

# ***Disrupting the business of producing automobiles: technologies for cleaner production***

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# ***Presentation Outline***

- 1- Theoretical discussion: Innovation
  - Regulatory innovation
- 2- The Automotive Industry: Alternative fuels and powertrain: Incremental and radical innovation
- 3 - Case studies
  - The Brazilian experience with ethanol;
  - Hybrids;
  - Hydrogen Fuel Cells;
- 4 - Conclusions.

# ***Innovation***

- Christensen's effect how incumbents fail due to the introduction of innovation.
- Radical innovation - discontinuous change that sweeps away much of the firm's existing investment. - new market structure (Colarelli 1998).
- Radical innovations present both macro level innovativeness features: as the product is new to the world, the market and the industry.
- Micro level features: it is novel to the firm and consumer (Garcia and Calantone 2002).

# ***Disruptive innovations***

Innovation - Radical in nature but not disruptive.

The radical nature - technological dimension the  
disruptiveness - market effect to the incumbents.

Disruptiveness can be technological less-radical  
or technological more radical but is related to the  
phenomenon of the consumer changing tastes  
and switching from the mainstream product to  
the new one. Rogers (2003)

# ***The Automotive Industry***

The present business model adopted by the automotive industry is not *sustainable* !



***Alternative Fuels***

***Alternative Powertrains***

# ***The Automotive Industry***

- The existing costs and amortisation of sunk costs are key elements in any decision regarding future technology choices.
- high new capital-intensive systems, or abandonment of existing high capital-intensive systems, it is likely to meet considerable resistance from the industry.
- If such an alternative energy source can be used within the existing capital investments, its chances of being accepted by the industry are so much higher.

# ***The Automotive Industry***

- An alternative fuel is an energy source that can be used with no or minimal modification in existing engines.
- Alternative powertrain replace the existing ICE, thus rendering existing sunk investments in ICE technology obsolete and requiring new investments into a different manufacturing system for a different type of powertrain.
- Alternative fuels can be classed as incremental and alternative powertrain as radical innovation.

# Innovation - Automotive Industry

<b>Technology</b>	<b>Incremental innovation</b>	<b>Radical innovation</b>
LPG	*	
CNG	*	
biodiesel	*	
bioethanol	*	
Hydrogen IC	*	
IC-electric hybrid	*	
Battery-electric		*
Fuel cell		*

# The business model of the automotive industry

- “They are prisoners of enormous sunk costs which they treat as unamortized assets, substituting accounting for economic principles...This mindset is a critical obstacle...new ways cannot diffuse without displacing old ones that resists with distinctive vigour” (Lovins et al. 1993: 17).
- Safeguarding existing investments until fully amortised. This explains the industry’s comparative willingness to embrace hybrid technology, but also its reluctance to do the same with fuel cell technology.

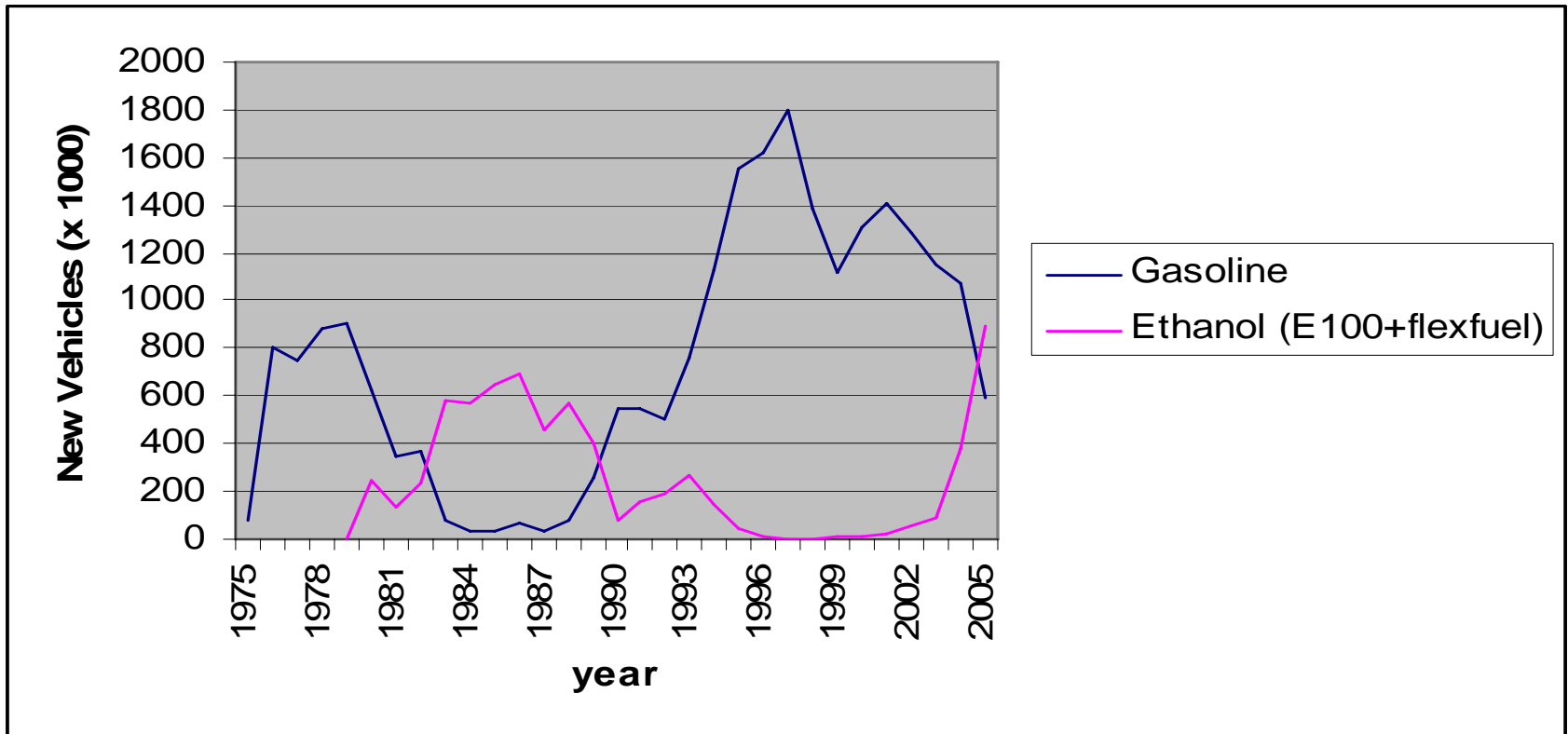
# ***Case studies***

- 1- Biofuels – The Brazilian experience with Ethanol;
- 2- the Hybrid car – The Toyota Prius;
- 3- Hydrogen Fuel Cells.

# ***Biofuels – The adoption of Ethanol in Brazil***

- 1925 – the first experiments
- 1975 the proalcohol program.
  - (1975-1979) E20/E25
  - (1980- 1986) E100
  - (1986-1998) decline
- 2003 Flexifuel technology

# ***Biofuels – The adoption of Ethanol in Brazil***



# ***Biofuels – The adoption of Ethanol in Brazil***

- Little engine development was required to adapt the traditional petrol fuelled ICE engines to Ethanol.
- there were some fundamental mechanical issues that needed to be fully addressed before ethanol-only vehicles started to be produced The same rationale can be used for the biodiesel program.

# ***Hybrids – The Toyota experience with the Prius***

- Internal committee created to forecast the future perspectives in the automotive industry for the 21st century– G21.
- Response to the US Partnership for the Next Generation of Vehicles (PNGV).
- extremely economical mid-sized family car based on new production methods. The initial goal : 47.5 miles per gallon.

The group decided to attach an electrical engine to the petrol-fuel one. For the 1995 Tokyo Motor Show, Toyota prepared a concept car - Toyota's vision of the future.

# ***Hybrids – The Toyota experience with the Prius***

Prius Type	Generation I	Generation II	Generation III
Year	1997-1999	2000- 2003	2003-2006
Petrol Engine (HP)	58	70	76
Electric motor (Hp)	40	44	67
Acceleration 0-96 kph (seconds)	14.1	12.5	10.1
Battery-Pack Energy (W/kg)	600	900	1250
Battery-Pack Weight (kg)	57	52	45

# *Hydrogen Fuel Cells*

- The problems with hydrogen technology appear to be in three areas: vehicle integration, manufacturability and infrastructure.
- Practical hydrogen fuel cell vehicles within the next five years or so and certainly by the much forecast 2012-2015 period.

# ***Hydrogen Fuel Cells***

- ‘optimistic scenario’ whereby 10,000 fuel cell cars would be produced between 2005 and 2008 and by 2010 this figure would be up to 300,000. One million a year would be reached before 2020 by which stage the technology would be cost competitive with conventional cars. Beyond 2020, 10 new factories could be built each year.

# ***Conclusions***

- Public policy (Environmental Regulation) has played a prominent role in the development of alternative fuels and powertrains technologies. (i.e's California's ZEV mandate and the EU End of life Vehicle Directive and the proposed European CO2 emissions regulations).
- The present economic state of the industry is a major cause for the delay in the adoption of more sustainable technologies (ie – Hydrogen and Electric);
- We are on the verge of seeing a sea of change in the automotive industry with the emergence of battery electric cars and hydrogen.

# Thank you for your attention!

*Comments and suggestions are greatly appreciated.*

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