UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

División de Investigación

XXIV INTERNATIONAL COLLOQUIUM OF GERPISA
2016

Main technological strategies of the world automotive industry to reduce air pollution caused by the use of the automobile: Restrictions for their use on the Mexican market

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OBJECTIVES

- To analyse the main technological strategies carried out by the world automotive industry to reduce greenhouse gas emissions caused by the use of vehicles

- To point out the obstacles to generalize such solutions in the Mexican market.

CONTENTS

- General situation of automotive industry in Mexico
- Mexican vehicle fleet age
- Greenhouse gas (GHG) emissions in Mexico
- Technological strategies to reduce automobile GHG emissions
- Obstacles for electric and hybrid vehicles widespread use in Mexican market

THE AUTOMOTIVE INDUSTRY SETTLED IN MEXICO

KEY INDICATORS FOR MEXICO 2014

7 Worldwide producer of light vehicles **(3.22 million units)**[4]

7 World´s largest vehicle producer in the world **(3.39 million units)**[5]

4 Exporter of light vehicles[9] **(2.64 millions of units)**

19 of the top leading automakers are located in 14 states of Mexico

6 Worldwide producer of heavy vehicles **(168,882 units)**[8]

4 Exporter of heavy vehicles [8] **(124,015 vehicles)**

More than 300 Tier 1 suppliers established in Mexico

Employed workers: **66,017**[7]

The automotive industry in Mexico accounts for:

3% of the National GDP[7]
17% of the manufacturing GDP[7]
20% of the Foreign Direct Investment [6] (FDI):
32% of Mexican total exports[9]

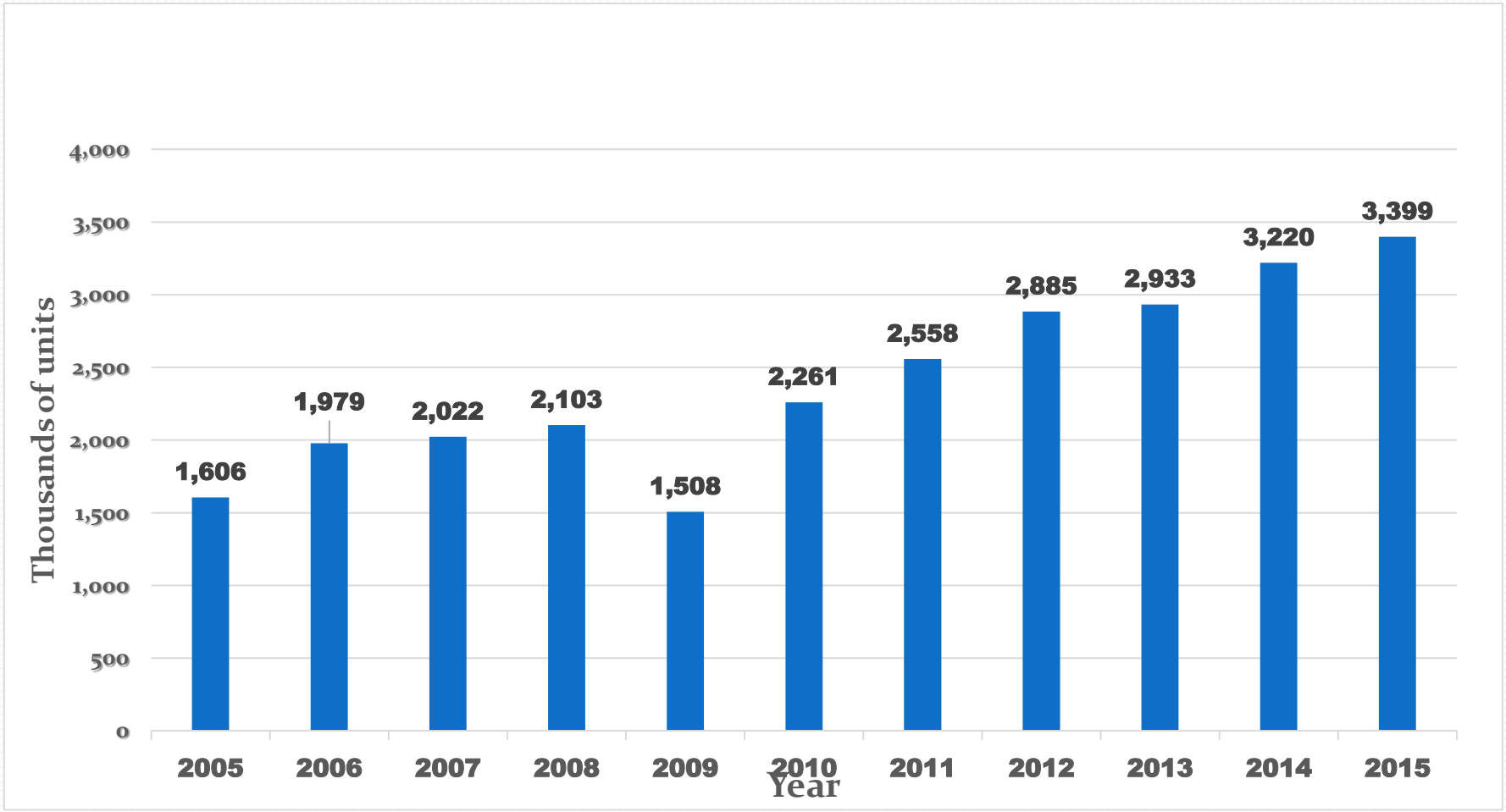
4 Source AMIA
5 Souce: OICA
6 Source: Ministry of Economics
7 Source: INEGI
8 ANPACT
9 ProMexico with information from Global Trade Atlas

LIGHT VEHICLE PLANT LOCATIONS IN MEXICO

HEAVY VEHICLE PLANT LOCATIONS IN MEXICO

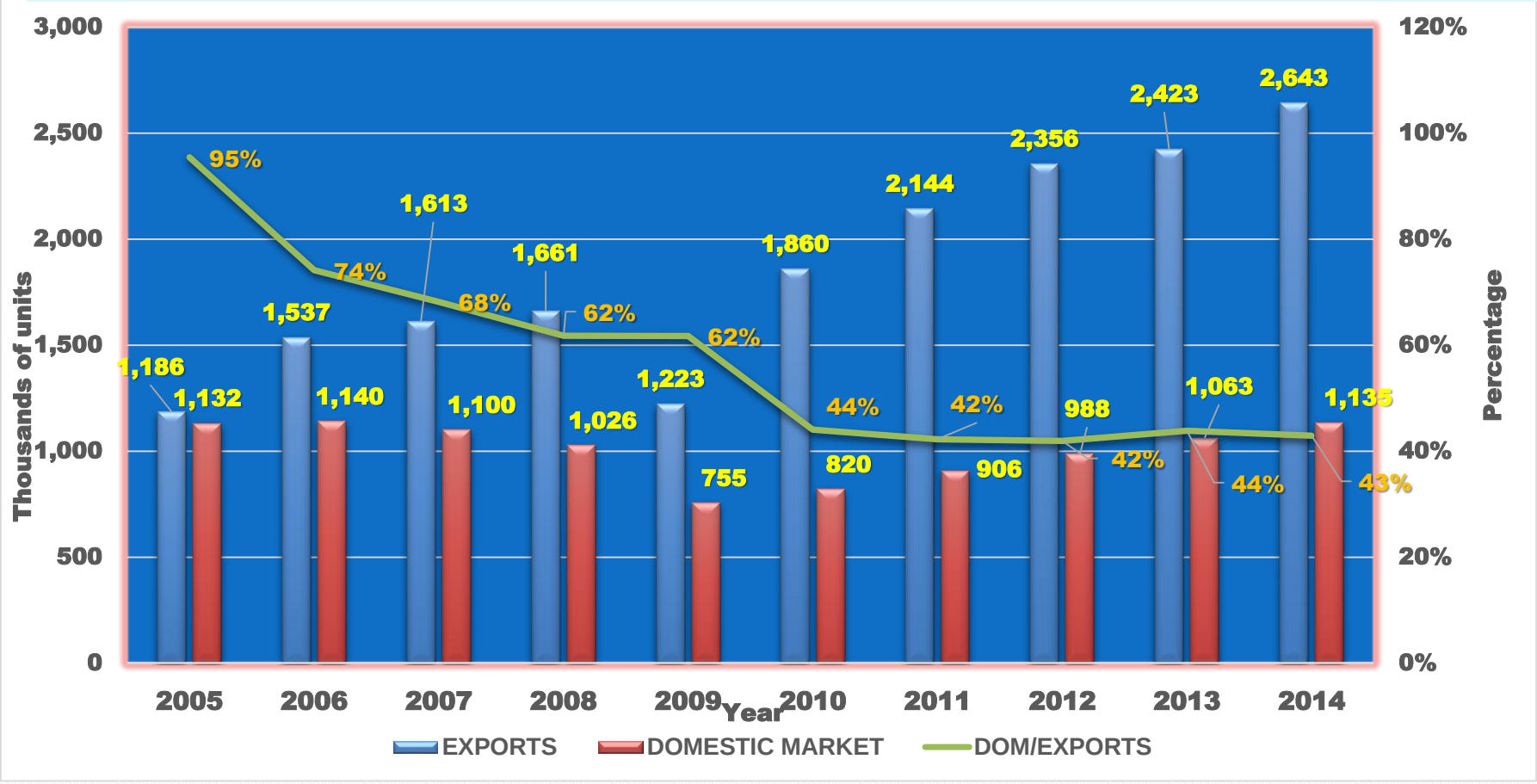
R & D CENTER LOCATIONS IN MEXICO

LIGHT VEHICLE PRODUCTION (2005-2015)



Source: Asociación Mexicana de la Industria Automotriz (AMIA). (January 2016). "Producción total" in *Boletín de prensa de enero de 2016*. Accessed at www.amia.com.mx/descargarb.html on February 20th, 2016.

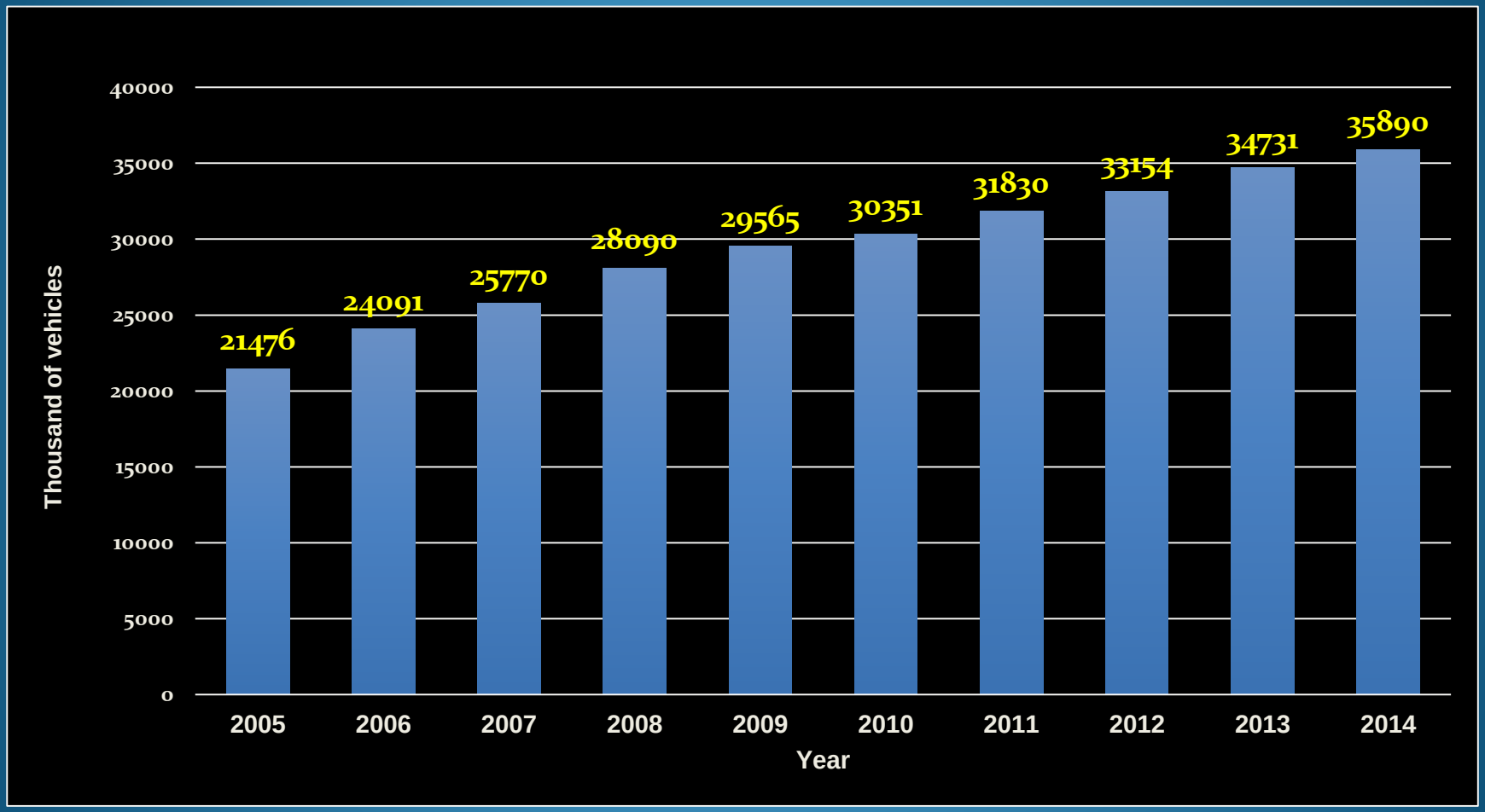
AUTOMOTIVE EXPORTS AND DOMESTIC MARKET (2005-2014)



Source: Graphic drafted with data from Asociación Mexicana de la Industria Automotriz (AMIA). (January 2015a). Exportaciones y mercado doméstico" *in Boletín de prensa de enero de 2015*. Accessed at www.amia.com.mx/descargarb.html on February 20th, 2015.

MEXICAN VEHICLE FLEET AGE

TOTAL REGISTRED VEHICLES IN USE

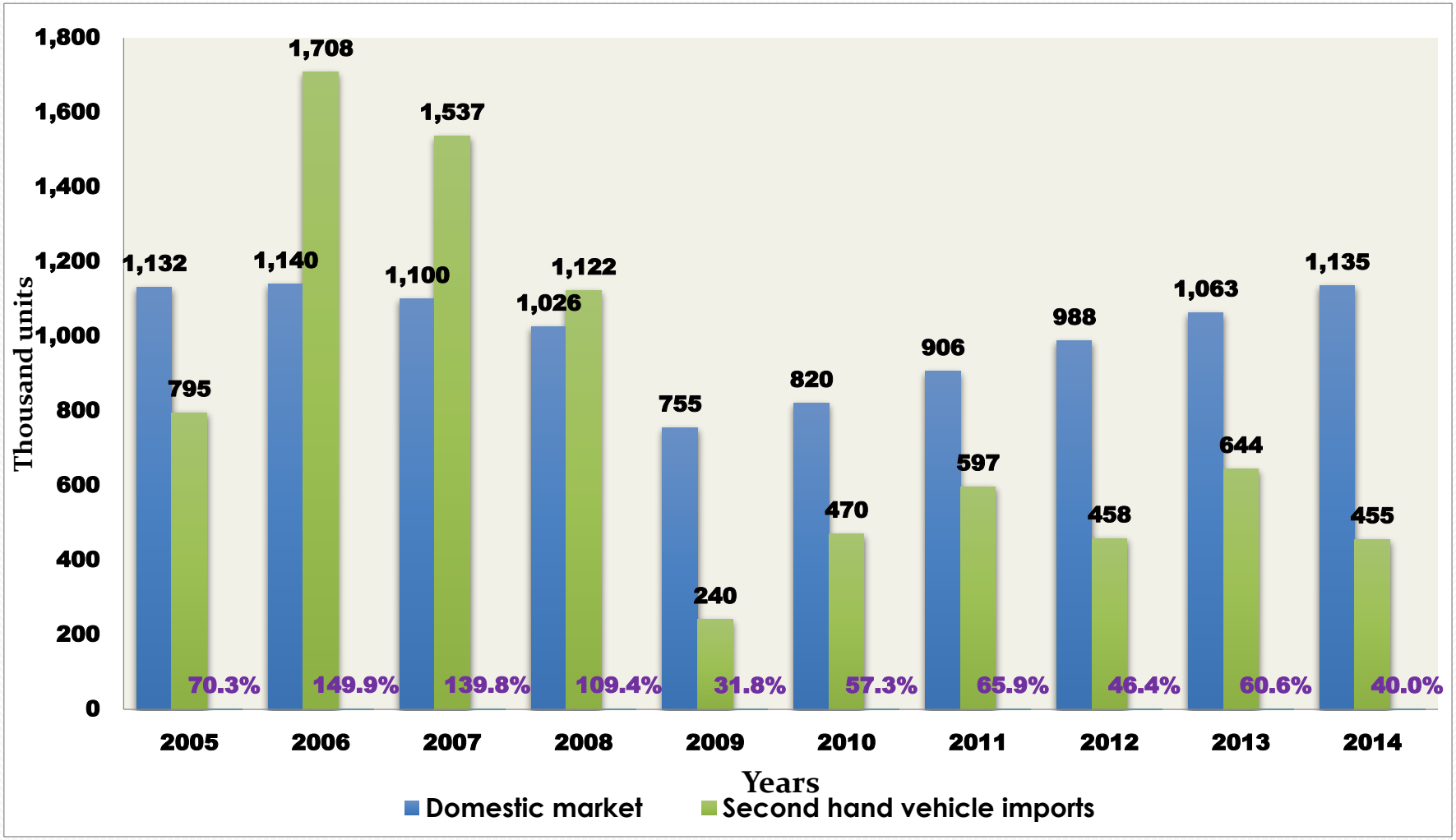


Source: Graphic drafted with data from Instituto Nacional de Estadística, Geografía e Informática (INEGI), (January 28th, 2015), Vehículos de motor registrados en circulación in *Banco de Información Económica*, Mexico. Accesed at http://www.inegi.org.mx/sistemas/bie/?_idserpadre=1090053&d10900530#1090053 on February 25th, 2015.

MEXICAN VEHICLE FLEET AVERAGE AGE

- 2008: 15 years
- 2012: 17 years
- Vehicle fleet is getting older

DOMESTIC MARKET AND SECOND HAND VEHICLE IMPORTS (2005-2014)



Source: Asociación Mexicana de Distribuidores de Automotores [AMDA] (January, 2015). *Reporte del Mercado Interno Automotor, diciembre de 2014*. Accessed in http://www.amda.mx/images/stories/estadisticas/coyuntura/2014/Ventas/1412 Reporte_Mercado_Automotor.pdf on February 2015.

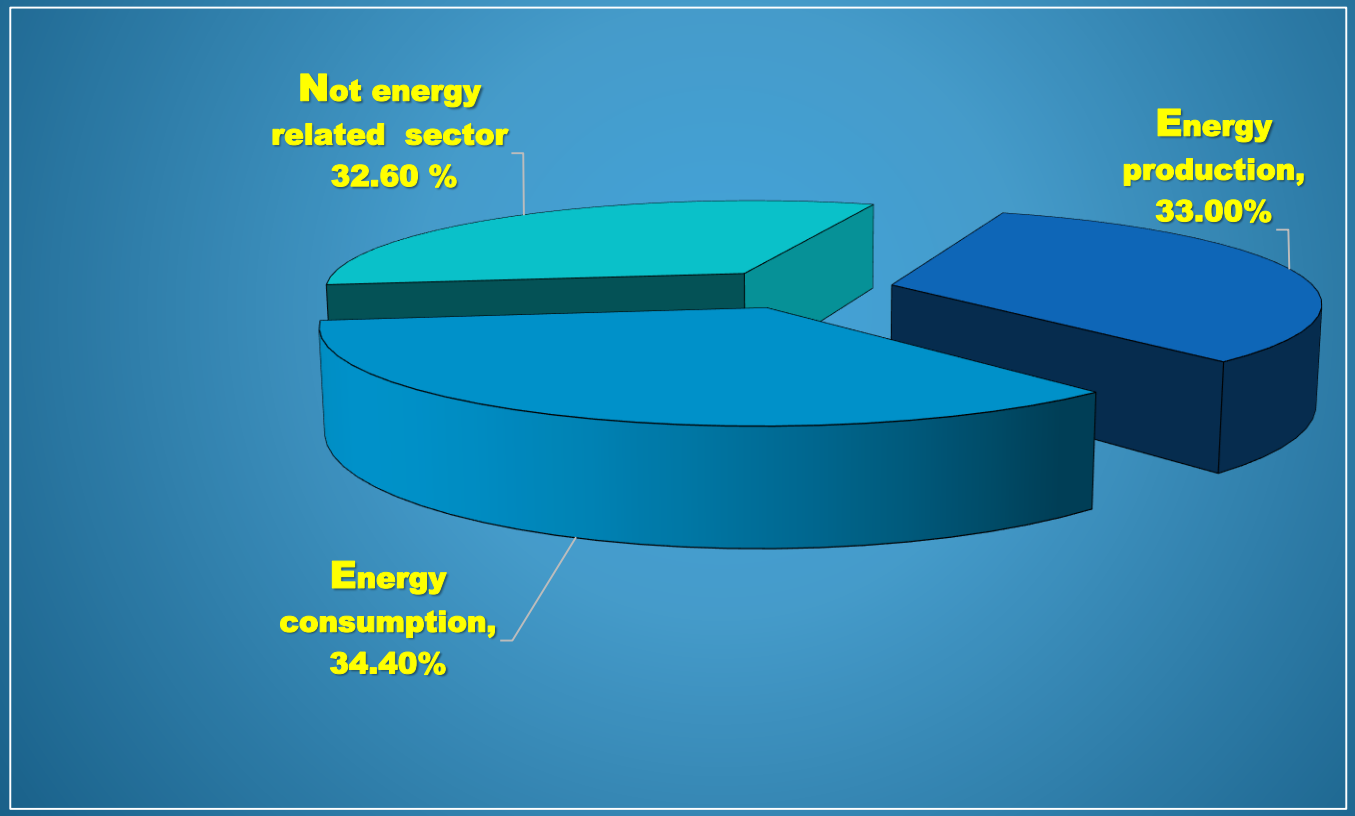
SECOND HAND VEHICLE IMPORTS 2005-2014

Used vehicles imports have represented 80% of total new vehicle sales from October 2005 to December 2014.

43 % of these vehicles were not mechanical or pollution checked up.

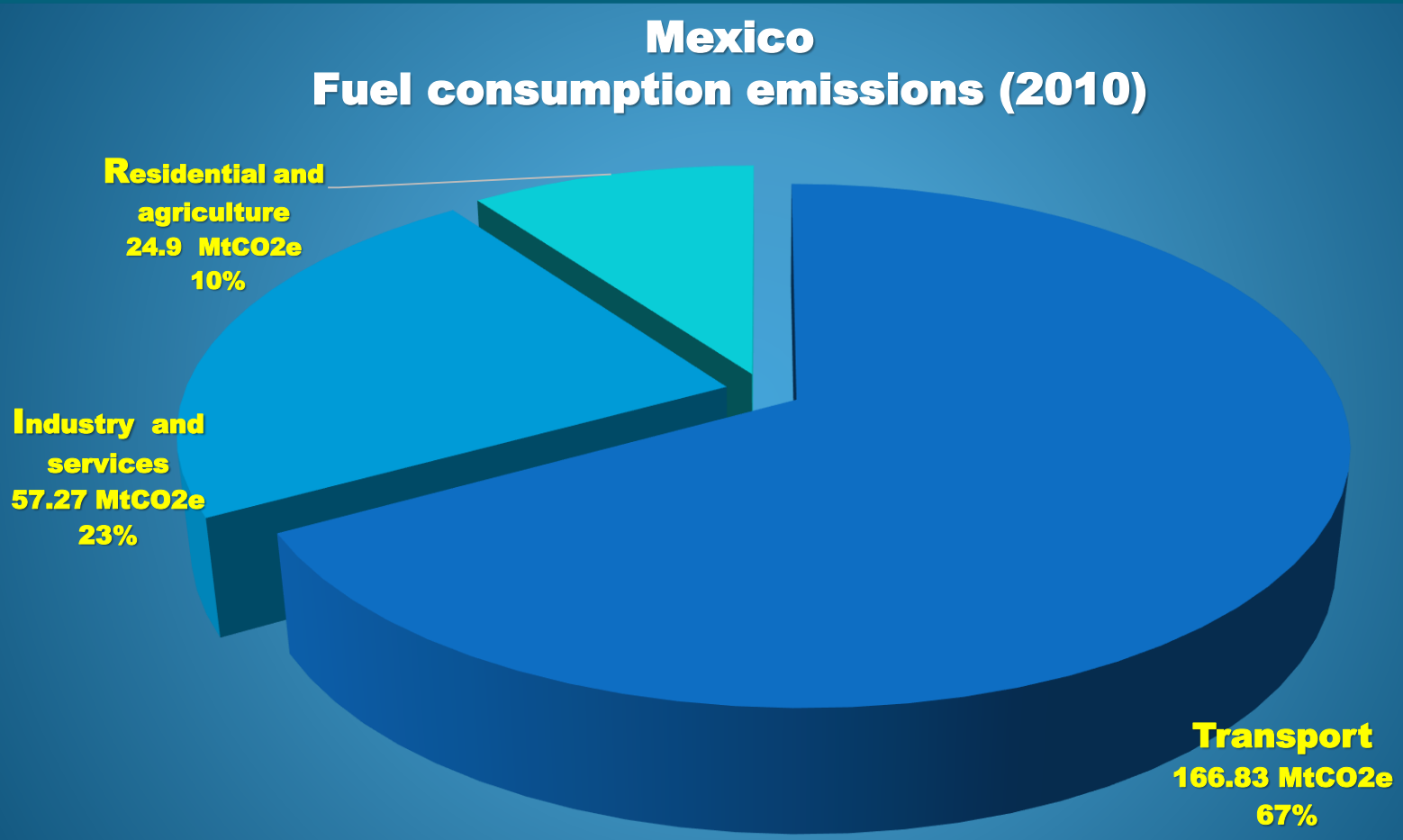
GREENHOUSE GAS EMISSIONS

Mexico
Sources of greenhouse gas emissions (2010)



Source: Semarnat, (March, 2014) *Registro Nacional de Emisiones*. México: Semarnat, figures of INEGI and Semarnat-INECC, accessed at http://www.thepmr.org/system/files/documents/sesion%205B%20-%20Registro%20de%20Emisiones Mexico_ SEMARNAT.pdf , on June 2nd., 2015.

GREENHOUSE GAS EMISSIONS

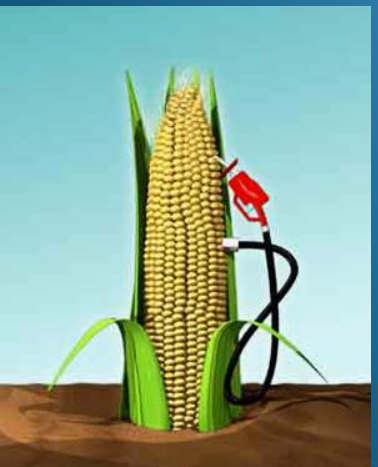


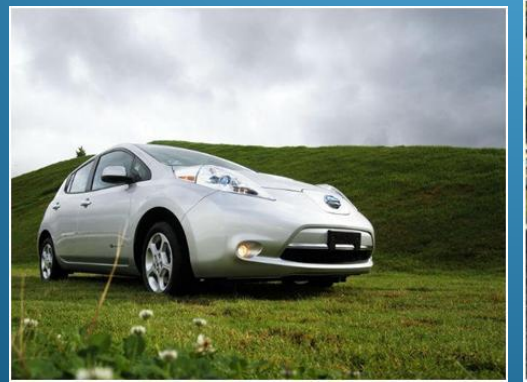
Source: Semarnat, (March, 2014) Registro Nacional de Emisiones. México: Semarnat, figures of INEGI and Semarnat-INECC, accessed at http://www.thepmr.org/ system/files/documents/sesion%205B% 20-%20Registro%20de%20Emisiones_Mexico_ SEMARNAT.pdf on Jun 2nd., 2015.

Technological strategies to reduce automobile GHG emissions

Technological options:

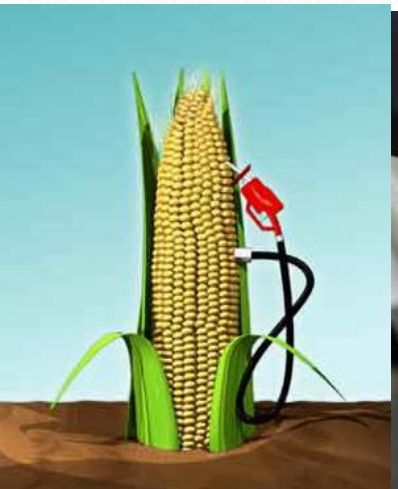
1. Alternative energies
2. New types of motors
3. Other technologies
4. Hybrid and electric vehicles





ALTERNATIVE ENERGIES

- **BIOFUELS**
  - **Ethanol or ethylic alcohol (sugar cane, beet, wheat)**
  - **Biodiesel or Diester (fats and vegetable oils)**
  - **Biogas or methane gas**



ALTERNATIVE ENERGIES

- **BIOFUELS USAGE RESTRICTIONS:**
  - **Biofuels have to be mixed up to 10% with conventional fuels.**
  - **Specially designed engines are necessary for higher concentrations**
  - **The agriculture surface area is limited and the crops destined to produce biofuels could compete with food production.**

ALTERNATIVE ENERGIES

- **BIOFUELS USAGE RESTRICTIONS:**
  - **Forest areas could be needed to produce them, which could result harmful from the environment point of view**

ALTERNATIVE ENERGIES

- **LESS POLLUTING FOSSILE ENERGY:**

  - **Propane or butane (LPG)**
  - **Natural gas for vehicles (NGV)**

There are some commercial vehicles that use LP gas in Mexico

ALTERNATIVE ENERGIES

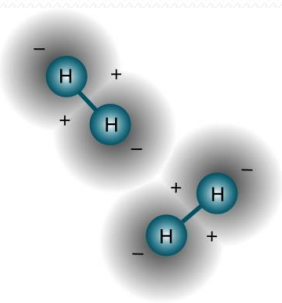
- **HYDROGEN**

  It is an ideal fuel for the environment because when it burns, it releases water vapor.

- **USAGE RESTRICTIONS:**

  Automobile cost transformation is 25 000 Euros

  Special and safe infrastructure is needed for a generalized use.



THE ECO INNOVATION IN VEHICLE MOTORS

- **The motor performance influences on the volume of polluting emissions, so as less fuel is used by one motor for a given power, its emissions could be less important.**

- **The more cylinders a motor has, the more polluting emissions it will produce.**

THE ECO INNOVATION IN VEHICLE MOTORS

DOWNSIZING

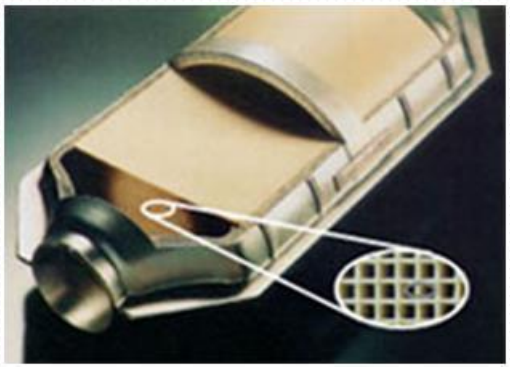
The number of cylinders of a motor is reduced, preserving its performance through a turbocharger and a direct injection.

FUEL BATTERY

It works through gas hydrogen.

OTHER TECHNOLOGICAL INNOVATION

- Catalytic converters
- Transmissions
- Driving help systems
- New assembly technics
- New materials
- New designs



OTHER TECHNOLOGICAL INNOVATION

- **Vehicle Aerodynamics: reduces the air resistance, which reduces fuel consumption and pollution.**

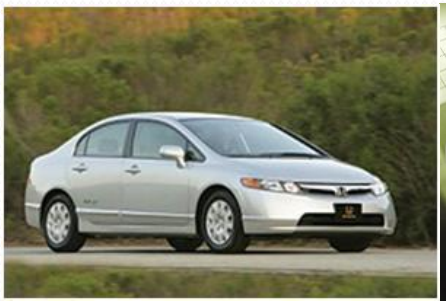
THE ECO INNOVATION IN VEHICLE MOTORS

HYBRID VEHICLES

Their motor combines electrical and mechanical energy of a thermal motorization of fossil fuel. It has fuel savings that go from 4 to 25%.

USAGE RESTRICTIONS

- Vehicle's high cost
- Battery cost



Hybrid vehicles

Model	Brand	Price MXP	Price USA DLLS
Tesla Model S	Tesla Motors	$ 1,387,500	$ 75,000
Prius	Toyota	$ 339,700	$ 18,362
Civic Hybrid	Honda	$ 361,900	$ 19,562
BMW i8	BMW	$ 2,299,900	$ 124,319
Chevrolet Volt	Chevrolet	$ 657,800	$ 35,557

ELECTRIC VEHICLES

- **ELECTRICITY**

  Electricity production forms could be nuclear, wind and hydraulic so it could be environmental friendly.

- **USAGE RESTRICTIONS:**

  - **Urban use; average autonomy from 100 to 150km.**
  - **Freeway 90km.**
  - **Complete recharge 8 hrs.**
  - **Places of quick charge (2 hrs) are needed**

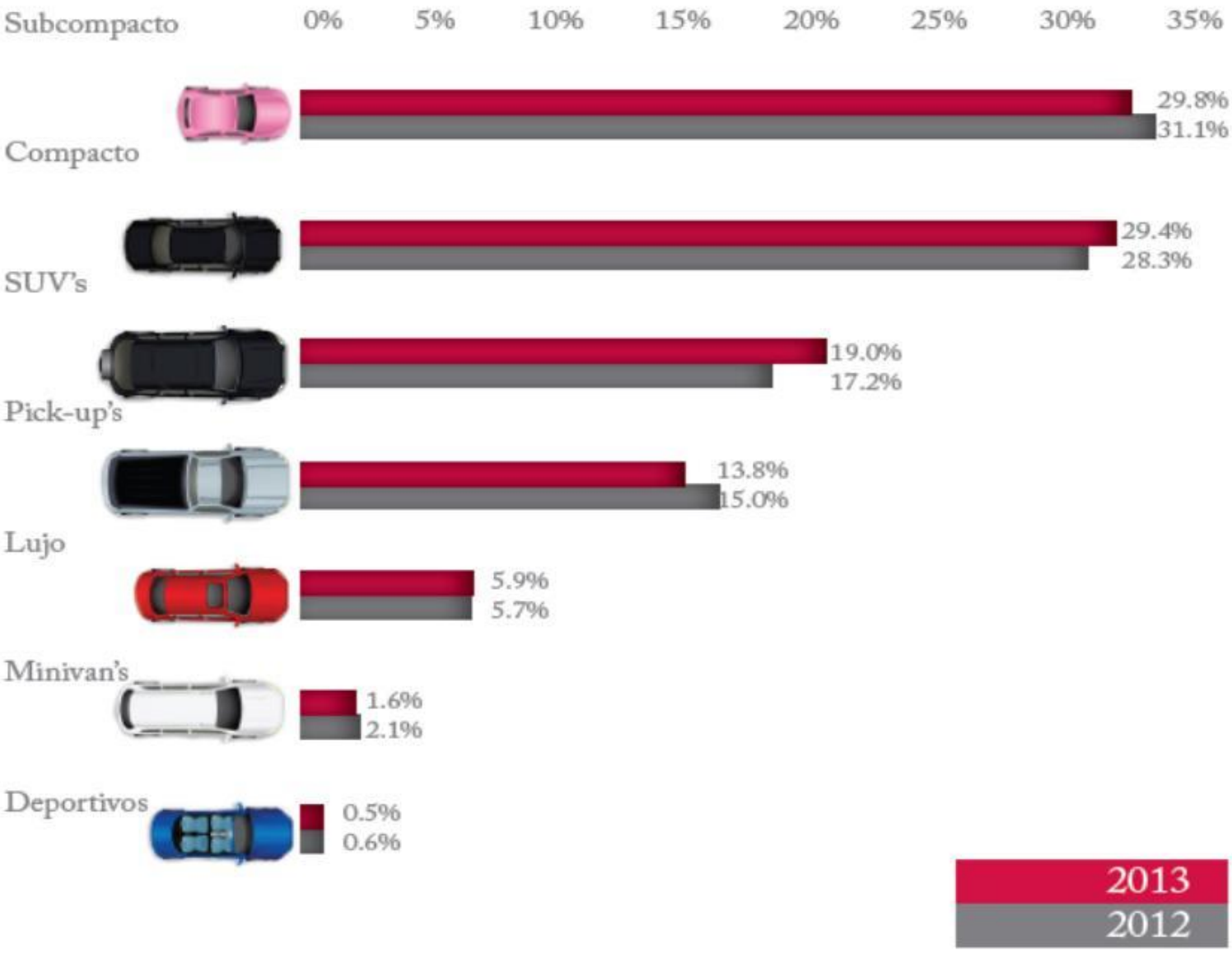
Electric vehicles

Model	Brand	Price MX	Price USA DLLS
BMW i3	BMW	$ 749,000	$ 40,486
Nissan Leaf	Nissan	$ 545,400	$ 29,481
Spark EV 2015	Chevrolet	$ 399,000	$ 21,568

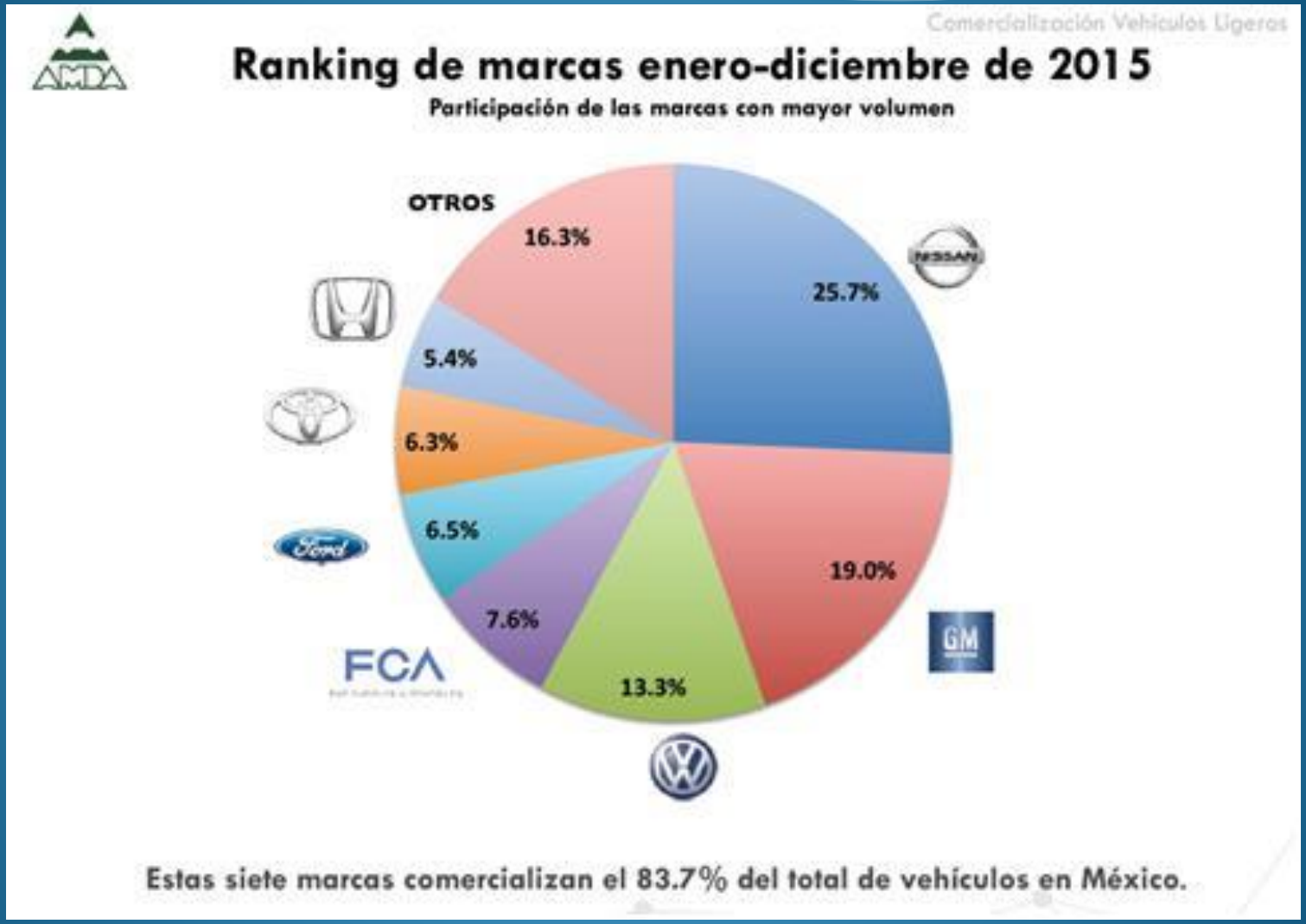
Are electric and hybrid vehicles affordable in Mexican market?

Vehicle demand in Mexico

Participación de mercado de vehículos por segmento, 2012 y 2013



fuentes



Source: Asociación Mexicana de Distribuidores de Automóviles [AMDA] (January, 2016), *Reporte del mercado interno automotriz, diciembre de 2015*. Accessed in http://www.amda.mx/images/stories/estadisticas/coyuntura/2015/ventas/1512Reporte_Mercado_Automotor.pdf?utm_source=Boletin+413&utm_campaign=Boletin+413&utm_medium=email on February 12th, 2016.

Los diez modelos más vendidos

Posición	Modelo	Marca	Segmento	Unidades	% del Mercado	Variación 2015 vs. 2014	
						Unidades	%
1	AVEO	GM	Subcompactos	76,696	5.7%	11,302	17.3%
2	VERSA	Nissan	Compactos	64,454	4.8%	10,677	19.9%
3	VENTO	VW	Subcompactos	53,096	3.9%	14,622	38.0%
4	NUEVO JETTA	VW	Compactos	50,385	3.7%	15,331	43.7%
5	MARCH	Nissan	Subcompactos	49,658	3.7%	13,093	35.8%
6	TSURU	Nissan	Subcompacto	49,134	3.6%	3,610	7.9%
7	SPARK	GM	Subcompactos	41,914	3.1%	5,435	14.9%
8	SENTRA 2.0	Nissan	Compactos	35,996	2.7%	5,369	17.5%
9	Chasis Largo	Nissan	Camiones Ligeros	31,700	2.3%	6,938	28.0%
10	SONIC	GM	Subcompactos	29,606	2.2%	7,515	34.0%

Fuente: Elaborado por AMDA con información de AMIA

Source: Asociación Mexicana de Distribuidores de Automóviles [AMDA] (January, 2016), *Reporte del mercado interno automotriz, diciembre de 2015*. Accessed in http://www.amda.mx/images/stories/estadisticas/coyuntura/2015/ventas/1512Reporte_Mercado_Automotor.pdf?utm_source=Boletin+413&utm_campaign=Boletin+413&utm_medium=email on February 12th, 2016.

MOST WIDELY SOLD AUTOMOVILE PRICES

GM	**Aveo**		**$ 149,900**
	Spark		
	LS		**$123000**
	LTZ		**$198,100**
Nissan	**Tsuru**		**$ 140,700**
	Versa		
	Versa Sense		**$ 222,500**
	Versa Exclusive		**$ 222,500**
	Sentra 2.0		
	Nissan Sentra Sense MT		**$ 236,800**
	Nissan Sentra Exclusive		**$ 324,400**
Volkswagen	**Vento**		
	Startline transmisión manual		**$ 169,900**
	Highline transmisión triptonic		**$ 229,900**
	Nuevo Jetta		
	Volkswagen Jetta 2.0 Manual		**$ 229,900**
	Volkswagen Jetta TDI		**$ 356,940**

AUTOMOVILE PRICE COMPARATION

MOST EXPENSIVE FOSSIL FUEL AUTO	Volkswagen JettaTDI	$ 357 000
CHEAPEST ELECTRIC AUTOMOVILE	Chevrolet Spark EV	$ 399 000
CHEAPEST HYBRID AUTOMOVILE	Toyota Prius	$ 340 000

CUADRO 5

PERCEPTORES DE INGRESOS E INGRESO CORRIENTE MONETARIO TRIMESTRAL POR RANGOS DE SALARIO MÍNIMO, SEGÚN TAMAÑO DE LOCALIDAD, 2014

(Porcentajes)

Múltiplos de salarios mínimos generales	Total		Tamaño de localidad			
			De 2 500 y más habitantes		De menos de 2 500 habitantes	
	Perceptores	Ingreso	Perceptores	Ingreso	Perceptores	Ingreso
Total	75 330 247	1 000 878 802	56 048 314	883 656 626	19 281 933	117 222 176
menor a 2.00	64.2	19.9	57.3	16.8	84.3	42.5
2.01 -6.00	28.7	41.4	33.8	41.4	14.1	40.9
6.01 y más	7.0	38.8	8.9	41.7	1.6	16.6

CONCLUSIONS

- Automotive industry is a very important activity for Mexican economy.
- Fuel automobiles produce the most greenhouse gas emissions during their use phase.
- Research and Development strategies have been implemented by automotive industry in order to mitigate these emissions.

CONCLUSIONS

- Electric and hybrid vehicles are environmental friendly
- There is a lack of infrastructure for electric vehicle use in México
- Hybrid vehicles are the most possible option for Mexican market

CONCLUSIONS

- Electric and hybrid vehicles are unaffordable for most Mexicans
- There are important restrictions for their use in Mexican market

¡Gracias! Thank you!

Vielen Dank! Merci beaucoup!