Fundamentals for Decreasing Sulphur in Fuels in LAC: Approach Systems. Refining Challenges

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Conference on Sulphur in Fuels in South America

Quito, Ecuador – February 13 -14, 2007

Contents

- Approach Systems.
- Challenges from the refining sector.
- Trends in fuel quality in Latin America and the Caribbean.
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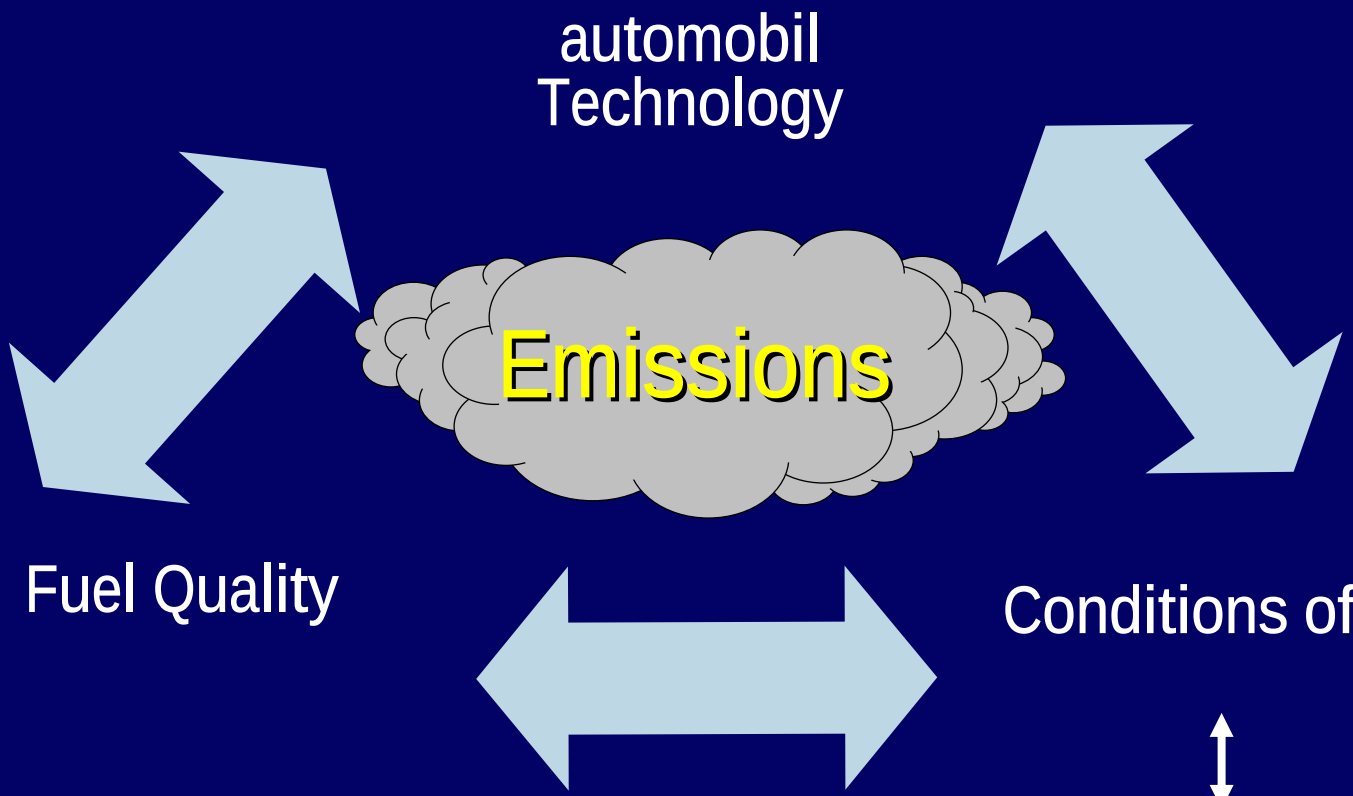
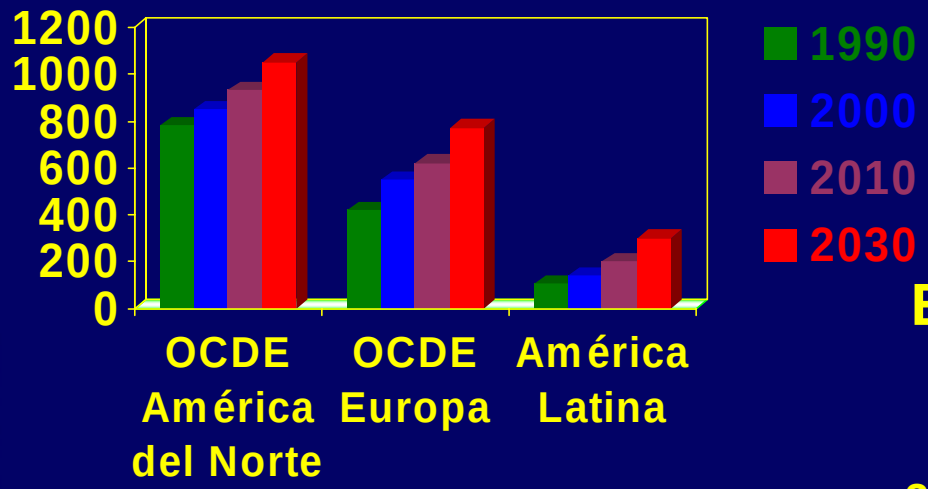
ARPEL's Approach Systems for vehicle emission control



Approach Systems

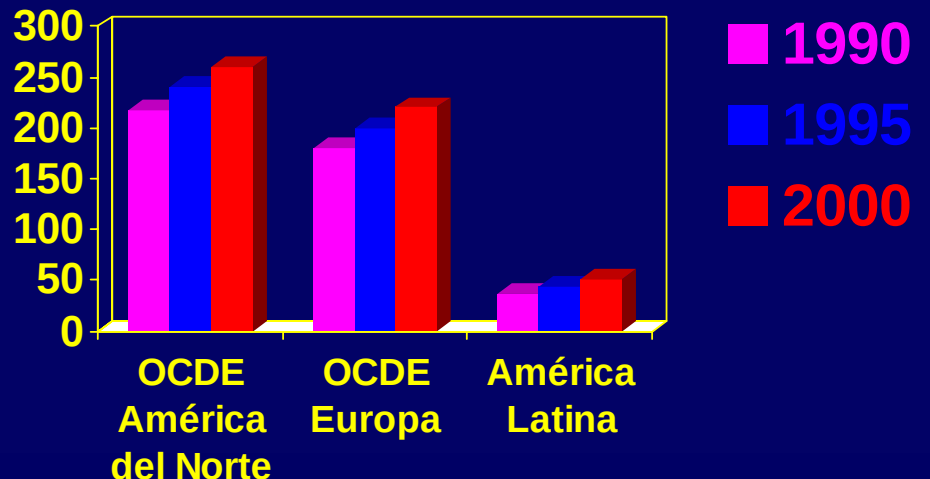
Vehicles per e/1000 persons Tendency



Different magnitud of problem → Different focus

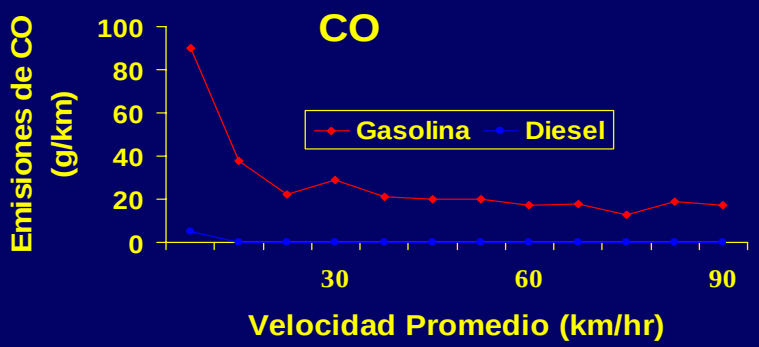
Ownership rate

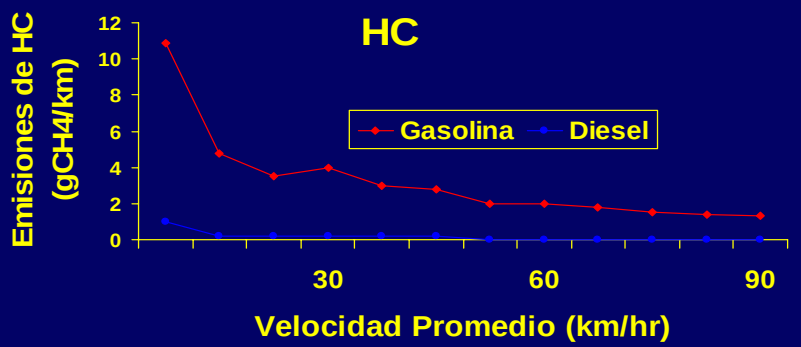
Estadísticas de vehículos en millones

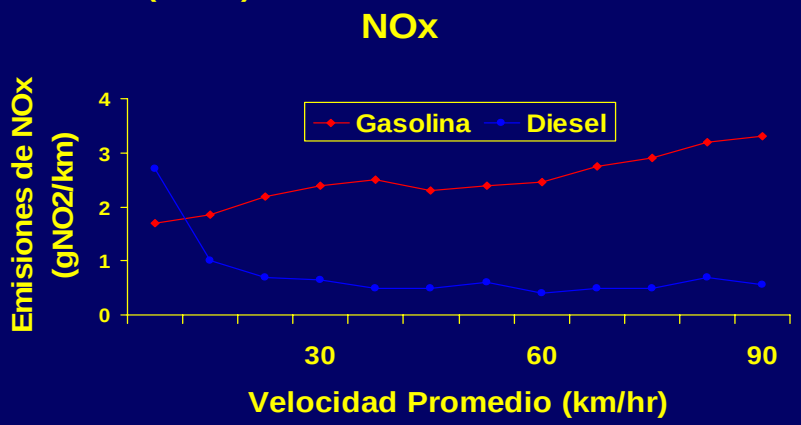


Impact from conditions of use on vehicle emissions

Speed and emissions from vehicles without catalysts







INRETS Driving Cycles

Source: World Bank, 1996

Impact of vehicle technology on vehicular emissions

Control of exhaust emissions for light gasoline powered vehicles

Control Stages

Parameter	% controlled*	Controls Required	
HC	66	Ignition Timing	
CO	63	Air/fuel Relation	
NOx	11	Air injection	Recirculation Exhaust gases
HC	89	Oxidation catalyst	
CO	83	Ignition Timing	
NOx	39	Recirculation Exhaust gases	
HC	94	Three Way Catalyst	
CO	95	Closed loop carburetor or	
NOx	71	Electronic fuel injection	
HC	94	Oxidation Catalyst	
CO	98	Electronic fuel injection	
NOx	71	Quick burning combustion chamber	
HC	96	Three way catalyst	
CO	97	Electronic fuel injection	
NOx	88	Recirculation of exhaust gases	
HC	99	Three way electric catallyst	
CO	99	Electronic fuel injection	
NOx	94	Recirculation of exhaust gases	

See Fuel Specifications

Standards of more demanding fuels

* Compared with levels that are not controlled

Source: Asif Faiz, 1996

Impact of vehicular technology on vehicle emissions

Control of exhaust emissions on light diesel powered vehicles

Control Stage

Parameter	% controlled*	Controls Required	
NOx	40	Injection Timing	
MP	33	Optimization of combustion	
NOx	40	Variable Injection Timing	See Fuel Specifications
MP	78	Combustion Optimization, RGE	
NOx	40	Electronic Fuel Injection	
MP	92	Optimization of combustion, RGE, Catalyst converter or particle trap	

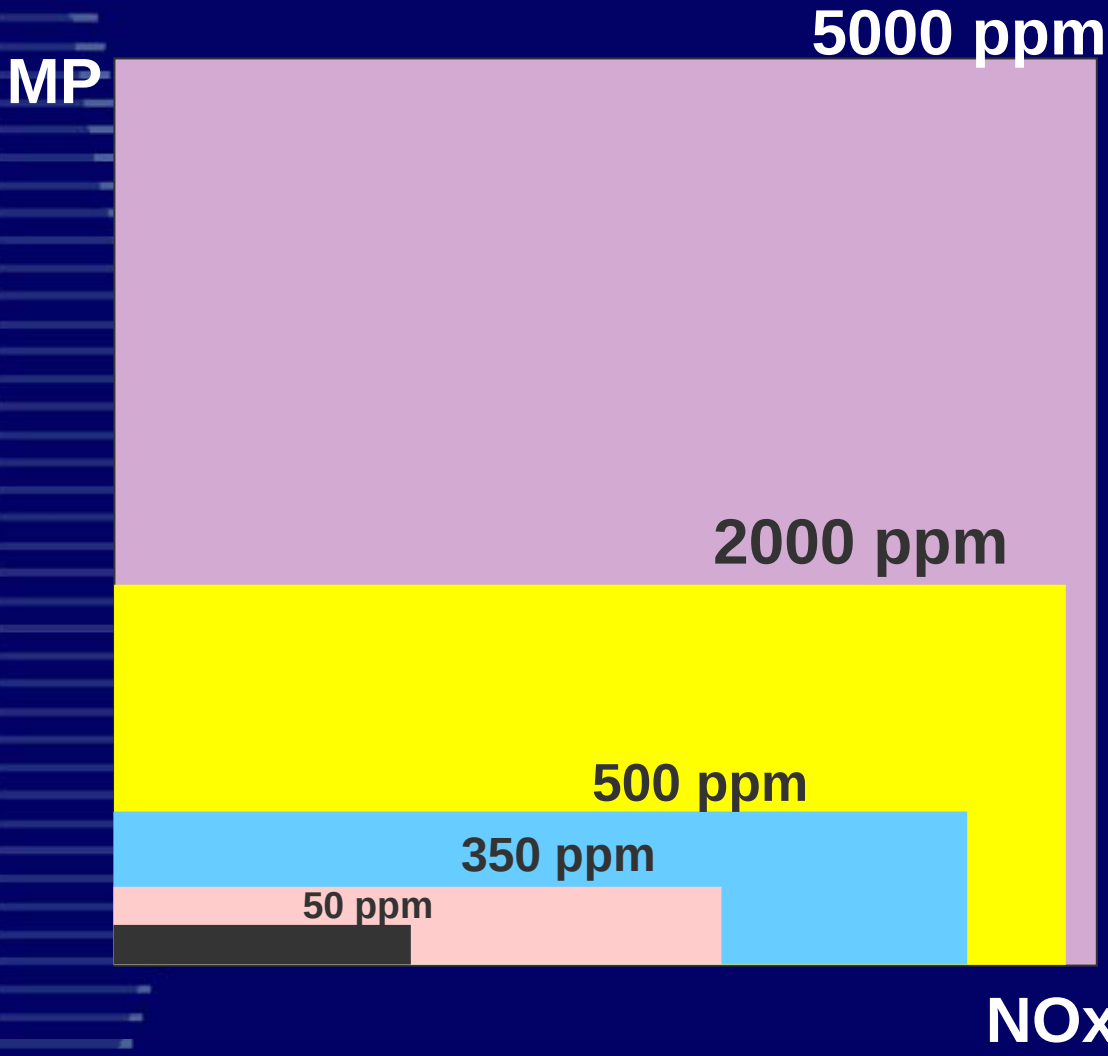
More Demanding Fuel Standards

* Compared with uncontrolled levels

Source: Asif Faiz, 1996

Approach Systems

Importance of base line in selecting cost/effective alternatives
Sulphur in diesel fuel – Associated Technologies – Heavy Vehicles



- Injection Timing Optimization of Combustion
- Variable Injection Timing
- RGE
- RCS
- Catalyst Converter
- Particle Trap
- NOx Absorber

MP + NOx Emissions Reduction

[S] LB ppm	LB fixed	
2000	60%	N/A
500	85%	+25%
350	95%	+10%
50	99%	+ 4%

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Challenges from the Refining Sector

Assumptions – Fuel Specifications Fuels

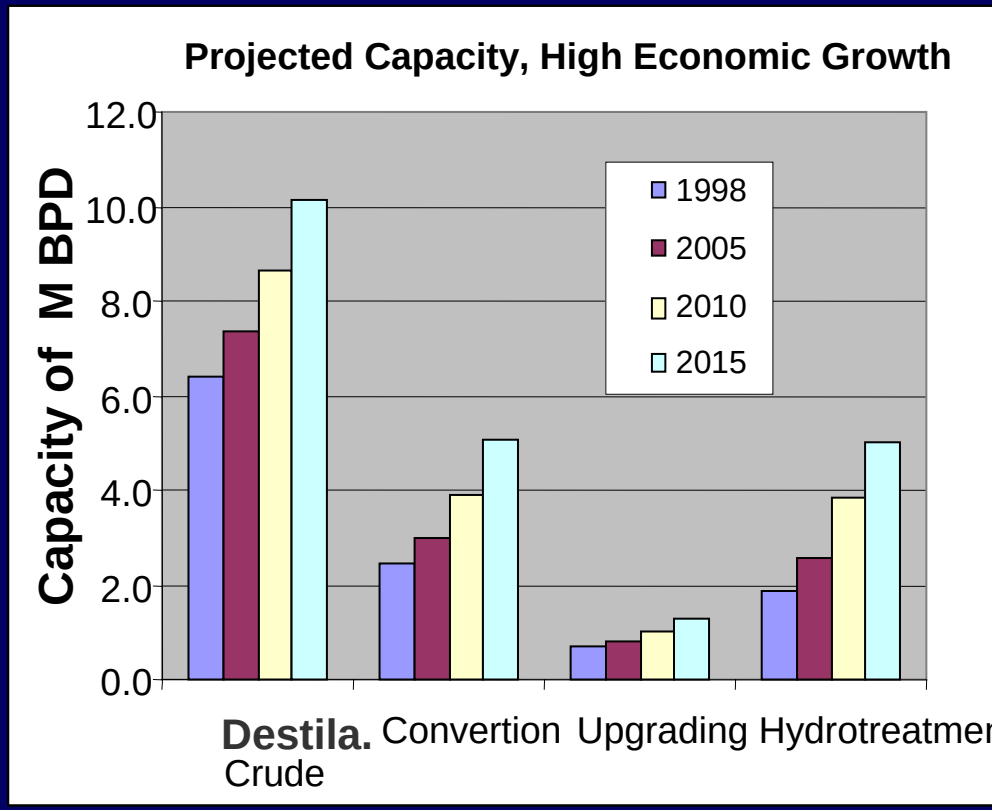
Refined Product Quality	2005	2010	2015
Gasoline			
Lead Use	Venezuela, ~~Cuba~~	Lead Free	Lead Free
S (wppm), maximum	400	400	400
Diesel Fuel			
S (wppm), maximum	2.000	1.200	500

Economic Growth: 4%

Challenges from the Refining Sector

Capacity up to 2015

- Crude Distillation in 2015 is 10 m BPD
- Conversion in hidrocracking, FCC and delayed cracking grows
- Upgrading includes more reforming
- Large growth in hydrotreatment



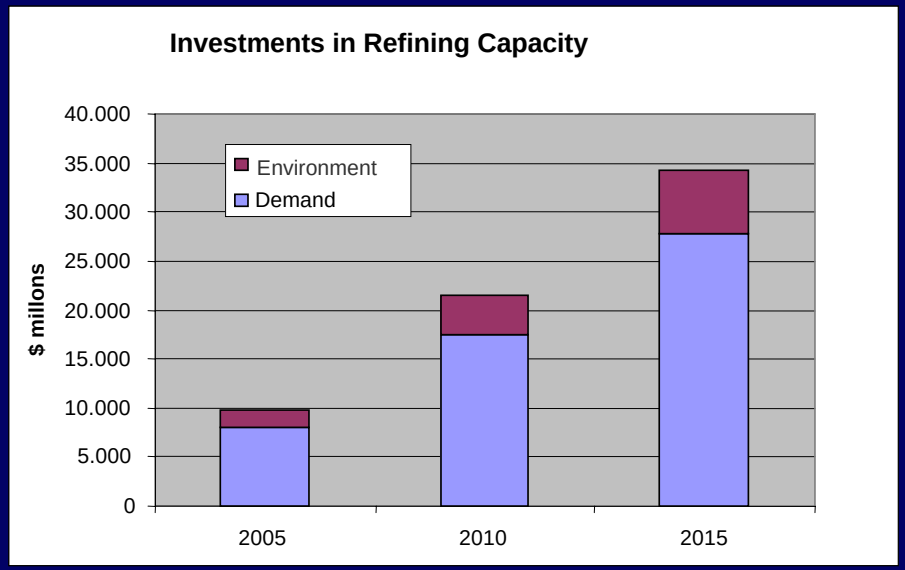
Total Regional Capacity

Capacity, k BPD	1998	2015	% Growth
Crude Distillation	6,005	9,803	63
Fluid Cat Cracking	1,393	2,727	96
Hydrocracking	148	691	367
Visbreaking	368	651	77
Delayed Coking	344	874	154
Catalytic Reforming	472	987	109
Naphtha HDS	566	1,499	165
Diesel HDS	960	2,645	176

Challenges from the Refining Sector

Investment up to 2015

- Investment to growth of demand for 2015 is US$28 billion
- Investments in the environment for 2015 are US$ 6.0 billion



Challenges from the Refining Sector

S Reduction in Gasoline and Diesel Fuel

- Gasoline and diesel fuel have 50 ppm of sulphur
- Investment increases by US$9.61 million for the region
- Added units are hydrotreatment and hydrogen generation

Conclusions – Investments

- **Investments in the refining sector in the region exceed historic investment by 50%, from US$ 2 billion to US$ 3 billion per year**

- **Rapid growth in demand from refineries with limited space for expansion, shall require building new refineries in Mexico, Brazil and Central America**

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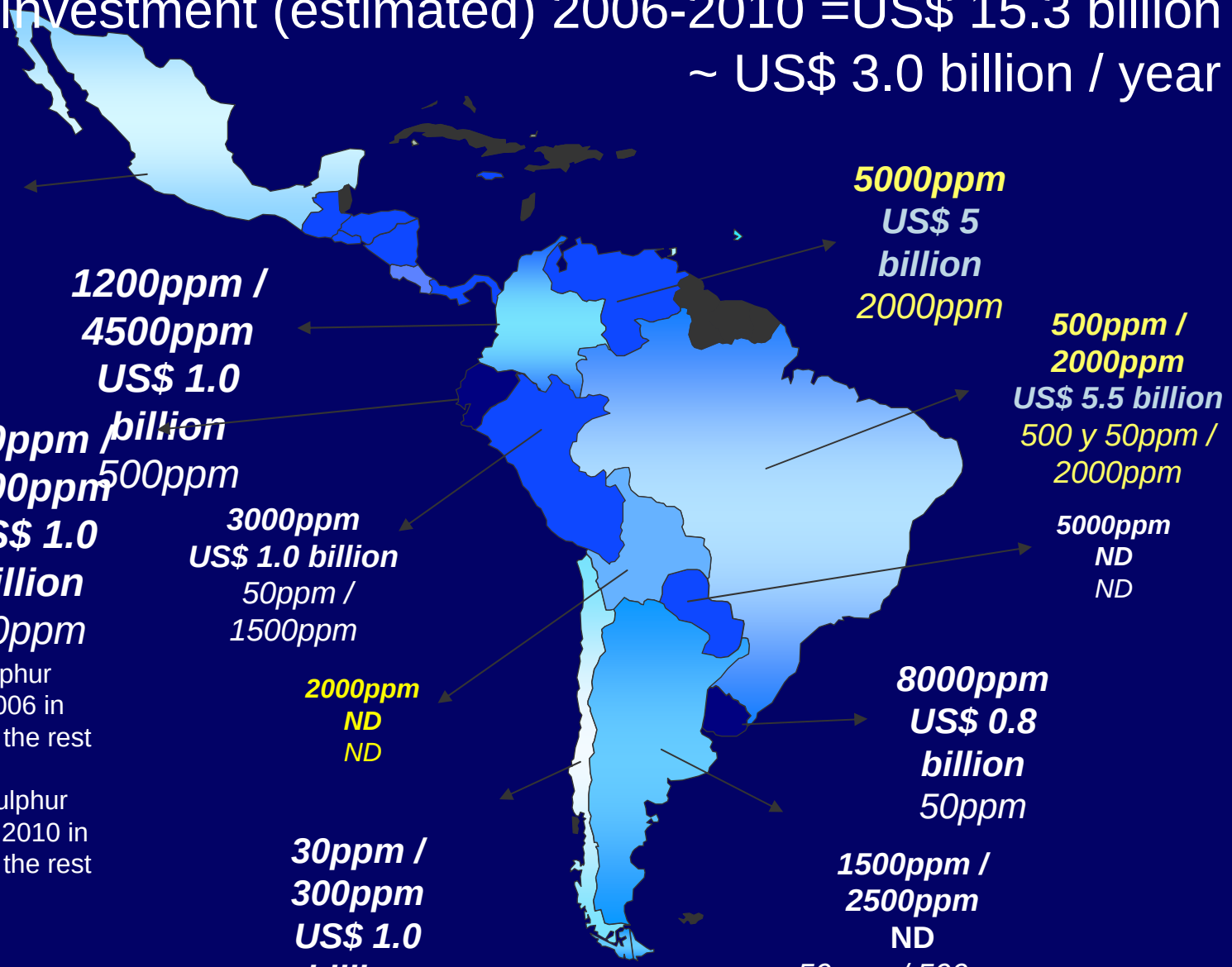
Sulphur in Gasoline– 2006 – 2010

References
Amounts in bold are sulphur content in gasoline in 2006 in Metropolitan Areas and the rest of the country (green)
Amounts in italics are sulphur content in gasolines for 2010 in Metropolitan Areas and the

Sulphur in diesel fuel - 2006 - 2010

Total Investment (estimated) 2006-2010 =US$ 15.3 billion
~ US$ 3.0 billion / year



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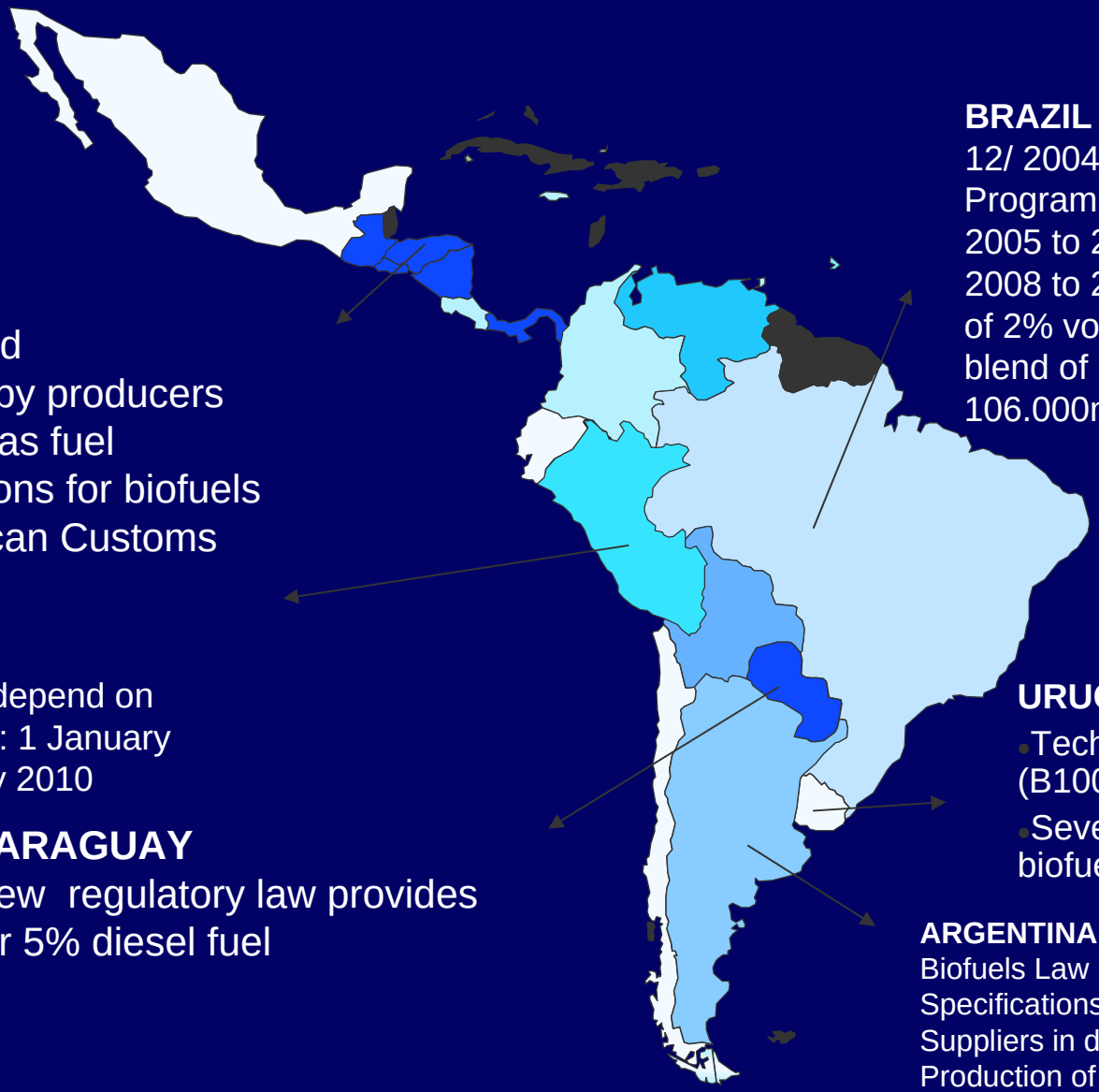
Biofuels in LAC

Biodiesel Fuel



BRAZIL
12/ 2004 Biodiesel Fuel Program started
2005 to 2007: 2% vol
2008 to 2013: mandatory blend of 2% vol. 2013: mandatory blend of 5% vol. Production: 106.000m³/year

HONDURAS
Production: 10.000 g/d
75% self-consumed by producers
Remaining 25% sold as fuel
Reviewing specifications for biofuels by the Central American Customs Union ("UAC").

PERU
5% vol. Periods depend on geographic area : 1 January 2008 – 1 January 2010

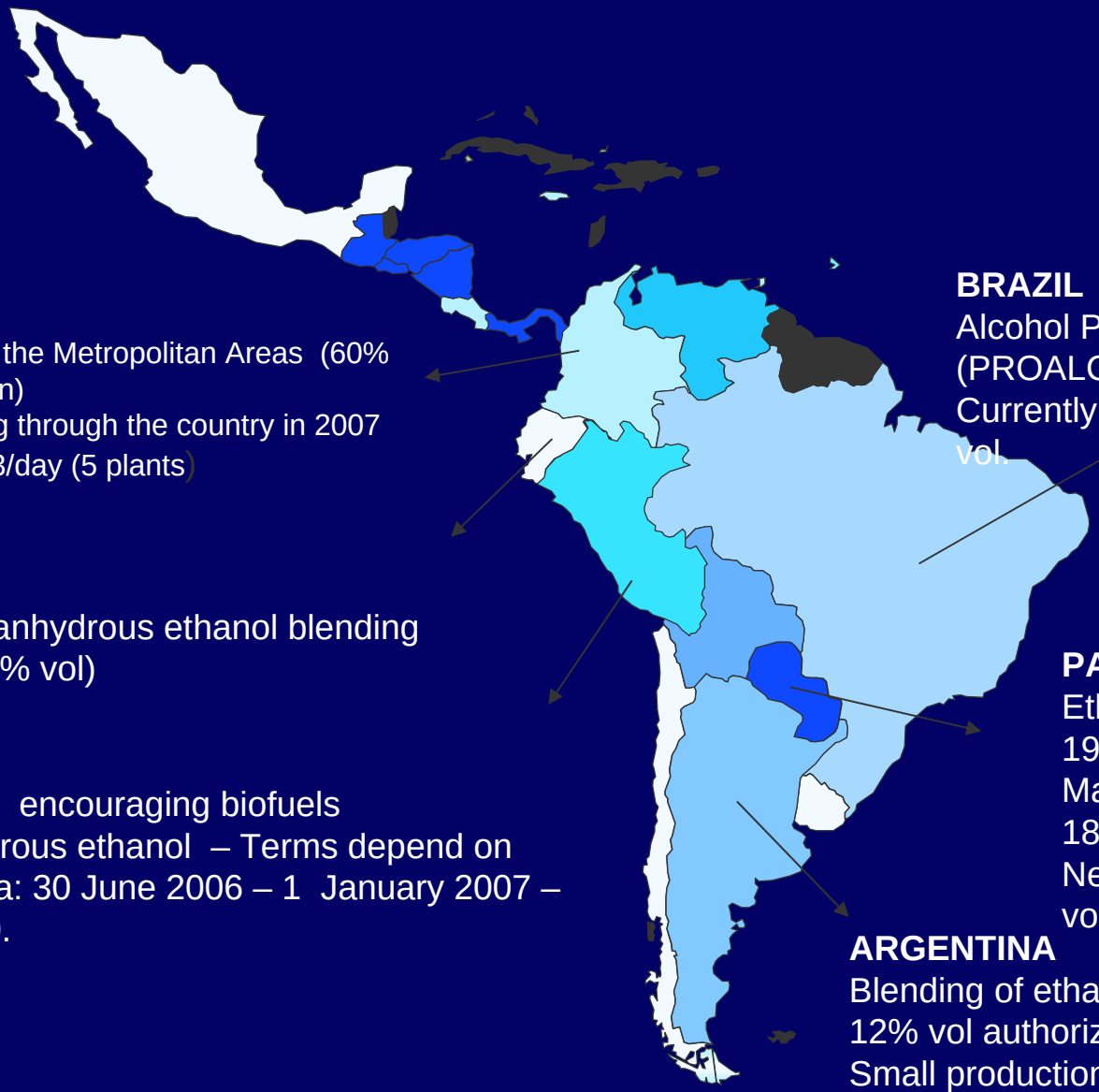
PARAGUAY
New regulatory law provides for 5% diesel fuel

URUGUAY
- Technical Standard (B100), converted into a bill
- Several initaitives for biofuels (public-private)

ARGENTINA
Biofuels Law passed in April, 2006
Specifications in force under review
Suppliers in development (pilot scale)
Production of soy in short term

Biofuels in LAC

Ethanol



COLOMBIA
July, 2005 10% for the Metropolitan Areas (60% of total consumption)
Mandatory blending through the country in 2007
Production 1000m3/day (5 plants)

ECUADOR
Pilot plan for anhydrous ethanol blending (maximum 10% vol)

PERU
Law in force for encouraging biofuels
7.8% vol anhydrous ethanol – Terms depend on geographic area: 30 June 2006 – 1 January 2007 – 1 January 2010.

BRAZIL
Alcohol Program (PROALCOOL)
Currently blends of 20 - 25% vol.

PARAGUAY
Ethanol in gasoline since 1982.
Maximum allowed: 18%vol.
New law provides 25% vol.

ARGENTINA
Blending of ethanol in gasoline at 5-12% vol authorized by law
Small production plants

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Air Quality Management (IAL in Latin America)

- **Implementation IPIECA Toolkit**
  - Tool for evaluating alternatives in the management of emissions control.
  - Used in Lima-Callao. 10 most effective actions determined.

- **Measurement of vehicular emissions**

  - Field testing with municipalities in Buenos Aires (RepsolYPF + ExxonMobil), San Paulo (PETROBRAS) and Santiago (ENAP) for light vehicles

- **Field testing with the IAL Management Committee for Lima- Callao – emissions measurement in cities with high altitudes for GNC vehicles**

Thank you very much!

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