Impacts of air pollution in La Paz, BCS.

Mexican Institute for Competitiveness

Background

IMCO conducted a study to estimate the impact of air pollution in 34 Mexican cities considering that:

Mexico became an urban country in the last 60 years

→ Thus, increased its industrial, vehicular and service activities

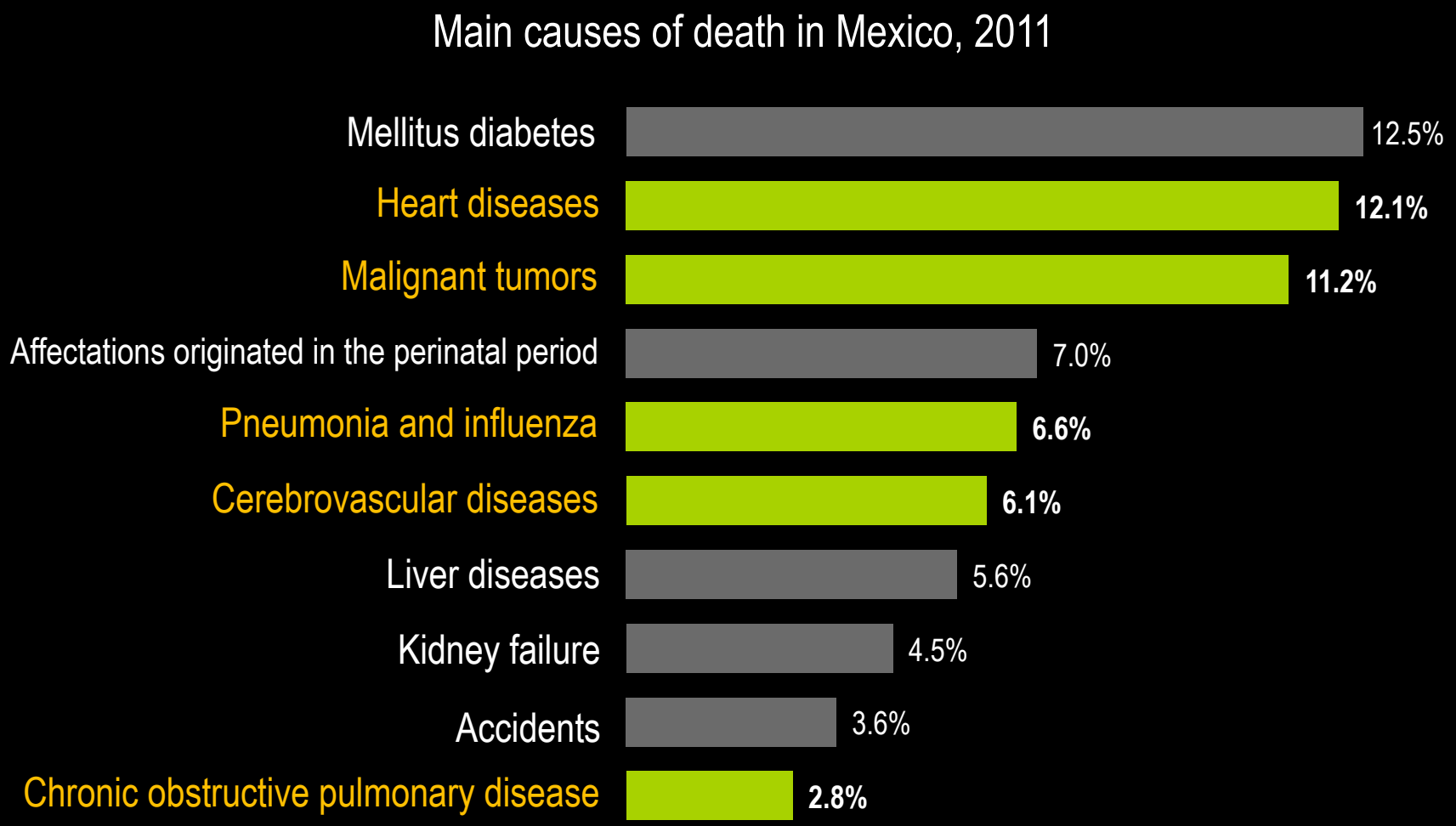
→ As a result, we went from emitting 1.63 metric tons per capita in 1961 to 3.76 in 2010.

→ This represents a higher concentration of air pollutants.

→ This translates into new challenges and threats to the health of the population. Air pollution is associated with five of the ten leading causes of death in our country.

Source: IMCO with information from the Ministry of Health, INEGI, Semarnat, INECC

Association of pollution with 5 of the top 10 causes of death in Mexico…

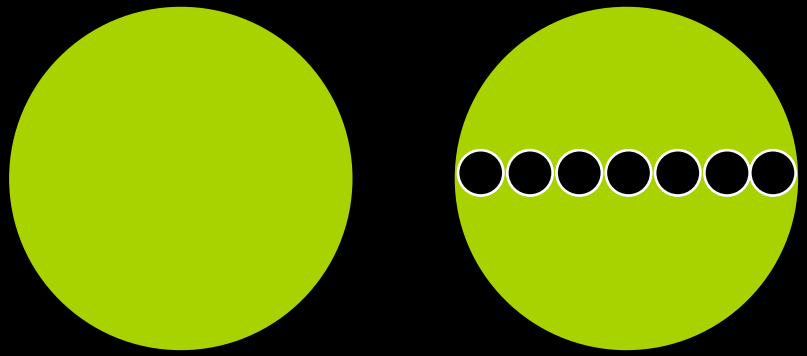


Source: IMCO with information of the Ministry of health (2011)

IMCO's model estimates were based on PM_{10}:

- As it is the most commonly measured and reported pollutant in Mexican cities
- Because their size allows them to enter directly into the respiratory system

Human hair diameter
50-70 µm



PM_{10} Particles diameter:
10 µm

Source: EPA

The model considers NOMs and WHO's limits*:

The model was built considering the Mexican Official Standards (NOMs) that regulate the concentration of pollutants in Mexico, as well as the recommendations of the World Health Organization (WHO) on good air quality.

Pollutant	Formula	Max limit in Mexico	Who's recommendations
Ozone	O_3	216 µg/m^3 in 1 hr.	100 µg/m^3 as an 8 hr. average
Sulfur dioxide	SO_2	288 µg/m^3 as a 24 hr. average	20 µg/m^3 as a 24 hr. average
		66 µg/m^3 yearly average	
		524 µg/m^3 as an 8 hr. average	500 µg/m^3 as a 10 min average
Nitrogen dioxide	NO_2	395 µg/m^3 in 1 hr.	40 µg/m^3 yearly average
			200 µg/m^3 as an 1 hr. average

*World Health Organization

Source: NOM-020-SSA1-1993, NOM-021-SSA1-1993, NOM-022-SSA1-2010, NOM-023-SSA1-1993, NOM-025-SSA1-1993, NOM-026-SSA1-1993 and WHO, Health and Air quality, Descriptive note N°313, September 2011.

The costs were estimated based on:

- Health damage attributable to pollution*
  - Premature deaths
  - Hospitalizations
  - Medical consultations
- Associated costs
  - *Tangibles* => Health expenses
    - Average unit cost of hospitalization and medical consultations in a day
  - *Intangibles* => Losses in productivity
    - Average daily wage by those days of medical care
    - Productive years lost to premature death based on an average annual salary

* With epidemiological estimates that measure how sensitive the population is to suffer damage from particle exposure levels above WHO's recommendations.

Results: from January 1, 2010 to September 24, 2013 the accumulated costs for Mexico are:

19,242
Premature deaths

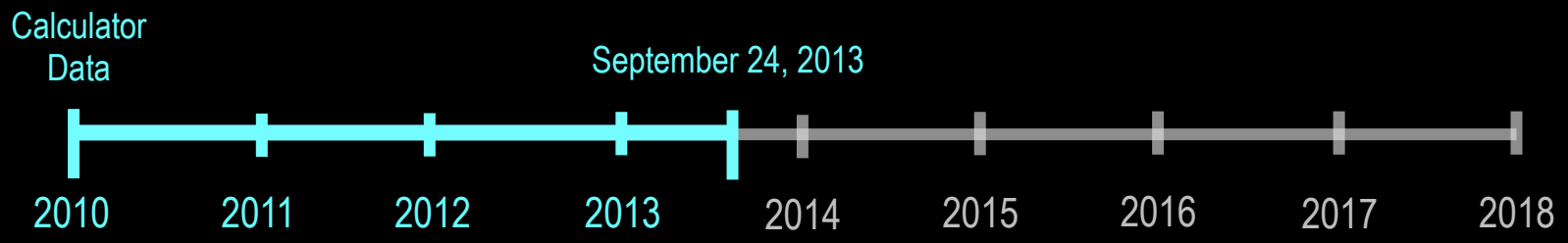
53,191
Hospitalizations

3,110,072
Medical consultations

Accumulated economic losses…

$ 13,979

Million pesos of 2010



Assumptions: CONAPO's population growth rate (2010-2025 projections). It is assumed that the pollutions of each city is equal to that recorded in 2010. A discount rate of 12% was used (SHCP).

Failure to address this issue will increase the costs to:

37,488
Premature deaths

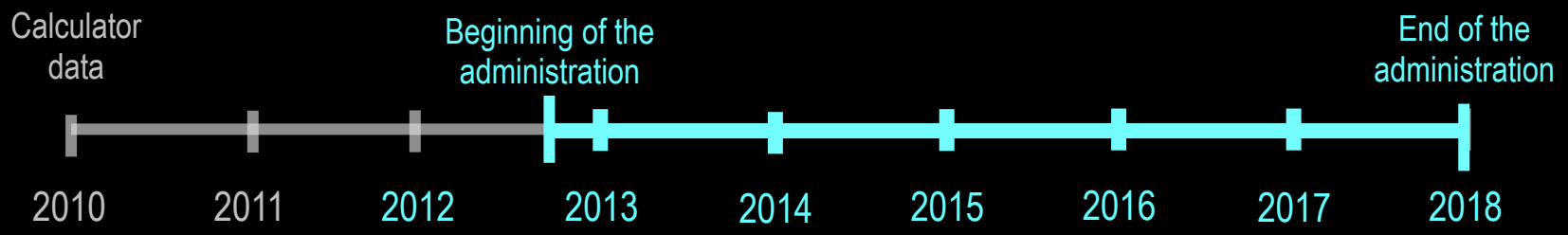
103,629
Hospitalizations

6,059,118
Medical consultations

Accumulated economic losses…

$ 20,288

Million pesos of 2010



Assumptions: CONAPO's population growth rate (2010-2025 projections). It is assumed that the pollutions of each city is equal to that recorded in 2010. A discount rate of 12% was used (SHCP).

Consequences:

In the short term:

- The diseases caused health expenditures, to the families or the public sector.
- **Reduce productivity** because of absenteeism and poor performance of workers

In the long term:

- Repel **talent**
- Discourage of **investments**

Project La Paz

Objectives

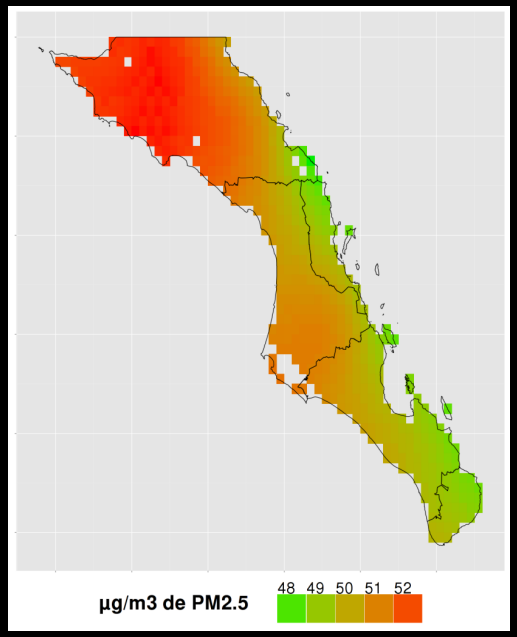
1. To estimate the impacts of pollution on La Paz from an economic point of view, linked to health costs.

2. To estimate the externalities of the power generation plants in La Paz

1 Impacts of air quality in La Paz

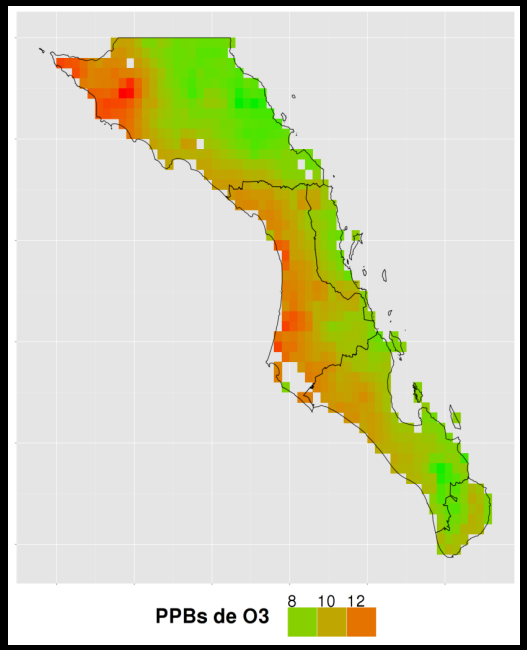
According to the global study of pollution (PM2.5 and ozone), based on satellite images, La Paz has no contamination problems

$PM_{2.5}$ particles



Under WHO's recommendations of 9.08 ug/m3.

Ozone



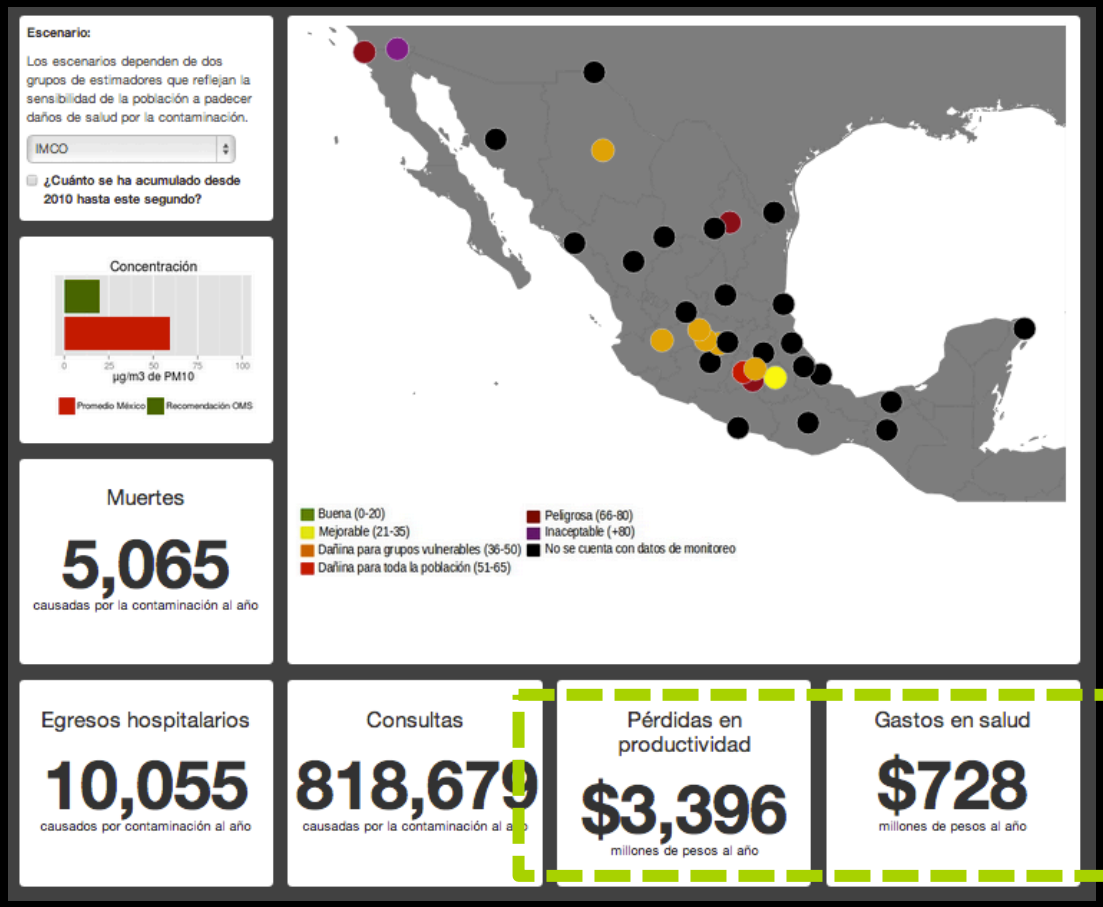
Under WHO's recommendations of 49.73ppb

Source: Exposure Assessment for Estimation of the Global Burden of Disease Attributable to Outdoor Air pollution" by Brauer et al 2011. Data for 2010

1 Impacts of air quality in La Paz

We were unable to incorporate La Paz to IMCO's calculator for 34 cities because of the lack of information on PM_{10} emissions.

It allows to analyze different scenarios and change the assumptions



It is the study with the largest number of cities (disaggregated results)

It quantifies the costs associated with health damage

www.imco.org.mx/calculadora-aire

1 Therefore, we built a model for La Paz

The model was constructed from two official series: emissions (SINAICA) on the one hand and the other hospital records (IMSS)

Poisson regression model with time series*

Equation: $Log(\gamma)=\alpha+ \beta 1*SO2+ \beta 2*NO2+ \beta 3*NOx+ \beta 4*NO+U$

Dependent variable: logarithm of the number of hospital admissions for respiratory diseases. (Set of 884 days)

Independent variables: average daily concentrations of SO2, NO2, NOX y NO. (Set of 1181 days with entries for 28,344 hours)

Because of missing values in air quality measurements the model was constructed using information only from the 14 of march 2010 till the 31 of december 2012.

* The Poisson regression model was used because it and the negative binomial regression are used when the dependent variable is generated by counts (number of events occurring in a given time). The Negative Binomial results were not significant, so we kept on with the Poisson regression.

1 Results from the model for La Paz

- The independent variables **DO NOT** explain the behavior of changes in the number of hospital admissions (with a confidence level of 95%).
- Modifying the model, SO_2 is the only pollutant with statistical significance and explains 0.43% of the variation in hospitalizations for respiratory diseases.

In other words: the NO_2, NOx, NO y SO_2 pollutants have no impact on the health of the population of La Paz (respiratory diseases).

Source: IMCO with information of SINAICA and IMSS 2013.

IMCO

1 Results from the model for La Paz

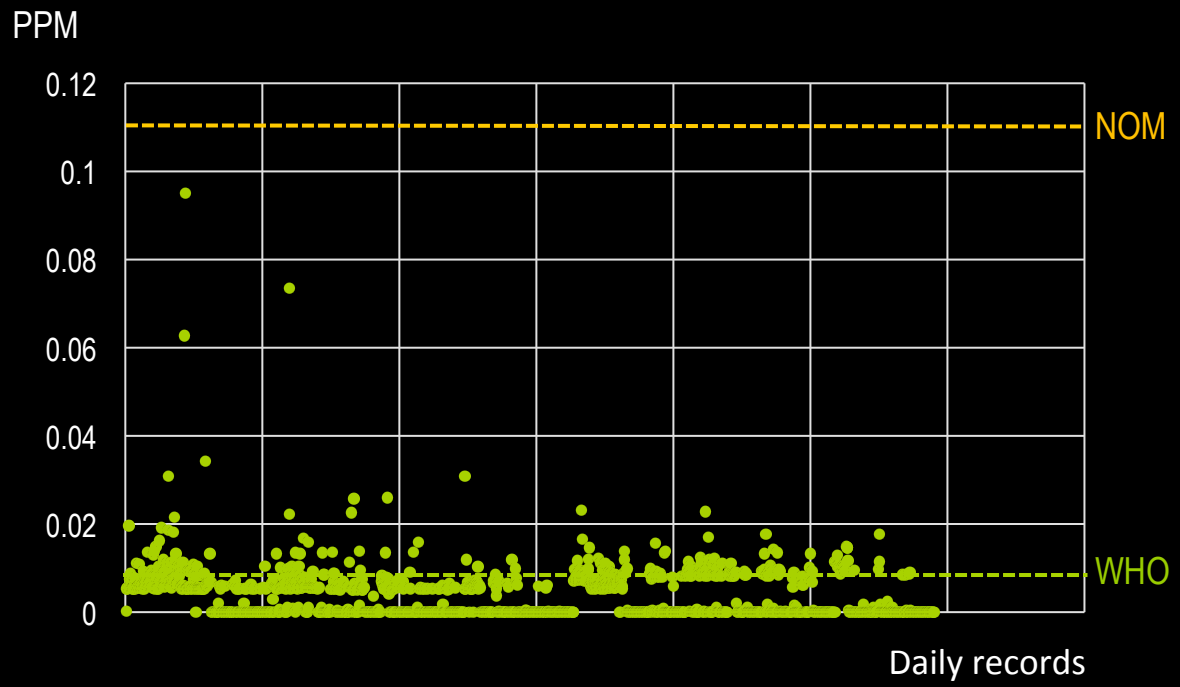
Although monitoring stations are not necesarrily in the most appropiate areas:

Source: Javier Huerta Lara Alfredo Bermúdez Contreras en «*Apuntes sobre la contaminación ambiental producida por las centrales eléctricas de Comisión Federal de Electricidad que afectan la imagen, salud y economía de La Paz, B.C.S*» 2014

1 Results from the model for La Paz

SINAICA records come from 1,181 days and 28,344 hours for each pollutant: SO_2 NO_2, NOx and NO, which never exceed the limits of the Mexican NOMs but do surpass WHO's SO_2 standards 21.25% of the days.

SO_2 concentrations in La Paz (24 hour average)

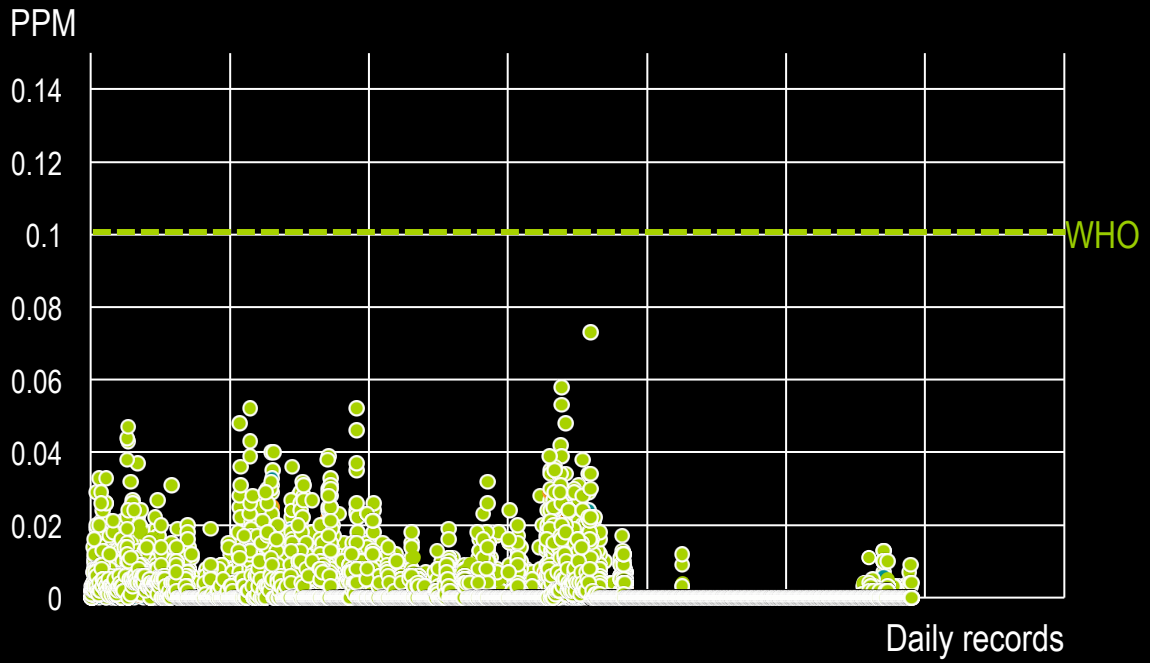


Source: IMCO with information of SINAICA.

1 Results from the model for La Paz

On the other hand, NO_2 concentrations in la Paz never exceed the limits of the Mexican regulation or WHO's standards.

NO_2 concentrations in La Paz (1 hour average)



There is no national or international regulatory framework to limit the concentrations of NOx and NO since they don't have a direct impact on the health.

Source: IMCO with information of SINAICA.

1 Limitations of the model for La Paz

1 Diseases database:

- The data used exclude valuable information from the public health units of the state government.
- It was not possible to differentiate the entry of chronic recidivists patients from the rest of the people.
- There was no hospital admissions entries recorded for the 46.38% of the days.
- As a result of the low number of hospital admissions, no distinction was made between younger patients, the people older than 65 years and the rest of the population.

Source: IMCO with information of IMSS, 2013.

1 Limitations of the model for La Paz

2 Emissions database:

- Some records of the SO2, NO2, NOX and NO concentrations had negative figures, which were replaces by zeroes in order to run the Poisson regression.
- A significant number of hourly measurements recorded zero ppm for contaminants, which could be generated by:
  - Not having any particle contaminants that hour.
  - *Not accounting any measurement, recording a null entry (zero)
- We were unable to add control variables such as humidity and temperature.
- Two points of comparison were used (both with similar results):
  - The hospital admissions as a result of air pollution from the same day.
  - The hospital admissions as a consequence of pollution concentrations from the previous day.

Source: IMCO with information of SINAICA, 2013.

2 Estimating the externalities of the generating plants located in La Paz

There are 3 CFE power plants in La Paz

Punta Prieta II

Turbo gas La Paz

Baja California Sur 1 (CI)

* With IMCO's externalities methodology

Source: IMCO with information of CFE, Cepal, Aipacks, IPCC, SENER

2 IMCO's externalities model in one slide

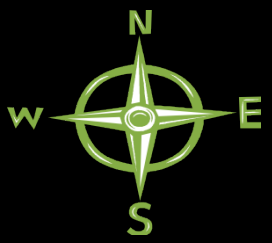
It considers the 4 phases of the methodology of impact (ExternE), an universal externalities methodology created by an UN agency with the following considerations:

1. A model of simple pollutant dispersion
2. The operation of plants
3. Impacts on health, biodiversity and climate change

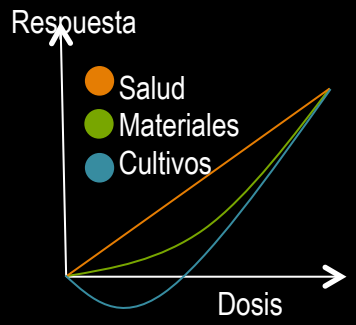
The model consists of the quantification of:

The sources' characteristics

Dispersion model



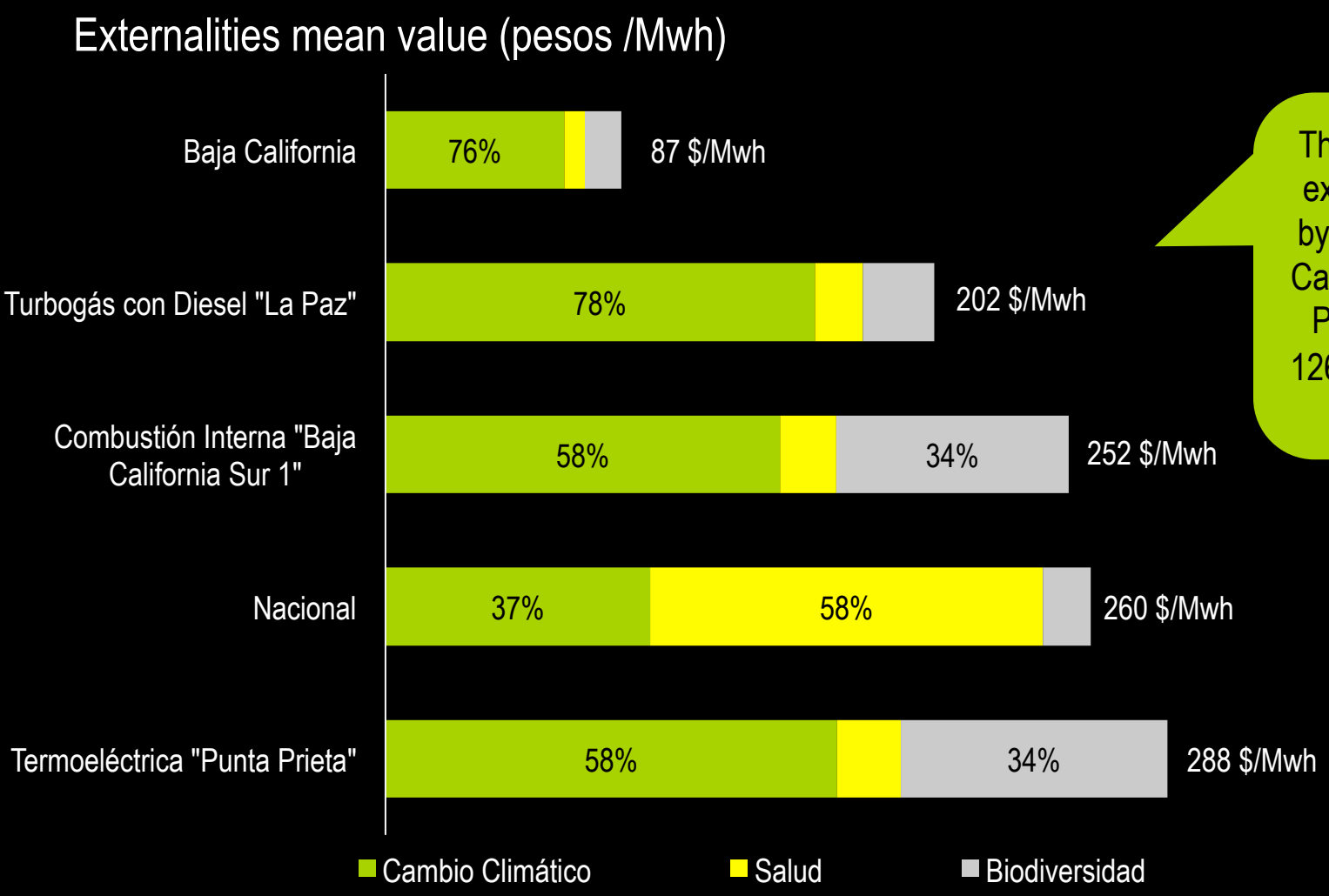
Evaluation of impacts



Economic assessment

Source: IMCO, to see more details:
http://imco.org.mx/medio_ambiente/externalidades_asociadas_a_la_generacion_de_electricidad

2 Results: externalities costs by Mwh in the 3 plants of La Paz



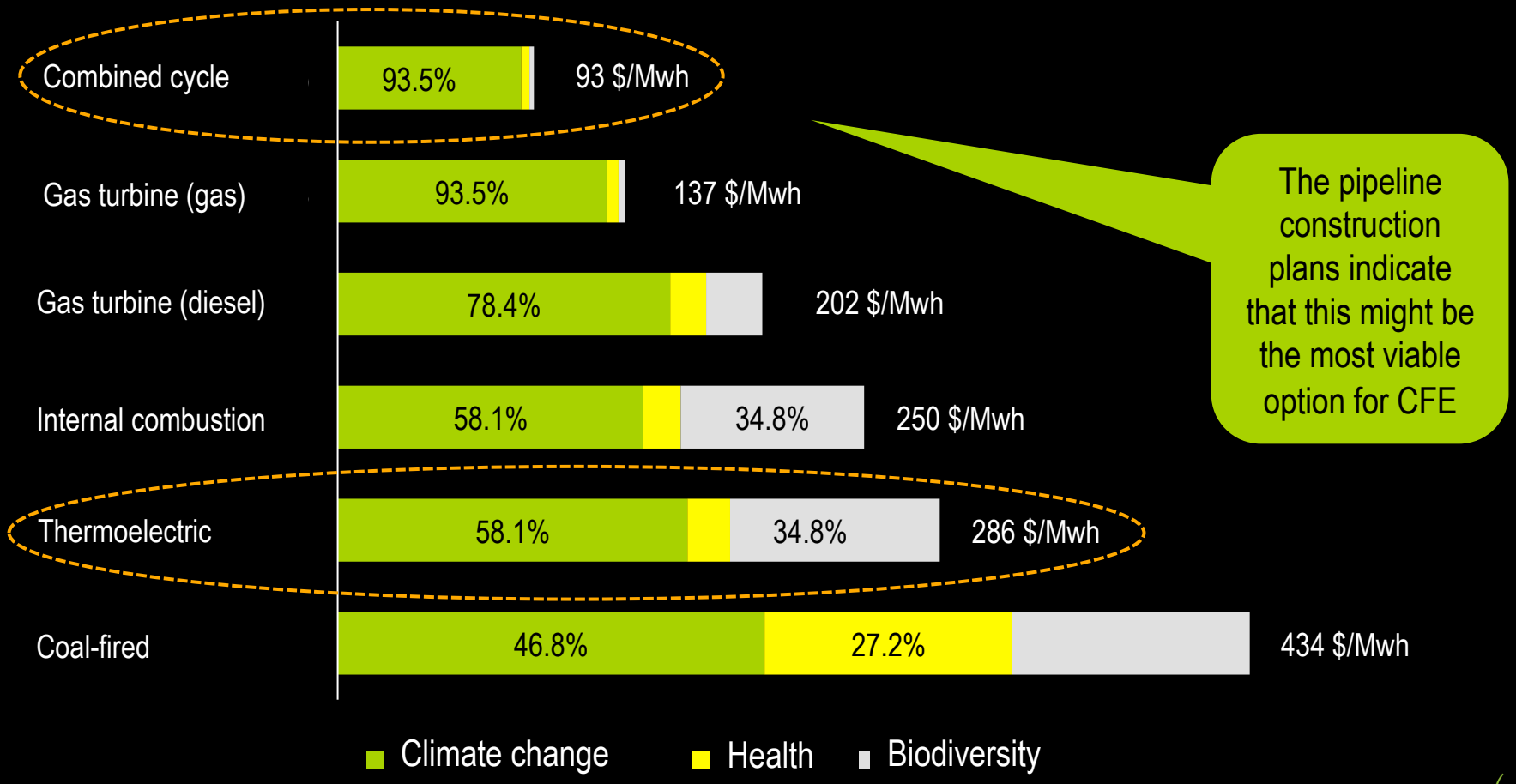
The annual costs of the externalities generated by "Punta Prieta", "Baja California Sur 1" and "La Paz" are estimated at 126, 70 and 8 million per year respectively

* Using IMCO's externalities methodology

Source: IMCO with many sources of information, 2012 (CFE, Cepal, Aipacks, IPCC, SENER)

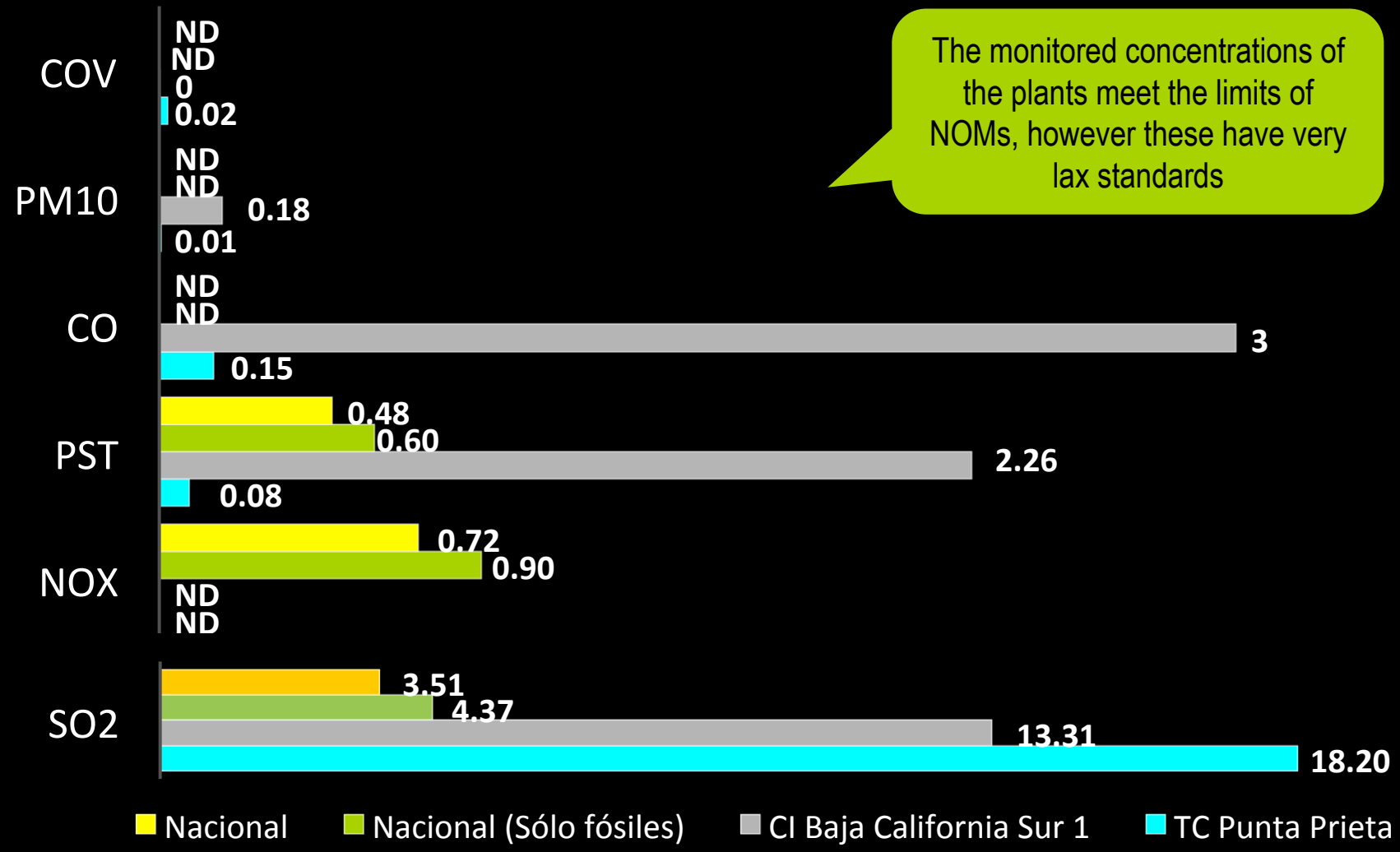
2 Externalities comparison against other CFE generation sources

Externalities mean value (pesos /Mwh) to build a plant in BCS



The pipeline construction plans indicate that this might be the most viable option for CFE

2 Pollutants emissions in La Paz (tons / Mwh)



Source: IMCO based on the Annual Operating ballots of Punta Prieta and Baja California Sur 1 (Semarnat) and the Work Program and Power Sector Investment 2012-2026 (Federal Electricity Commission)

Recommendations

1 Increase and improve the information of air quality and hospital records

Federal government

- Incentives for more cities to measure and report air quality
- Create an evaluation system of cities, through networks of parallel monitoring
- Create a national monitoring system

BCS and La Paz governments

- To measure air quality in major cities with alternate monitoring systems (the technology is cheap, <300USD x equipment in real time)*
- Report daily pollution levels and provide access to historical records of both emissions and hospitalizations

Source: IMCO's study «Impacts of air quality in 34 cities»
** http://airqualityegg.com/ that are sold in http://shop.wickeddevice.com/?main_page=index&cPath=28&zenid=LnA905IJ-yg,PBagmUuYe3

IMCO

2 Enhance regulations on air quality

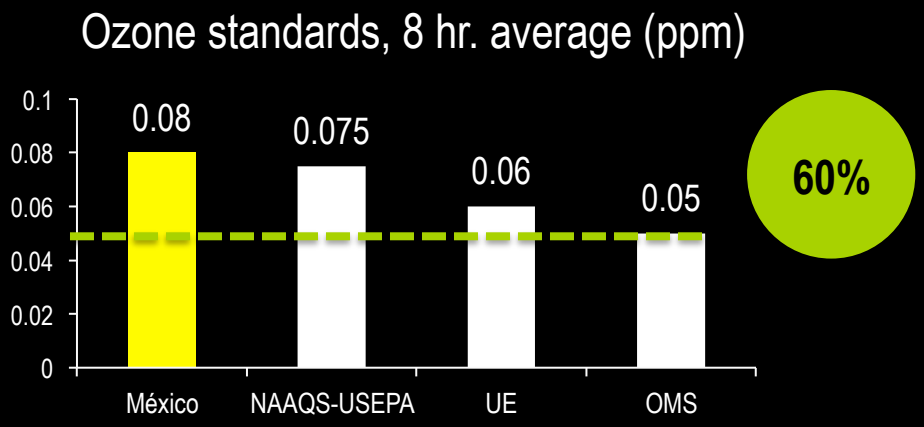
Federal government

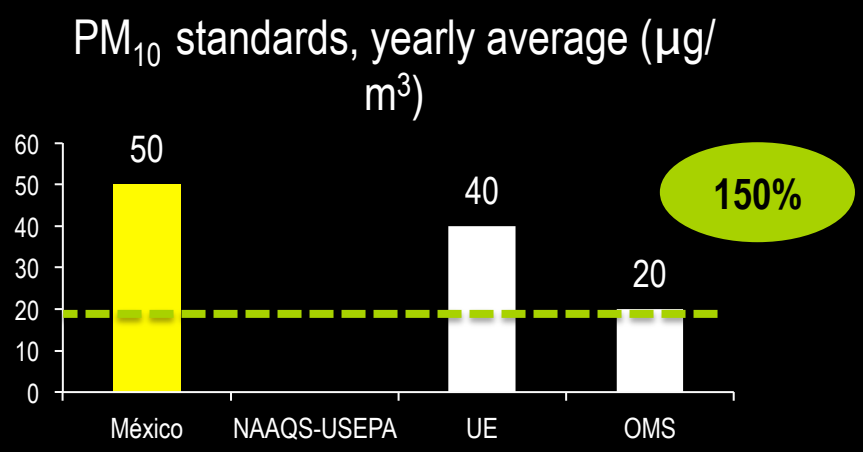
- Strengthen relevant air quality standards and emission standards for vehicles
- Approve the law that requires clean fuels distribution across the country

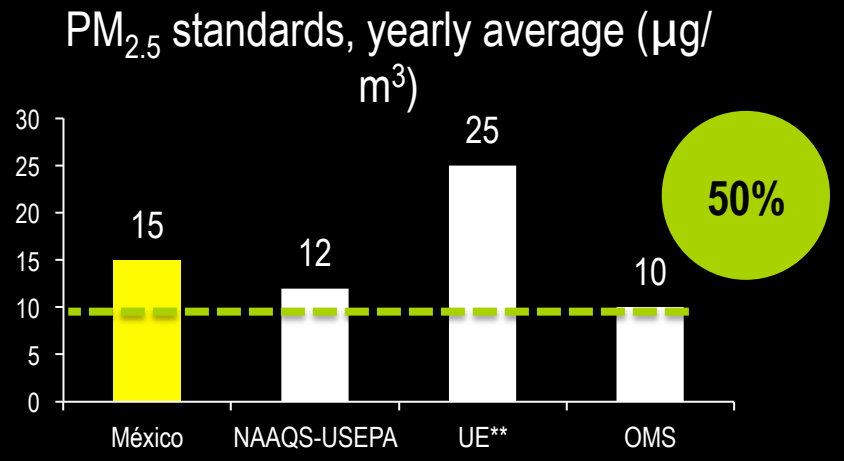
BCS and La Paz governments

- Develop local standards under the federal regulations
- Make air quality indexes to increase the perception of risks
- Improve building regulations

2 Environmental health standards are low







Source: IMCO with information from Ministry of Health in Mexico, EPA in US and Council of European Union

3 Improve policies that affect the air quality

Federal government

- Provide incentives for the creation of more and better "ProAires"
- Accelerate the deployment of clean fuels across the country
- Discourage the use of cars
- Analyze options for replacing CFE fuel oil generation in favor of cost competitive renewable energy

BCS and La Paz governments

- Develop a "ProAire" for La Paz, including measures adjusted to the needs of the city
- Follow up the goals set in the program
- Promote the densification of La Paz
- Adopt criteria for compact growth in cities and make more expensive the use of cars

IMCO

3 Improve policies that affect the air quality

Federal government

- Instal precipitadores electrostátic precipitators and dosifiers of chemichal components to remove particles and sulfur oxides in the internal Combustion plan of BC1 (similar to what Punta prieta has).
- Install catalytic systems to remove nitrogen oxides in Punta Prieta, similar to those in Baja California 1 plant
- Change the energy planning (POISE) to substitute 100% the use of heavy oils in La Paz generation plants in the middle term instead of 70% as it is contemplated.

BCS and La Paz governments

Source: Analysis of Javier Huerta & Alfredo Bermudez Apuntes sobre la contaminación ambiental producida por las centrales eléctricas de Comisión Federal de Electricidad que afectan la imagen, salud y economía de La Paz, B.C.S. ICF 2013

www.imco.org.mx

@IMCOmx facebook.com/IMCOmx