

Car Manufacturers in a Carbon Constrained World:

Some Preliminary Thoughts

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Hypotheses

- Emerging carbon constraints could significantly impact the auto industry, primarily through pressure to increase fuel economy or lower the CO₂ emissions intensity of vehicles.
- Carbon constraints are already in place in major automotive markets.
- A large number of lower-carbon technologies are emerging that may transform the industry.
- Original Equipment Manufacturers (OEMs) are differently positioned to challenge the carbon constraints.
- OEMs are differently positioned by virtue of their innovation and R&D choices and their overall management quality regarding carbon constraints.



Agenda



- Problem statement
 - Why is auto industry under the microscope for reducing CO₂ emissions?
 - Understanding the market characteristics

- What are the lower-carbon intensity options?
 - Incremental technologies, diesel, hybrid and fuel cell technologies

- Preparedness and position of car manufacturers in terms of competitiveness in a carbon sensitive marketplace

Average CO₂ Emission Rates (2002)



OEM	UNITED STATES		EUROPEAN UNION		JAPAN	
	g CO ₂ /km	mpg	g CO ₂ /km	mpg	g CO ₂ /km	mpg
BMW	251	22.0	214	25.8	-	-
DC	282	19.6	234	23.6	230	24.0
FORD	295	18.7	196	28.2	212	26.0
GM (a)	293	18.8	181	30.6	143	38.6
HONDA	214	25.8	174	31.8	174	31.7
NISSAN	242	22.8	159	34.8	185	29.8
PSA	-	-	166	33.2	-	-
RENAULT (b)	242	22.8	149	37.1	185	29.8
TOYOTA	245	22.5	180	30.7	200	27.6
VW	220	25.1	179	30.7	-	-

NOTES:

(a) GM's sales in Japan represent less than 8000 sales of Suzuki and Isuzu vehicles, which reflect GM's ownership stakes in these companies.

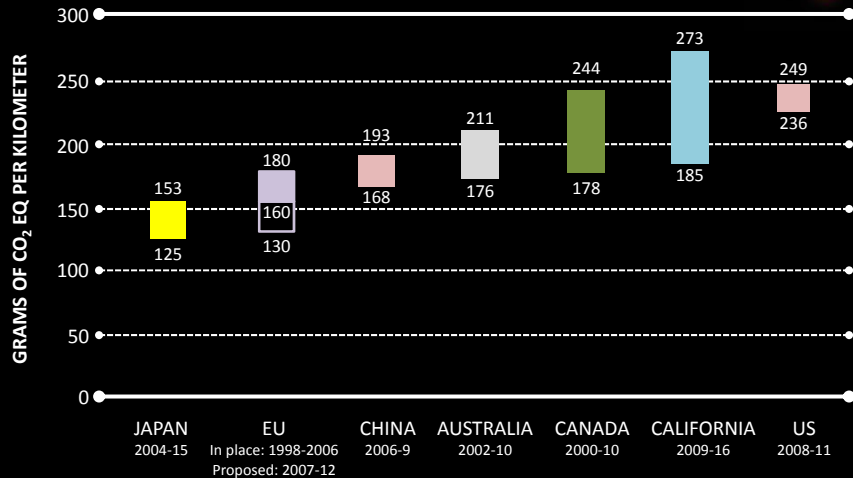
(b) Renault's figures for the US and Japan represent sales of vehicles by Nissan, in which Renault has a 44% ownership stake.

Regulations



- In **Japan**, new legislation requires fuel economy improvements in cars of 23 percent beyond 1995 levels by 2010. Specific targets vary with vehicle weight but extend to 125 g CO₂/km (44 mpg).
- In the **European Union**, requires the industry to reduce CO₂ emissions from passenger cars by 25 percent relative to 1995 levels by 2008. This would bring emission rates to a level of 140 g CO₂/km (39 mpg). Regulation extends the target to 120 g CO₂/km (46 mpg) by 2012 and 95 g CO₂/km (58 mpg) by 2020.
- In the **United States** Corporate Average Fuel Economy (CAFE) standard for cars remains fixed at 201 g CO₂/km (27.5 mpg) level first set in 1990.

Regulations – Global Perspective

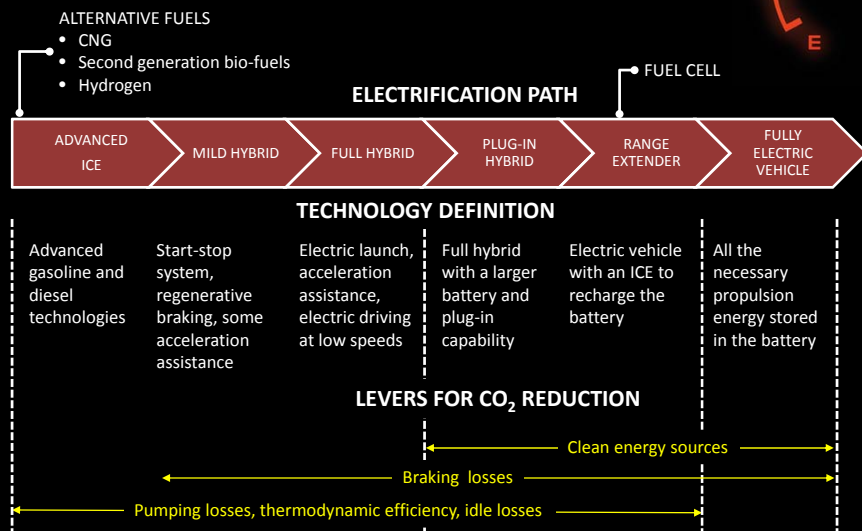


Key Lower-Carbon Technologies



- ➔ **Incremental** [engine, transmission and vehicle] **Technologies**
 - ➔ Offer immediate low-cost opportunities for fuel economy gains
- ➔ **Diesel** (Compression Ignition) **Technology**
 - ➔ Well understood but faces challenges outside Europe
- ➔ **Hybrid Technology**
 - ➔ Will probably become mainstream over the next decade
- ➔ **Fuel Cell Technology**
 - ➔ Represents the long-term goal, but faces formidable economic and technological obstacles

Electrification Path Power Train Technologies



Carbon Constrained World

The Undefined Factor



→ Natural Constraint

- Shortage of fossil fuel

→ Imposed Constraints

- Limits on carbon emission
- Cost of carbon emission (e.g., due to carbon taxes or carbon trading schemes)

Resources



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