OIL & GAS CASE STUDY

Quantifying Future Benefits of Implementing Cost-Effective Emissions Reduction Technologies in Natural Gas Production: A Case Study on China

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OVERVIEW:

- POTENTIAL COMPANY/ENTITY: ANY NATURAL GAS PRODUCTION SERVICES PROVIDER AND/OR OPERATING ENTITY
- GEOGRAPHIC LOCATION: CHINA
- SECTOR: NATURAL GAS PRODUCTION
- METHANE EMISSION REDUCTION OPPORTUNITY:
  - EMISSION SOURCE: PRODUCTION WELLHEADS
  - MITIGATION TECHNOLOGIES: REDUCED EMISSIONS COMPLETIONS, NO-BLEED PNEUMATIC CONTROLLERS, PLUNGER LIFT SYSTEMS
  - QUANTIFYING BENEFITS: EMISSIONS MONITORING AND REPORTING PROGRAMS AND ECONOMIC ANALYSES

ESTIMATED ANNUAL EMISSION REDUCTIONS FOR NATURAL GAS PRODUCTION IN 2030: 360 bcm / 35 MMTCO_2e

INTRODUCTION

Cost-effective measures in natural gas production and distribution can reduce emissions by up to 90%. A high price of natural gas would make emissions reduction technologies highly cost-effective and profitable. This is the case in China, where production is expected to grow exponentially due to large unconventional resources. However, the high level of uncertainty is a limiting factor in quantifying benefits of these mitigation technologies.

OBJECTIVES

- Select cost-effective emissions reduction technologies for natural gas production in China.
- Quantify future benefits of implementing the technologies.
- Propose emissions monitoring and reporting programs catered to the selected technologies to address uncertainties.

SUMMARY OF RECOMMENDATIONS

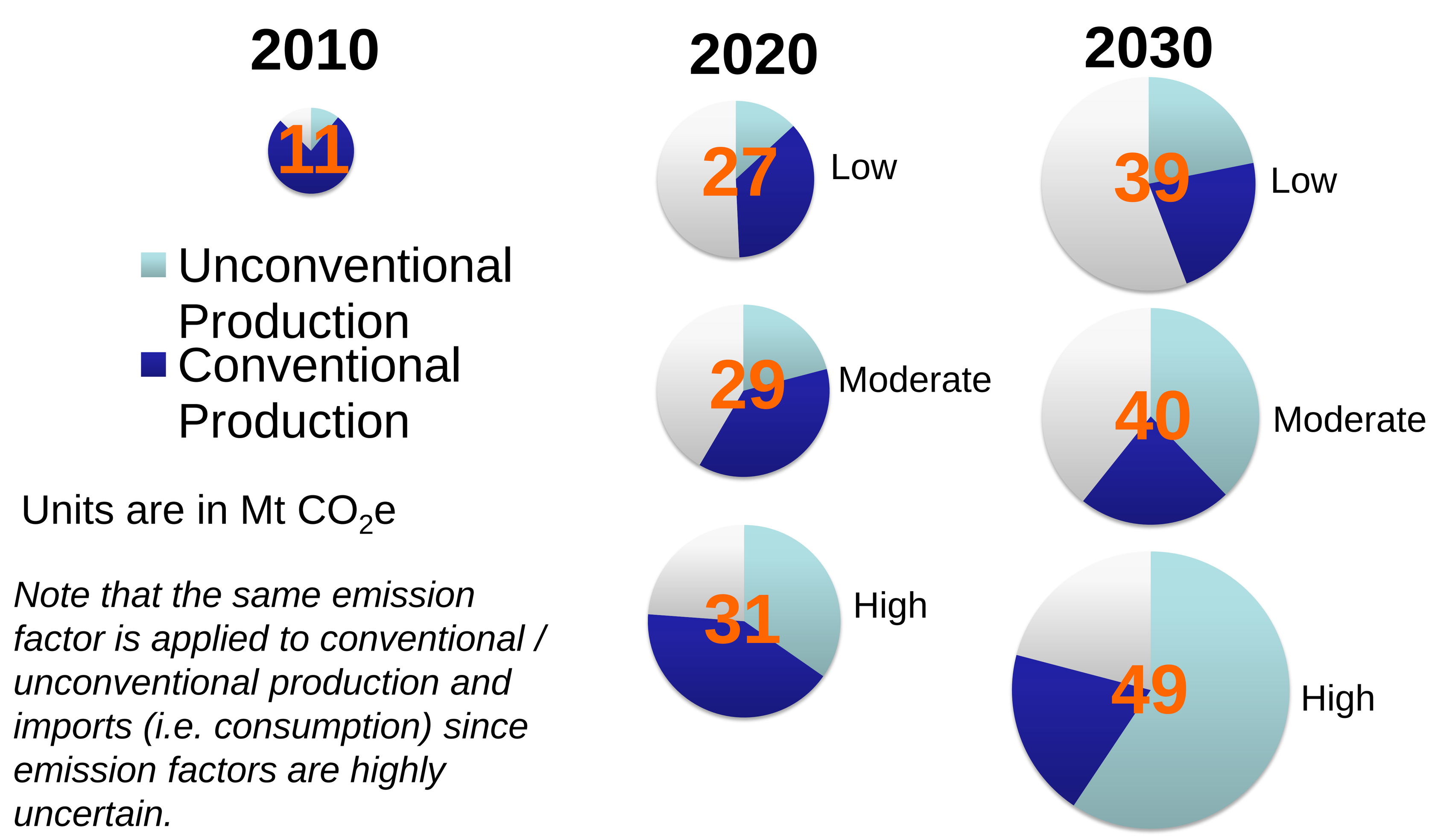
Implement three highly cost-effective emissions control/mitigation technologies for production wells:

- Reduced Emissions Completions
- Pneumatic Systems with Air
- Plunger Lift Systems

Implement a comprehensive methane emissions monitoring and reporting program to quantify benefits of the three technologies

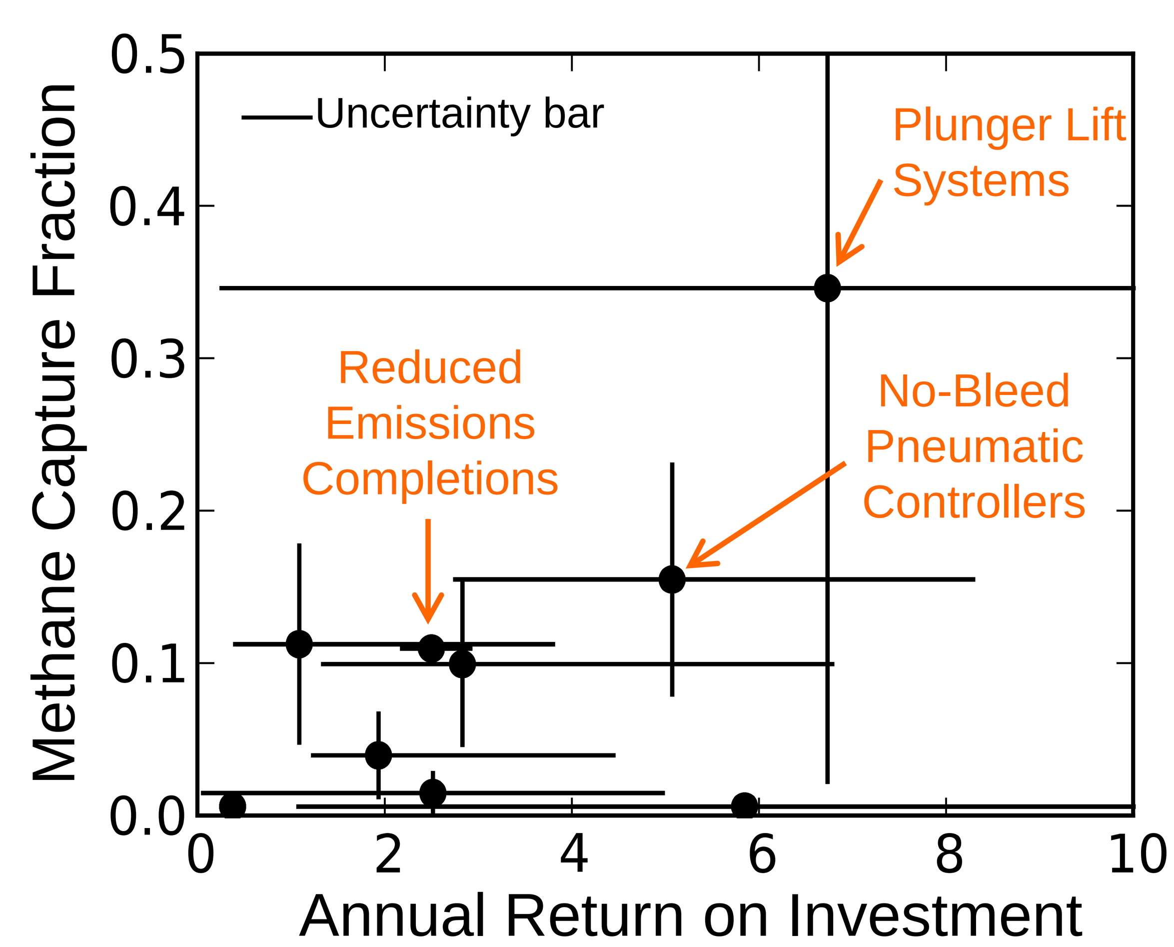
- Direct emissions measurement at the production wellhead
- Indirect emissions measurements for each well and/or facility-wide level

EMISSIONS PROJECTIONS FOR CHINA'S NATURAL GAS INDUSTRY



Note that the same emission factor is applied to conventional / unconventional production and imports (i.e. consumption) since emission factors are highly uncertain.

METHANE EMISSIONS REDUCTIONS VS. RETURN ON INVESTMENT



- Selected technologies are cost-effective
- Other cost-effect technologies are based on operational changes

DISCLAIMER: The information and predictions contained within this poster are based on the data provided by the site owners and operators. The Global Methane Initiative cannot take responsibility for the accuracy of this data.

PROPOSED MITIGATION TECHNOLOGIES

- Criteria for selecting mitigation technologies are:
  (1) payback period is less than 1 year in China,
  (2) the technology is permanently installed (ideal for new wells) and requires minimal operation and maintenance,
  (3) emissions reduction potential is greater than 5%.

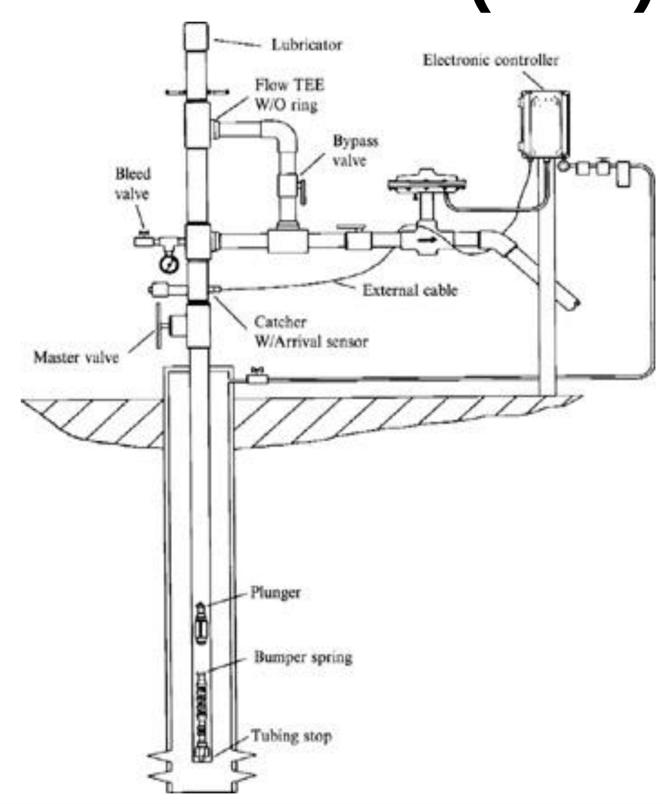
PNEUMATIC SYSTEMS WITH AIR (APS)

- 11% of emissions due to pneumatic systems
- Profits vary from $2000 - $100,000 per well

REDUCED EMISSIONS COMPLETIONS (REC)

- 9% of emissions due to completions and workovers
- Profits up to $40,000 per well

PLUNGER LIFT SYSTEMS (PLS)



- 33% of emissions due to well cleanup
- Profits vary from $2000 - $100,000 per well

ECONOMIC ANALYSIS/BENEFITS

- Payback period in China is much shorter than in the U.S., given higher prices for methane in China.
- These estimates have high uncertainty.

Technology	Savings Volume at Facility Level(Mcm)	Value of Gas Reclaimed (USD)		Technology Cost		Payback Period	
		US Prices ($3/MMBTU)	Chinese Prices ($6.5/MMBTU)	Purchase Cost (USD)	Operating Costs (USD/yr)	US (months)	China (months)
REC	7,600	810,000	1,800,000	500,000	120,000	5	2
APS	570	60,000	130,000	60,000		12	5
PLS	520	55,000	120,000	10,400		2	1

PROPOSED MONITORING METHODS

- Focus on monitoring methane emissions from natural gas production addressed by the three proposed technologies to reduce uncertainty and better constrain payback periods.
- Options:
  - Direct emissions measurement at the production wellhead (e.g. high volume sampler, meters, calibrated bagging).
  - Engineering estimation and emission factors (e.g. emission factors from manufacturer.
  - Combination of direct measurement and engineering estimation.

PNEUMATIC SYSTEMS WITH AIR (APS)

- Engineering estimation and emission factors
  - Data from manufacturer
  - Data from similar device
  - One-time measurement
  - Estimate based on published emission factors:

Emissions = Activity x (Emission Factor)

REDUCED EMISSIONS COMPLETIONS (REC)

Direct and indirect methods:

1. Flow meter
2. Engineering calculation for flow based on measured pressures
3. Daily production rate as emission rate

PLUNGER LIFT SYSTEMS (PLS)

- Combination of direct measurement and engineering estimation

Emissions = (constant)
x (casing diameter)^2
x (well depth)
x (shut-in pressure)
x (no. vents per year)
x (avg. sales flow rate)
x (unloading time)

CHALLENGES

- TECHNOLOGY TRANSFER to ensure that the mitigation technologies are available for implementation in China
- TECHNOLOGY ADVANCEMENT to facilitate China-specific infrastructure, regulatory environment, and geology
- WATER RESOURCES to support growth in unconventional natural gas production
- REGULATORY FRAMEWORK for emissions reporting programs to be wide-spread in China

FOR MORE INFORMATION

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