Carbon Limits

Best Practices to reduce Methane emissions from Arctic Oil and Gas Production

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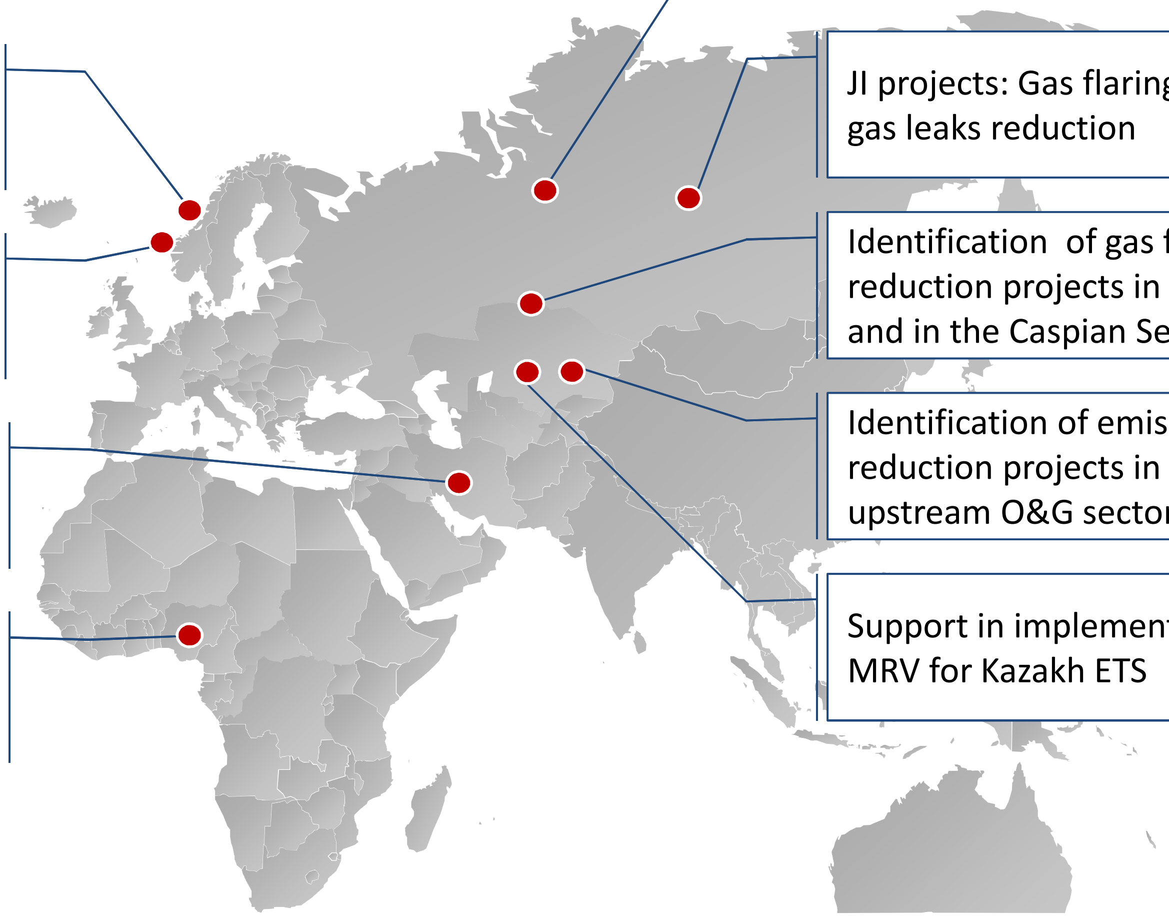
Carbon Limits?

- Formed in 2005, based in Oslo
- Broad range of research and consultancy on **climate change** issues with emphasis on the **oil & gas sector**



Evaluation of best available technologies to reduce gas flaring emissions.

EU ETS monitoring plan preparation – O&G sector

Associated gas utilization projects

Associated gas utilization projects

Associated gas utilization project

JI projects: Gas flaring and gas leaks reduction

Identification of gas flare reduction projects in Russia and in the Caspian Sea.

Identification of emission reduction projects in upstream O&G sector

Support in implementation of MRV for Kazakh ETS

Context and overview of the study presented

CONTEXT

O&G operations in the Arctic are material and expected to increase

O&G represent 20% of the global anthropogenic methane emissions

EPA, 2011

The BC snow/ice radiative forcing is larger for the Arctic Council nations than for the Rest of the World.

AMAP, 2011

The significance of BC emissions from gas flaring remains highly uncertain, but is a source of potential concern in the High Arctic.

Arctic Council, , 2011

KEY OBJECTIVES OF THE STUDY

1. Document the best available technologies
2. Evaluate their abatement costs in “arctic” conditions
3. Document the current practices

Project financed by:

MINISTRY OF THE ENVIRONMENT

AGENDA

Methodology

Methane emissions sources

Gas Flaring

Abatement Costs

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Project's methodology and approach

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WORKPLAN

- Literature Review
- Interview with technology providers
- Interview with Oil and Gas companies
- Interview with other stakeholders

> 50 INTERVIEWS PERFORMED

BC and Methane emission sources

Where, when, what type of emissions?

	 TRANSPORT	 WELLS	 OIL PRODUCTION	 GAS PRODUCTION	 STORAGE/LOADING
BLACK CARBON	• Vessels and ships • Land and air transport	• Drilling operations • Well tests	• Power/Heat generation • Associated Gas Flaring	• Gas flaring	• Vessels and ships • Land and air transport
METHANE		• Completion/ testing • Well plugging and abandonment • Gas venting and flaring • Well tests	• Associated Gas Flaring • Associated Gas Venting • Fluid degasing • Casinghead gas venting	• Compressors • Dehydrator and pumps • Pneumatic devices • Fugitive leakages • Well blowdown • Well completion	• Storage tanks/ loading • Sea transport

< PRODUCTION >

< EXPLORATION >

KEY

- Applicable both onshore and offshore
- Applicable offshore only
- Applicable only onshore

AGENDA

Methodology

Methane emissions sources

Gas Flaring

Abatement Costs

Key sources of potential methane emissions

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FLOW ASSURANCE

PNEUMATIC DEVICES

STORAGE AND LOADING

COMPRESSORS

FUGITIVE EMISSIONS

OTHER SOURCES

Components can develop leaks due to normal wear, process variations and environmental conditions

FUGITIVE EMISSIONS

Emission Source	Technology /practice	Maturity	Offshore? Onshore?	Applicable Exploration development?	Emission reduction
Fugitive emissions	Directed Inspection and Maintenance	H	BOTH	YES	60%-80%
	Subsea leakages detection & repair	M	OFF	NA	Uncertain

Compressors can leak through the components ensuring the sealing of the compressed gas

COMPRESSORS

Emission Source	Technology /practice	Maturity	Offshore? Onshore?	Applicable Exploration development?	Emission reduction
Centrifugal compressor	Dry seal	H	BOTH	YES	94%
	Seal Oil Vapor Recovery System	H	BOTH		95%
Reciprocating compressors	Economical replacement of rod packing	H	BOTH	YES	50%-65%
	Collecting and using/flaring the vent	M			95%

Glycol re-generation and gas-driven pumps related to flow assurance upstream can cause methane emissions

FLOW ASSURANCE

Emission Source	Technology /practice	Maturity	Offshore? Onshore?	Applicable Exploration development?	Emission reduction
Glycol dehydration and flow assurance	Install Flash Tank Separator (FTS) & Optimize glycol circulation rates	High	BOTH	NA	90%
	Use electric pump				80%
	Reroute Glycol Skimmer Gas			NA	95%

Remote, non-electrified sites often use gas-driven pneumatic devices emitting CH_4 for automatic process control

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PNEUMATIC DEVICES

Emission Source	Technology /practice	Maturity	Offshore? Onshore?	Applicable Exploration development?	Emission reduction
Pneumatic devices	Replacement to low bleed devices	H	BOTH	NA	90%
	Retrofit into low bleed				90%
	Replacement to air driven instrument				100%

Methane and nmVOCs are released from hydrocarbon products during storage and loading

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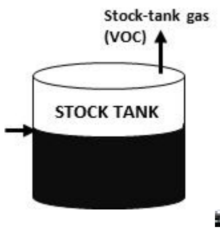
STORAGE AND LOADING



Emission Source	Technology /practice	Maturity	Offshore? Onshore?	Applicable Exploration development?	Emission reduction
	Reduce operating pressure upstream	H			Up to 30%
	Increase tank pressure	L-M			10-20%
	Change geometry of loading pipes	M			Poor data
Storage and loading of hydrocarbon products	VRU: Gas compression	H	BOTH	NA	95%
	VRU: Ejector	H			>95%
	VRU: VOC condensation & gas recovery	M-H			

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CH_4 emissions can be controlled through increased gas utilization and use of appropriate flare design

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INVEST IN GAS INFRASTRUCTURE

Maximize local use:

- **Heat**
- **Re-injection**

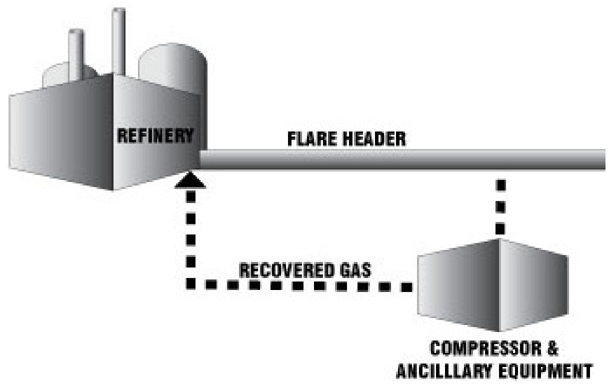
Export of marketable product(s):

- **Rich gas** (for
- **Heat** (industry/ ntial)
- **Dry gas, LPG, condensate**
- **Industrial products**
- **Electricity** (industry/grid)
- **Liquid fuels** (Gas-to-Liquids)

OPTIMIZE COMBUSTION CONDITIONS

Maximize recovery:

- Flare gas recovery system



OPTIMIZE COMBUSTION CONDITIONS

Picture: From Zeeco

Gas investments often lags behind oil investments, resulting in significant flaring

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EXAMPLE: Vankorskoye

- Largest field in Russia last 25 years
- Flaring of 1.1 BCM in 2010 (sattelite data)
- Gas pipeline under construction
- Estimated 95% utilization by 2013

TIMELINE

2009 2010 2011 2012 2013

Start of production

Significant flaring for 3.5 years

95% gas utilization

Flare design is important for CH_4 and BC emissions

Picture from Quartz

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Approach and Methodology

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APPROACH

What are the costs for ….?

It depends….

There is not one abatement cost….

Abatement costs depends on:

- Whether the project is new or retrofit
- Whether it is offshore or onshore
- The size of the infrastructure
- The local value of the gas
- The emissions factors of the emission source
- The share of methane in the recovered gas….

More than 850 abatement cost estimates for 16 technologies

SOURCE OF INFORMATION

Literature review

Interview results

Factors influencing abatement costs in the Arctic

Factors Influencing Costs

Generally, equipment/material costs are similar

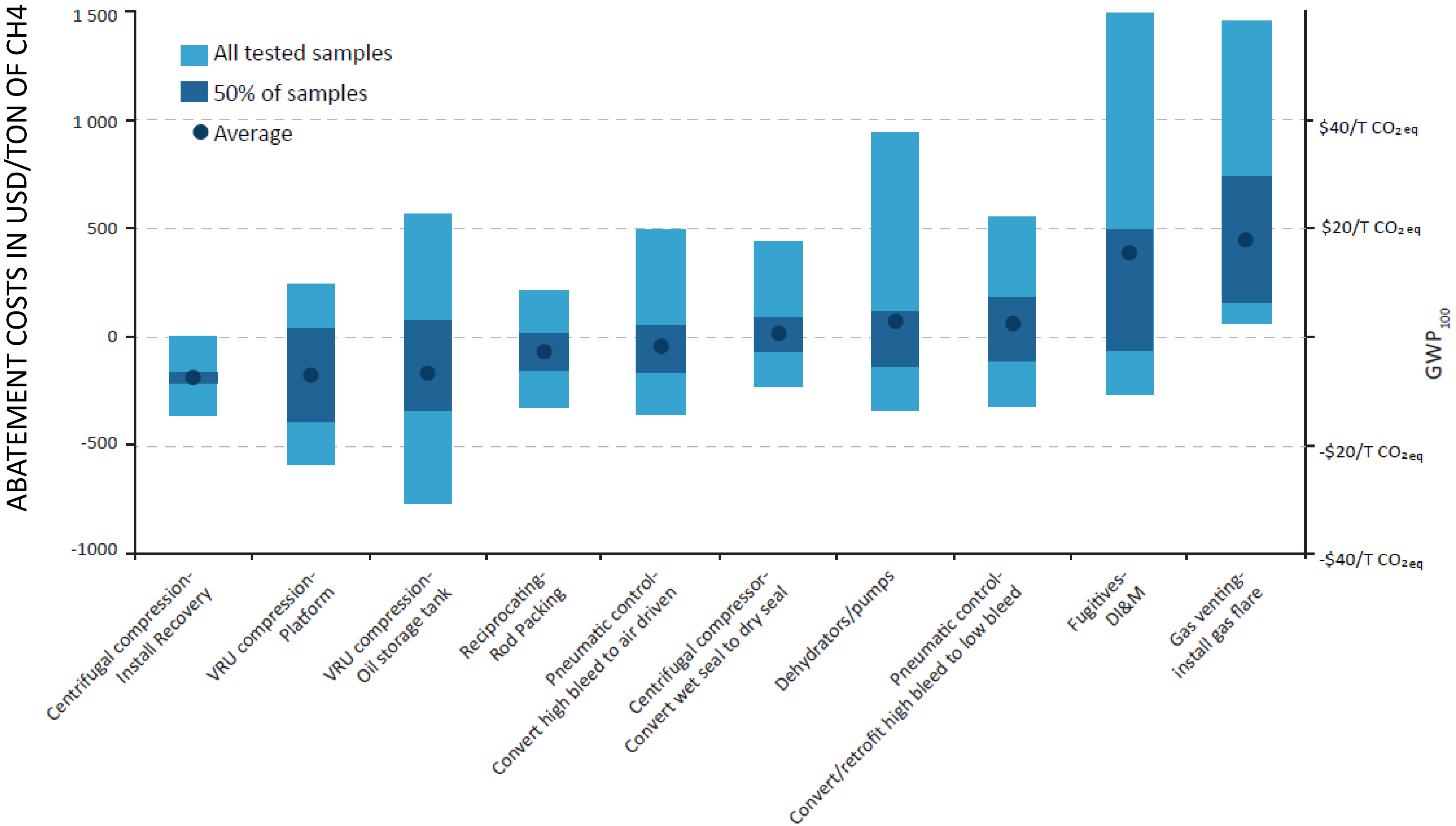
But differences in

- Installation costs
- Transport and freight costs
- Labour costs
- Design and engineering costs

Factor Influencing Revenue

Local gas (or other products) value

Methane abatement Costs



There are a number of barriers to projects implementation

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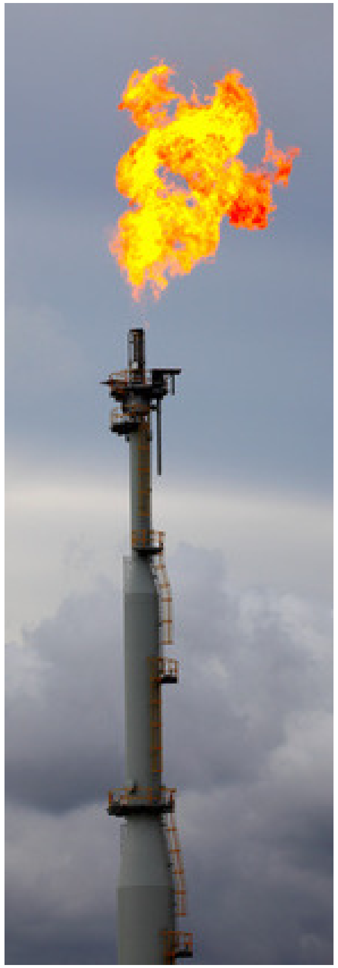
- DATA/INFORMATION GAPS
- ECONOMIC BARRIERS
- PRACTICAL BARRIERS
- POLICY UNCERTAINTIES
- GAS UTILISATION BARRIERS

CONCLUSIONS



- Most technologies can be applied **in the Arctic without technical barriers**
- Some of the best practices are commonly applied in Norway, North America, and in some cases, in Russia
- Key challenges remain for **smaller, old or dispersed sites**
- Abatement costs vary **significantly between cases**
- Higher installation and operational costs in the Arctic coupled with low value of gas (e.g. where gas is re-injected or flared) represents a barrier

Report available: http://www.carbonlimits.no/

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