



Pemex Gas y Petroquímica Básica
(Pemex Gas and Basic Petrochemicals)
Division of Production

**Identification and Documentation of GHG Reduction
Projects in Natural Gas Processing Complexes**

November 2008

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1. Introduction

- Within the framework of a sustainable development policy, the Production Division of PEMEX Gas is working to identify and document greenhouse gas (GHG) emissions reduction projects.
- These activities are part of a strategic initiative called “PEMEX and Environmental Care” that promotes operational security and a better relationship with environment, under the National Climate Change Strategy promoted by President Felipe Calderón.
- In close collaboration with the Methane to Markets Partnership, PEMEX has carried out on-site measurement studies in different gas processing complexes in order to identify methane and other GHG emissions reduction options, as well as energy efficiency opportunities.



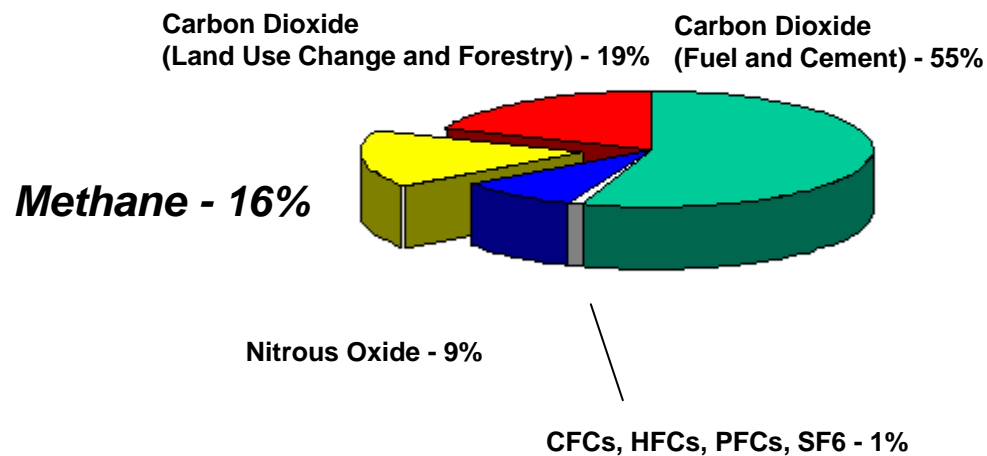
- SEMARNAT is the agency in charge of the M2M program in Mexico, and PEMEX co-presides the International M2M Oil and Gas Subcommittee with the Russian Federation and Canada.
- PEMEX is carrying out emissions inventories and energy consumption studies to improve environmental performance and reduce industrial risks, as well as to achieve economic savings and preserve natural resources.
- To take advantage of the technical support provided by M2M, M2M and the Division of Production of PEMEX Gas carried out a methane emissions measurement campaign in gas processing complexes (GPC) in the context of broader energy efficiency diagnostics, and to comply with the social responsibility of PEMEX Gas.



Why focus on methane?

- A potent greenhouse gas (GHG) with 100-year global warming potential of 23; atmospheric lifetime of ~12 years
- The 2nd most important GHG, accounting for ~16% of total climate forcing
- A primary component of natural gas and a valuable, clean-burning energy source

Global GHG Emissions in 2000 40,702 million tonnes carbon dioxide equivalent (MtCO₂e)



Methane emissions from oil and gas

The majority of oil and gas methane emissions come from

- Oil production
- Natural gas
 - Production
 - Processing
 - Transmission
 - Distribution

Methane emissions can be intentional or unintentional

- Leaks
- Process venting
- System upsets



2. M2M - PEMEX Gas Collaboration

- The Methane to Markets Partnership (M2M) is an international initiative supported by the US EPA with 25 partner Governments including Mexico, and who are responsible of 70% of methane emissions in the world
- The Methane to Markets Partnership (M2M) is an international initiative that advances in methane recovery and use as a clean energy source in four sectors:



Oil and Gas Systems



Coal Mines



Landfills



Agricultural Waste

The goals of the Partnership are to reduce global methane emissions to

- Enhance economic growth
- Strengthen energy security
- Improve air quality and industrial safety
- Reduce emissions of greenhouse gases

2. M2M - PEMEX Gas Collaboration

How does Methane to Markets support PEMEX Gas?

On-site measurement study

- For gas processing complexes seriously considering implementing emission reduction project, on-site measurement studies, leak & vent detection for proposed projects are performed
- M2M uses methane emission identification and measurement equipment to quantify methane emissions

Develop estimated methane emissions inventory

- The gas complex provides operational data to a consultant provided by M2M with EPA funds that is used to estimate methane emissions and to propose methane reduction opportunities
- Consultant delivers a report detailing economic, operational and environmental benefits from emissions reduction
- Helps prioritize opportunities

“Desktop” project analysis

- Using results from estimated inventory, consultant and the gas processing complex can further evaluate priority projects with high economic and environmental potential
- Consultant can do further analysis to provide more specific project recommendations (detailed technical, economic, etc.)

Benefits from methane recovery and use projects

Economic benefits

- Increased revenue by reducing losses
- Reduced maintenance and fuel costs

Environmental benefits

- Reduced greenhouse gas emissions
- Improved local air quality

Operational benefits

- Increased energy efficiency at oil and gas facilities
- Reduced waste of a valuable fuel and energy source
- Improved industrial safety
- Potential maintenance and fuel savings
- Progress toward **corporate goals**



2. M2M - PEMEX Gas Collaboration

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

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



3. Success Stories at PEMEX Gas

Wet seals replacement from compressors

- In April 2006, PEMEX Gas hosted the *International Oil and Gas Subcommittee Meeting and Technology Transfer Workshop*, where it presented the project “Shifting from wet seals to dry seals in natural gas compressors in Ciudad PEMEX GPC.” This project was selected by the International Oil and Gas Subcommittee as a *Flagship* project to promote methane recovery actions in Latin America. On October 2006, a certified measurement study to set up the project base line was sponsored by M2M.
- In October 2006, the project represented Mexico in the *13Th Annual Implementation Workshop of Natural Gas*, in Houston TX, and was recognized as an example of *Best Practices* for emissions reduction.
- On October 2007, the results were verified and methane emissions reductions of 99.95% (67,718 Mcf/y) were measured.

Compressors seals emissions factor

2006 Leak Survey					2007 Post Measurement Survey		
Component Category	Number of wet seals	Emission Factor (SCFM)	Emission Factor (Mcf/Yr)	Emission Factors by cost \$/Yr @ \$6/Mcf	Emission Factor (SCFM)	Emission Factor (Mcf/Yr)	Emission Factors by cost \$/Yr @ \$6/Mcf
Turbine Wet Seal	3	43.11	22,654	\$135,924	0.02	10.50	\$63

3. Success Stories at PEMEX Gas

Quantification of Emissions at PEMEX Gas GPCs

- On August 2006, with USAID and M2M support, a methane fugitive emissions identification and measurement study was conducted in 3 GPCs: Cactus, Nuevo PEMEX and Ciudad PEMEX.
- Components with the biggest impact were immediately repaired/replaced. On October 2007, a post-measurement survey was performed by Heath Consultants with the following results: 98.38% of emissions reduction, 75% from Ciudad PEMEX wet seals and 25% from other components

Summary results by GPC

GPC	Before	After
	Rate flow, 2006 MMcf/year	Rate flow, 2007 MMcf/year
Cactus	4.847	0.830
Nuevo PEMEX	15.336	0.000
Ciudad PEMEX	70.842	0.641
Total	91.025	1.471
Emissions reduction 98.38%		



Quantification of Emissions at PEMEX Gas GPCs

Work in gas processing complexes included identification and tagging of leaking components. Additionally, the leak rate was measured, allowing operations staff to implement corrective actions. The successful results of this work were verified in the 2007 post-measurement survey

The main implementation activities included:

- A valve maintenance program was successfully implemented in Ciudad PEMEX. 7 leaking valves were replaced during a maintenance stop. Emissions reductions of 2.9 MMcf/year were achieved
- Nuevo PEMEX focused on the replacement/substitution of valves from Cryogenic Plant 2. This effort achieved a complete elimination of emissions worth to 15.3 MMcf/year.
- In Cactus, 7 leaks were repaired and 2 more leaks were minimized, a total reduction in emissions of 4.0 MMcf/year was achieved.



4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostic

- On October 2007 and February 2008, measurement campaigns were conducted in Nuevo PEMEX and Poza Rica GPCs, respectively, in order to generate a GHG emissions inventory and reduction opportunities by:
 - Methane emissions control programs
 - Energy efficiency improvement
- The measurement campaign included:
 - Inventory of leaking components, process vents and flares
 - Gas process heater efficiency measurement
- Specific emissions control opportunities were identified, and an economic assessment for opportunities was prepared.
- The assessment was performed Clearstone Engineering (Canada) and PA Consulting Group (USA), with the technical support of M2M.
- These results have been integrated into action plans to implement preventive and corrective actions of energy optimization in the processes in order to reduce methane and CO₂ emissions.



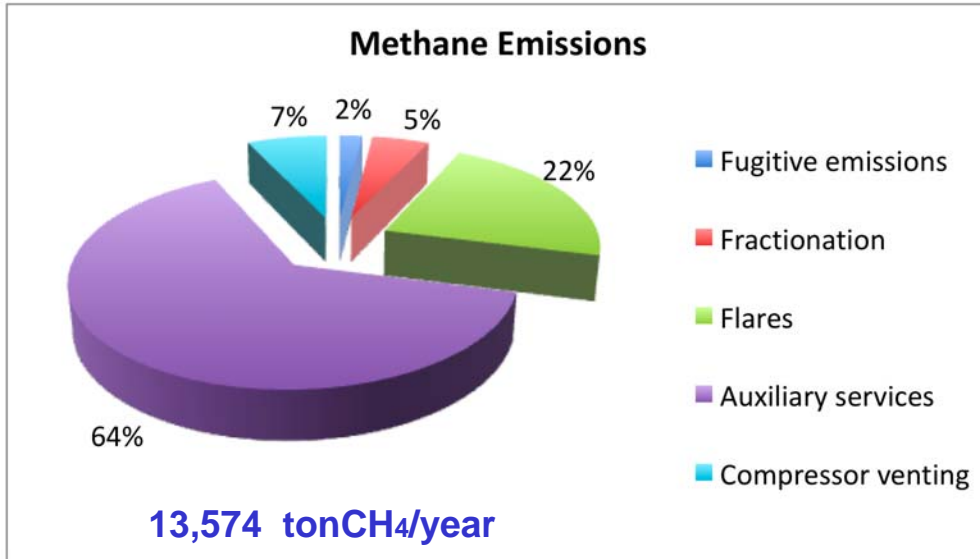
4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Emissions reduction potential in CO₂e at Nuevo PEMEX GPC

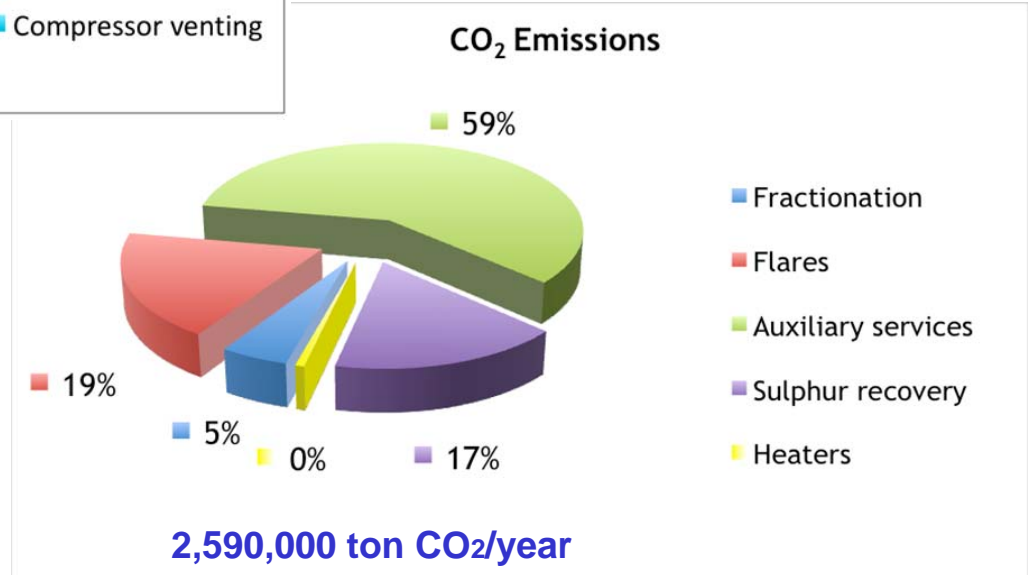
Source	Contribution %	Control Technology	Reduction Potential [%]
Heaters	1%	A/F management	10-15
Flares	19%	Purge gas optimization and flare valve leak detection program	95
Fugitive Emissions	0.2%	DI&M program	70 – 80
Compressor Venting	0.8%	Vapor recovery system	95
Sulphur Recovery	15%	Waste gas recovery system	95
Fractionation	5%	Regular inspection/tuning	10-15
Auxiliary Services	59%	Regular inspection/tuning	10-15
Total	100%	-	-

4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Project opportunities¹ at Nuevo PEMEX GPC



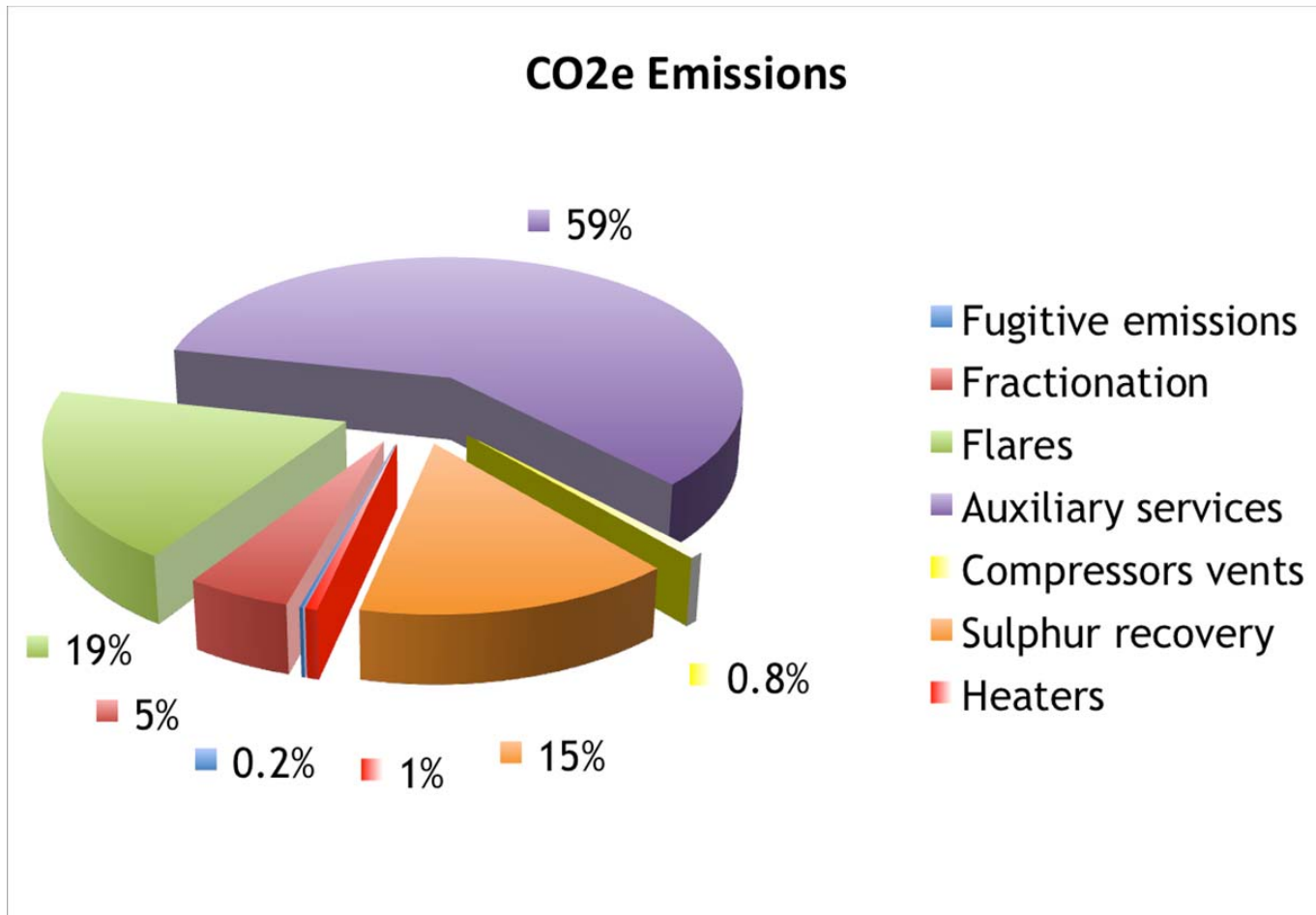
CO₂ measurement results



¹ These figures are based on measurements performed during the inventory on fuel consumption, volumes of vented and/or burned gas, and fugitive emissions in components and equipment.

4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Total CO₂e emissions at Nuevo PEMEX GPC



Total emissions = 2,875,000 Ton CO₂e/year

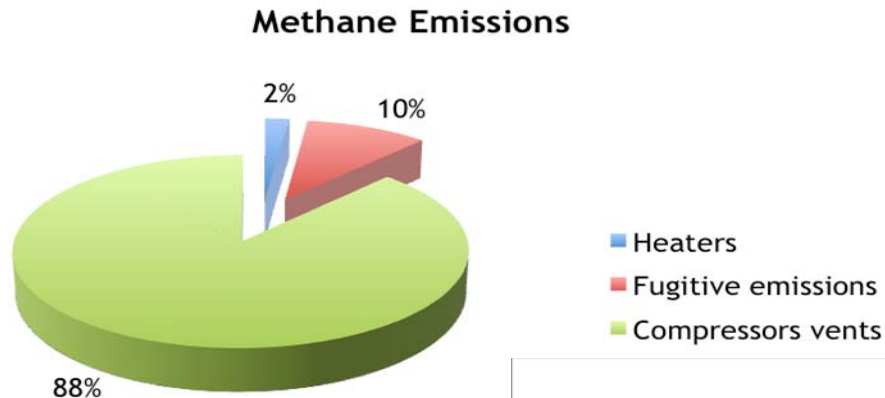
4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Emissions reduction potential CO₂e at Poza Rica GPC

Source	Contribution %	Control Technology	Reduction Potential [%]
Heaters	4%	A/F management.	10-15
Flares	4%	Purge gas optimization and flare valve leak detection program or flare gas recovery system.	95
Fugitive Emissions	2%	DI&M program.	70-80
Compressor Venting	17%	Vapor recovery system.	95
Sulphur Recovery	18%	Review sweetening plant	95
Fractionation	2%	Regular inspection/tuning.	10-15
Auxiliary Services	53%	Regular inspection/tuning.	10-15
Total	100%	-	-

4. Nuevo PEMEX and Poza Rica GPCs energy diagnostic

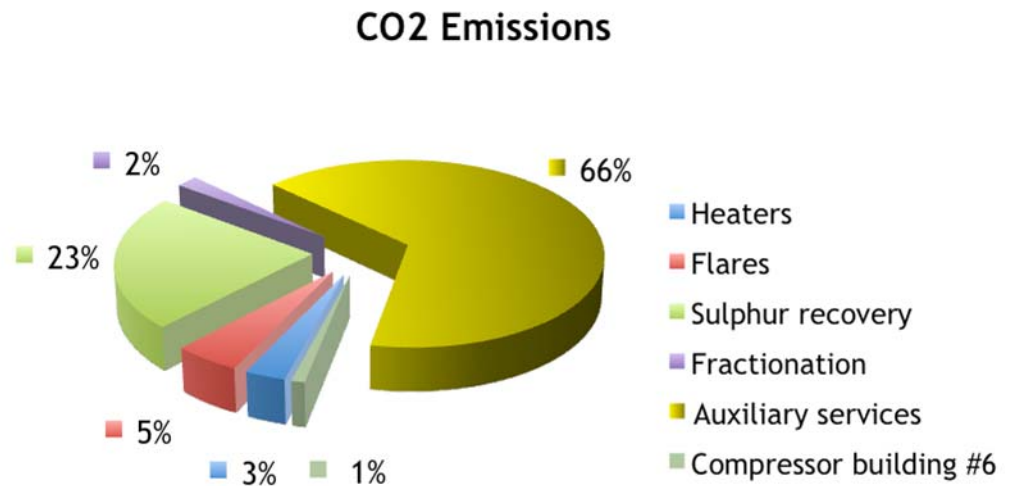
Project opportunities¹ at Poza Rica GPC



88%

4,704 tonCH₄/year

CO₂ Measurement results



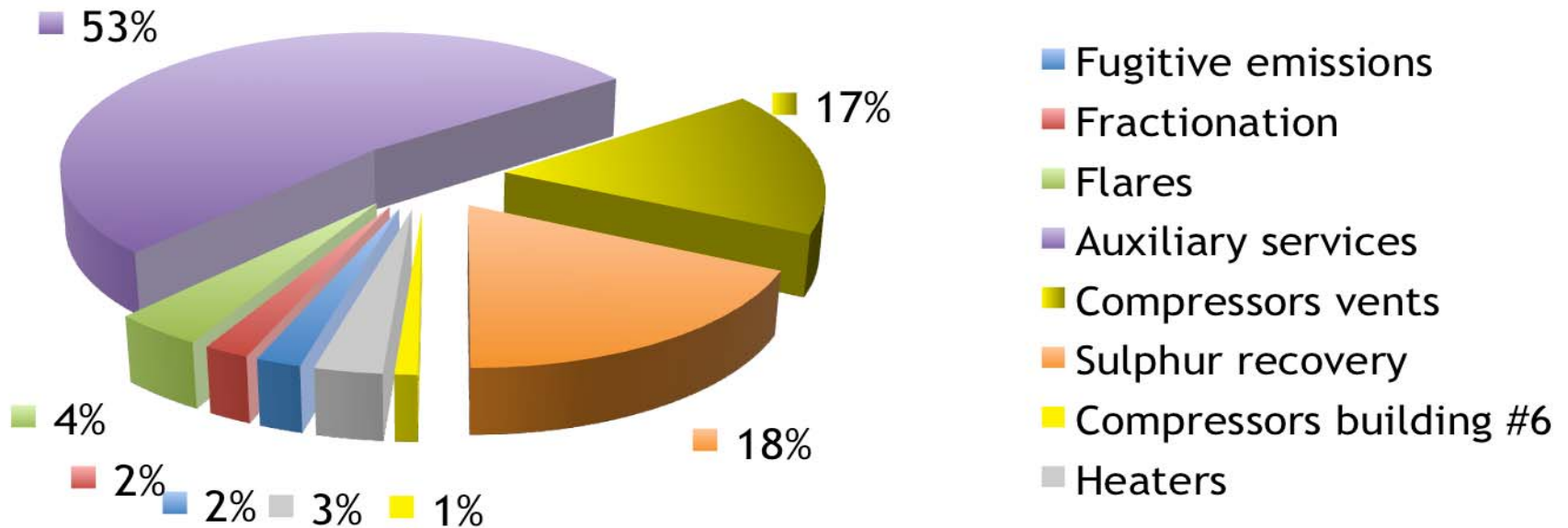
401,318 tonCO₂/year

¹ This figures are based on measurements performed during the inventory on fuel consumption, volumes of vented and/or burned gas, and fugitive emissions in components and equipment.

4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Total CO₂e emissions at Poza Rica GPC

CO₂e Emissions



Total emissions = 500,100 TonCO₂e/year

5. Next Steps

Develop detailed work plans for the Nuevo PEMEX and Poza Rica GPCs, generated from energy diagnostics performed by Clearstone Engineering and PA Consulting Group



Complejo Procesador de Gas Poza Rica

Descripción: Propuesta de iniciativas para integrar proyectos de Mecanismo de Desarrollo Limpio (MDL)

CONCEPTO	2008						2009												2010	
	JUL	AGO	SEP	OCT	NOV	DIC	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC		
1.- Recepción del reporte técnico de diagnóstico energético y reducción de emisiones	P																			
	R																			
2.- Presentación y difusión de los resultados	P																			
	R																			
3.- Verificación por el CT de los datos indicados en los reportes técnicos	P																			
	R																			
4.- Análisis de resultados y elaboración de programas de trabajo	P																			
	R																			

CONCEPTO	2008						2009												2010	
	JUL	AGO	SEP	OCT	NOV	DIC	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC		
Eliminar las emisiones fugitivas detectadas en equipo de proceso de TF, Girbotol y Criogénica, por orden de magnitud, considerando el reemplazo de componentes (ver nota en observaciones)	P																			
	R																			
Reemplazar los componentes emisores identificados, susceptibles de reparación rentable	P																			
	R																			
Mejorar la eficiencia de combustión de las calderas, mediante ajuste de la relación A/C	P																			
	R																			
Reducir venteo de los sellos y de la grasera de los compresores en la planta criogénica	P																			
	R																			
Ajustar la combustión de calentadores y hornos en las plantas criogénica, azufre y fraccionamiento	P																			
	R																			
Implantar un programa de detección de fugas en las válvulas a QW ó instalar un sistema de recuperación de gases en QW	P																			
	R																			
Optimizar el flujo de purga a QW's de fosa y elevado, implementando su medición	P																			
	R																			
Reducir venteos de las unidades GB-602 A/B/C	P																			
	R																			
Análisis causa-raíz de las pérdidas de metano en la planta de endulzamiento	P																			
	R																			

5. Next Steps

- Replace wet seals with dry seals in 13 compressors in Nuevo PEMEX and Poza Rica GPC, replicating the Ciudad PEMEX GPC project
- Request M2M support for an energy diagnostic for Burgos GPC to be performed in December and implement valve maintenance training at the GPCs.
- Propose feasible CDM projects and take advantage of the carbon market.
- The Production Division of PEMEX Gas will present the achievements in GHG emissions reductions on November 11 to 13, in the *15th Annual Natural Gas STAR and Methane to Markets Implementation* in San Antonio, TX and will share experiences with other countries.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460
OFFICE OF
AIR AND RADIATION

September 22, 2008

Roger Fernandez, Team Leader
Natural Gas STAR Program

Ing. Armando Arreola-Brown, Subdirector de Operación
PEMEX Gas y ~~Operación~~
Tercer ~~Grupo~~ de PEMEX 13 País
Av. México Nacional 839, Col. ~~Polanco~~
~~Polanco~~, Miguel Alemán, CP 13111
~~Polanco~~, MEXICO

Dear Mr. Arreola:

On behalf of the United States Environmental Protection Agency and the Methane to Markets Partnership, I would like to personally invite Mr. Fernando Arreola to speak at the upcoming 15th Annual Natural Gas STAR and Methane to Markets Implementation Workshop, taking place November 11-13, 2008 in San Antonio, TX.

PEMEX has proven to be a world leader in the area of methane emissions reduction activities and your leadership under the Methane to Markets Partnership has proven invaluable in the success of this international initiative. Based on ~~PEMEX's~~ prior success in reducing methane emissions, we would sincerely welcome the participation of Mr. Arreola at this important conference to present on ~~PEMEX's~~ experience in reducing methane emissions.

The workshop will begin with off-site tours of processing or production facilities, followed by technical presentations on topics including greenhouse gas management programs and strategies, sector-specific techniques and best practices for production, processing and transmission and distribution patterns, small and general leak detection technologies, and leak measurement technologies. The audience will be both U.S. and international Methane to Markets participants.

I thank you for your consideration of this request. Should you have any questions, please contact me at any time on ~~fernando.fernandez@epa.gov~~.

Best regards,

Roger Fernandez

CC: Dr. Roberto Ramirez ~~roberto.ramirez@epa.gov~~, Dr. ~~Roberto Ramirez~~, Ing. Julio Cesar Ferrer Soto

6. Conclusions

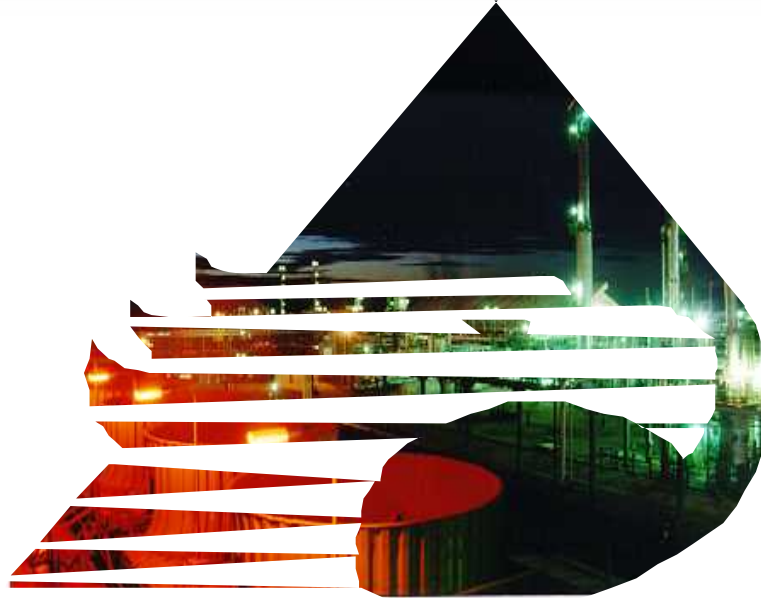
At PEMEX Gas we are integrating these kinds of energy diagnostic measurements into our Operational Discipline at our gas processing complexes by buying detection and measurement equipment for methane and CO₂ equipment and training our personnel.



These diagnostics will not only promote the development of CDM projects, but form the basis for a permanent program to sustain and replicate these actions throughout PEMEX Gas.



PEMEX Gas y Petroquímica Básica



Production Subdivision

¡ Thank-You!

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