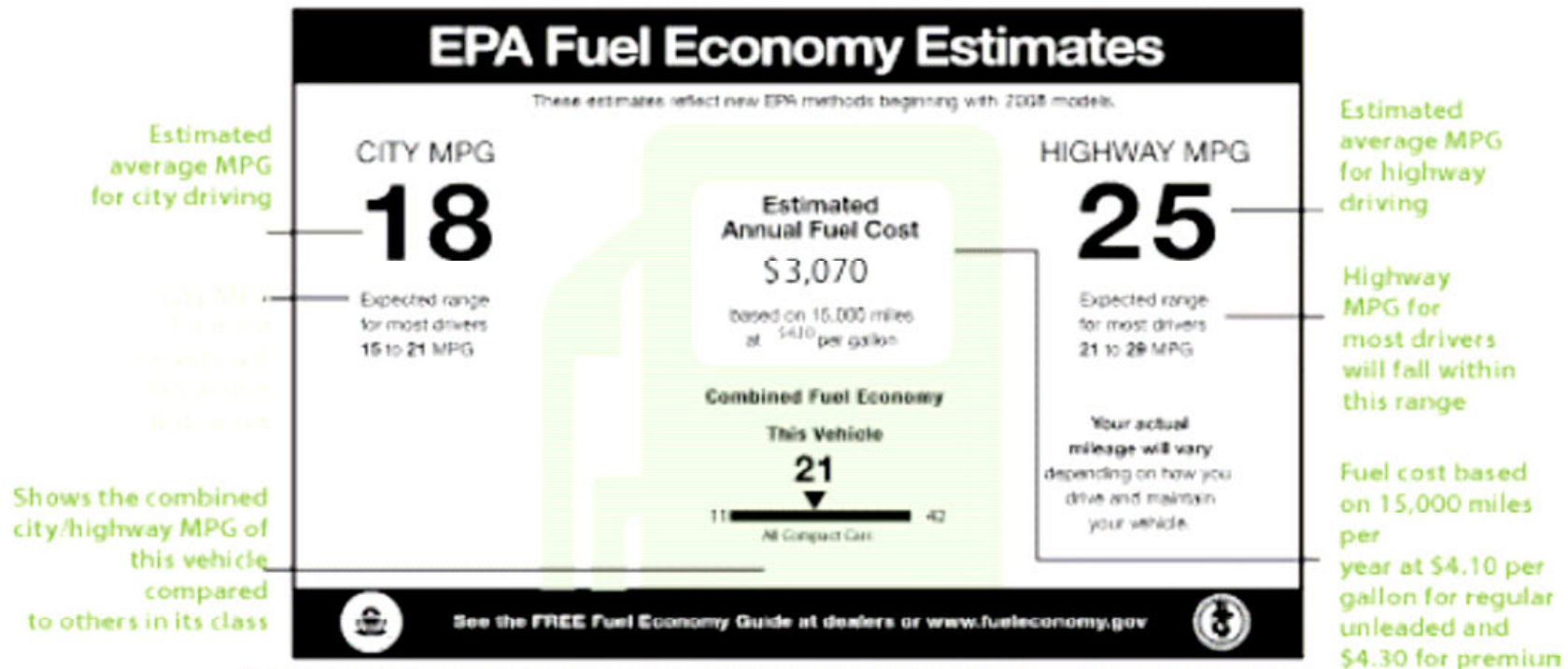


- Nella Guida si riporta la spesa media annuale di carburante per classe di veicolo, assumendo una percorrenza media di 15'000 mi/anno e un costo di 2,67\$/gal per benzina e 2,91\$/gal per diesel



## Sample Fuel Economy Label

(Attached to New Vehicle Window)



Check the fuel economy label on the vehicle at the dealer showroom for its specific fuel economy (MPG) ratings. The ratings may vary slightly from the values in this guide because of engine and fuel system differences not listed here.

- Il calcolo della fuel economy (per l'etichetta) si basa su 5 cicli:
  - FTP 75 (city)
  - HFET (highway)
  - US06
  - SC03
  - Cold Temperature FTP 75 (city)

# FUEL ECONOMY – Etichetta

**Sample Fuel Economy Label**  
(Attached to New Vehicle Window)

**EPA Fuel Economy Estimates**

These estimates reflect new EPA methods beginning with 2008 models.

<p>CITY MPG</p> <p style="font-size: 2em; font-weight: bold;">18</p> <p><small>Expected range for most drivers 15 to 21 MPG</small></p>	<p>Estimated Annual Fuel Cost</p> <p style="font-size: 1.5em; font-weight: bold;">\$3,070</p> <p><small>based on 15,000 miles at \$4.10 per gallon</small></p> <div style="border: 2px solid red; padding: 5px; display: inline-block; text-align: center;"> <p><b>Combined Fuel Economy</b></p> <p><small>All Compact Cars</small></p> </div>	<p>HIGHWAY MPG</p> <p style="font-size: 2em; font-weight: bold;">25</p> <p><small>Expected range for most drivers 21 to 28 MPG</small></p> <p><small>Your actual mileage will vary depending on how you drive and maintain your vehicle.</small></p>
---	--	--

See the FREE Fuel Economy Guide at dealers or [www.fueleconomy.gov](http://www.fueleconomy.gov)

Estimated average MPG for city driving

Expected range for most drivers

Shows the combined city/highway MPG of this vehicle compared to others in its class

Estimated average MPG for highway driving

Highway MPG for most drivers will fall within this range

Fuel cost based on 15,000 miles per year at \$4.10 per gallon for regular unleaded and \$4.30 for premium

Check the fuel economy label on the vehicle at the dealer showroom for its specific fuel economy (MPG) ratings. The ratings may vary slightly from the values in this guide because of engine and fuel system differences not listed here.

$$FE_{\text{combined}} = \frac{1}{\frac{0,55}{FE_{\text{city}}} + \frac{0,45}{FE_{\text{highway}}}}$$

- **CAFE → Corporate Average Fuel Economy**
- Ogni Carmaker deve soddisfare un valore Corporate per i consumi (**CAFE**)
- CAFE MY 2010 è **27,5 mpg**
- Occorre pagare una tassa di 5,50\$ per 0,1 mpg di Fuel Economy al di sotto del limite
- NHTSA propone CAFE standards per MY2011 – MY 2016 basati su footprint

	2011	2012	2013	2014	2015	2016
Passenger Car (mpg)	30,2	33,6	34,4	35,2	36,4	38,0
Light Truck (mpg)	24,1	25,0	25,6	26,2	27,1	28,3
Combined Car+Truck (mpg)	27,3	29,8	30,6	31,4	32,6	34,1