ADDRESSING URBAN AIR QUALITY
AN URGENT ENVIRONMENTAL ISSUE

12th December 2019

8:30-10:00

Chile Pavilion

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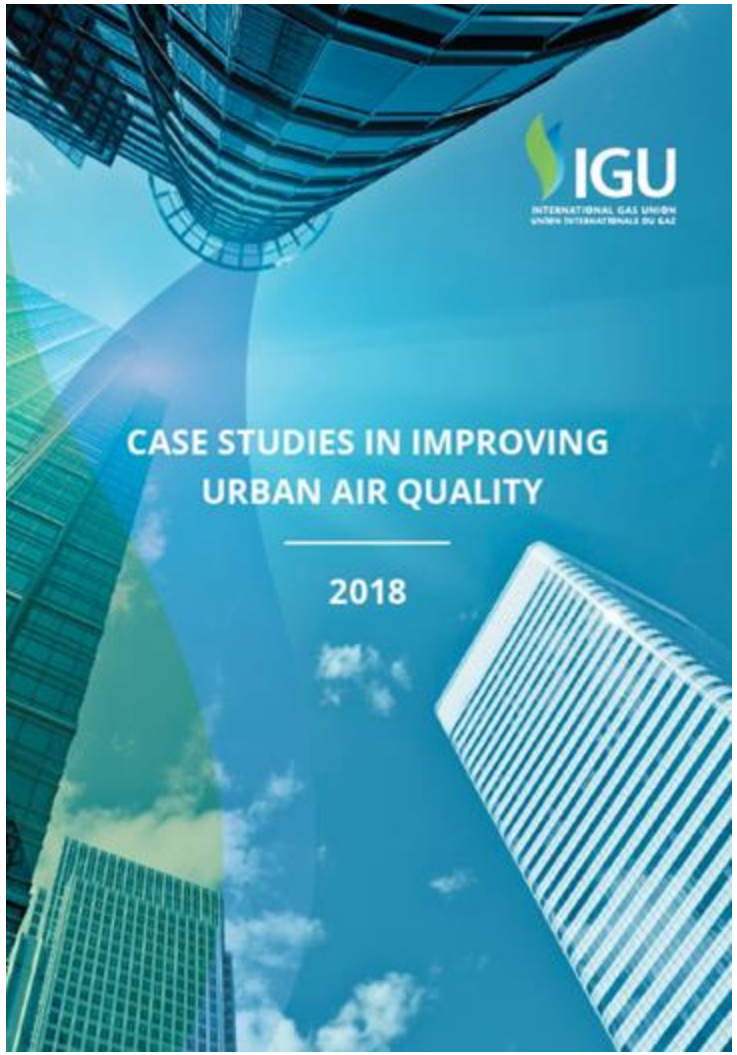
CASE STUDIES IN IMPROVING URBAN AIR QUALITY 2018



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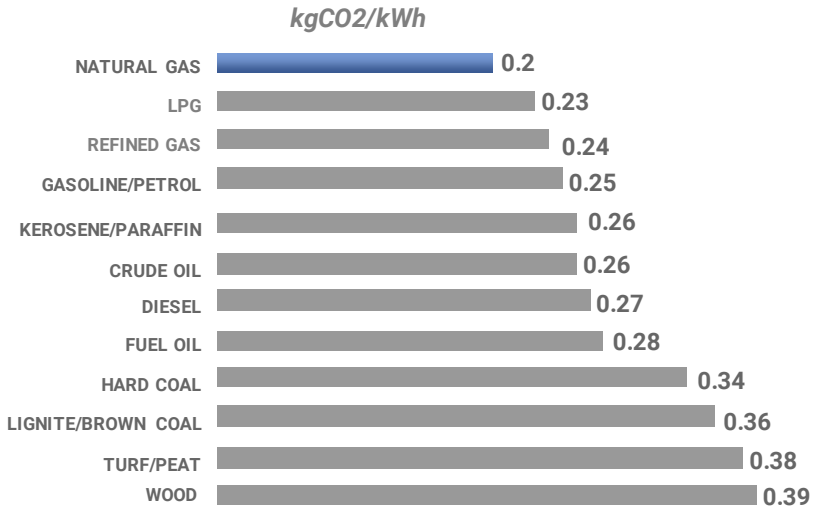
NATURAL GAS IS THE CLEANEST CONVENTIONAL ENERGY SOURCE

/ CO2 EMISSIONS

Natural gas has a lower carbon footprint than other conventional energy sources

Source: www.volker-quaschning.de



/ LOCAL EMISSIONS

The use of **coal in electricity generation** emits **61** times more PM 2.5 than **natural gas.**

Source: Factores de emisiones gaseosas para calderas de generación eléctrica- Guía metodológica inventario de emisiones atmosféricas 2011

The use of **wood in residential heating** emits **500 times** more PM 2.5 than **natural gas.**

Source: Plan de prevención y descontaminación atmosférica Región Metropolitana

The use of **diesel in public transportation buses** (Euro 6 standard) emits **7 times** more PM 2.5 than **natural gas.**

Source: Cummins USA, fabricantes de los motores

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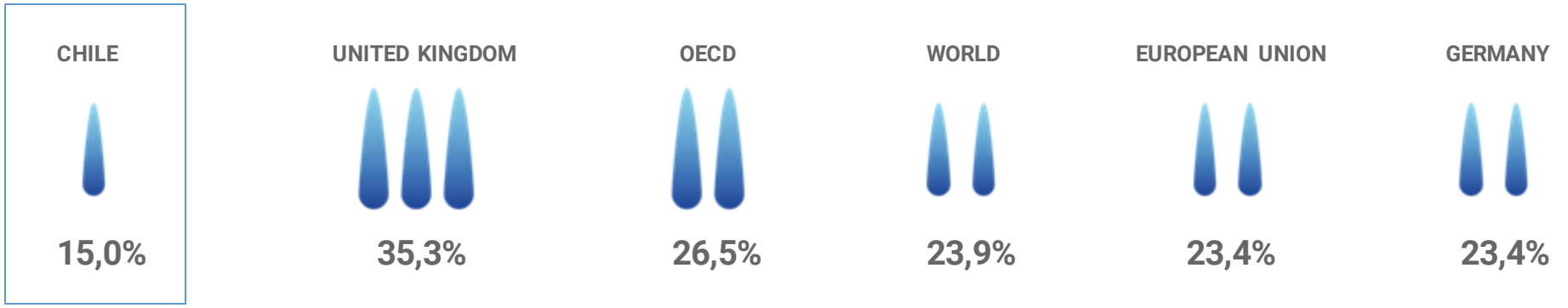
IN CHILE, NATURAL GAS STILL ONLY PLAYS A SMALL PART WHEN COMPARED TO OTHER MORE CONTAMINATING FUELS SUCH AS COAL, OIL AND BIOMASS

/ PARTICIPATION OF NATURAL GAS CONSUMPTION IN THE PRIMARY ENERGY MATRIX



Source BP Statistical Review of World Energy 2018 | 68th edition

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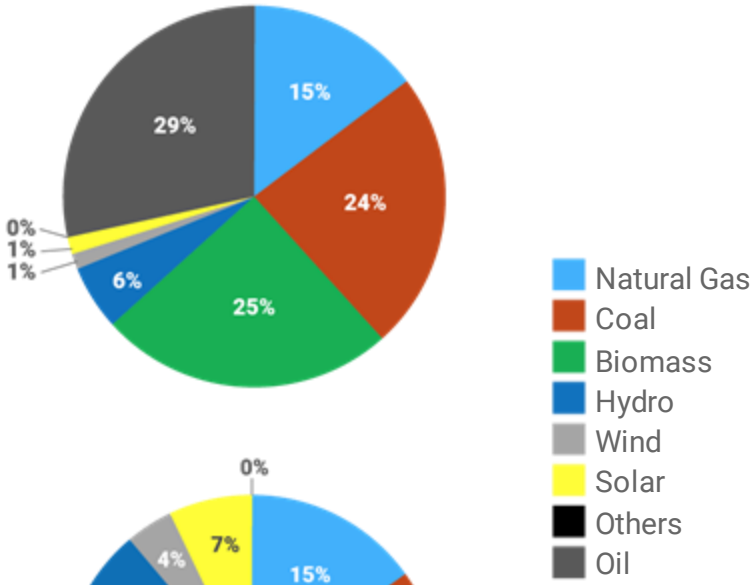
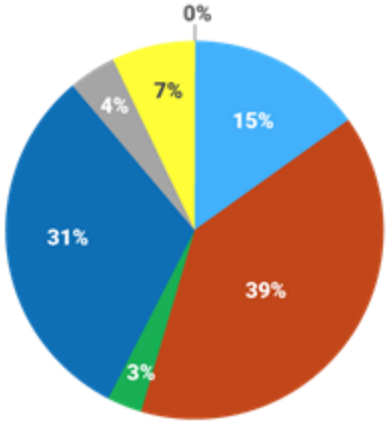
CHILEAN ENERGY MARKET AND NATURAL GAS INFRASTRUCURE

Primary Energy -
National Energy Balance (CNE 2017)



Electricity Generation Mix SEN (CNE 2018)



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POOR AIR QUALITY IN SANTIAGO, CHILE

- In 1989, Santiago's PM 2.5 concentration was registered at 68.9 µg/m^3, nearly seven times the recommended WHO level.
- The main causes of air pollution were wood burning for residential heating, transportation activity, and the use of coal, fuel oil, and diesel by industries.
- Santiago is located in a basin with poor atmospheric ventilation; its geography and climate are adverse to the diffusion of air pollutants, making the issue worse.

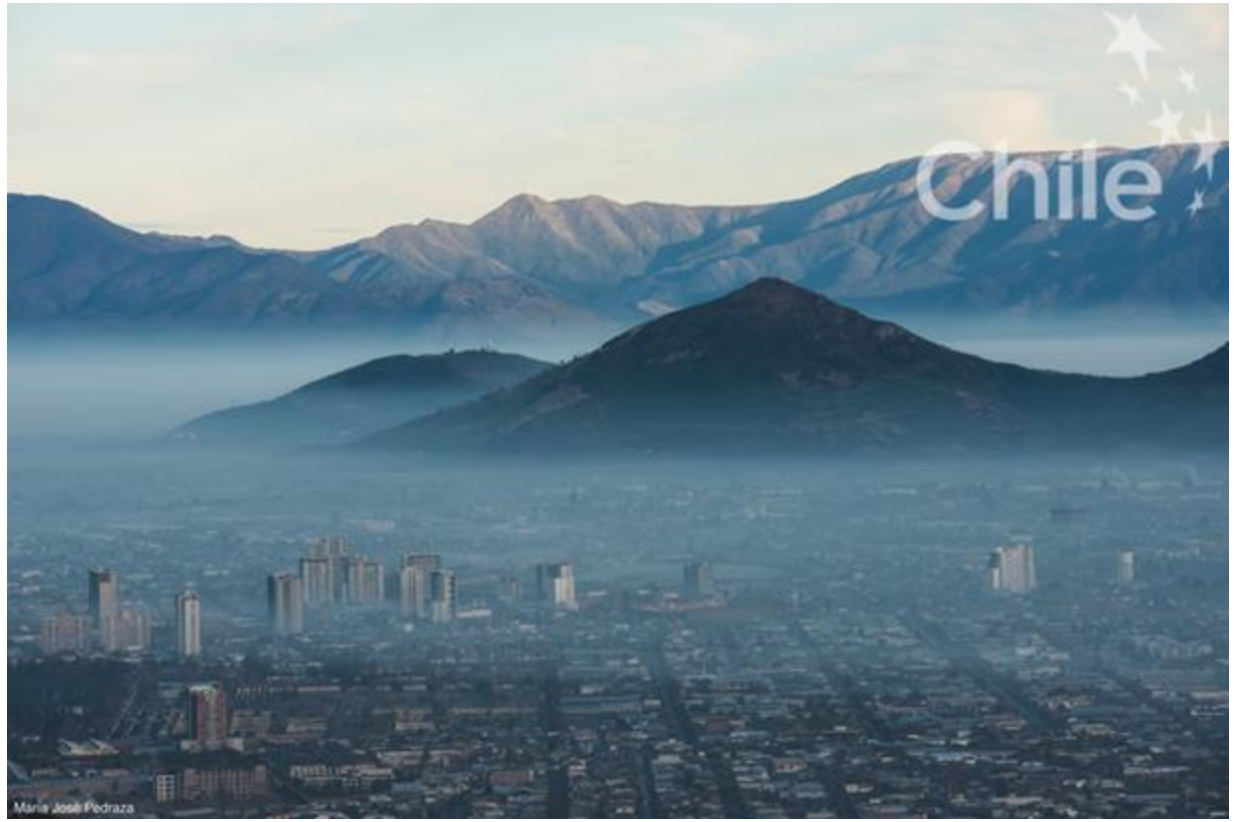
AIR QUALITY MANAGEMENT MEASURES

- Chile became acutely aware of Santiago's severe air quality problem in the 1970s, after the installation of air quality monitoring stations. In 1978, the government introduced the first air quality norms, regulating total suspended particles and other pollutants.

- In the 1990s, environmental management policies started to take root with the creation of dedicated government departments and new stricter regulations.

- In 1994, the government enacted the Law for the Environment.

- In 1995, Chile and Argentina signed an international treaty called the "Gas Integration Protocol". The execution of the treaty was expected to satisfy at least eighty-two per cent of Chile's **natural gas** consumption.



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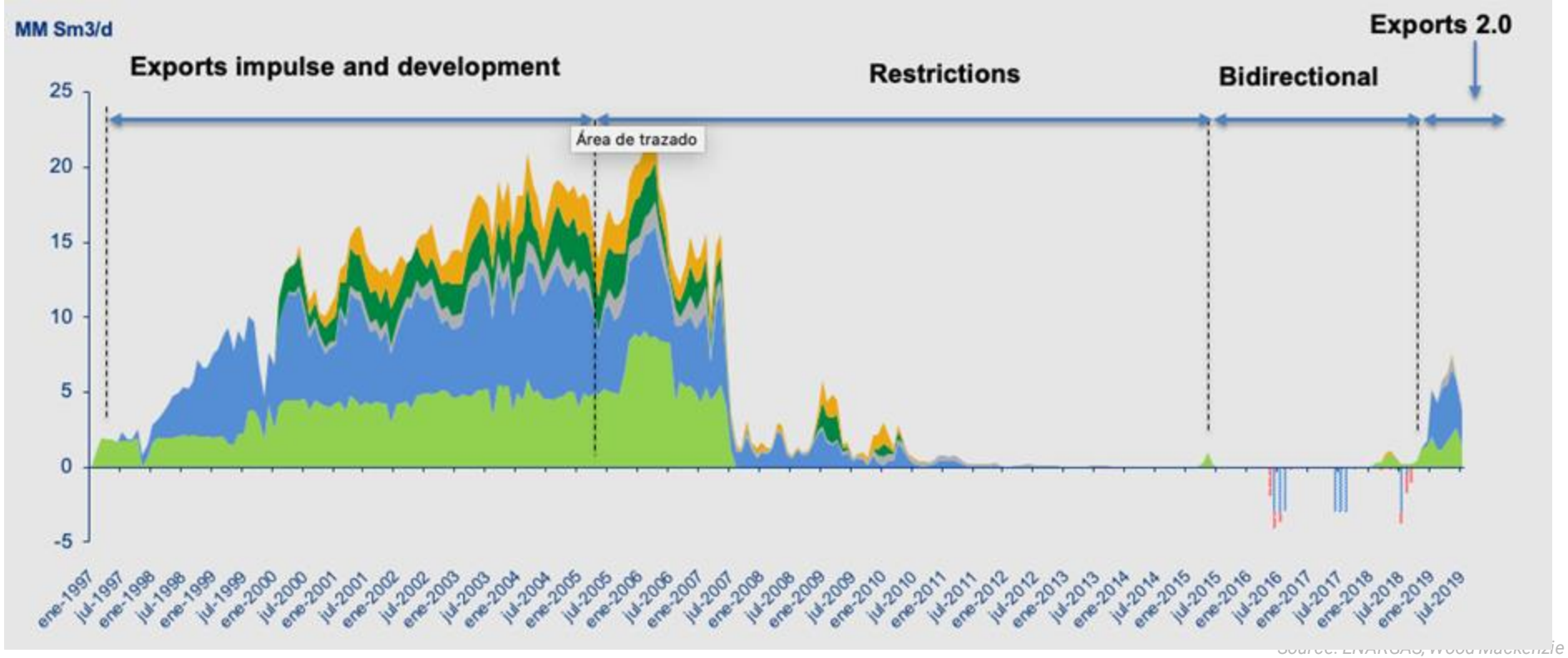
NATURAL GAS IS A SOLUTION, BUT...

- As a consequence of the gas interconnection with Argentina, the **natural gas** market in Chile reached an important stage of development, increasing its market share in the primary energy matrix from 8% in 1996 to 24% after nine years.
- In Santiago, the industrial and residential sectors started using **natural gas** provided via new pipelines that facilitated imports from Argentina (70% industrial / 24% residential).
- However, starting in 2004, Chile began experiencing interruptions in the gas supply, causing shortages. As a result, the industry was forced to switch back to dirtier fuels, and there was a corresponding increase in industrial emissions.

PIPELINE OPERATIONS BETWEEN ARGENTINA AND CHILE



Source: ENARGAS, Wood Mackenzie

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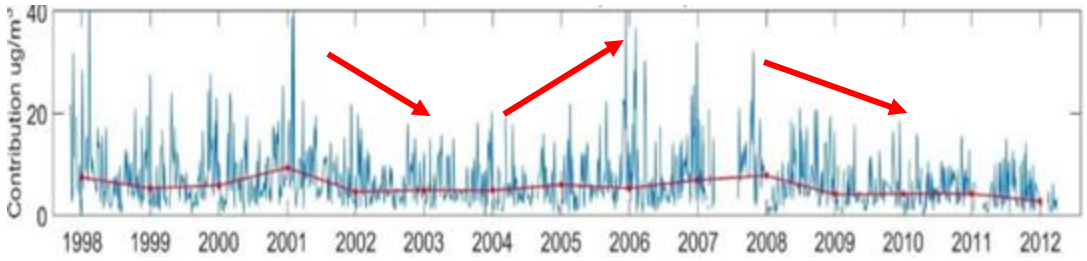
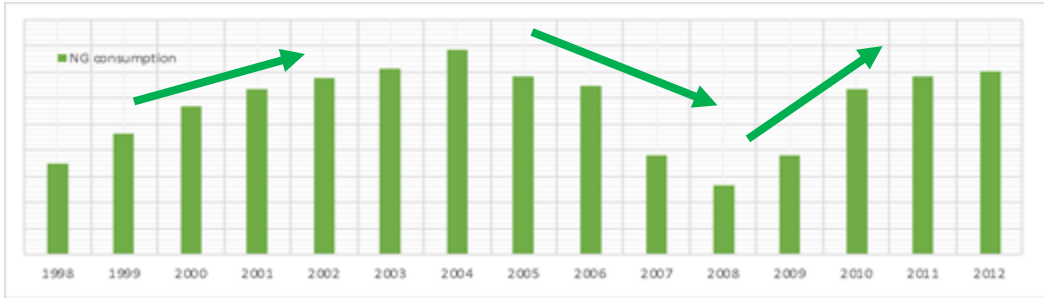
NATURAL GAS CONSUMPTION VERSUS PM 2.5 CONCENTRATION

- The upper graph shows temporal evolution of PM2.5 concentrations associated with industrial processes in Santiago between 1998 and 2012; and the lower depicts **natural gas** consumption in the same period.
- Analysis of source-specific pollution changes showed that between 2005 and 2007, the contributions to PM concentration from industrial sources increased significantly, coinciding with the gradual reduction in imports of gas from Argentina and its replacement by diesel or fuel oil.

Air Quality



NG Consumption

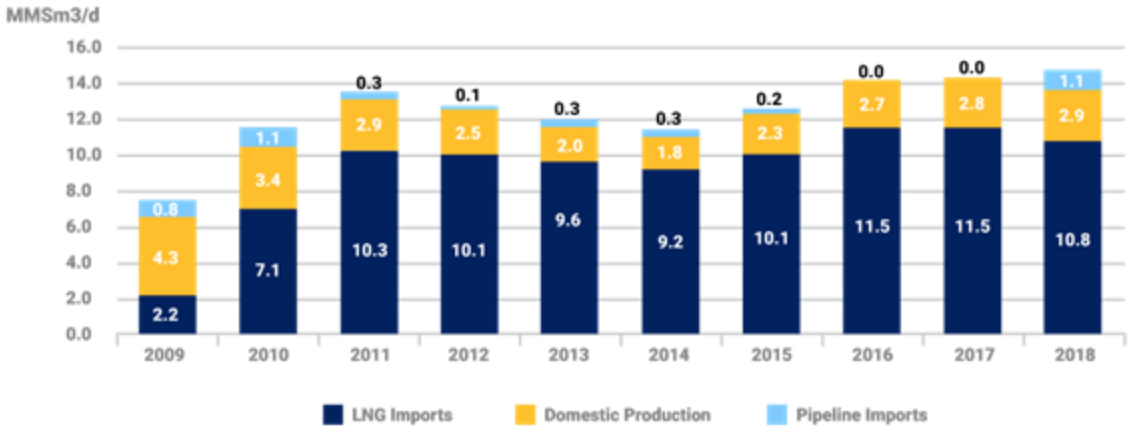


Source: Source: Barraza el al. (2017).

CHILE - NATURAL GAS SOURCES SINCE 2009

- In response to the disruption of supply, Chile's large **natural gas** importers developed an LNG terminal on the central coast of the country (GNL Quintero).
- The terminal started operations in 2009, with new imported natural gas supplies helping to overcome dependence on gas from Argentina and restoring security of supply.

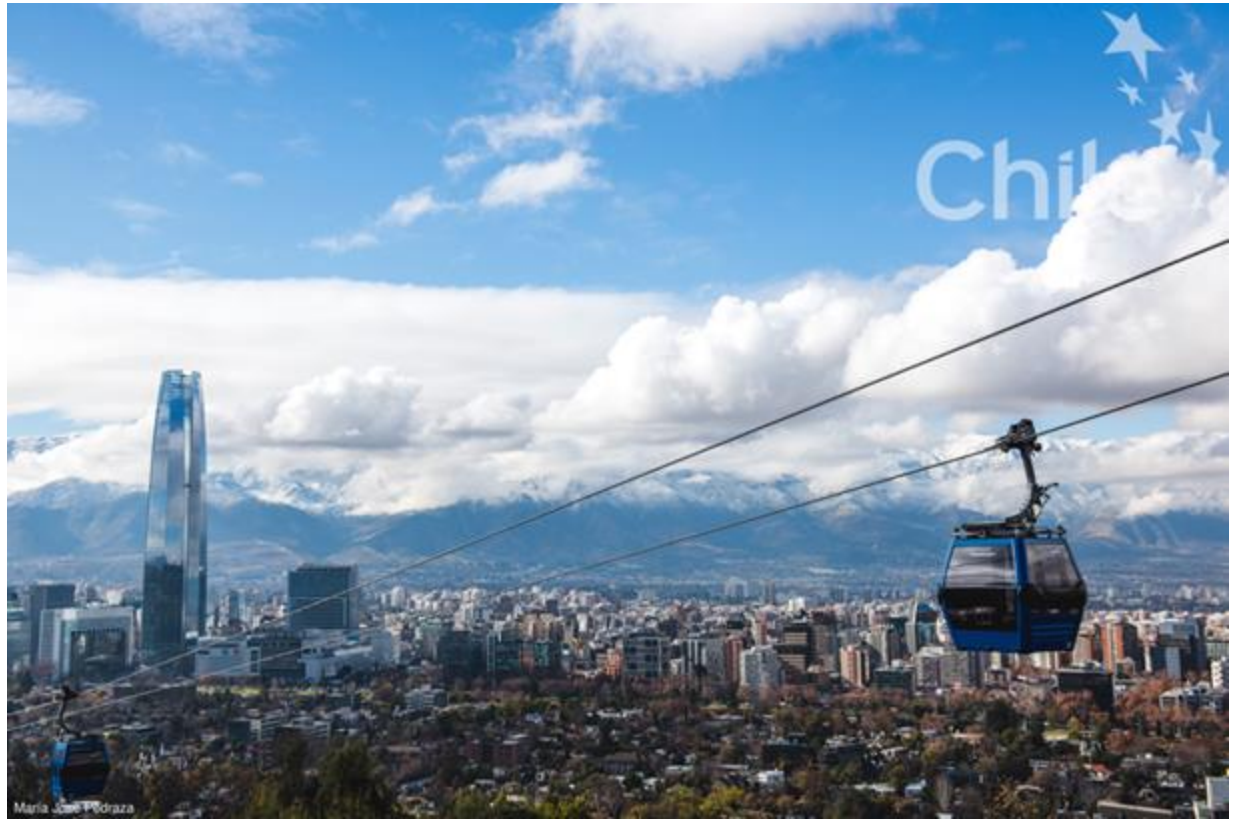
Natural gas consumption by source 2009-2018 (Average MMSm3/d)



Sources: Enargas, GNL Quintero, CNE, SEC.

IMPROVED AIR QUALITY IN SANTIAGO

- The recovery of a stable supply caused a significant shift back from diesel to **natural gas** and a consequentially, a reduction in industrial emissions.
- PM 2.5 concentration in Santiago was reduced by 1.76 µg/m^3, compared to the 2004-2008 period.
- Based on the analysis of PM filters from 1998 to 2012, it can be concluded that replacing diesel with **natural gas** in the industrial sector has had a positive impact on PM 2.5 concentrations.
- Furthermore, results showed a reduction of 2.63 µg/m^3 in PM 2.5 from industrial sources during the study period, largely due to the fuel switch towards **natural gas.**



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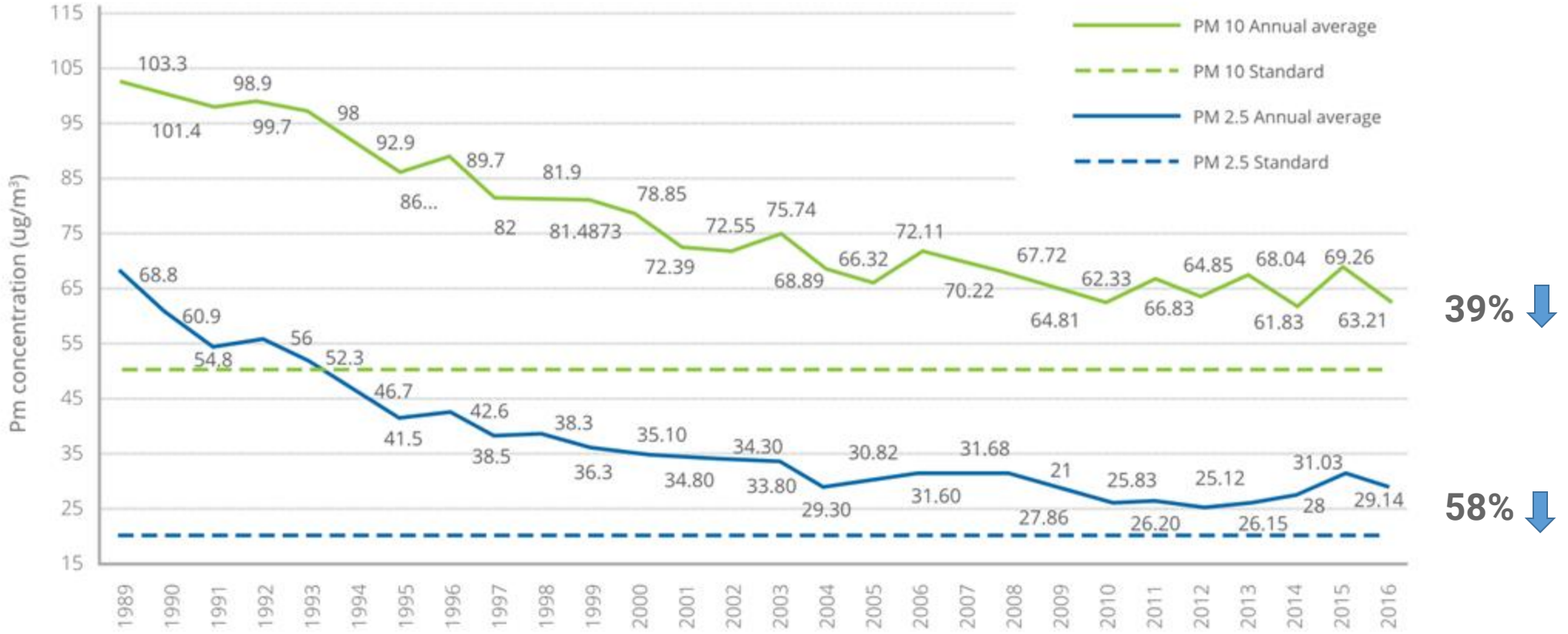
AIR QUALITY TRENDS IN SANTIAGO



Sources: SINCA 2017, Sistema de Información Nacional de Calidad del Aire, Ministerio del Medioambiente, Chile.

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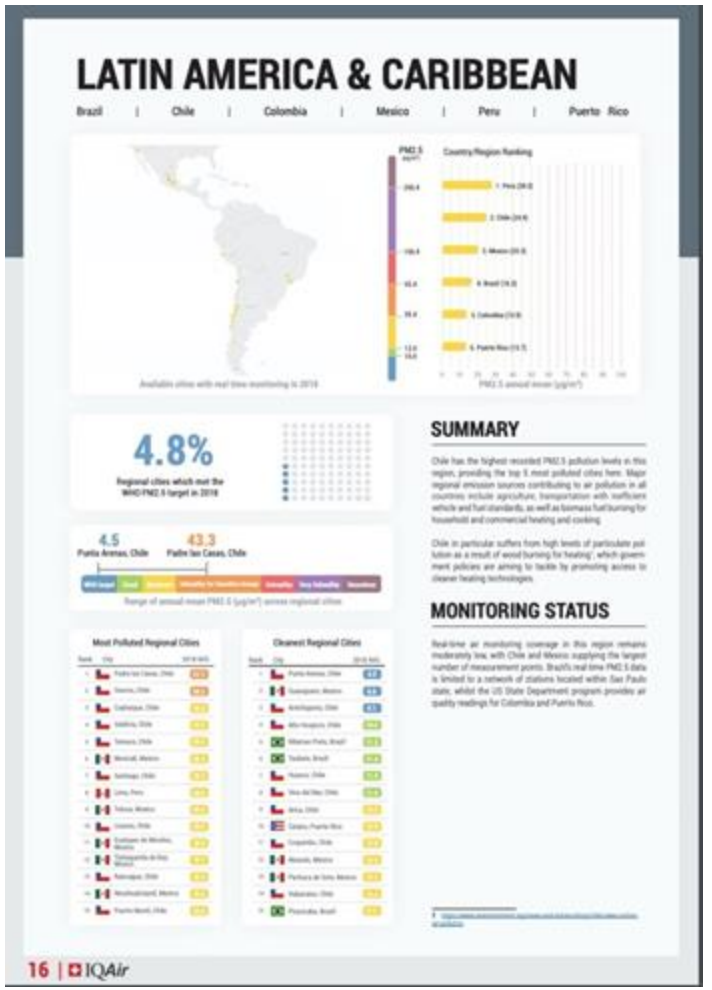
PUNTA ARENAS, THE CLEANEST CITY IN LATIN AMERICA

- According to a recent study, 9 out of the 15 most polluted Latin American cities are located in the central and southern regions of Chile, mainly due to the high use of wood for heating.

- However, the same ranking shows that Punta Arenas, with a high use of **natural gas (**99% residential), has the best air quality within Latin America.



Source: Air Visual

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IN SUMMARY...

- **Natural gas** will play a key role in the future of energy, both because of its complementary role with intermittent renewable energy sources in electricity generation, and because of its contribution to the decontamination of cities and access to a modern energy source.
- Chile can advance in the coming decades towards a competitive, clean and sustainable matrix, promoting the safe and reliable use of **natural gas**.
- At AGN, we are convinced that it is possible to obtain a better environment and quality of life for our people with a greater use of **natural gas** in our energy matrix.

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