Qatar LNG GHG Management Strategy

Afzal A. Subedar – Qatargas

Laurent Fragu – RasGas

IPIECA Side-Event at UNFCCC COP - 18

Doha – Qatar November 30, 2012

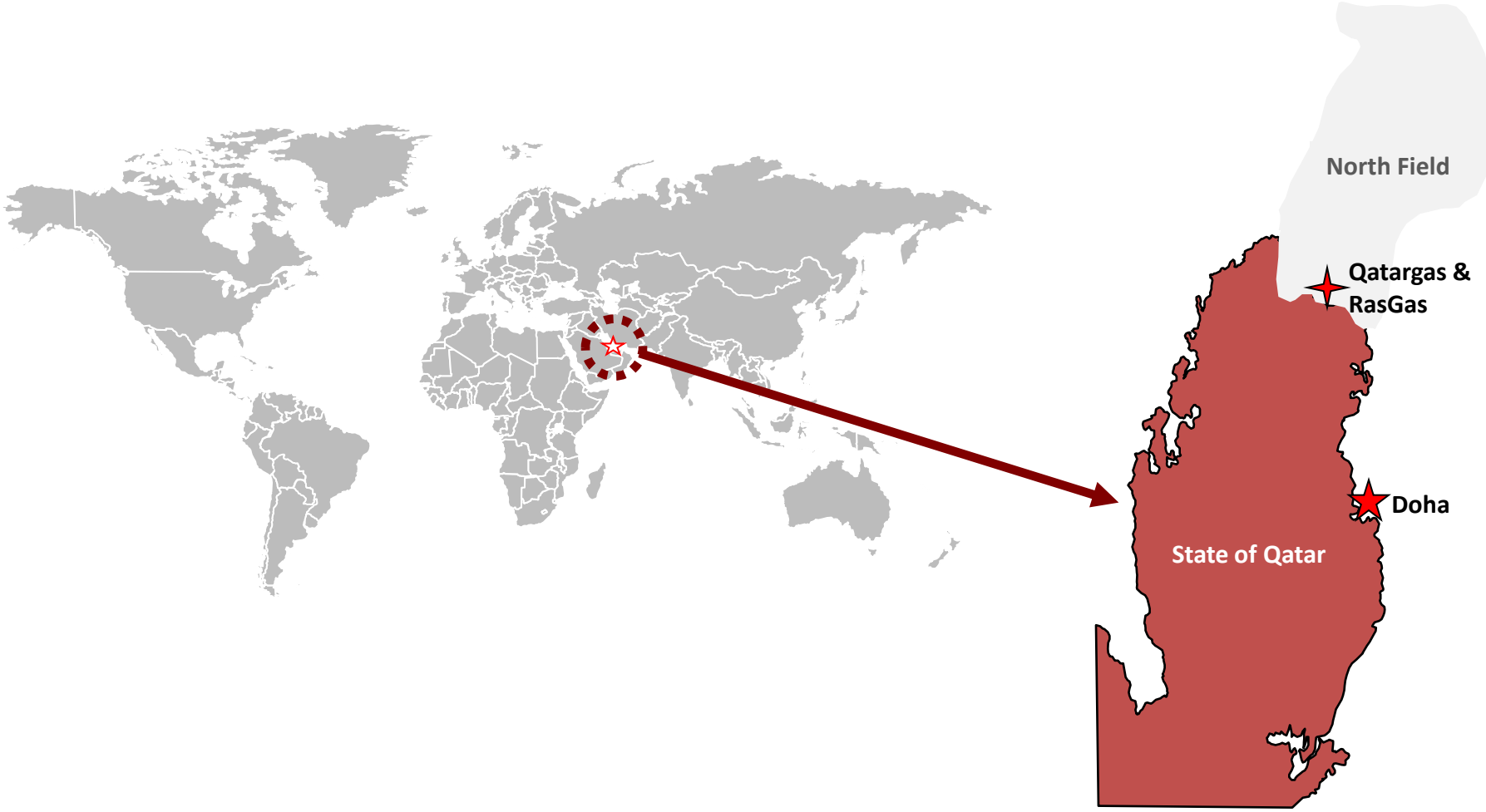
قطرغاز
QATARGAS

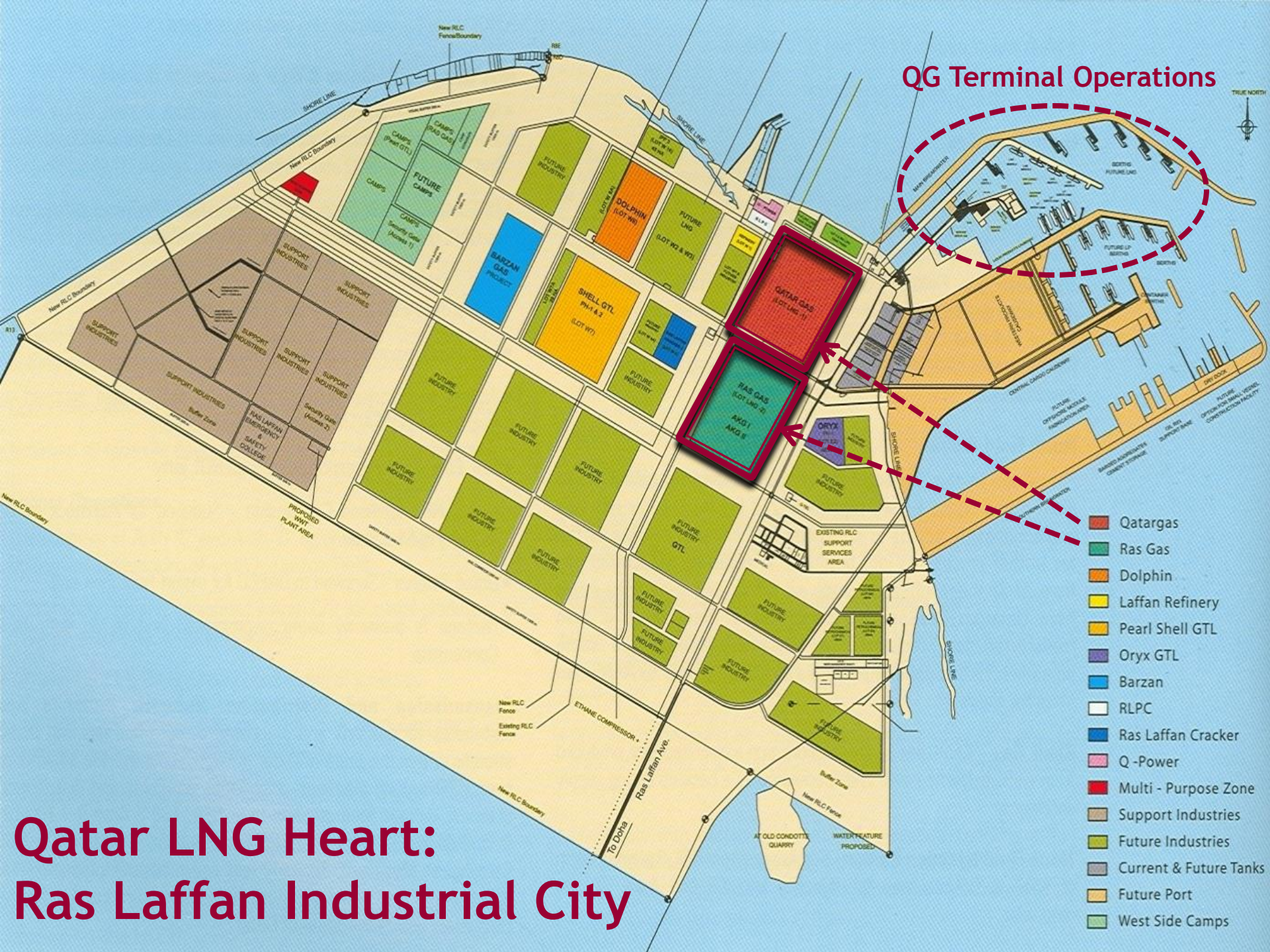
راس غاز
RasGas

Presentation Outline

- RLIC / Qatargas / RasGas Overview – Brief introduction
- Climate Change Framework – Qatar perspective
- GHG Strategy – Phased approach, Documentation
- Emissions Accounting & Reporting – Reporting, Emissions profile
- Mega-Trains Emissions – Savings along the value chain
- Case-Studies – Flaring, CCS
- Other Initiatives – Sustainability approach
- Concluding Remarks

Qatargas & RasGas at a glance




QG Terminal Operations
Qatargas
Ras Gas
Dolphin
Laffan Refinery
Pearl Shell GTL
Oryx GTL
Barzan
RLPC
Ras Laffan Cracker
Q -Power
Multi - Purpose Zone
Support Industries
Future Industries
Current & Future Tanks
Future Port
West Side Camps
QATAR GAS
RAS GAS
DOLPHIN
SHELL GTL
BARZAN GAS
ORYX
Ras Laffan Ave.
To Doha
SHORE LINE
New RLC Boundary
New RLC Fence
Existing RLC Fence
ETHANE COMPRESSOR
EXISTING RLC SUPPORT SERVICES AREA
PROPOSED WWT PLANT AREA
RAS LAFFAN EMERGENCY & SAFETY COLLEGE
AT OLD CONDOTTE QUARRY
WATER FEATURE PROPOSED
Qatar LNG Heart:
Ras Laffan Industrial City

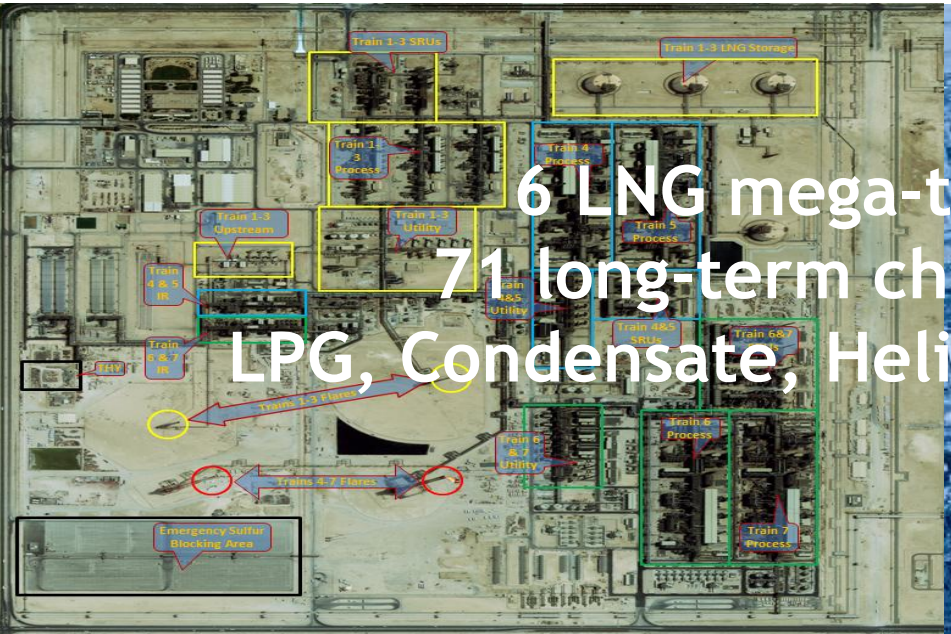
Qatargas & RasGas at a glance

Qatargas Operating Company Limited

- Venture between Qatar Petroleum, Total, ExxonMobil, ConocoPhillips, Shell, Mitsui, Marubeini, Idemitsu Kosan, Cosmo Oil
- 7 LNG Trains, 42 MTA capacity
- Ras Laffan Terminal Operations
- Laffan Refinery (LR), LR Expansion

RasGas Company Limited

- Venture between Qatar Petroleum and ExxonMobil
- 7 LNG Trains, 37 MTA capacity
- Al-Khaleej Gas 1&2 (2 bcf sales gas capacity)
- Barzan Project: Two 950 mmscf sales gas trains (under construction)
- Ras Laffan Helium 1 (9 tonnes /day), Helium 2 under construction (17 tonnes/day)

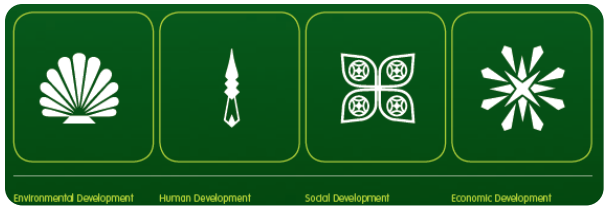


6 LNG mega-trains (7.8 MTA)
71 long-term chartered LNG fleet
LPG, Condensate, Helium, Sulphur production

Climate Change Framework in Qatar

Qatar National Vision 2030

- Developed in 2008 by the General Secretariat for Development Planning
- Define long-term outcomes and major challenges facing the country
- Four interconnected pillars of development: human, social, economic and environmental
- National Development Strategy 2011-2016: developed to address QNV four pillars



Ministry of Environment

- Chair National Committee on Climate Change
- CDM Designated National Authority, active in UNFCCC COP
- GHG emissions quantification in project permitting (EIA process)
- Define and monitor compliance with flare reduction target

Qatar Petroleum

- CDM implementation Guidelines
- Industry Committee on Climate Change
- Partnership with World Bank Global Gas Flaring Reduction (GGFR)
- GHG Accounting & Reporting Guidelines (Ras Laffan City)
- Steward Flare Reporting Guidelines (MEI)
- Sustainability Reporting Guidelines
- Climate Change Strategy for the Industry
- Energy Efficiency Initiative

Other Initiatives

- CCS R&D Project (QTSP, QP, Shell, Imperial College)
- Qatar Sustainability Assessment Systems (QSAS, Green Building)
- Qatar Energy & Environment Research Institute (Qatar Foundation)
- Investment in Green Technology and Renewable Energy (QIA)

- **Clear vision established for climate change and sustainability**
- **Implementation framework and multiple initiatives led by Qatar Petroleum and regulatory agencies for climate change mitigation.**

GHG Management Strategy Development

Gathering Inputs
2006-2010

- Understanding climate change impacts
- Emissions' benchmark (LNG industry)
- Regulatory assessment
- Best practices review for GHG Policy/Strategy
- Initiate advanced emissions inventory (QP/EU-ETS)
- Capacity building
- Mitigation efforts focuses on Flare Reduction;
- and CO_2 injection (RasGas)

Shape up Strategy
2010-2012

- Finalise GHG Policy / Strategy
- Develop action plan
- Allocate resources: GHG Specialist / GHG Team
- Detailed annual reporting plan, quality manual, and GHG measurement manual
- GHG management procedures and plans, cost-benefit analysis tools
- Benchmarking GHG efficiency/tonne of LNG, Corporate GHG KPIs

Implementation
2012 and beyond…

- Assessing carbon reduction opportunities and abatement techniques via sustainability assessment and engineering studies
- Inventory improvements: Scope 3, Life Cycle Assessment
- ISO 14064 accreditation
- Energy efficiency audit, improvements
- Collaboration with Global Methane Initiative
- Wider outreach and alignment with the existing GHG management global platform

Emissions Accounting & Reporting (Scope 1)

Monitoring & Reporting Scheme

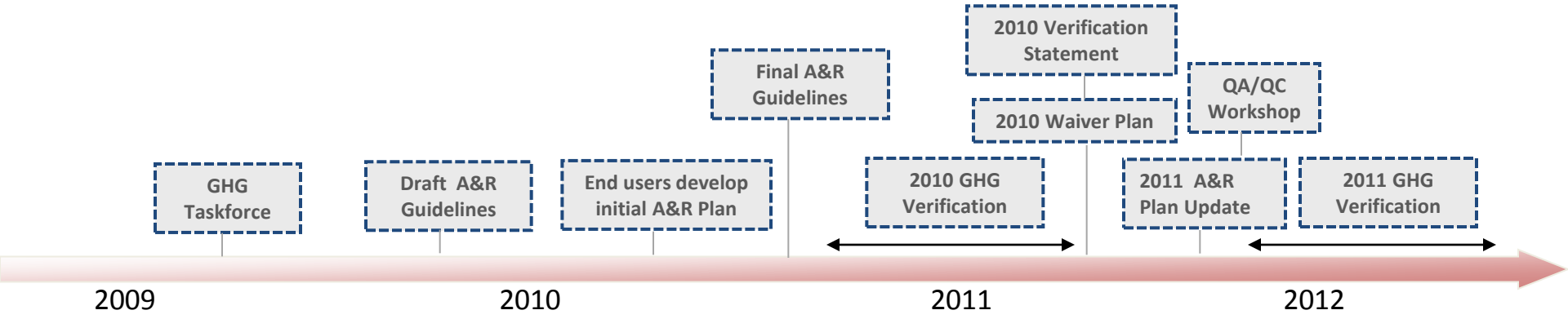
- QP Accounting and Reporting Guidelines (pilot in RLC for 2010-2012)
- Requirements based on EU ETS Monitoring & Reporting Guidelines (CO_2)
- Use of IPCC Emission Factors for CH_4 and N_2O
- Operational control, direct emissions only, include all offshore and onshore sources

Key Requirements

- Determination of flow/composition for each emission source
- Flow measurement uncertainty tiers: activity-based compliance required
- Laboratory and online measurement accreditation (ISO 17025). Sampling /analysis frequency (weekly)
- Quality Plan addresseing QA/QC, calibration and maintenance requirements
- Annual 3rd Party Verification (ISO 14064-3)
- Waivers issued for interim period

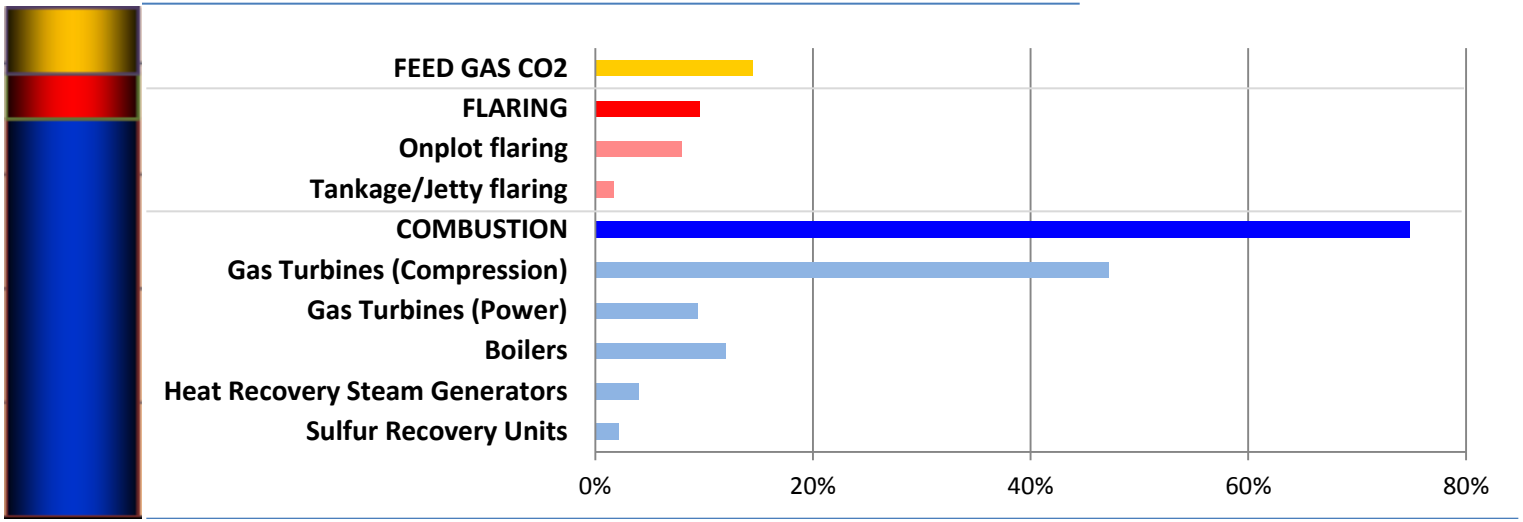
Challenges

- Fuel Gas systems: integrated/complex, multiple fuel sources/quality
- Metre classification/upgrade
- Flare streams measurement, composition and uncertainty
- Establish and document data flow / data control systems

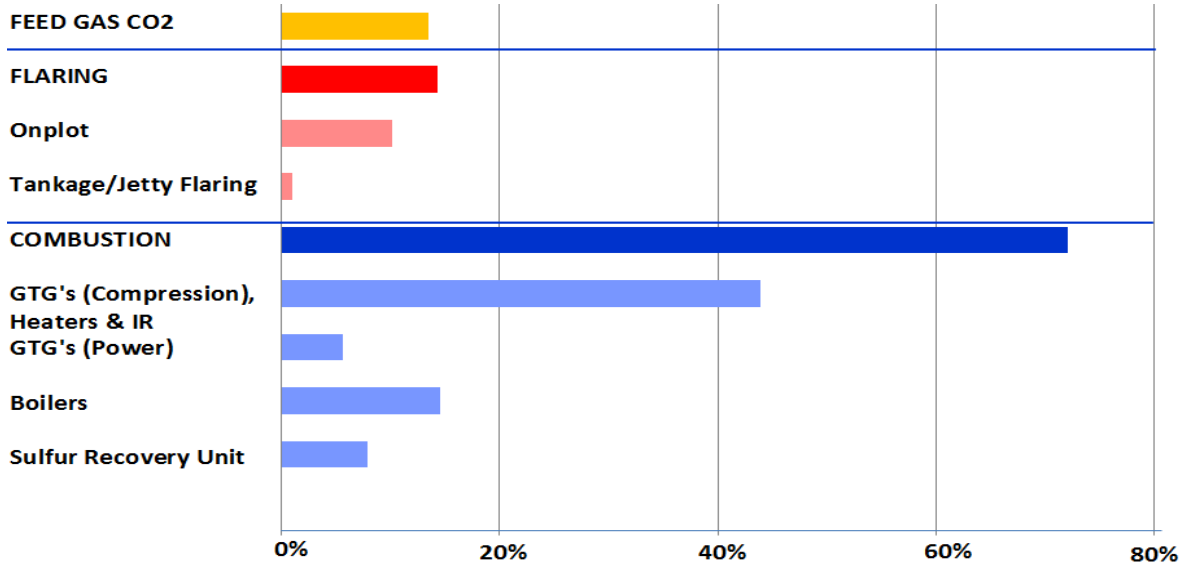


Emissions Profile (Scope 1 - based on 2011)

RasGas



Qatargas

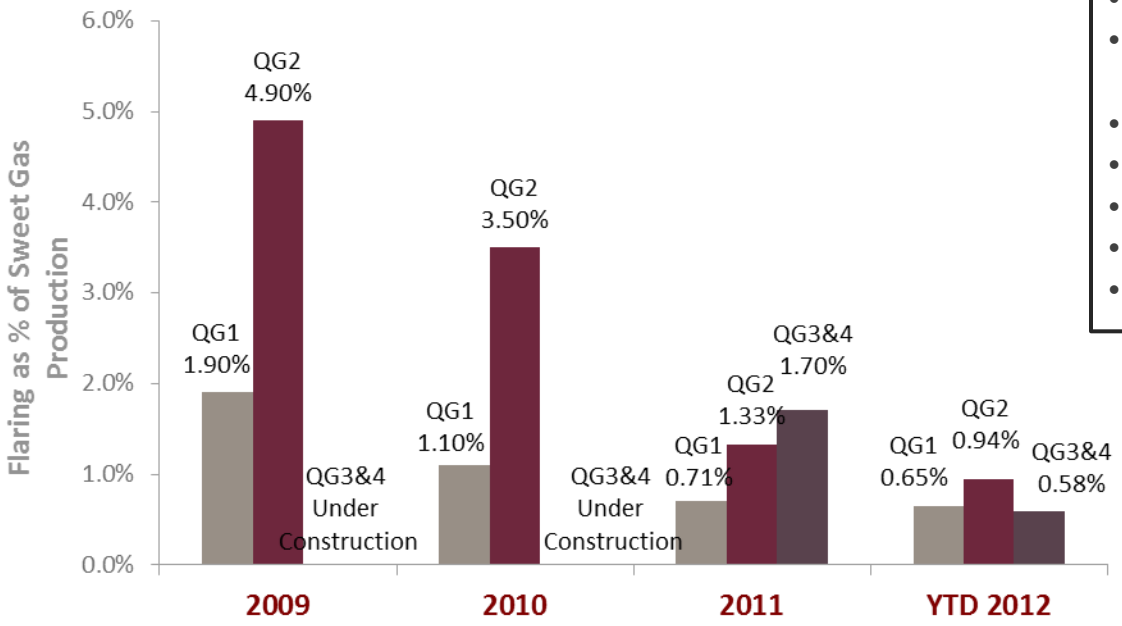


Case Study: Qatargas Flaring Performance

Over 65% reduction in flaring from on-plot LNG facilities since 2009

How was this achieved?

- Focused flare management initiatives
- Awareness, recognition and commitment to reduce flaring
- Operational source reduction
- Increased plant and equipment reliability
- Increased experience with mega-train operation
- Enhanced monitoring, tracking and reporting
- Reduction in shutdown flaring

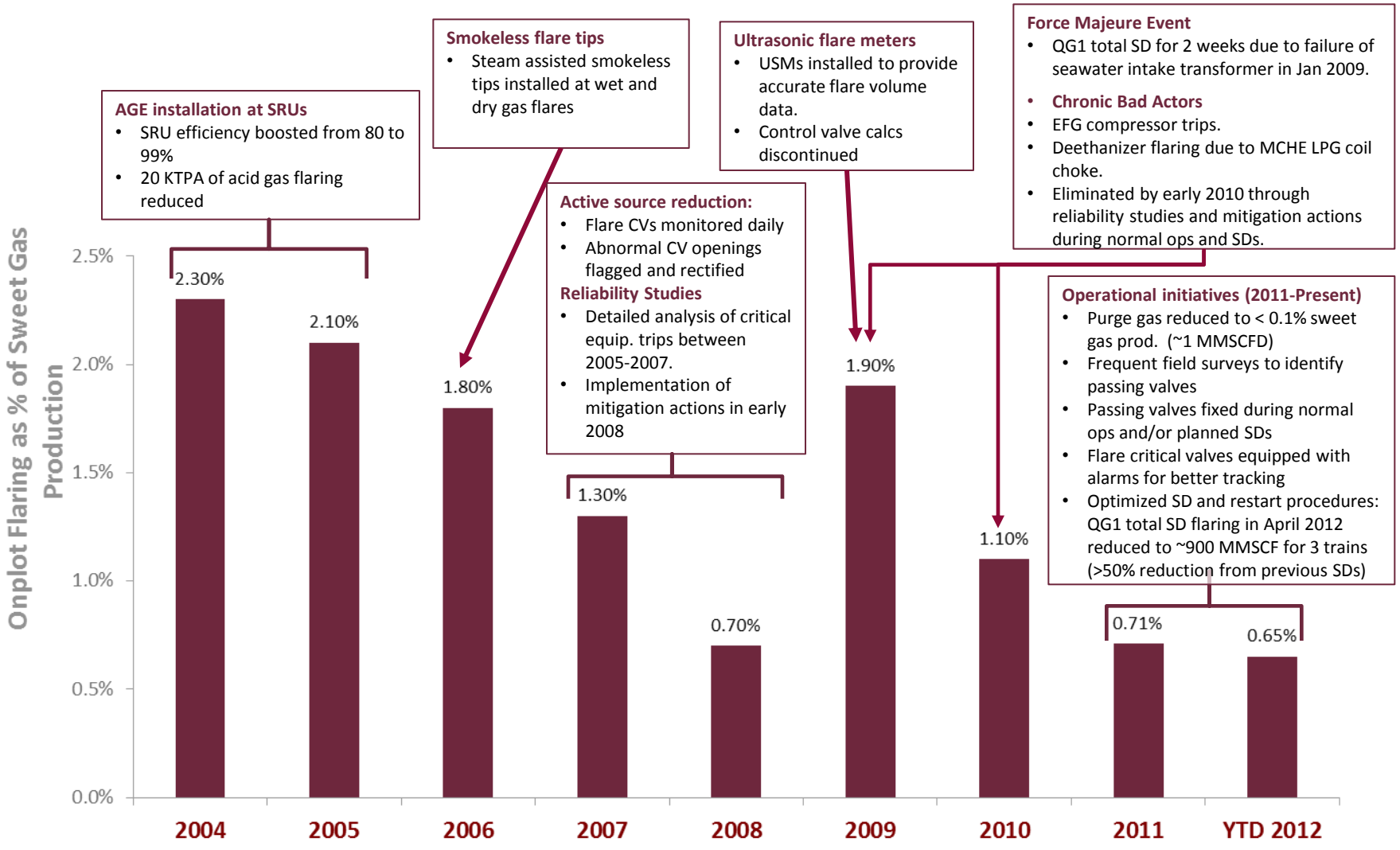


Note: Data shown is for on-plot flaring only, excluding jetty and tankage flaring. 2012 data is up to and including month of August.

Jetty Boil-off Gas (JBOG) Project

- The $1 billion Jetty Boil-Off Gas (JBOG) Recovery Project - largest environmental project of its kind in the world is part of the Common Facilities Projects at Ras Laffan Industrial city (RLC)
- Will enable boil-off gas to be collected from RasGas and Qatargas LNG ships and compressed at a central facility.
- When fully operational, will recover approximately 29 billion standard cubic feet (BSCF) per year of gas that would have been flared (90% recovery efficiency during normal operations).
- Enough natural gas to power more than 300,000 homes.
- Result in reducing Greenhouse Gas (GHG) emission reductions amounts to approximately 1.6 million tonnes of CO_2 per annum

Case Study: QG1 Flare Reduction Achievements

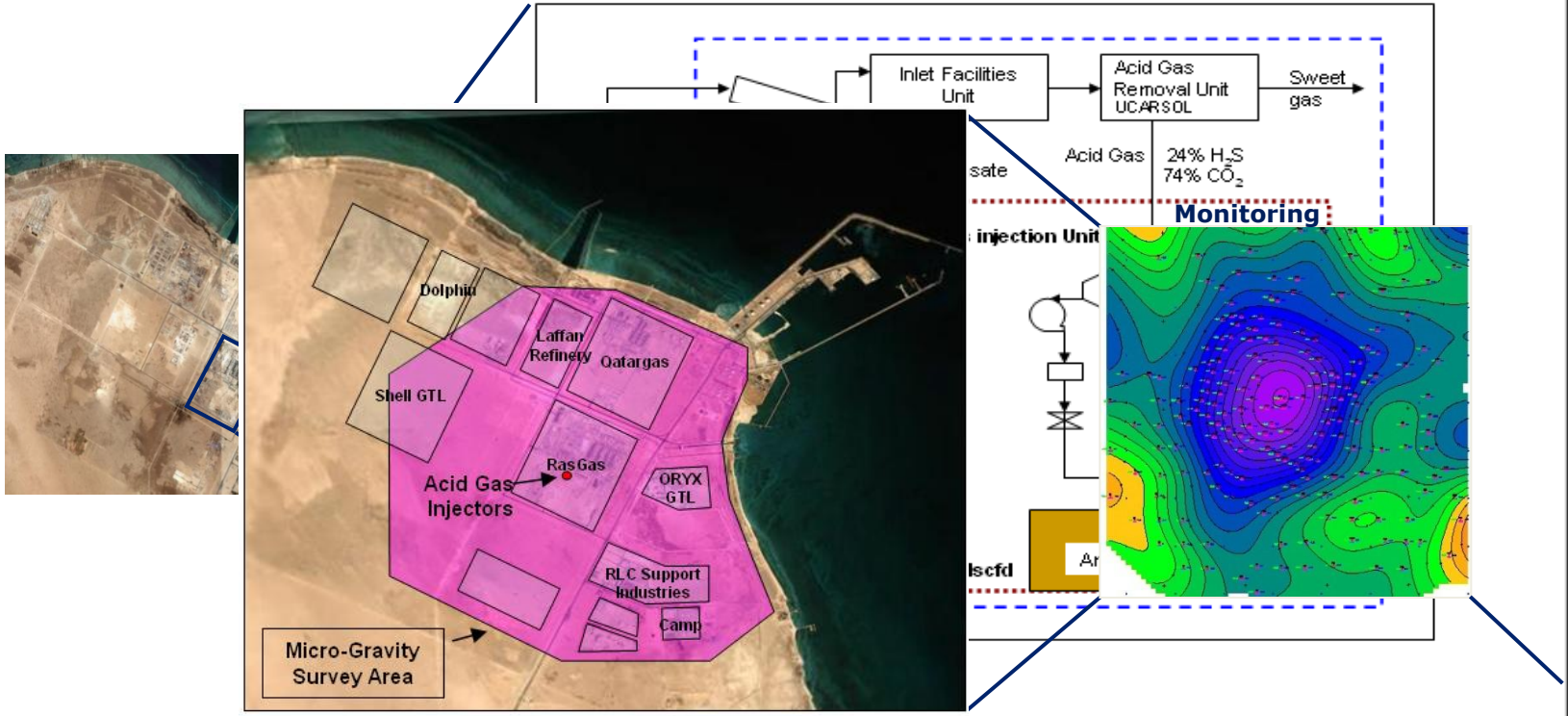


Mega-Trains Emission Savings along the Value Chain

Acid Gas Removal	❑ Use of aMDEA technology: reduce co-adsorbed Methane in Acid Gas Removal and CO_2 emissions from tail gas incineration
Liquefaction	❑ AP-X Hybrid Liquefaction Technology: economies of scale with lower specific CO_2 emissions (single vs. parallel train design) ❑ Frame 9E Gas Turbines in LNG service: excess power generated for supply to plant grid
Utilities	❑ HRSGs on compressor turbines reduce need for additional boilers ❑ Steam turbine generators (QG): minimise need for power generation through GTGs
Tail Gas Treatment	❑ Flexsorb-SE + solvent for: increased SRU efficiency and reduced CO_2 emissions from tail gas incineration
Flare Minimisation	❑ Process gas and BOG recycling ❑ Equipment specifications, sparing (offgas / BOG compressors) and crossovers.
Common Facilities	❑ Common Sulphur, Single Point Mooring: offsets in trucks/cargoes emissions ❑ Common Jetty Boil-off Gas Recovery (construction)
LNG Carriers	❑ Q-Max/Q-Flex largest LNG carriers ❑ Twin slow-speed diesel engines, onboard reliquefaction system
LNG Terminals	❑ Economies of scale with larger Submerged Combustion Vaporizers

Case Study: RasGas CO_2 Injection Programme

Capture & Injection



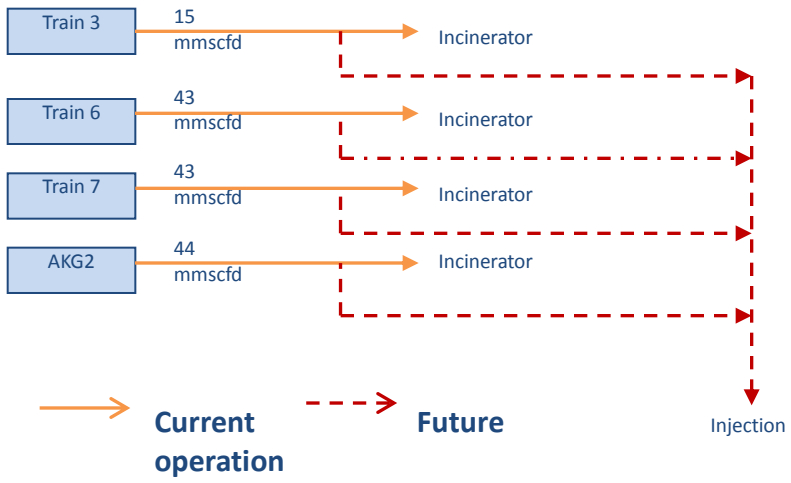
Storage

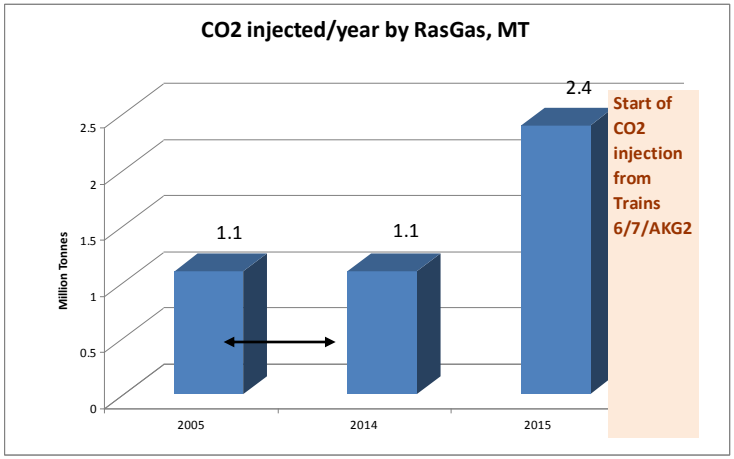
TERTIARY	Surface Deposits
	Hofuf
	Dam
	Dammam
	Rus
	Umm er Radhuma
CRETACEOUS	Simsima
	Figa
	Halul
	Laffan
	Laffan Mkr
	Khatiyahr
	Mauddud
	Nahr Umr
	Shuaiba
	Hawar
	Kharaib
	Lekhwair
	Yamama
	Sulaiy
JURASSIC	Hith
	Arab
	Darb
	Diyab
	Araej
	Izhara

- 1st large CO_2 sequestration project in the GCC region
- Approx. 1.1 MT CO_2 injected annually
- Micro-gravity adequately detects the total amount of gas injected
- Gas plume contained below seal formation, injectivity steady, pressure well below fracture pressure

Case Study: RasGas CO_2 Injection Programme

- **Current set-up:**
  - Injection of H_2S and CO_2 since 2005 using AGI facilities for LNG Train 4, 5 & AKG-1
  - Other processing trains use Sulphur Plants and CO_2 through Tail Gas Treatment (TGT) Incinerators
- **Opportunity:**
  - Inject CO_2 from other processing trains
  - Recover H_2S to produce Sulphur from all processing trains
- **Early Project Development:**
  - Tie-in from Train 4, 5 & AKG-1 to latest Sulphur Recovery Units (SRU Train 6, 7 & AKG-2)
  - Capacity enhancement in receiving SRUs
  - CO_2 injection from Train 4,5,6,7 & AKG 1-2 trains
  - Project utilises existing AGI compression capacity
  - Project currently progressed in coordination with QP Subsurface Group
  - Projected Total CO_2 Sequestration: 2.4 MTA
- **Ongoing GHG Strategy Opportunity:**
  - Review of CCS Best Practices
  - CDM Feasibility Study





Other Sustainability Initiatives

- ISO 14001-compliant
- Integrated Management System (QHSE)
- Implementing best practices from leading multinational shareholders.

Environmental Management System

- Major projects on-going to maximise reuse of treated wastewater (based on reuse, recycle and reduce philosophy)

Wastewater Management

- Coral relocation & monitoring
- Conservation of endangered hawksbill turtles
- Qatargas – pioneered new pulse chlorination programme
- Endemic tree planting and biodiversity conservation

Biodiversity Programmes

- Host training programmes locally on air quality and climate change
- Active in OGP, SPE, IPIECA
- Community awareness programmes: waste recycling, energy consumption.

Advocacy and Capacity Building

- QP Energy Efficiency Initiative
- Best Practices: GEMS, POEMS, ISO-50001
- Steam Loss Management Project

Energy Efficiency Programme

- Minimisation / recycling of industrial and domestic wastes
- Best LNG industry recycling performance (RasGas)

Corporate Waste Management

- Sustainability Report since 2009
- Dedicated Reporting Committee
- Adopted GRI and IPIECA Guidelines

Sustainability Reporting

- LEED certification for new Palm Tower
- Green Office Policy covering energy and water efficiency, waste recycling, transportation, etc.

Green Building - RasGas

Concluding Remarks

- GHG management being taken very seriously by Qatar-based companies and the State
- Mitigation opportunities are being identified . Efforts focusing on energy efficiency and reliability improvements
- Large scale mitigation efforts towards flare minimisation, carbon capture and storage
- Life Cycle Assessment (LCA) scope underway

Qatar LNG GHG Management Strategy

Thank you!