



**Reducing Methane Emissions from Wet Seal Centrifugal Compressors,
Replication of Projects Identified by Methane to Markets:
The Case of Compressor Dry Seals in PEMEX**

Pemex Gas and Basic Petrochemicals
Division of Production

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1.- PEMEX POSITIONING

Petróleos Mexicanos (Pemex) is a decentralized government agency that is solely responsible for carrying out strategic activities in the field of hydrocarbons which are reserved in the Mexican Constitution.

Based on the guidelines set forth by the Secretary of Energy, Pemex performs its activities for the purpose of maximizing the economic value of hydrocarbons for the country in harmony with both the community and the environment.



- Pemex is the largest company in Mexico and Latin America and the country's largest taxpayer
- Total production of liquid hydrocarbons was 3,486 Mbd (including crude oil and liquefied natural gas) and 6,058 MMpcd of natural gas
- Exports for 2007 were 1,686 Mbd of crude oil, 139 MMpcd of natural gas, 176 Mbd of petroleum products and 746 Mt of petrochemicals
- The amount of total sales increased 2.9% in respect to 2006, to approximately \$1,136 billion pesos (\$104.5 billion USD)

Pemex promotes development in Mexico

Pemex is one of the main generators of economic value for Mexicans. The company creates and distributes the value generated during its production chain in its different forms.

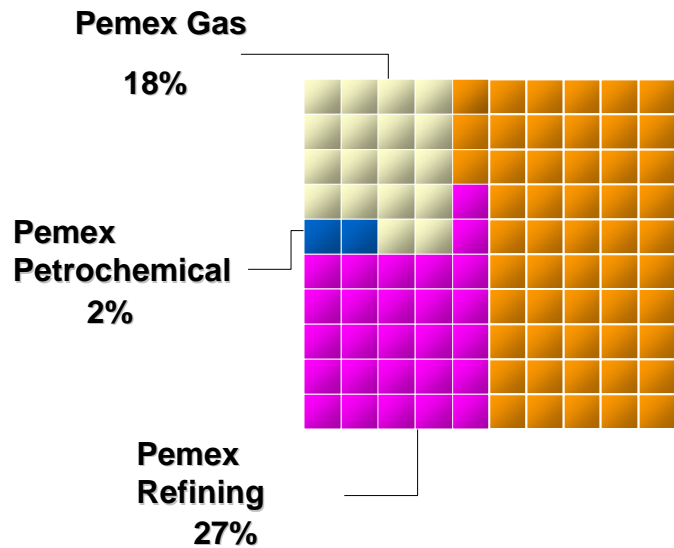
During 2007, total sales increased 2.9% in relation to 2006, reaching \$1,136 billion pesos (\$104.5 billion USD). Sales in the country rose 4.4% and exports rose 1.2% compared with 2006.

PGPB Positioning inside Pemex

Pemex - Gas and Basic Petrochemical (PGPB): processes natural gas and develops basic petrochemical products and liquefied gas in its nine Gas Processing Centers (CPG) in the states of Tamaulipas, Veracruz, Tabasco and Chiapas, and is responsible for transporting and marketing these products.

Positioning inside Pemex Group

Pemex Gas has generated 18% of total profits in the Pemex Group



Pemex
Exploration &
Production
53%

PGPB Facilities



PGPB Income

In 2008, Pemex Gas registered income of 20 billion USD, reaching 11th place in Latin America, and 5th place in México.

PGPB generated nearly 18% of the total profits of Petróleos Mexicanos.

With these numbers, the per capita income of PGPB reached 1.9 million USD.

Posicionamiento en América Latina	2008	Posicionamiento en México
Ingresos totales (millones de dólares)		
104,031		1°  98,162
98,162		2°  84,044
97,357		3°  40,444
84,044		4°  25,532
41,929		5°  20,027
41,341		6°  19,920
40,444		7°  18,091
36,211		8°  17,964
30,812		9°  14,635
25,532		10°  12,411
20,027		11°

Fuente: Fortune, Expansión 500 e Informe Anual Pemex, 2008

2.- ENVIRONMENTAL PERFORMANCE

One of the challenges Pemex faces consists of making compatible the production of oil resources with the natural environment's conservation and restoration processes, and with the resources found in the communities that surround its operation centers.

Pemex expects to invest approximately **\$7 billion USD** between 2007 and 2012 on its environmental development strategy.

Climate change

Pemex generates close to 6% of the nation's greenhouse gas (GHG) emissions.

The strategy to reduce GHG gas emissions is focused on improving energy efficiency, co-generation and use of methane, and to register Clean Development Mechanism (CDM) projects.



Petróleos Mexicanos Sustainable Development Report

This annual report provides useful, objective and straightforward information on Pemex's activities. It was produced with the participation of an independent group of citizens with experience in the issues covered by this report. This citizen group formulated questions on the report and queried Petróleos Mexicanos on its activities.

This publication complies with the indicators set forth in the Global Reporting Initiative (GRI). It is with great satisfaction that Pemex presents the first Mexican GRI Application Level A+ report, the highest level possible awarded by this initiative. Moreover, the Report meets the guidelines of the United Nations Organization Global Compact for communication in progress.

PEMEX collaboration with global Initiatives

Main initiatives and organizations that involve Pemex participation

Initiatives

- *UN Global Compact*
- *Energy Industry Partnership (EIP) of the World Economic Forum (WEF)*
- *Extractive Industries Transparency Initiative (EITI) - Board Member*
- *Methane to Markets (M2M)*
- *GHG emission Program in Mexico*
- *Kyoto Protocol (CMD)*



Organizations

- *Comisión de Estudios del Sector Privado para el Desarrollo Sustentable (CESPEDES).*
- *Asociación Mexicana para la Energía y el Desarrollo Sustentable (AMEDES).*
- *Association of Petroleum and Gas Companies of Latin America and the Caribbean (ARPEL)*
- *International Maritime Organization (OMI)*
- *The International Fuel Quality Center (IFQC)*
- *Chemical Distribution Institute (CDI)*
- *Oil Companies International Marine Forum (OCIMF)*
- *European Barge Inspection Scheme (EBIS)*
- *International Association of Independent Tanker Owners (Intertanko)*
- *International Tanker Owners Pollution Federation (ITOPF)*

3. M2M - PEMEX GAS COLLABORATION

List of projects performed to date under the M2M – PEMEX Gas collaboration:

- **August 2006** – Cactus, Ciudad PEMEX and Nuevo PEMEX GPCs. Fugitive emissions identification and quantification measurements.
- **October 2007** – Cactus, Ciudad PEMEX y Nuevo PEMEX GPCs. Post-repair/rehabilitation measurements from valves, etc.
- **August 2006** – Ciudad PEMEX GPC. Fugitive emissions measurement from compressors with wet seals (can be used as a baseline for a CDM project)
- **October 2007** – Ciudad PEMEX GPC. Post-implementation measurement from dry seals on compressors
- **October 2007** – Nuevo PEMEX GPC. Integrated methane emissions and energy diagnostic.
- **February 2008** – Poza Rica GPC. Integrated methane emissions and energy diagnostic.
- **December 2008** – Burgos GPC. Integrated methane emissions and energy diagnostic



4.- SUCCESS CASE

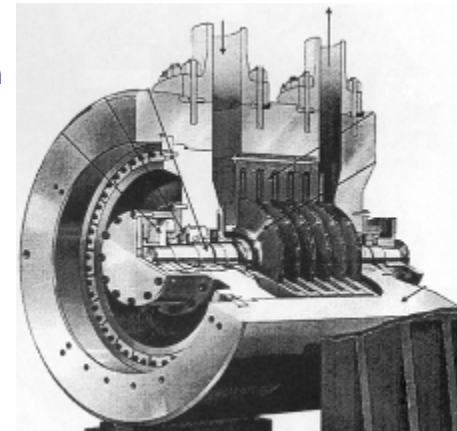
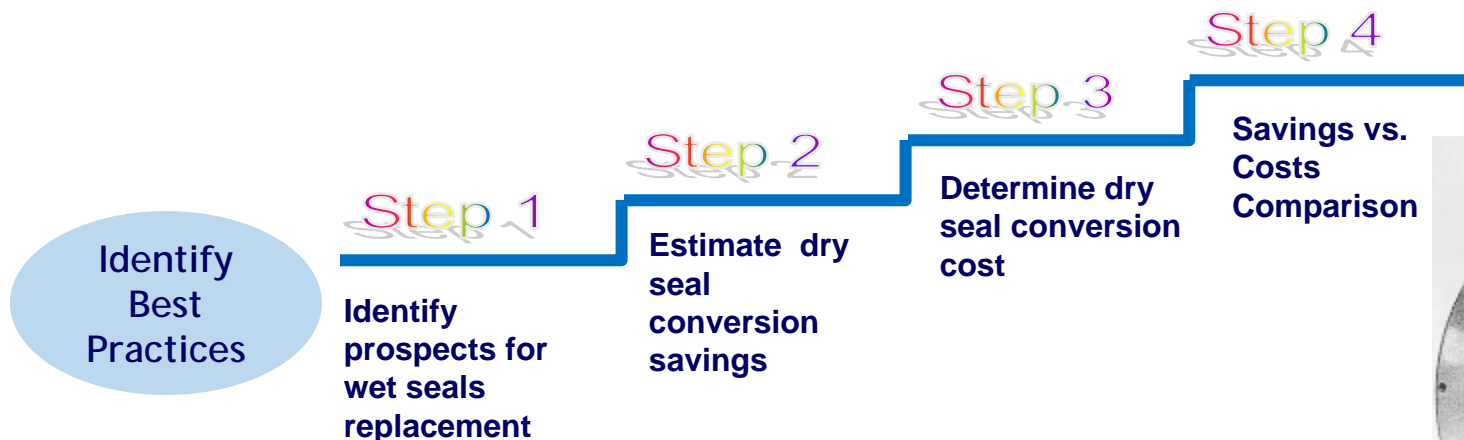
M2M has supported PGPB in the evaluation of the benefits of converting wet seals to dry seals in centrifugal compressors in south Mexico facilities (Ciudad Pemex CPG).

The prefeasibility study included:

- Preliminary estimations of benefits
- Methane emissions reductions in wet seals
- Adjustment of preliminary estimates
- Project economic evaluation
- Final measurements



Decision Making



Identify Best Practices

Due to the types of PGPB processes, methane emissions can occur in different equipment, such as:

- Process lines and equipment
- Internal combustion engines
- Pumps
- Controls
- Tanks
- Natural Gas Compressors



- Based on industry's information* it has been identified that typically 80% of methane emissions in natural gas compression stations originate at the compressor, particularly when equipped with wet seals.
- In this wet seal compressors, buffer oil degassing may vent 40 to 200 SCFM of gas to the atmosphere.*
- Dry seal technology offers, within certain application limits, a technically and economically feasible alternative to reduce these emissions.
- 70% of PGPB's Production Subdivision compressors are equipped with wet seals.

* Source: "Replacing wet Seals with Dry Seals in Centrifugal Compressors" (EPA430-B-03-012)



“REPLACING WET SEALS WITH DRY SEALS IN CENTRIFUGAL COMPRESSORS”
Lesson Learned From Natural Gas STAR Partners



Methane to Markets

Comparison between Wet Seals and Dry Seals on Compressors

Before



GB-203 A/B/C

After



The verification of the results indicated a Emissions Factor Reduction of 43.09 SCFM

GB-203	Design	With Re-powering
MMSCFD	55	80
KW	3,309	4,594
RPM	10,900	10,900
EFIC.	72%	74%
Seal	Wet	Dry

Emission Factor by compressor: Before

Component category	Emission factor (SCFM)	Emission factor (Mcf/yr)	Emission Factors by cost \$/yr@US\$6/Mcf
Seals	43.11	22,654	US \$135,924

After

Emission factor (SCFM)	Emission factor (Mcf/yr)	Emission Factors by cost \$/yr@US\$6/Mcf
0.02	10.15	US \$63

5.- LEAK DETECTION AND MEASUREMENT

The leak detection was carried out according to Method 21 of United States EPA (1997) that permits using infrared chambers, VOC chambers or hand-held gas detectors of gas hydrogen (Bascom-Turner Gas Sentry CGI-201, CGI-211 o GMI Gas Surveyor3).



Leak measurement provided by M2M is consistent with the requirements of the Kyoto Protocol.

UNFCCC approved technologies to detect and measure leak flow rates*

To Detect

- Electronic Screening
- Acoustic Leak Detection
- Organic Vapor Analyzers (OVAs) and Toxic Vapor Analyzers (TVAs)

To Quantify

- High volume or hi-flow samplers
- Bagging techniques
- Rotameters
- Ultrasonic flow meters

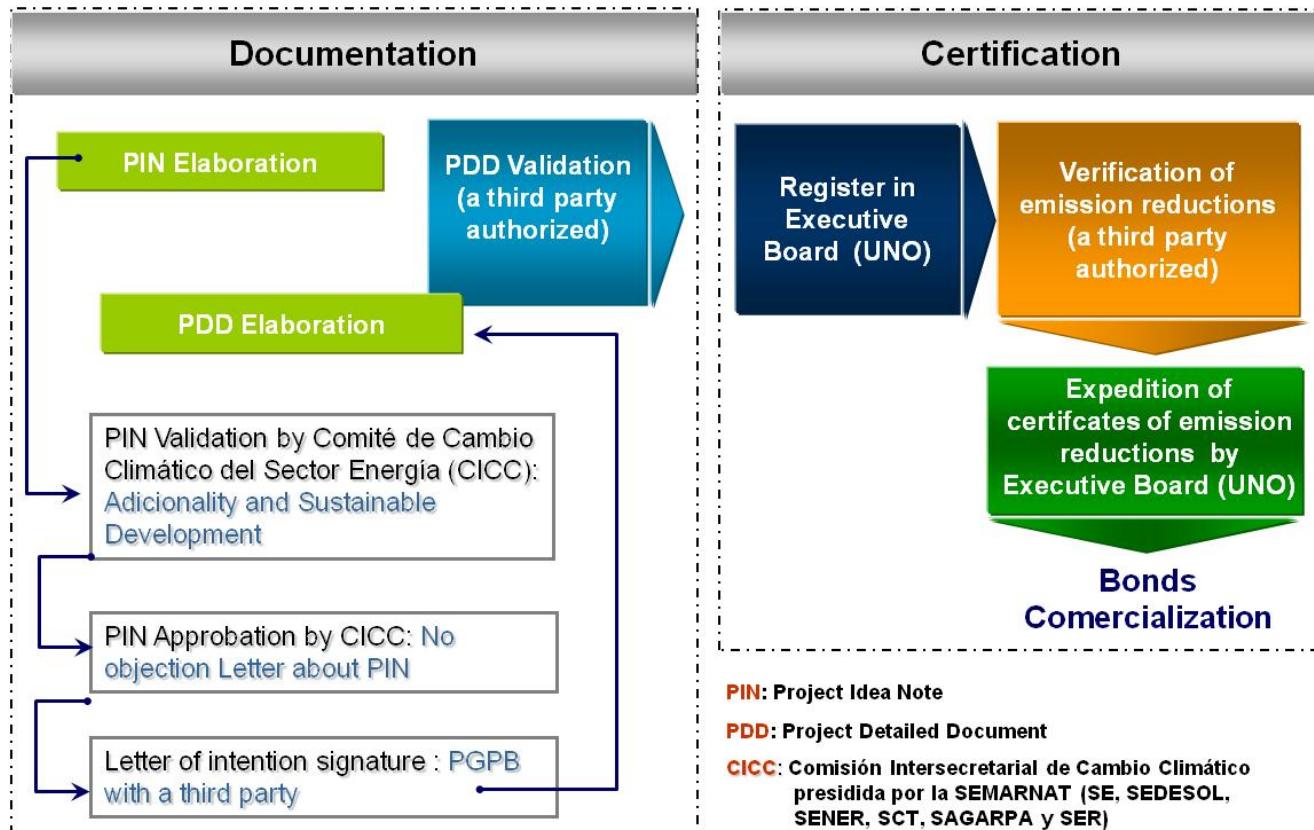
* *Leak reduction from natural gas pipeline compressor or gate stations*, CDM – Executive Board AM0023 / Version 02

6.- MIGRATION FROM M2M TO CDM PROJECT

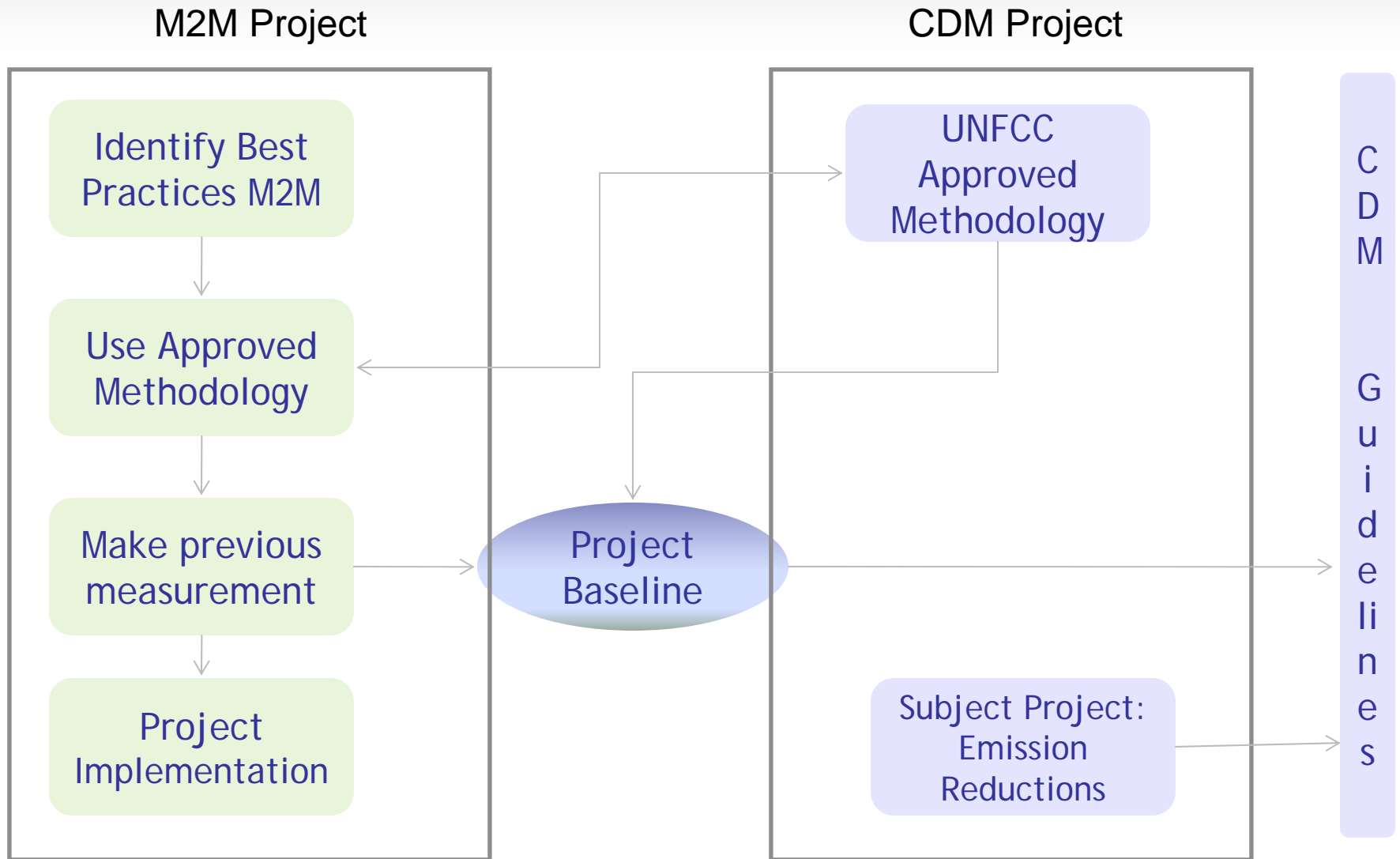
The success of the Dry Seals Project of Ciudad Pemex, permitted his replicability to others PGPB facilities.

The measurement results of October 2007 carried out by M2M, were taken as Base Line of a new Dry Seals Project for 15 additional compressors at Nuevo Pemex and Poza Rica CPG's. According to the CDM Methodology, PGPB has developed the required steps for the new Project:

Description	Dates
PIN	October 07
No Objection Letter	November 07
Letter of Intention	January 08
Stakeholders consult	November 08
PDD	January 09
CICC Approbation	March 09
ERPA signature	April 09
PDD Validation on site	May 09
PDD Validation doc.	
Monitory Plan	



Migrating from M2M Project to CDM Project?



7.- CONCLUSIONS

- One of the top strategic priorities of PEMEX Gas and Basic Petrochemicals Production Subdivision is the technological modernization of its installations in compliance with Quality, Safety, Health, Environmental Protection, Sustainable Development and Added Value (AVA) policies, therefore, this project meets all established premises.
- Methane to Markets support has been and will prove fundamental to ratify the project's potential, verify real life situations and assess its replication at all PEMEX gas compression facilities.
- Based on our findings, these activities have also a high replication potential in all Gas Processing Complexes, with the added feature that only a fraction of the potential was estimated, so the real, global potential could be significantly higher.
- In this particular case of compressor seals, the potential for project replication in other PEMEX divisions must be affordable, so the final benefits from the program to the Corporation could be more than attractive.

PGPB reiterates its commitment to sustainable development by carrying out these important initiatives: M2M and CDM Projects contribute to the effort to prevent climate change.



Pemex Gas and Basic Petrochemicals



Production Subdivision

¡ Thank-You!

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