PEMEX
EXPLORACION Y PRODUCCION ®

Pemex Exploración y Producción (PEP)

Air emissions reduction strategy

Natural Gas STAR Implementation Workshop
Global Methane Initiative

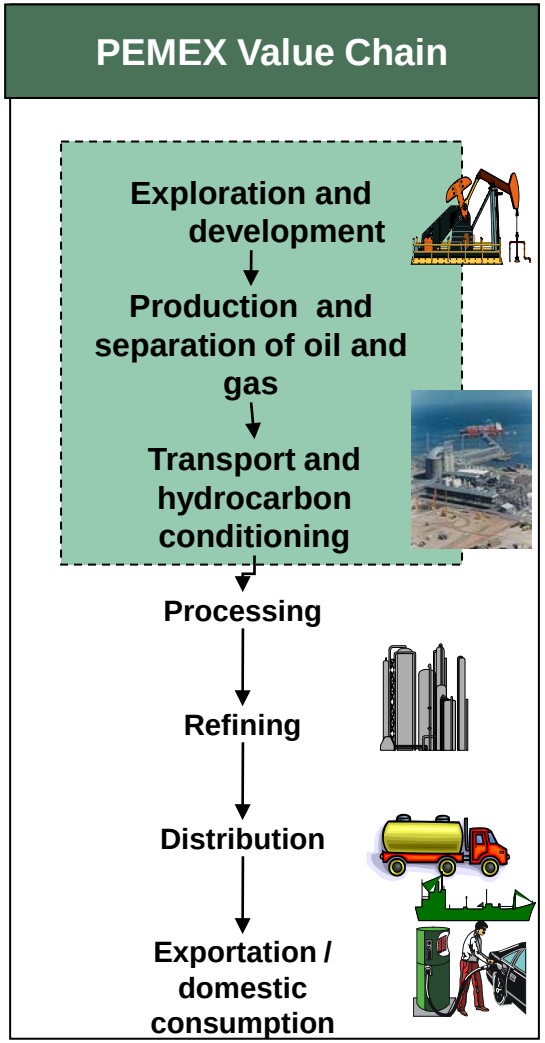
Denver, Colorado. April, 2012

Agenda

Introduction

- Business Plan 2010-2024
- Emission reduction strategy
- Emission sources and reduction opportunities
- Base line

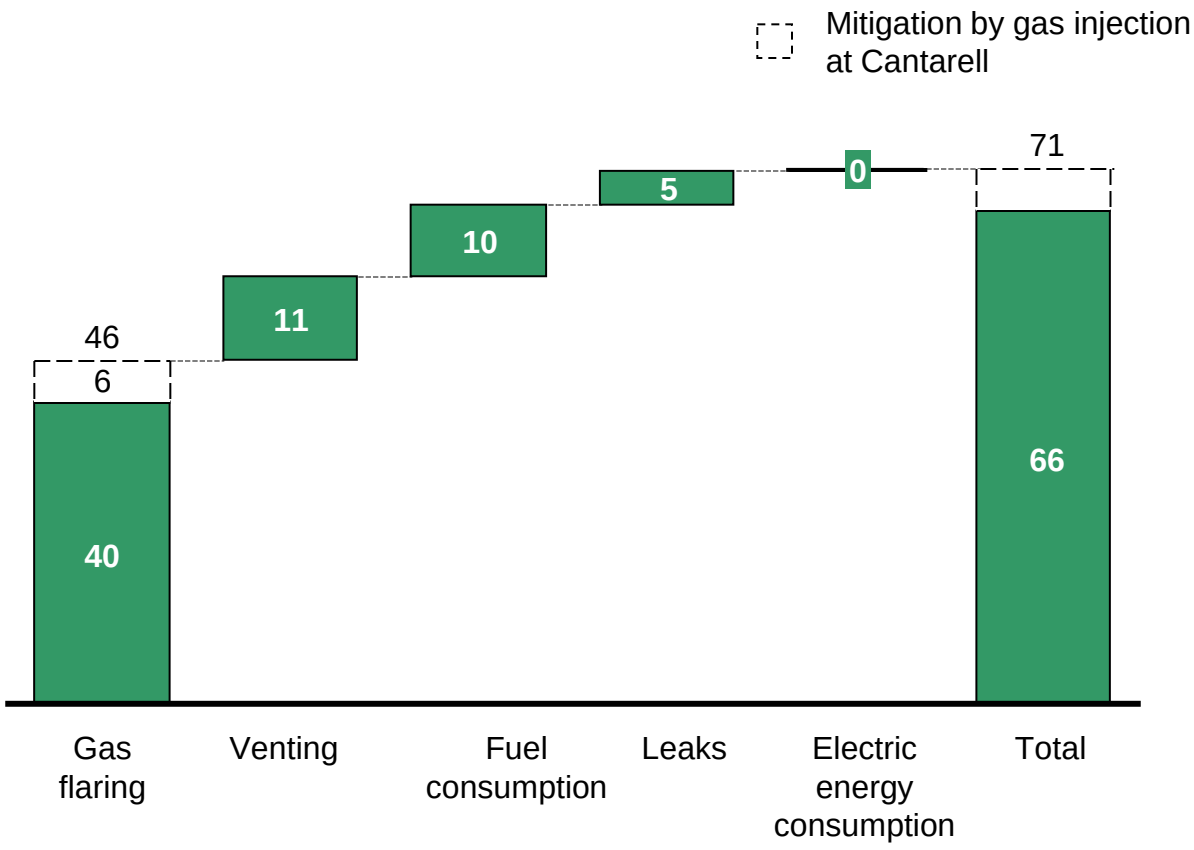
- Emissions to air from the oil and gas industry:
  - Pollutants as SOx and Nox affect human health, and
  - Carbon Dioxide (CO_2), Methane (CH_4) and BC contribute to global warming.
- Nowadays, many industries implement actions to reduce in their processes these emissions.
- PEP, one of the four subsidiaries of Petróleos Mexicanos, is implementing a strategy to reduce air emissions, aligned to the Pemex Business Plan



During 2009 the estimated GHG emission of PEMEX reached 71 millions of tons/y of CO_2e

PEMEX's emission inventory, 2009

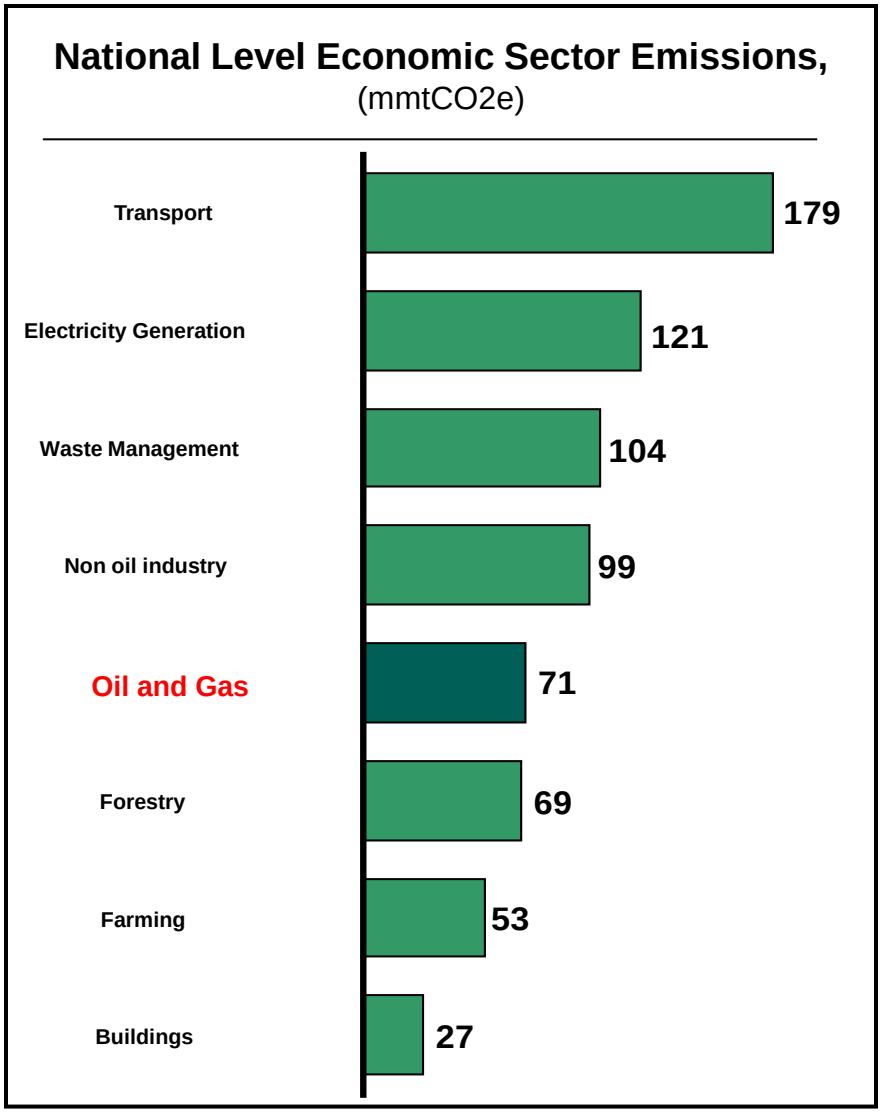
$mmtCO_2e$

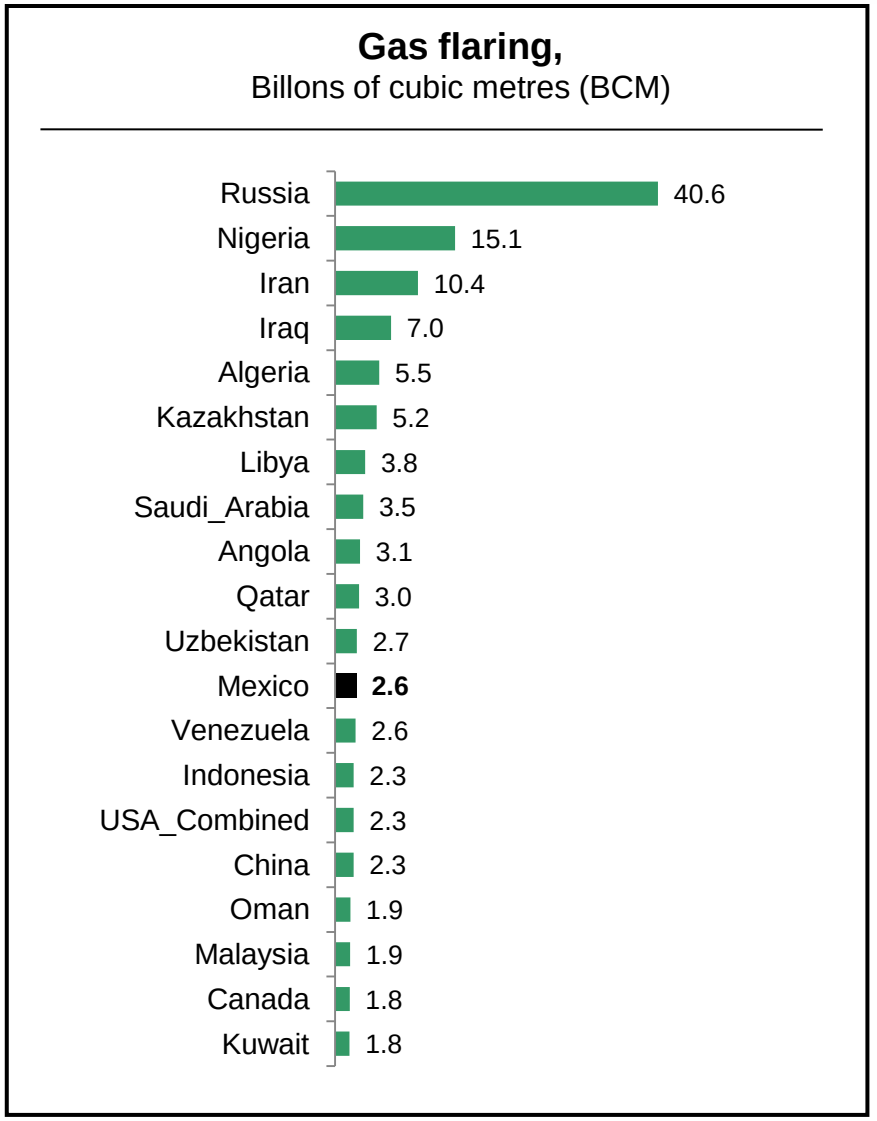


- Gas flaring represented 64% of total emission, being Cantarell the main source
- It is estimated that with re-injection of gas project at Cantarell, 5.6 mmt/y of CO_2e to air will be avoided

SOURCE: SISPA, API,BDI

PEP is located at the fifth spot in terms of GHG emissions in Mexico, and the country is twelfth in gas flaring in the international scenario.





SOURCES: National Geophysical Data Center (NGDC) 2008 and Carbon Declaration Project, companiesi internet web pages , equipo global v2.0 (Información estimada por observaciones satelitales)

PEP's Business Plan (2010-2025). One objective is focused on being a clean and socially responsible company

2010-2025 Objectives

- Maintain production of oil (2.4-3.0 mmbd)
- Maintain production of gas (6.0 y 7.2 mmmpcd)
- Reestablishment of 100% of the proven reserves as of 2012
- Maintain the production costs
- Achieve zero accidents goal
- Achievement of public perception a as socially responsible company.

Profitable Growth

1. Increase oil production
2. Increase the reserve inventory
3. Improve the implementation capacity
4. Optimization of the investment expenditures

Organization and Knowledge

5. Technology modernization
6. Development of human talent
7. Focusing the organization to business objectives

Planning and Operating Excellence

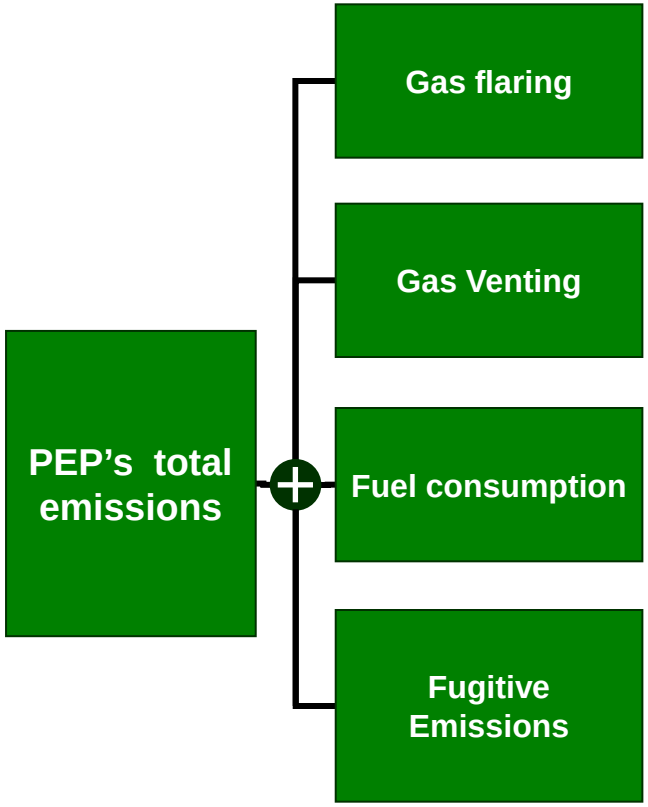
8. Improvement of project planning and implementation
9. Optimization of production, distribution, and commercialization
10. Application of best Safety, Health and Environmental practices

Social Responsibility

11.
- C
- Environmental protection and sustainability

12.
- Improve relationship with communities

Main sources of emission in PEP's operations



1. Gas flaring emissions:
- CO_2 from gas combustion
- CH_4 from incomplete combustion of gas

2. Gas released to the atmosphere
- Vapours in storage vessels
- Degasification of drilling mud
- Pipeline maintenance

3. Emissions derived from fuel consumption:
- Dynamic equipment operation (Pumps, turbines, compressors)
- Electric generation.

4. Emissions derived from operative activities (leaks)
- Pipelines and its components
- Dynamic equipment
- Static equipment and instrumentation
- Due to accidents

PEP will improve its environmental protection performance through five programs:

Challenges

- Improvement of the gas utilization
- Development of an investment portfolio of projects to mitigate atmospheric emissions.
- Systematic management of environmental topics
- Support reforestation and ecosystem protection.

Programs	Activities
A **Infrastructure to increase associated Gas utilization**	▪ Re injection of gas ▪ Management of oil wells with high gas-oil ratio ▪ Investment portfolio for gas utilization projects.
B **Strategies to mitigate emissions to air (energy efficiency)**	▪ Definition of the GHG mitigation strategy. ▪ Energy savings programs ▪ Definition of the process model ▪ Participation in national and international partnerships to support mitigation projects (GMI, GGFR, EC and ARPEL).
C **Clean Industry Certificates (environmental audits)**	▪ Facilities to be certified ▪ Implementation of best practices
D **Remediation of environmental liabilities**	▪ Remediation of the areas and dams considered to be environmental liabilities
E **Efficient use of water**	▪ Assure the efficient use, handling and disposition

PEP's emission reduction strategy is focused in three action lines:

PEP must take accomplish the National Hydrocarbons Commission (CNH) dispositions on gas utilization and flaring.

Objective

Reduction of PEP's Emissions

Action Lines

1. Increase the gas utilization

- Accomplish the National Hydrocarbons Commission´s regulation
- Reduction of gas flaring and venting
- Capacity for gas processing
- Enhancement oil recovery

2. Reduce Methane Emissions

- Evaporation in tanks
- Efficiency of flare systems
- Fugitive emissions reduction

3. Increase the energy efficiency

- Equipment efficiency
- Heat recovery

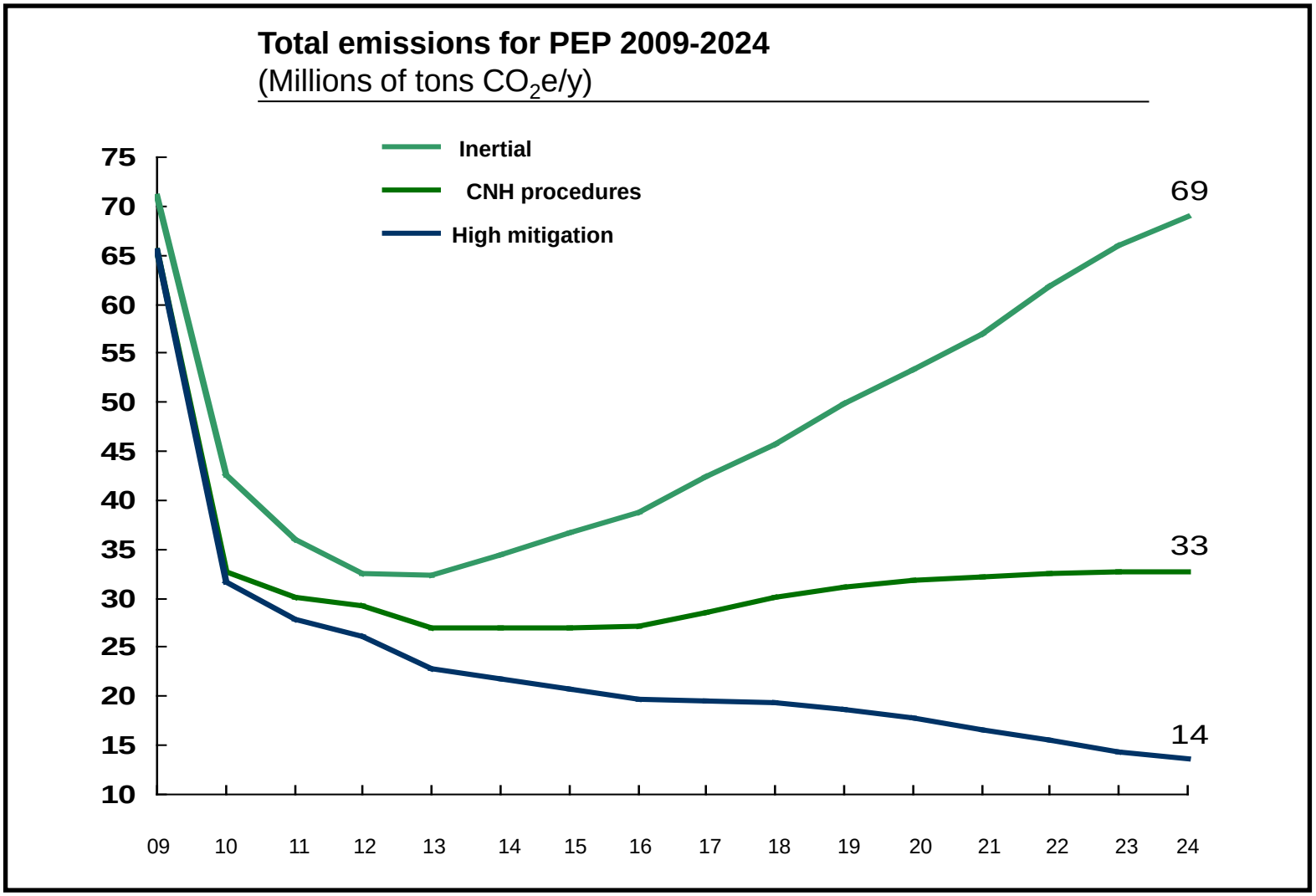
Specific goals have been defined for each mitigation aspect

	Action	Specific Goals
Gas utilization	▪ Increase the utilization of associated gas	▪ Maintain gas flaring below the maximum level allowed by CNH
Methane emissions reduction	▪ Flaring efficiency ▪ Reduce gas evaporation in tanks. ▪ Substitution of seals in compressors. ▪ Substitution of pneumatic equipment	▪ Reach at least 98% efficiency in flares ▪ Decrease of 36% in the loss of gas to evaporation in tanks. ▪ Substitution of wet seals in 36% of the compressors ▪ Substitution of 36% of self-contained pneumatic equipment.
Increase in energetic efficiency	▪ Thermal efficiency ▪ Cogeneration	▪ Increase of 20% of thermal efficiency in 36% of equipments ▪ Reduction in 15 mmpcd of fuel gas by usage of thermal currents. ▪ Cogeneration of 100 MW of electric energy
Impact		
Mitigation	▪ Total emissions abatement	▪ Mitigation of 48 million of tons of CO_2 equivalent by 2024
Carbon Intensity	▪ Total of emission per unit barrel of oil equivalent	▪ A maximum of 14.25 $kgCO_2e$ / BPCE

To estimate PEP's future emissions for 2010 – 2024, three scenarios were constructed

	1. Inertial	2. CNH Procedures	3. High Mitigation
Gas flaring	▪ Gas utilization equal to the registered in 2009	▪ Flaring in accordance to the defined procedures of CNH as of 2011	▪ Average electric consumption per produced barrel equal to the historic average reported ▪ Substitution to high efficiency flares
Venting	▪ Gas evaporation equal to average in 2009	▪ Decrease factor by evaporation ▪ Emission factor per billion cubic feet of gas estimated by API ▪ Emission factor per day of perforation estimated by API	▪ 85% reduction of evaporation losses in tanks due to modifications to the stabilizer systems, installation of tanks with floating roofs and vapour recovery systems.
Fuel Consump-tion	▪ Combustion of barrel produced per production asset equal to the reported 2009	▪ Combustion of barrel produced per production asset equal to the reported 2009	▪ Increase the thermal efficiency of 100% of the compressors ▪ Implementation heat recuperation projects
Fugitive emission	▪ Emission factors per oil well, pipeline length and equipment, estimated by API	▪ Emission factors per oil well, pipeline length and equipment, estimated by API	▪ Substitution of 100% of wet seals in equipments. ▪ Substitution of 100% of pneumatic equipment for self contained equipment.
Indirect	▪ Average electric consumption per produced barrel equal to the historic average	▪ Average electric consumption per produced barrel equal to the historic average reported in SISPA	▪ Installation of a 250 MW cogeneration system

It is estimated that with the implementation of these scenarios, PEP's emission will be located between14 y 69 mmtCO_2e in 2024



FUENTE: Análisis de equipo

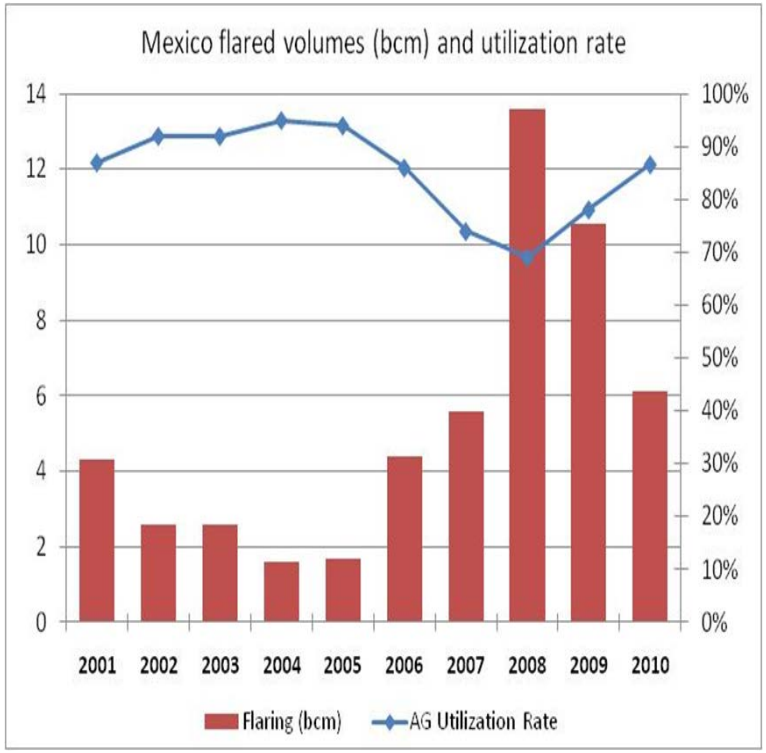
Collaboration PEP - Global Methane Initiative(GMI)

- Global Methane Initiative is an international initiative that promotes the recovery and use of methane as a clean energy source.
- GMI started in 2004 as an association of countries, and currently is integrated by near 40 countries.
- On behalf of the Mexican Government, Pemex is a co-chair of the Oil and Gas Subcommittee of GMI
- This association's aims are the reduction of global methane emission reductions to:
  - Encourage economic growth
  - Increase energetic security
  - Improve air quality and industrial safety
  - Reduce greenhouse gas emissions

Collaboration between PEMEX- Global Methane Initiative

1. **Project Identification**
   - Measuring and diagnostic studies in working areas.
   - Fugitive emissions reduction activities
     - Technology substitution projects
   - Training PEMEX's personnel
     - Courses and workshops at workplace.
     - Participation in international conferences

2. **Development of strategies and implantation policies**
   - Development of emission inventory (Base line)
     - Inventory and base line construction for CH_4 and CO_2
     - Marginal abatement cost model (MAC)
     - Measures and profitable project analysis for PEMEX
     - Identification of mitigation projects



Activities carried on with Global Methane Initiatives (GMI)

- **22 CH_4 Emission measurements campaigns**

  - Gas processing plants Cactus, Ciudad PEMEX, Nuevo PEMEX, Poza Rica, Burgos.
  - Gas compression centers: Cunduacán, Atasta, José Colomo and Samaria II
  - Production Field Nejo 1, Activo Integral Burgos
  - Ammonia plant: CPQ Cosoleacaque
  - Production Platform Abkatun - D
  - Chilapilla y Jose Colomo Fields
  - Recollection Station San Roman
  - Vernet Battery
  - Maritime terminal Dos Bocas
  - Gas compression station and battery Ogarrio 4
  - Gas compression station and battery Cinco Presidentes 4
  - Cárdenas Pipeline sector

Final remarks

- Nowadays, several oil and gas companies implement actions plans to reduce air emissions in its operations (SOx, NOx, CO2, CH4, and BC)
- During 2009 the estimated GHG emission of PEMEX reached 71 millions of tons of CO2e. Gas flaring represented 64% of total emission, being Cantarell the main source
- Pemex Exploración y Producción (PEP) is implementing a strategy to reduce air emissions, aligned to the Pemex Business Plan. One objective of the PEP's Business Plan (2010-2025) is focused on being a clean and socially responsible company
- PEP is located at the fifth spot in terms of GHG emissions in Mexico, and the country is twelfth in gas flaring in the international scenario.
- The main sources of emission in PEP are: Gas flaring and venting, fuel consumption and fugitive emissions
- PEP will improve its environmental protection performance through five programs: increase associated gas utilization, energy efficiency projects, environmental audits, remediation of environmental liabilities, efficient use of water.
- Pemex participates in several alliances (Global Methane Initiative (GMI), Global Gas Flaring Reduction (GGFR), Environment Canada and ARPEL); this partnership has been very productive to help Pemex to recognize the importance of the emissions to air issue and to develop several actions to mitigate them.

Thank you!

Miguel Angel Granados
Pemex Exploración y Producción
Strategic Planning Management
miguel.angel.granados@pemex.com

Javier Bocanegra
Petroleos Mexicanos
Corporate Operations Direction
javier.bocanegra@pemex.com