



# Biogas from landfills and waste water treatment plants

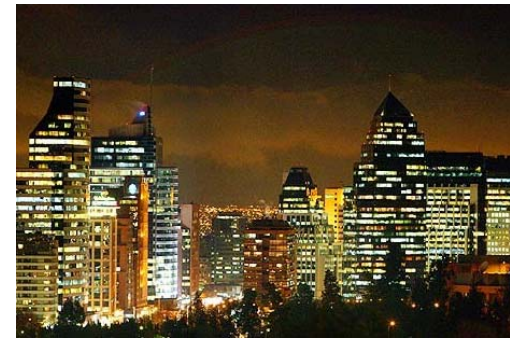
The chilean experience

Monterrey- México  
January 2009

# General facts about Chile



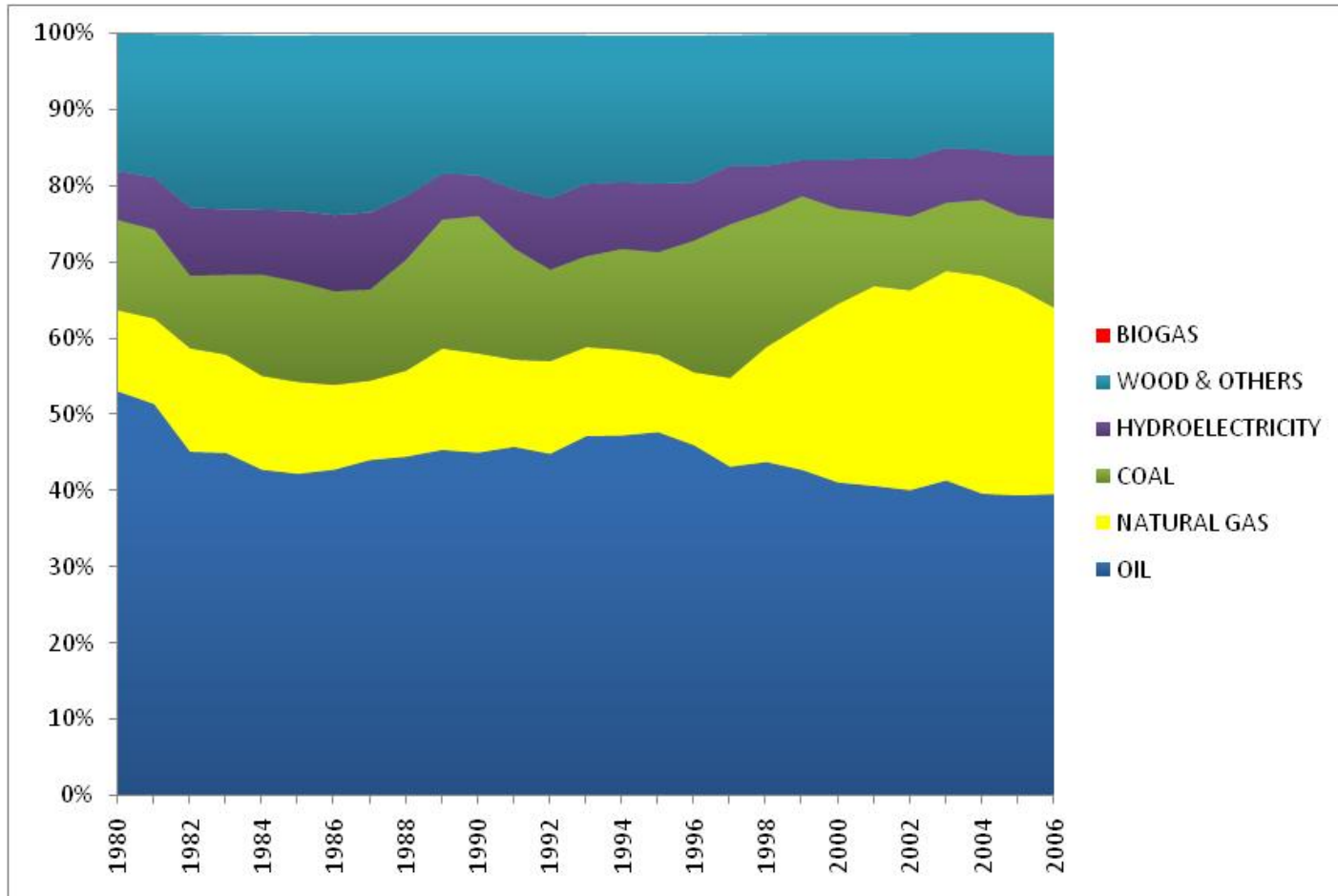
- **Population: 16 M (Santiago, 6 M)**
- **Area: 756.000 Km<sup>2</sup>**
- **Exports 2006: 58,2 B**
- **GDP per capita: 9.700 US\$ (13.700 US\$ PPP)**
- **Copper: market share of 36%**
- **Primary energy consumption: 1,8 TOE/hab**  
(China = 1,4    France = 4,4    USA = 7,9    Latin America Average = 1,1)



# General facts about Chile



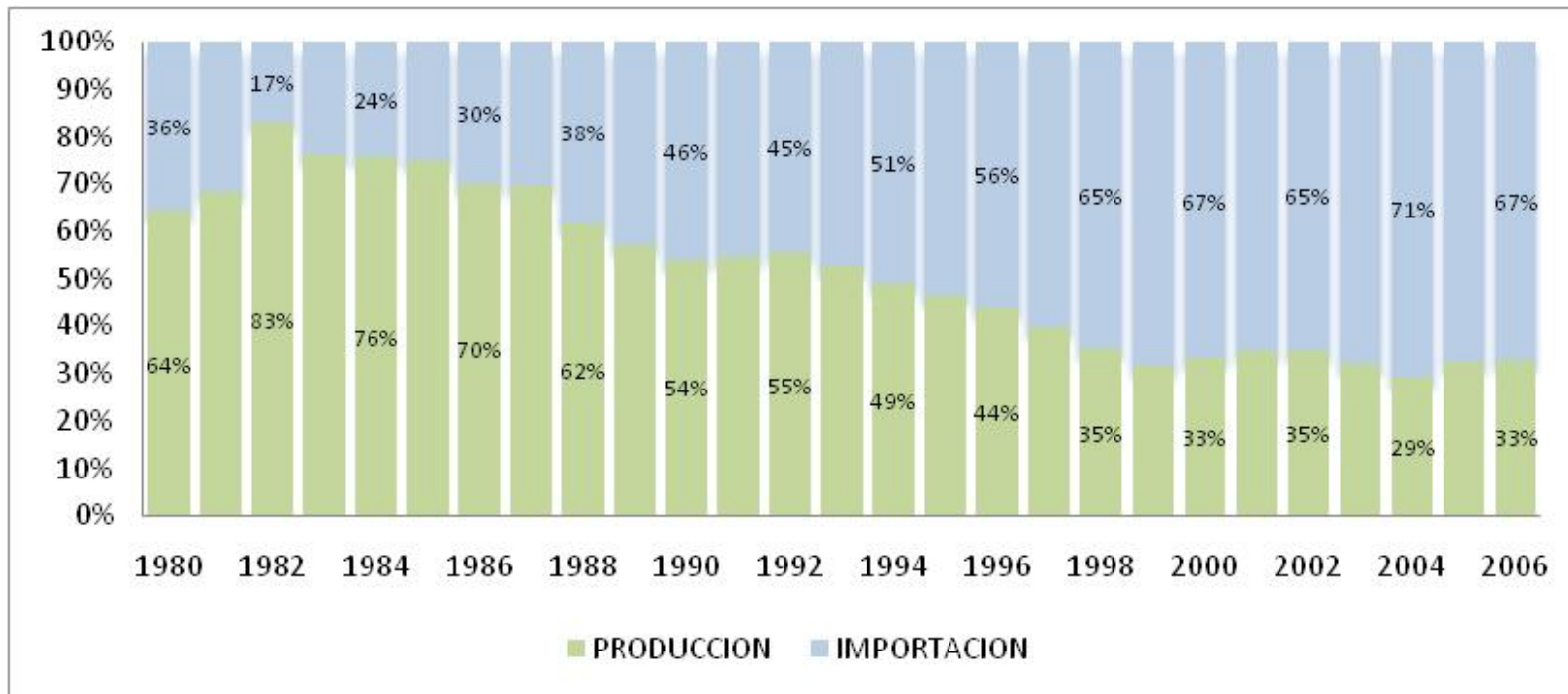
## Primary Energy : Fuels



# General facts about Chile



## Energy Dependency



# The Natural Gas Sector



Protocolo de Integración Gasífera (1995)

The “rush” for Natural gas took place at the end of the nineties

More than 3 bn US\$ in investments (pipelines, local distributors).

Main 5 Natural Gas Distribution Companies:



# Metrogas: Market



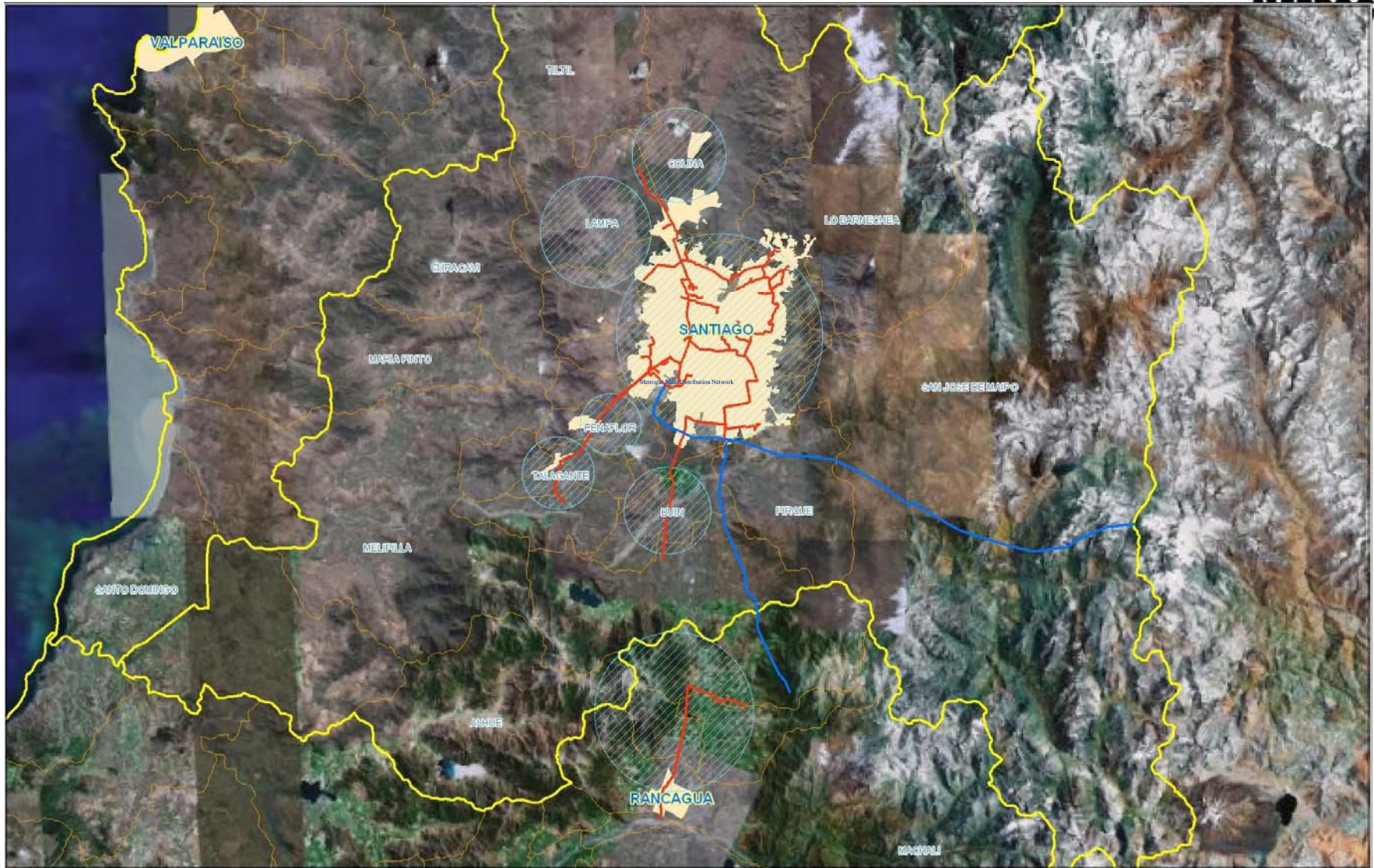
Metrogas is the largest Natural Gas distributor in Chile.

- Operations started in 1997
- 450.000 Customers ( as of end 2008)
- Over 400 Large customers (industries)
- 4700 km of pipelines
- > 1.000 MMUS\$ Investments
- Turnover: 300 MMUS\$/y
- 2006: Commercial and Residential demand: 317 [MMm<sup>3</sup>/year].
- 2004: Industrial Demand 532 [MMm<sup>3</sup>/year].
- Before the Natural Gas crisis, Metrogas reached 85% of Industrial market share, replacing liquid and gaseous fuels.



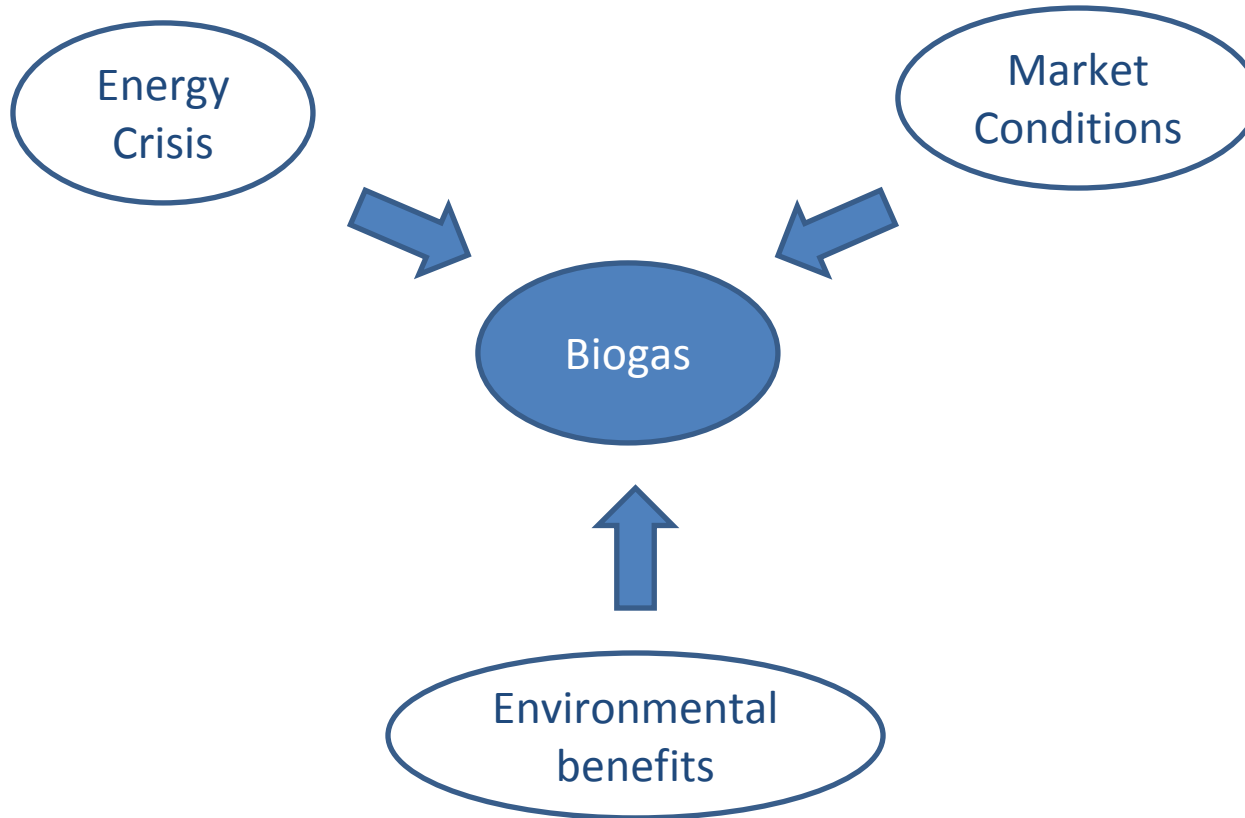


# Metrogas: distribution networks & GasAndes pipeline



METROGAS®

# Biogas, main drivers





# Energy Crisis

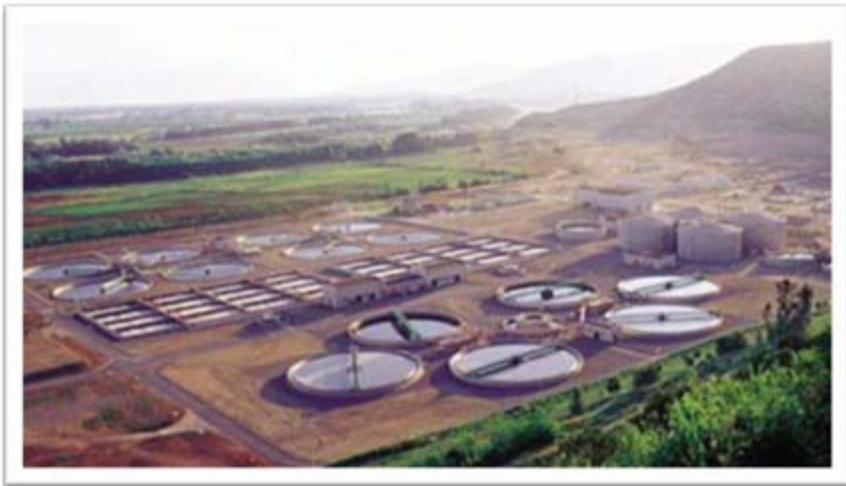


- Lack of investments in the upstream/midstream sector in Argentina; gas-elec prices “frozen” by regulatory decrees.
- Argentina reduced gas exports to Chile (2007: exports = less than cooking /heating needs for the residential-commercial sector) 
- Impact on the electricity sector: need to convert Combined Cycle Gas turbines to Diesel, more coal fuelled plants in operation, serious risks of electricity shortages.
- May 2006- Dec 2008: no gas at all for the Industrial sector.
- 2007-2008: Propane Air plant put in service to produce Synthetic natural gas.
- Nevertheless, small-medium customers never suffered gas shortages, so far.
- Government and Private sector took right decisions : investment incentives (Power sector – Upstream Gas), call for demand efficiency, strategic projects ( GNL, Propane Air for back up), promotion of renewable energy (wind, Geothermal, Biomass)
- Chile before 2004: focused on cost efficiency;
- Chile after crisis: cost efficiency, diversification of the energy matrix and secure fuel supplies

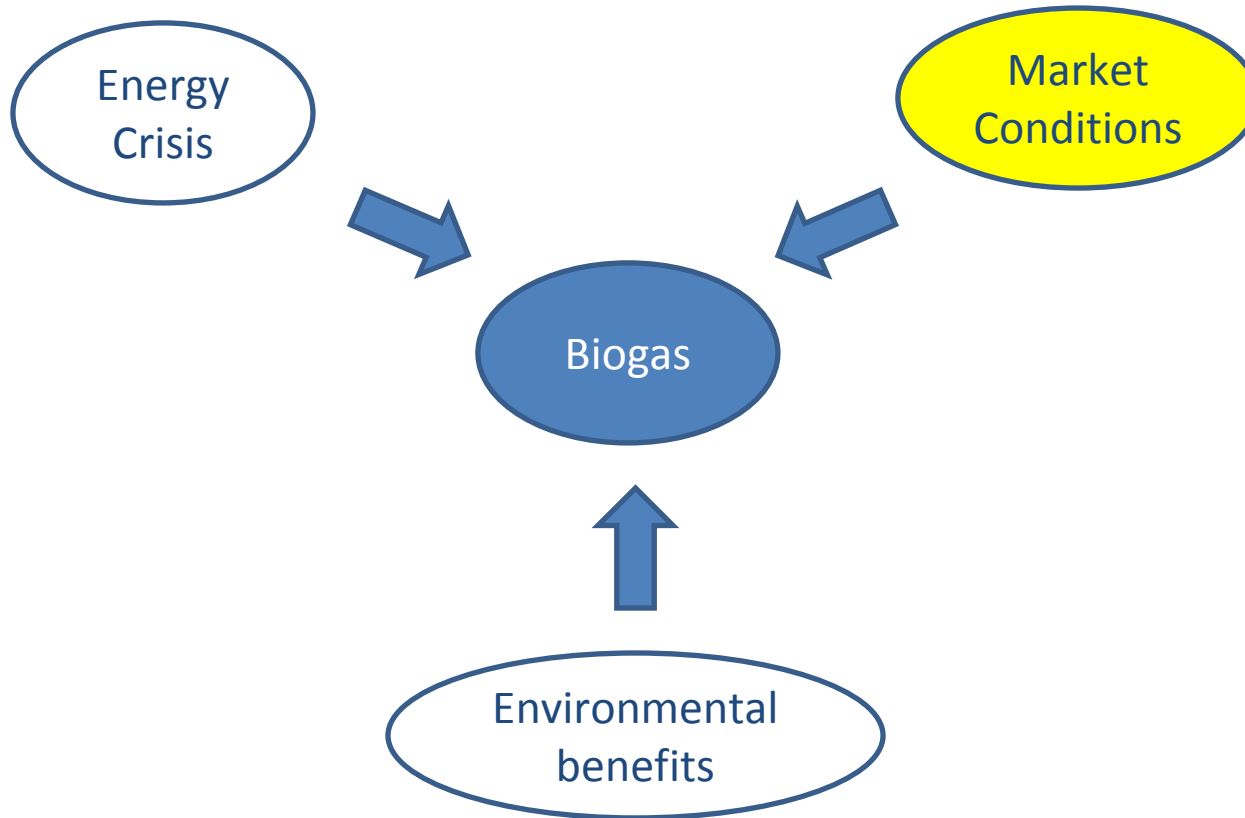
# Biogas is part of the country's energy strategy



- Landfills
- Water Treatment Plants
- Liquid Industrial Waste Treatment Plants
- Coal Mines
- Biomass



# Biogas, main drivers



# Biogas Potential in Chile

Fuente	Biogás [Mm <sup>3</sup> /año]	Metano [Mm <sup>3</sup> /año]
Plantas de Tratamiento de Aguas	137.369	82.421
Rellenos Sanitarios c/captación de biogás	115.551	57.775 *
Rellenos Sanitarios s/captación de biogás	53.671	26.835
RILES	47.838	28.703
Pre-tratamiento aguas residuales urbanas	80.652	50.811
Biomasa de principales cultivos de temporada	387.791	240.430
Biomasa de residuos de poda y desmalezados municipales	425	297
Biomasa de desechos industria vitivinícola	27.561	17.088
Biomasa de residuos sólidos industria cervecera	8.752	5.533
Biomasa de industria de Lácteos	3.580	2.148
Biomasa de industria conservera de frutas y verduras	65.163	39.098
Biomasa bebidas de infusión	2.412	4.387
Biomasa residuos de matadero	29.775	19.353
Biomasa residuos industrias aceites y grasas	132	92
Biomasa a partir de estiércol (avícola, vacunos y porcinos)	1.027.453	607.872
<b>Total</b>	<b>1.988.125</b>	<b>1.125.068**</b>

**Fuente:**

• Estudio de potencial de biogás.  
 Proyecto Energías Renovables no Convencionales en Chile (CNE/GTZ).  
 Septiembre 2007

\* Estimación Metrogas R.M: 74.841 Mm<sup>3</sup>/año.

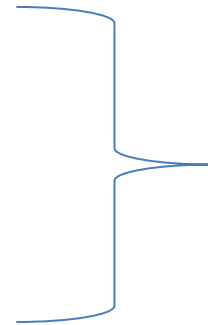
\*\* 3.082.378 m<sup>3</sup>/día.

**Less than 1%  
on the market!**

# Biogas To Market ?



- Where is it?
- How much is it?
- Who will need it?



**Relevant Market :** Metrogas focused on the largest biogas producers, located as near as possible to the existing grid



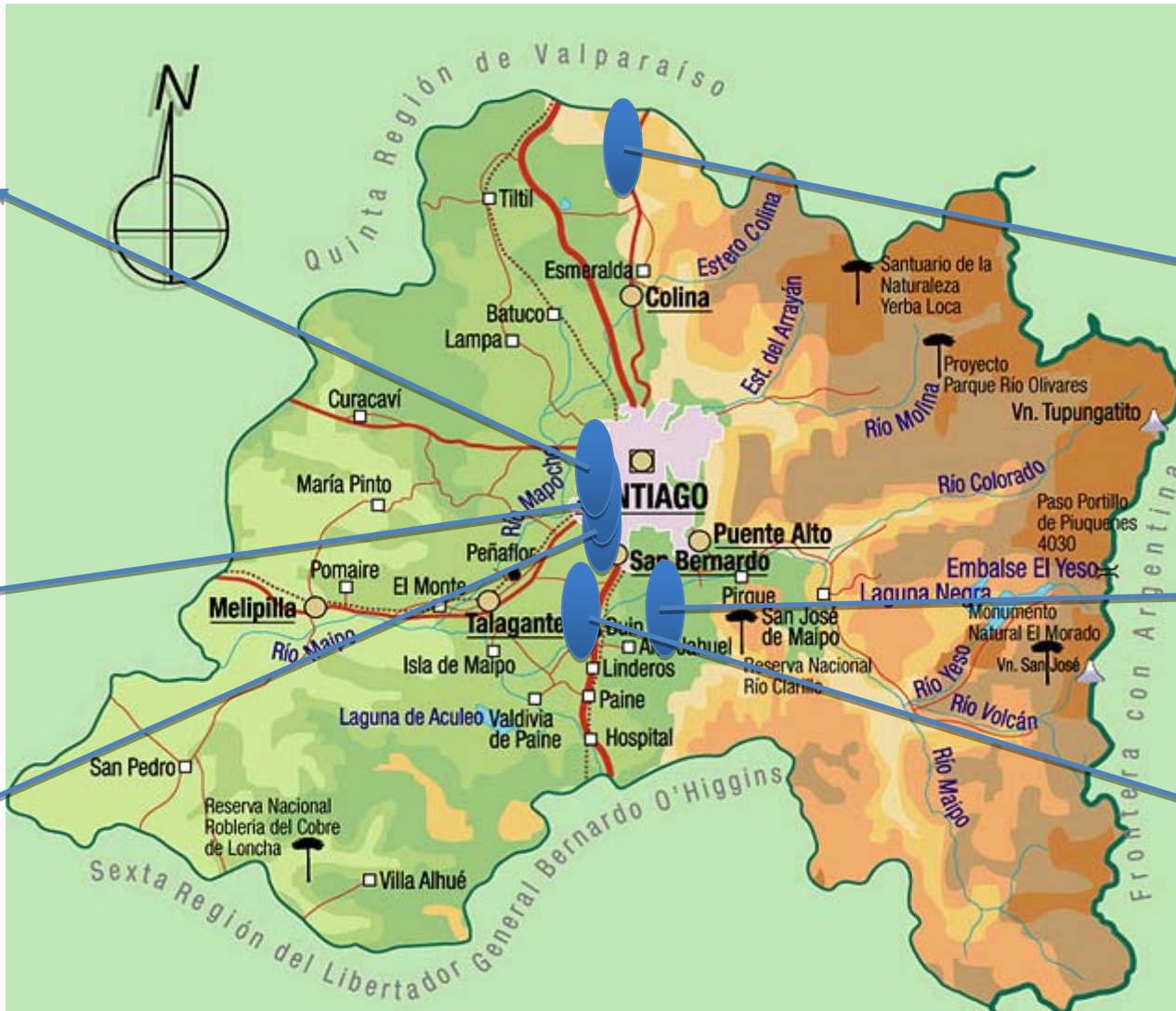
# Sources of Biogas



Relleno Santiago Poniente (COINCA)

Planta de Tratamiento de aguas "La Farfana"

Planta de Tratamiento de aguas "El Trebal"



Relleno KDM

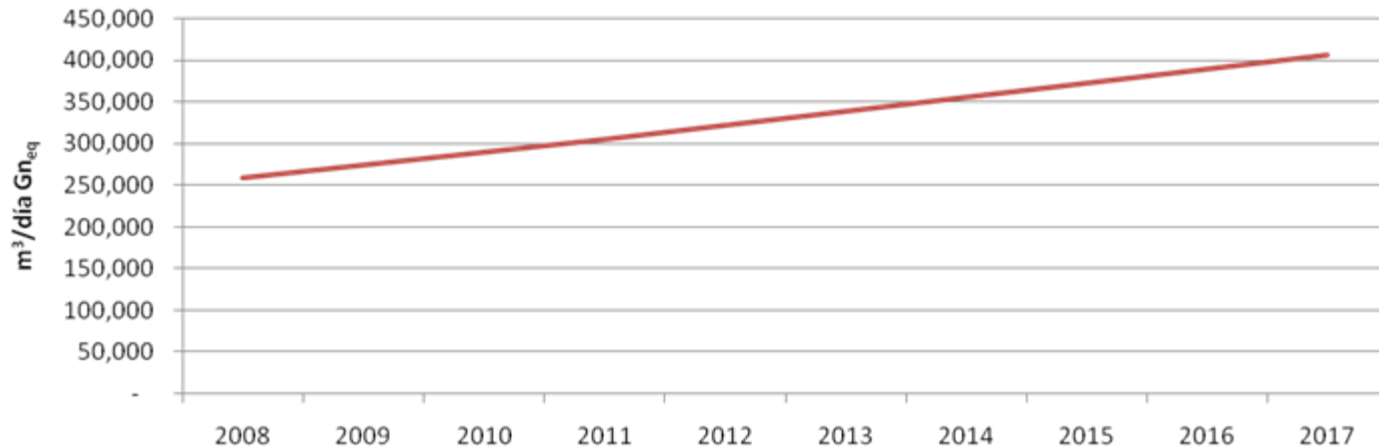
Relleno Lepanto

Relleno Santa Marta

# Sources of Biogas

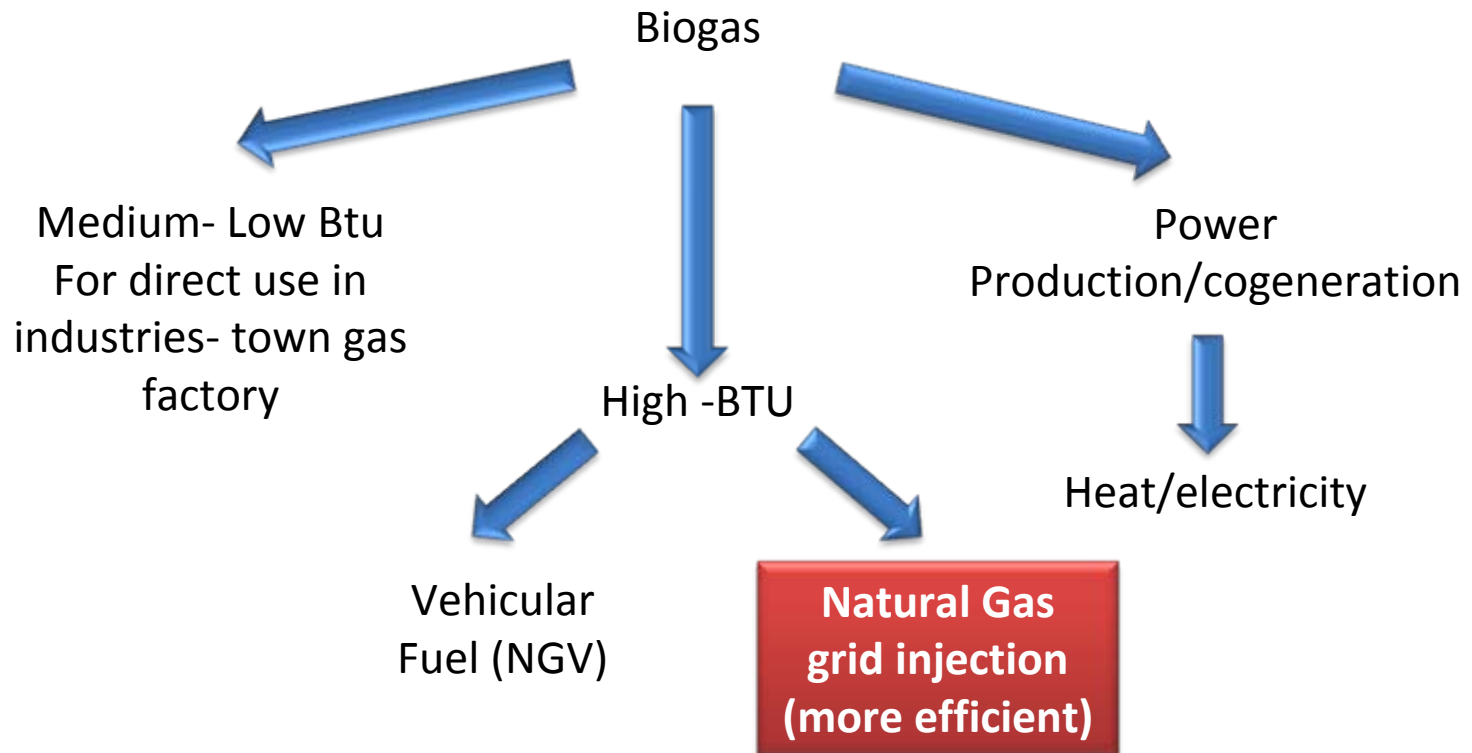
- In the vicinity of Santiago, biogas produced by landfills and WWTP is mostly flared.
- Concentrating on landfills and WWTP, the potential of production would be around 250-300.000 cubic meter per day equivalent of Natural gas imported, and is expected to grow 5% per year.
- ... cooking- heating needs for almost 200.000 houses in Santiago (= 1 M inhabitants)

**Potencial de Biometano RM (Agregado)**



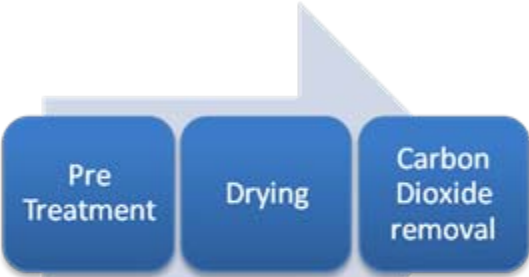
Fuente: Estimación Metrogas (información entregada por plantas tratamiento de aguas y rellenos sanitarios)

# Biogas: project alternatives





# Biogas upgrade to pipeline Quality



## Biogas

Metano	• 50 – 75%
CO2	• 25 – 50%
Nitrógeno	• 0 – 10%
SH2	• 0 – 3 %

High Heating Value (kCal/m3)  
 4500 Relleno Sanitario  
 5800 Planta Tratamiento Agua

## Gas Natural

Metano	• 95.9 – 97.8%
CO2	• 0.4 – 1.2%
Nitrógeno	• 0.8 – 1%
SH2	• 0 %

High Heating Value (kCal/m3)  
 8900- 9300

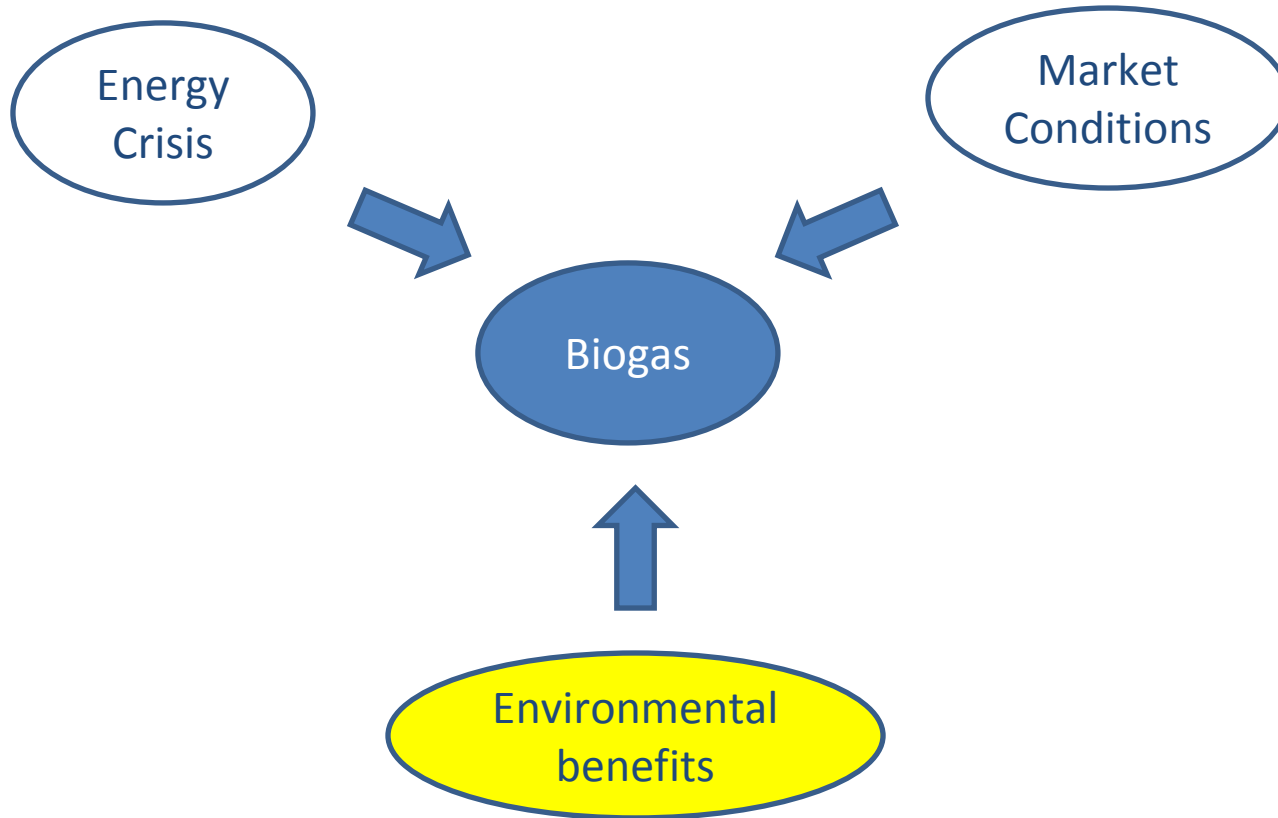


# Biogas: additional market considerations

- High oil & gas prices favor Biogas projects but also...
- Direct incentives (grants), indirect (tax deductions, renewable energy quotas, etc.)
- Gas Quality (for grid injection)
- Direct End-use of Biogas or electricity production?
  - A matter of relative prices of fuel /electricity (who pays more?)
  - Nonetheless, direct end-use more efficient

Proceso	Eficiencia
Flaring	0%
Power production	35% - 42%
Upgrade to Natural gas	82% - 94%

# Biogas, main drivers



# Environmental benefits

## Global Warming

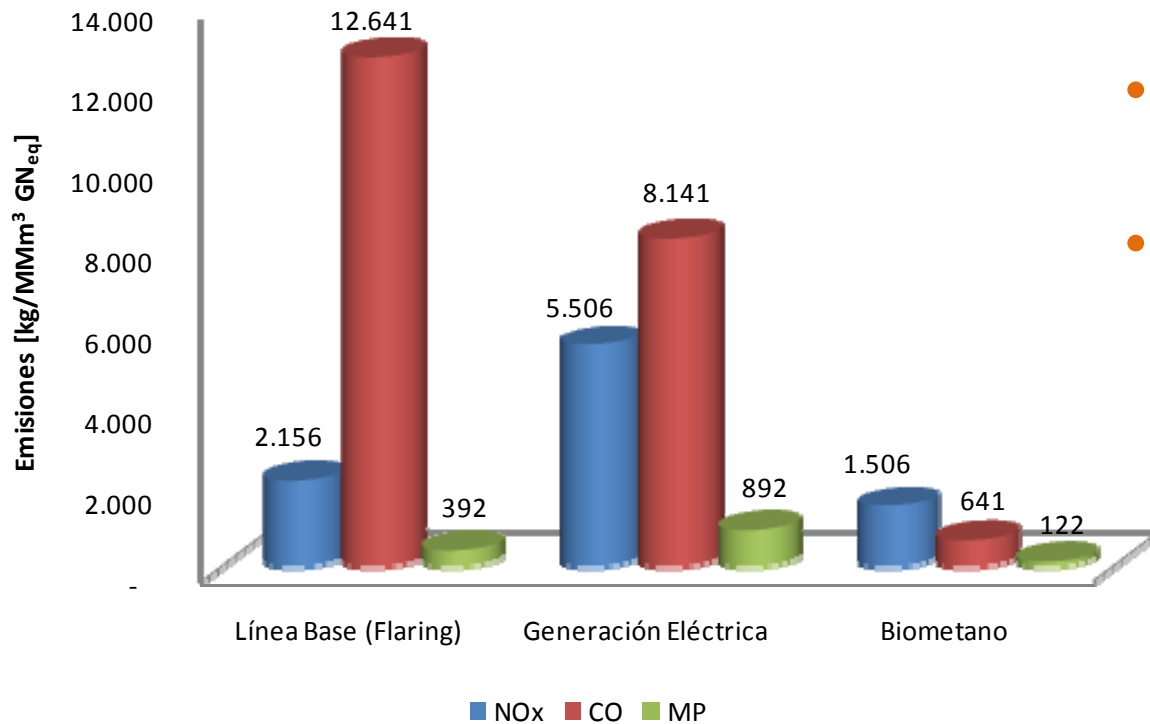


- **Methane capture**

- 21 times more effective than limiting Carbon Dioxide going to the atmosphere
- allow landfill owners to obtain Carbon Credits (ACM001)
  - Large investments in biogas wells and extraction systems, even in abandoned landfills
  - Owners looking to get additional returns...

# Environmental benefits

## Local pollution reduction



- Replaces fossil fuels
- Compared with the alternative of “flaring”, 30% reduction of Nox and 70% reduction of MP.

Fuente: Factores de emisión EPAAP-42

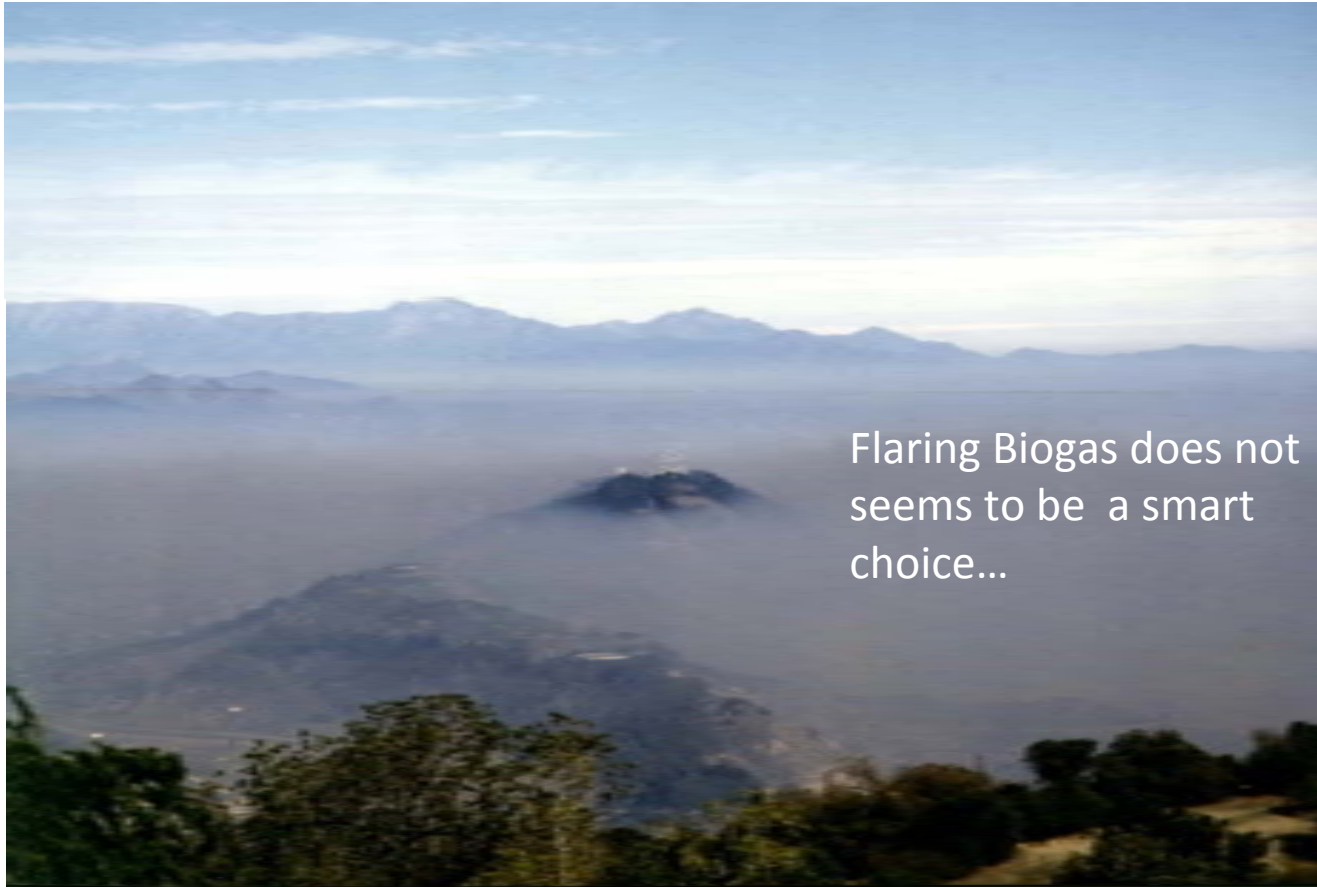
# Santiago, what we should see...



# Santiago: what we actually see (most of the time)



# Santiago: what we actually see (most of the time)



Flaring Biogas does not seem to be a smart choice...



# Metrogas: CDM Projects



## Landfill & Water Treatment Plants: Biogas Recovery

- **Methodology AM0053: “Injection of Biogenic Methane into a Natural Gas Distribution Grid”.**
  - Approved in 137 days without any objection.
- **AM00069: Biogenic methane use as Town Gas Factory feedstock and methane emission reduction of flare efficiency.**



# Biomethane Projects: Barriers

## The case of Landfill projects:

- When developing a new project over a registered one, landfill owners fear losing their current stream of CER's from the already registered project.
- For this reason Metrogas asked Executive Board to provide a solution and implement a mechanism allowing the modification of a registered project, particularly in order to upgrade the use of the biogas, a much more sustainable project.



**Allowing a verification modification plus a new Project based on the same biogas will provide a solution coherent with the sustainable principles imbedded in the Kyoto Protocol and CDM.**

# Metrogas: CDM Projects

## Two other methodologies developed by Metrogas:

### Industrial Fuel Switching

- Natural Gas produces lower emissions of CO<sub>2</sub> per unit of energy than other Fossil Fuels. Combustion is easier and more efficient. Nestlé–MGM International 2002/2004
  - Methodology: “Consolidated baseline methodology for fuel switching from coal to petroleum fuel to natural gas” ACM009 (Formerly AM008)



### Cogeneration

# Biogas To Market



## The challenges



# Biogas To Market



## - High Capex & Opex:

- Large investments to process/transport small volumes in comparison to large scale natural gas production/transport...
- the distance to the existing grid (either electricity or gas distribution grid)
- Economics highly sensitive to Oil – Natural Gas & Electricity price...

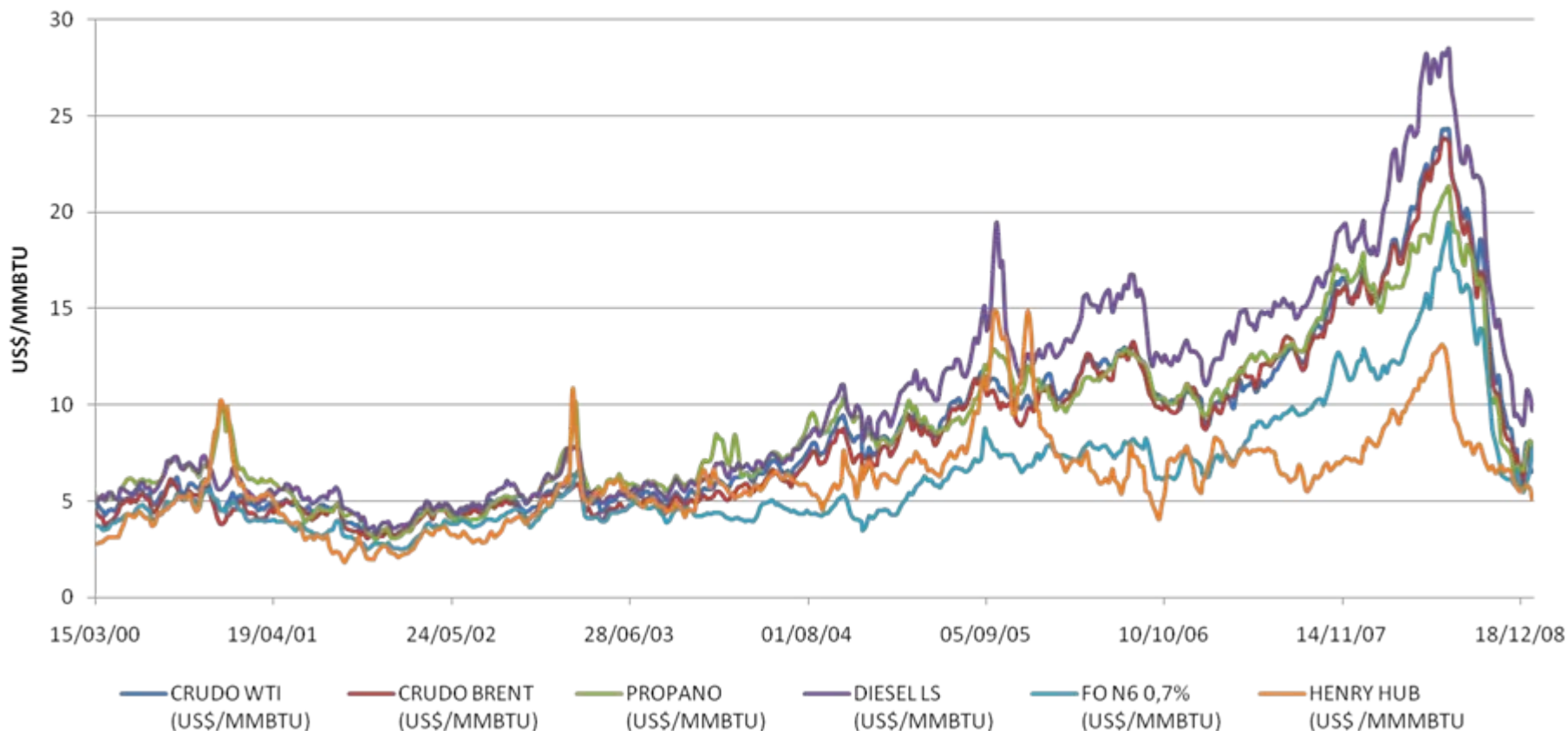
## - Risks

- Production
- Technology for upgrading

# Fuels Price evolution



Evolución precio semanal de combustibles  
US\$/MMBTU FOB 2000-2008



# Biogas To Market



## - Incentives are a key factor:

- What we already have:
  - Tax exemption for bio fuels (for transportation)
  - 5% -10% target of renewable electricity (including biomass) from 2010 onwards; traditional power producers must meet the target or pay a fine.
  - Natural Gas Quality standards in Chile (NCh2264) and “substitute gas” that may be mixed with NG.
- But not enough:
  - Generalized perception that these projects are risky , technology is not mature and costs may overrun.
  - Serious need to perform basic engineering before proceeding, at a high cost
  - Grants / subsidies at the early stage of the project would be a good solution.
  - Access to accurate information /analyses of which technologies suit best to a specific project, would be very useful.



# La Farfana Project





# La Farfana project



- La Farfana Plant processes over 60% of the waste water in Santiago – anaerobic digestion process.
- Biogas production = 24 [MCM /y] ~ 60-65 % methane content.
- Supplies energy needs for the town gas factory (35.000 customers) October 2008
- Economic & environmental benefits



# La Farfana – Town Gas factory pipeline

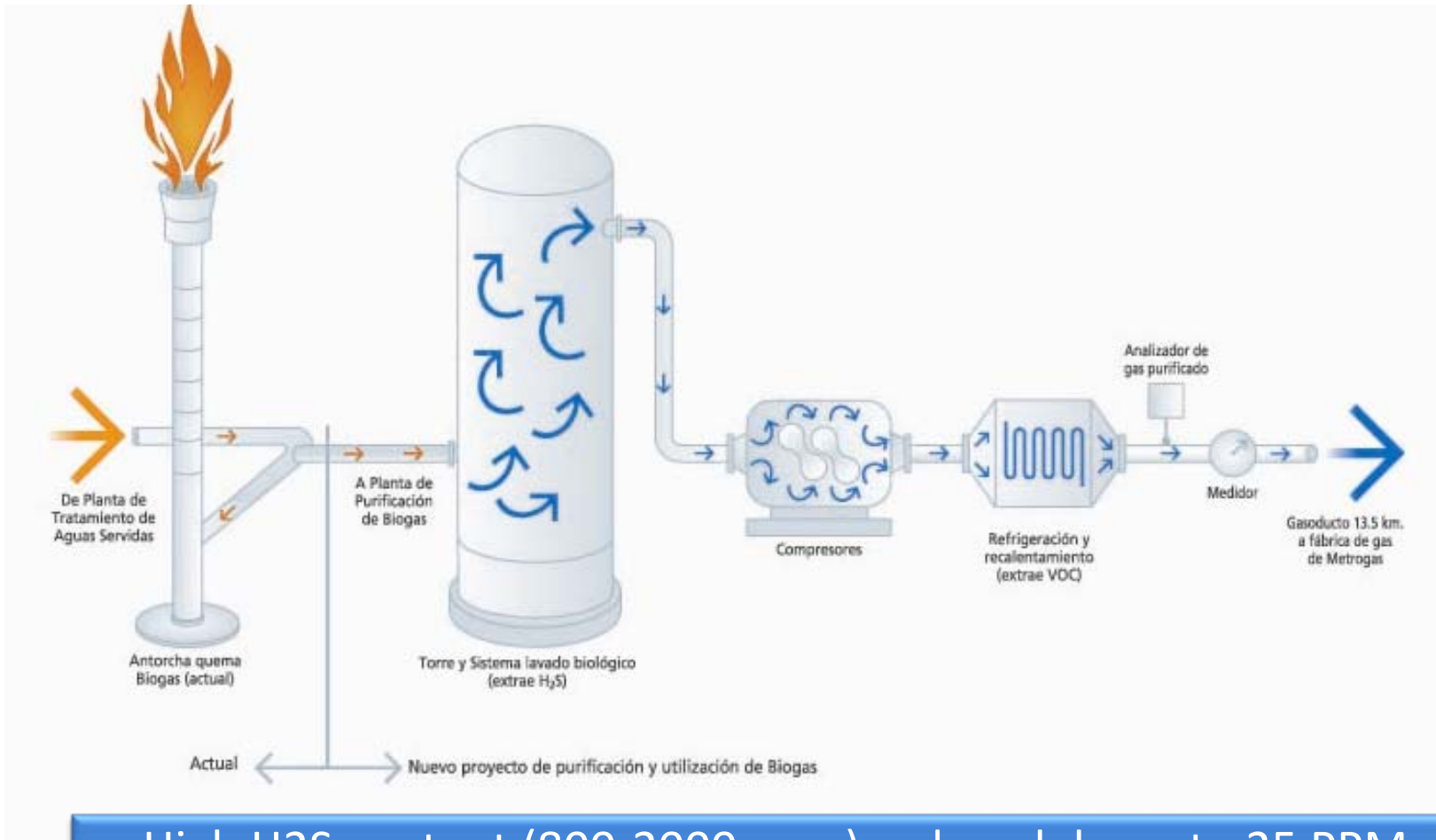
~ 13,6 km



PLANO DE MONTAJE LA FARFANA - PUDAHUEL- ESTACION CENTRAL



# Biogas pre-treatment process



High H<sub>2</sub>S content (800-2000 ppm) reduced down to 25 PPM, then the gas is dried and compressed

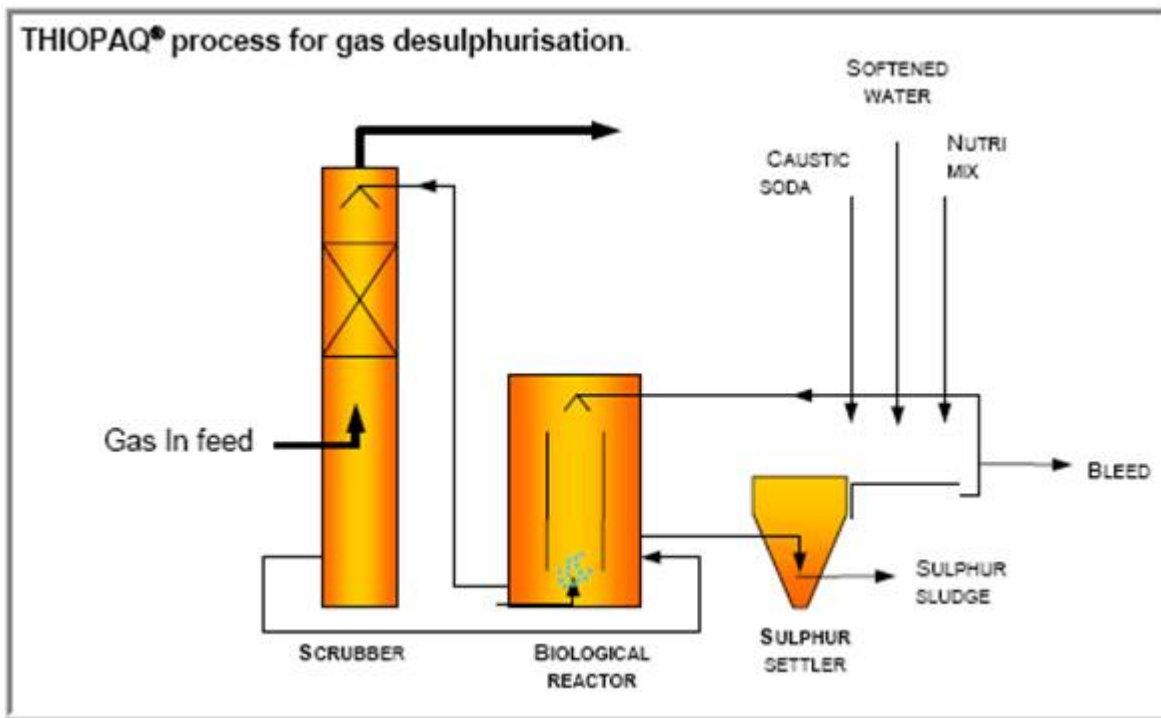
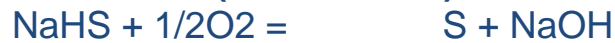
# Biological filter to remove H<sub>2</sub>S

2 stage reaction:

1.- Scrubber (Raw biogas with H<sub>2</sub>S is put in contact with water and NaOH )



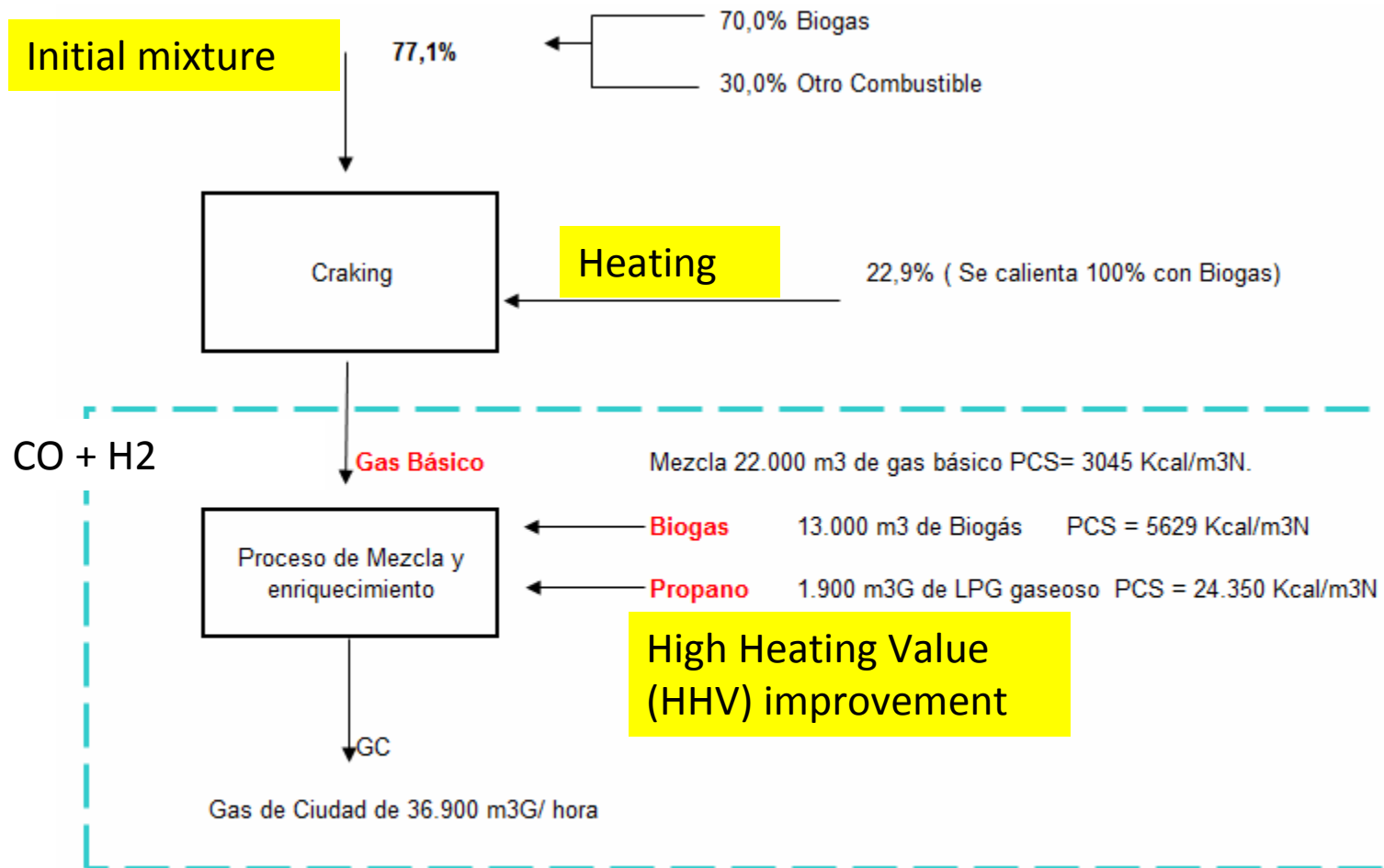
2.- Reactor (Thiobacillus)



# Instalaciones en La Farfana



# Biogas at the Town Gas Factory



En el Global

Biogas	67,8%
Otro Combustible	32,2%

# Biogas at the Town Gas Factory



Biogas is further cleaned (VOC & siloxane removal) with activated carbon scrubbers

# La Farfana project: environmental benefits



## Green House Gas reductions

- 21.300 [tCO<sub>2</sub>/año] equivalent to:
  - Avoid burning 7.800 tonnes of mineral coal per year.
  - Plant 3400 ha of woods.

**Reduce local contaminants such as:  
NO<sub>x</sub>, PM, CO.**





# Biogas from Waste Water Treatment plants: next steps



- Increase biogas utilisation
  - Farfana will increase production in 2009-2010 by 15%
  - At present Metrogas only requires 80% of what is produced at La Farfana
  - Fuel switching to town gas ? But also...
  - Possibility to upgrade part of the biogas and sell it as CBG (Compressed Biogas) for vehicular use...
  - ...and why not all of it to the NG grid?
- R&D , incentives key factors, but opportunities are real...

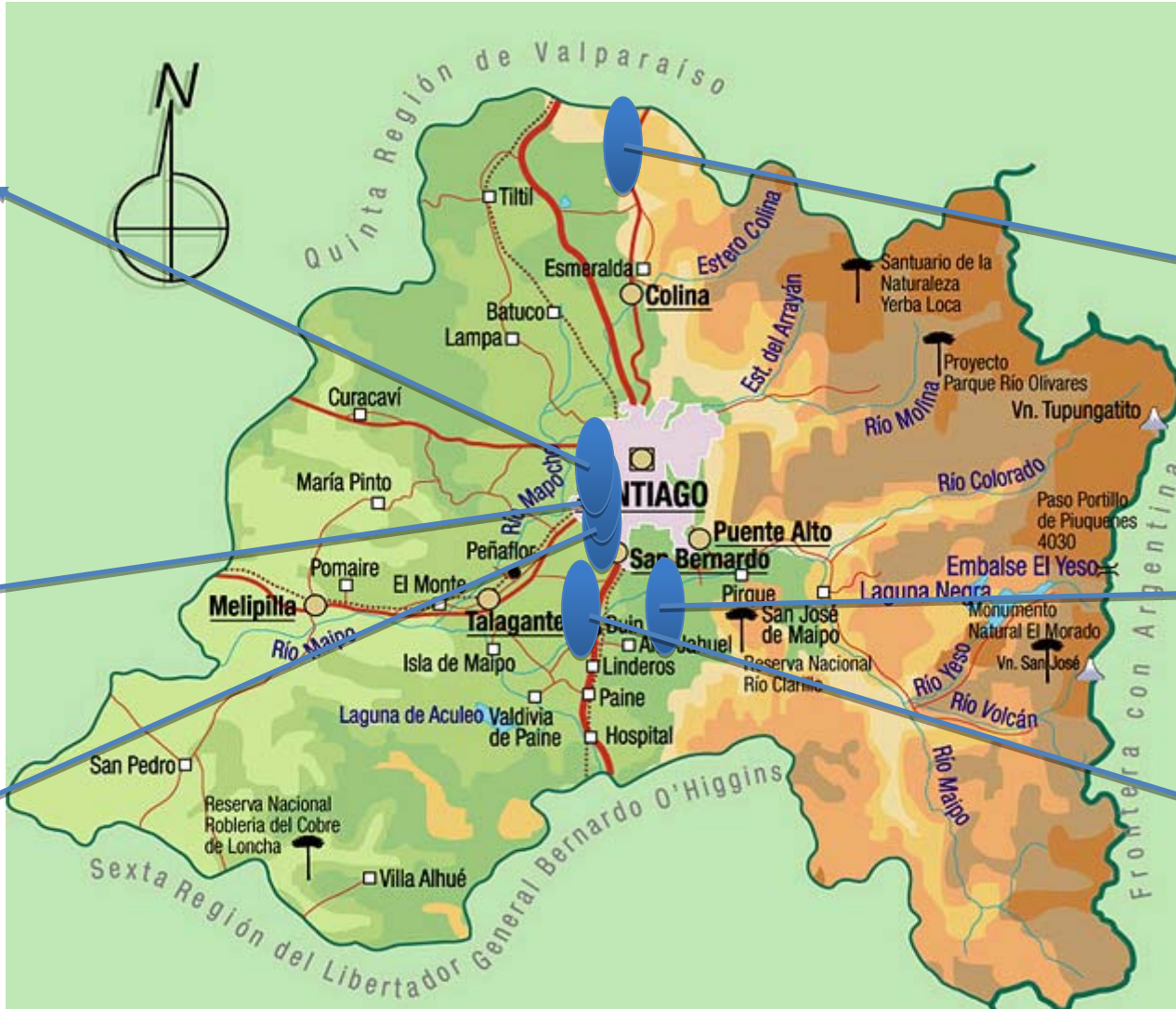
# And more...



Relleno Santiago Poniente (COINCA)

Planta de Tratamiento de aguas "La Farfana"

Planta de Tratamiento de aguas "El Trebal"



Relleno KDM

Relleno Lepanto

Relleno Santa Marta



# Biogas from landfills and waste water treatment plants

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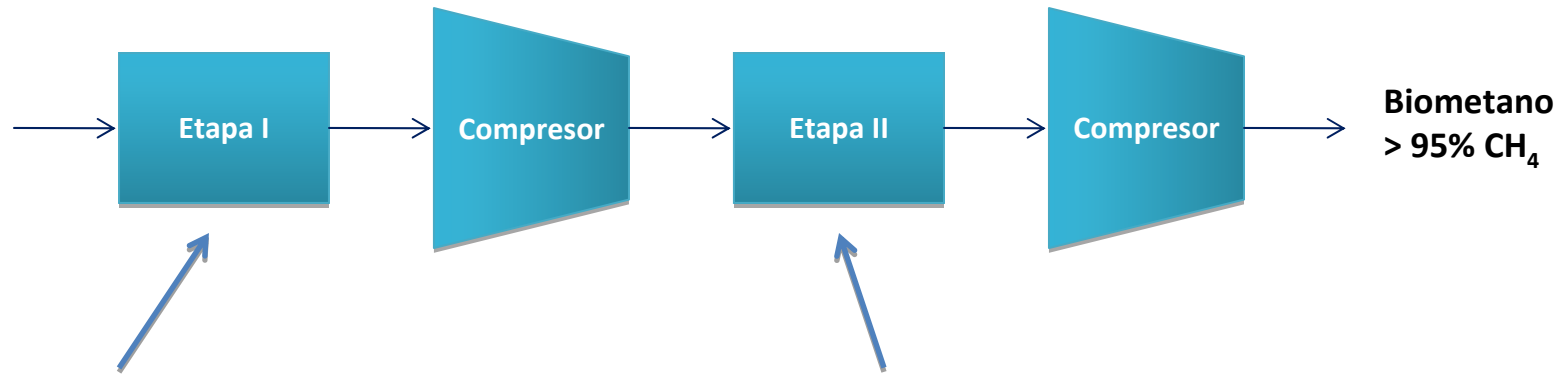




# Anexos



# Biometanización: Descripción del Proceso



## Etapa I - Limpieza:

- H<sub>2</sub>S, Agua, Partículas, Amoníaco, COV's, Hidrocarburos Halogenados
- Oxígeno, Componentes de Silicona (Siloxanos), Nitrógeno

## Etapa II - Tipos de proceso Upgrade:

- PSA (Pressure Swing Adsorption)
- Absorción con Agua (Scrubber)
- Absorción con Químicos (Selexol & Genosorb)
- Absorción con reacción química
- Separación con Membrana
- Proceso Criogénico

Estos proyectos convertirán a Chile en un referente en el uso de nuevas tecnologías para el aprovechamiento de energías renovables

# MDL Metrogas: Proyectos Nestlé Graneros



**Tipo de Proyecto:** Cambio de combustible

**Metodología:**

- Nueva Metodología Aprobada, "Consolidated baseline methodology for fuel switching from coal or petroleum fuel to natural gas" ACM009 (Formerly AM008)
- Permitted to decrease the price gap between Natural Gas and Coal

**Ubicación:** Graneros, VI región, Chile

**Productos:** Café, Cereales

**Combustibles iniciales:** Carbón, Fuel Oil y GLP

**Año:** 2002/04

**Otros Beneficios:** Reducción importante de emisiones locales (MP, NOx)

**Desarrolladores:**



Gamma Ingenieros

# MDL Metrogas: Cogeneration



**Tipo de Proyecto:** Cogeneración (Reducción de emisiones por aumento de eficiencia a través de generación conjunta de Electricidad y Calor)

## Metodología:

- Nueva Metodología Aprobada, “Natural Gas-Based package cogeneration” AM0014, 2004

**Ubicación:** Santiago, Chile

**Productos:** Oleaginosos (mantequilla, etc)

## Características:

- 2 Motores Caterpillar G3516 y G3520
- Potencia Eléctrica : 1,03 + 1,92 MW
- Vapor : 1200 + 1550 kgv/h
- Agua caliente : 6,53 MMBtu/h
- Eficiencia Total:73%

**Año:** 2003/04

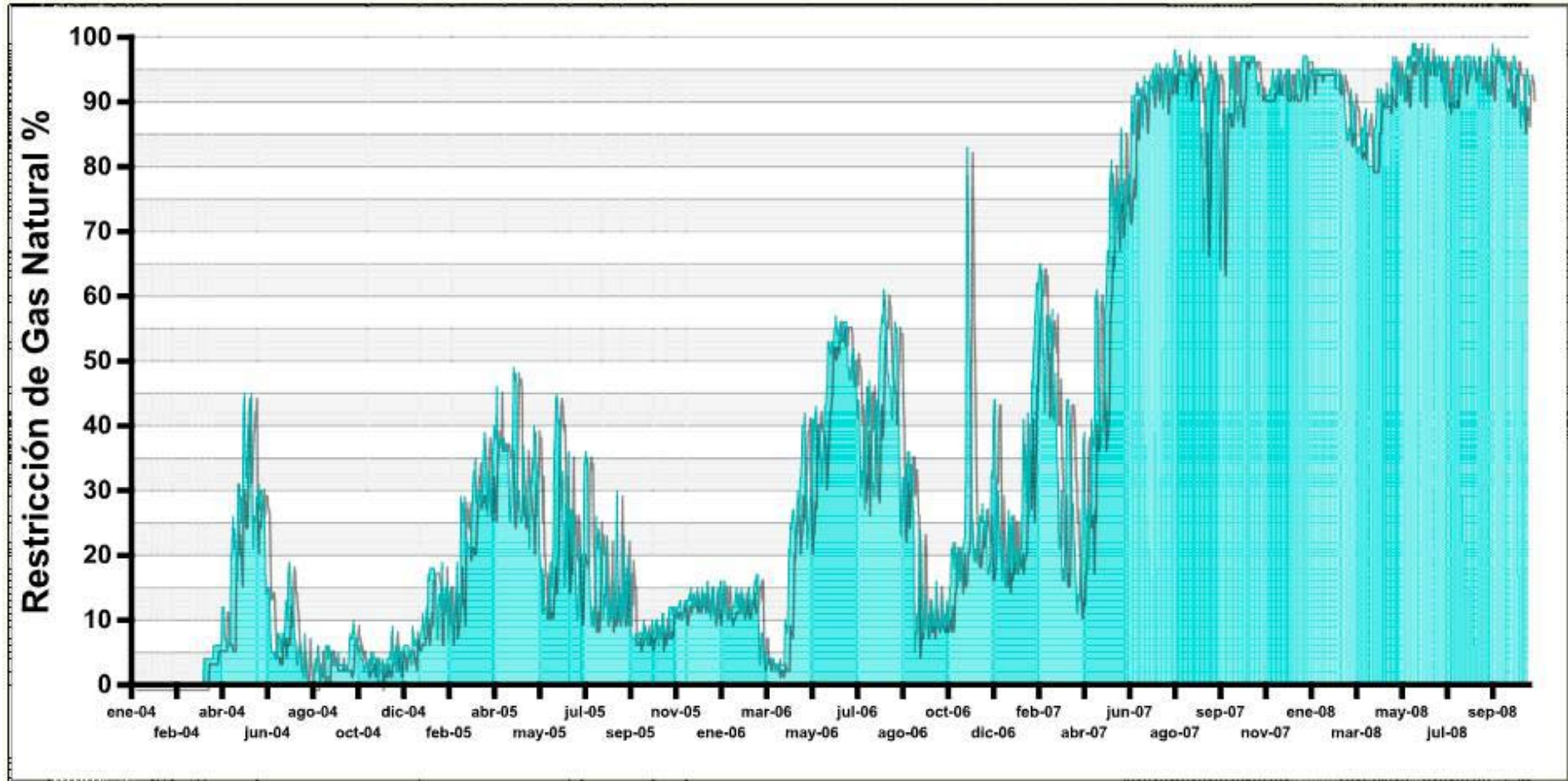
**Otros Beneficios:** Creación de know-how en proveedores y sistema eléctrico (energía distribuida)

**Desarrolladores:**



Gamma Ingenieros

# Unavailability of NG supplies ... a long track record



2004



2008