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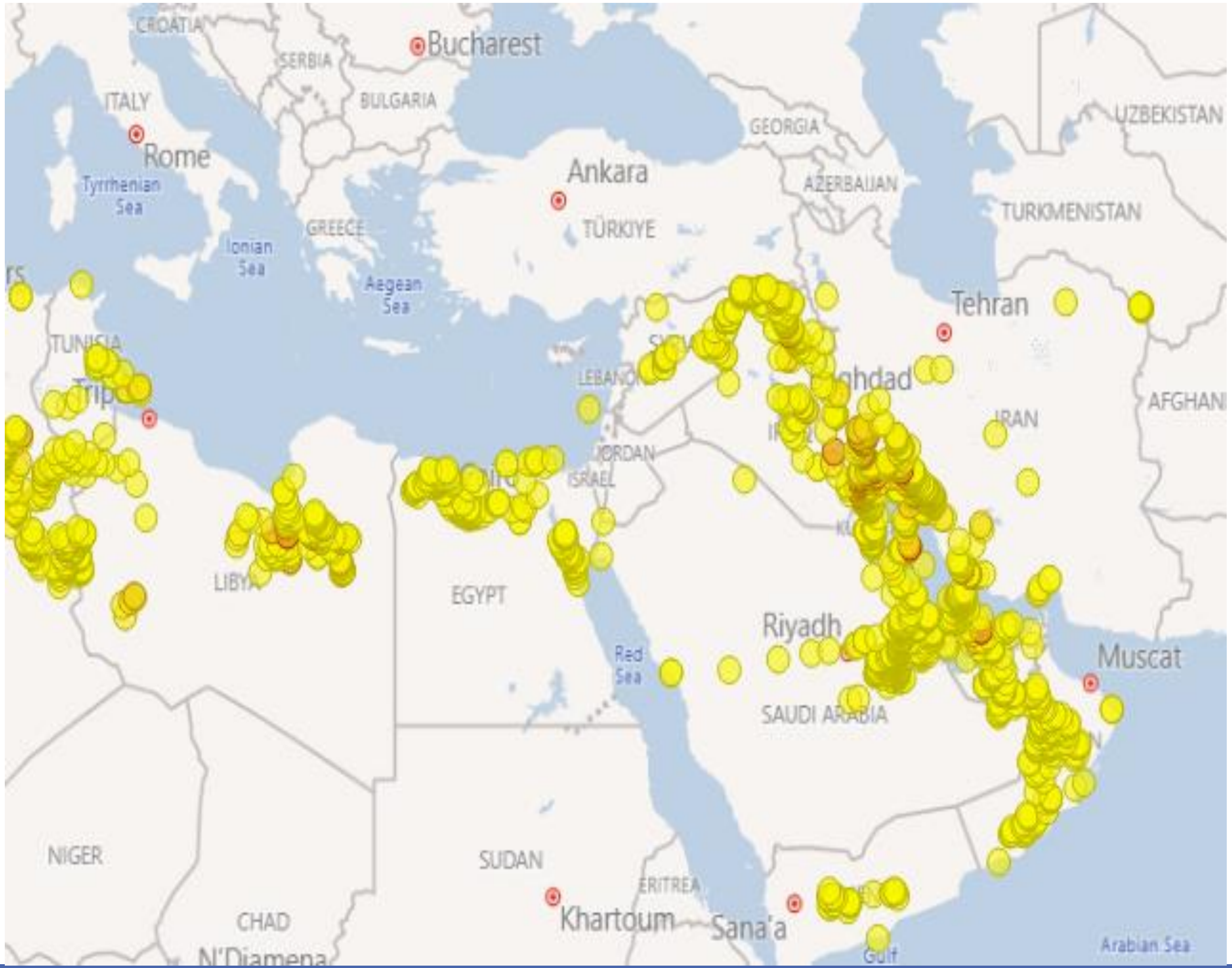
FLARING AND ECONOMY

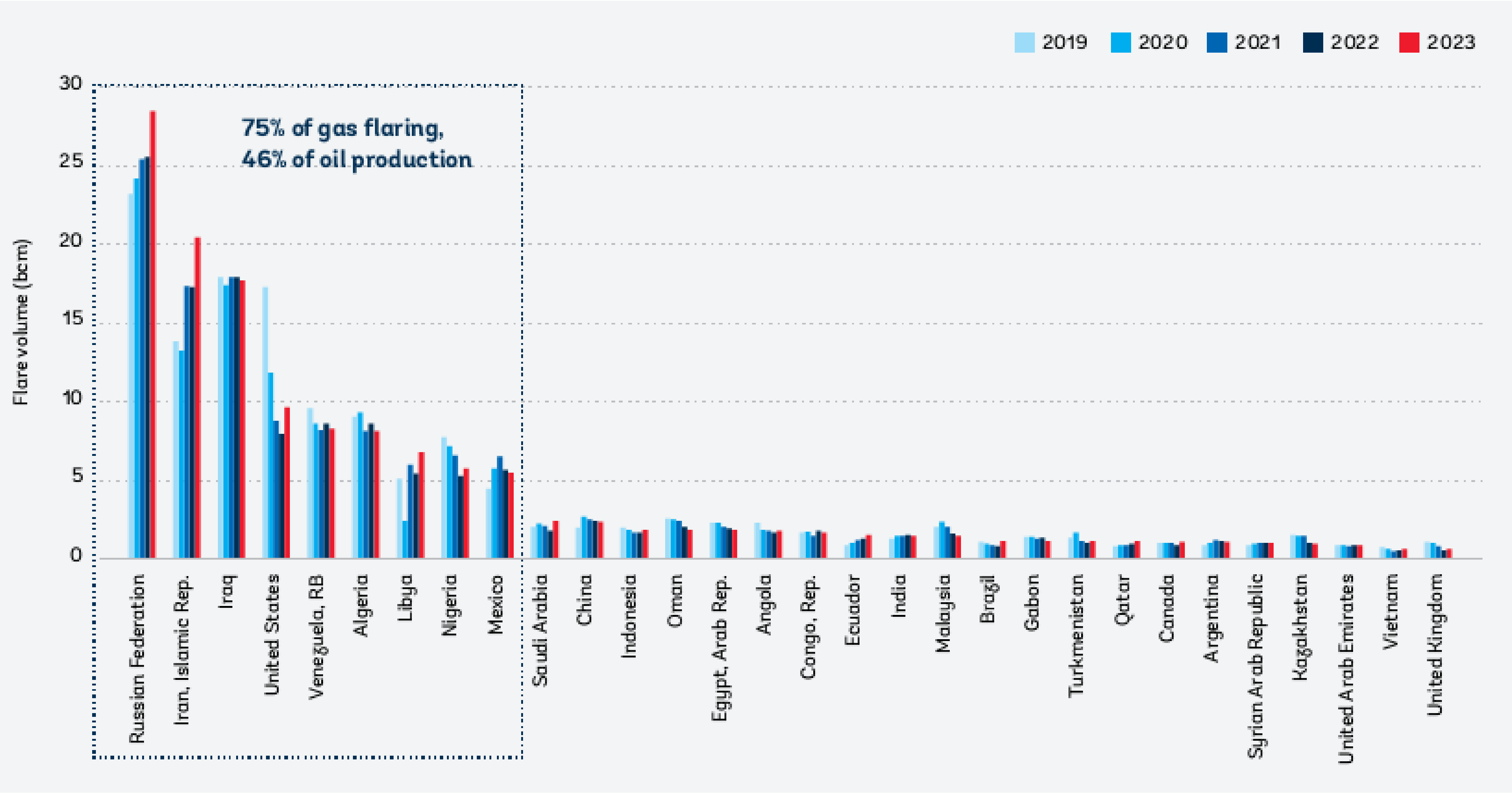
Introduction to Gas Flaring

- **Key Points:**
  - ~148 billion cubic meters (BCM) of gas was flared globally in 2023 (World Bank).
  - Flaring contributes to ~350 million tons of CO_2 emissions annually.
- **Economic Impact:**
  - Wasted energy worth billions of dollars.
  - Lost revenue from unutilized natural gas.



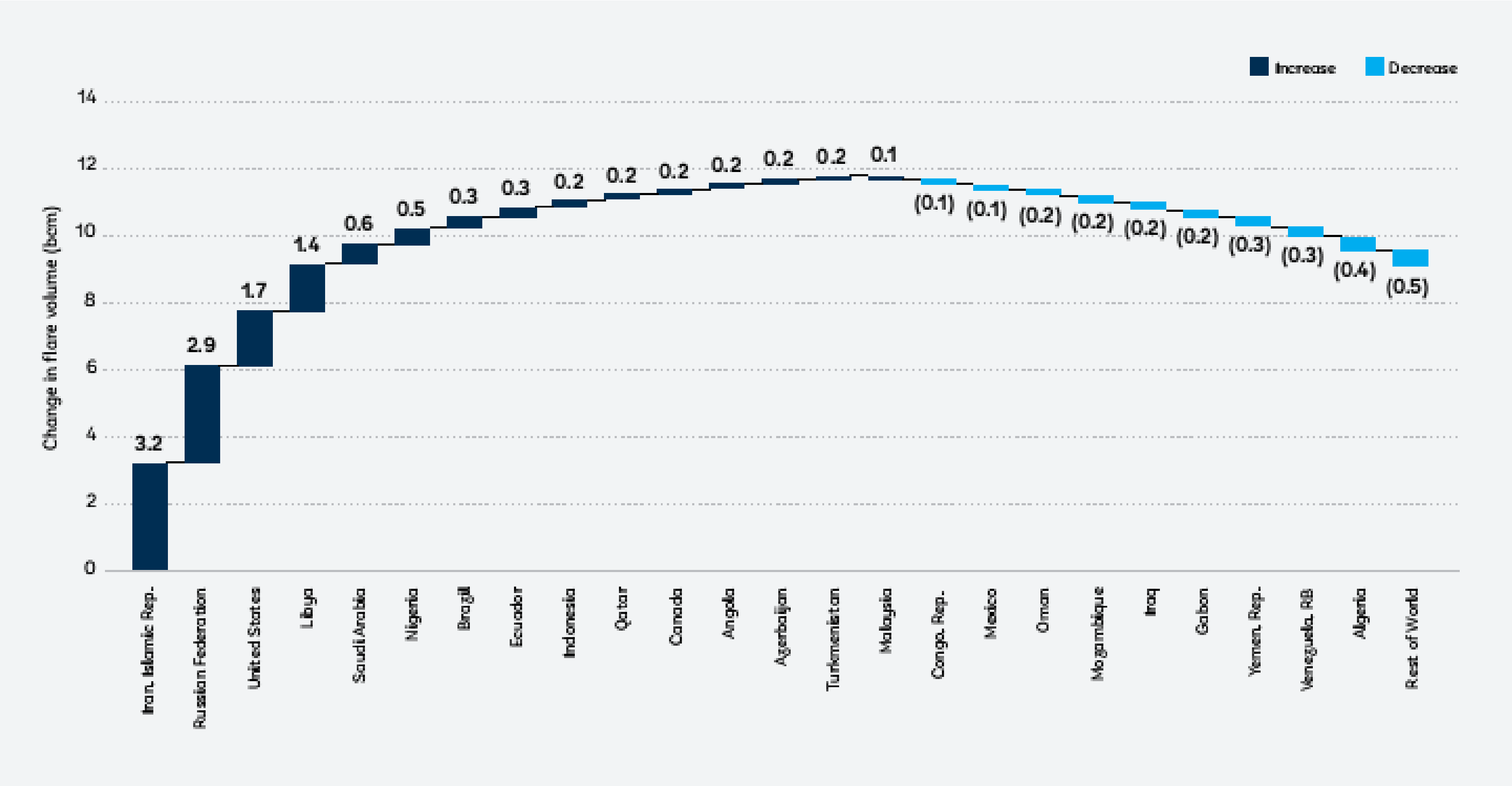
Global Flaring Statistics

I. Flare volumes in the top 30 flaring countries, in order of 2023 flare volume with the top 9 flaring countries indicated, 2019–23

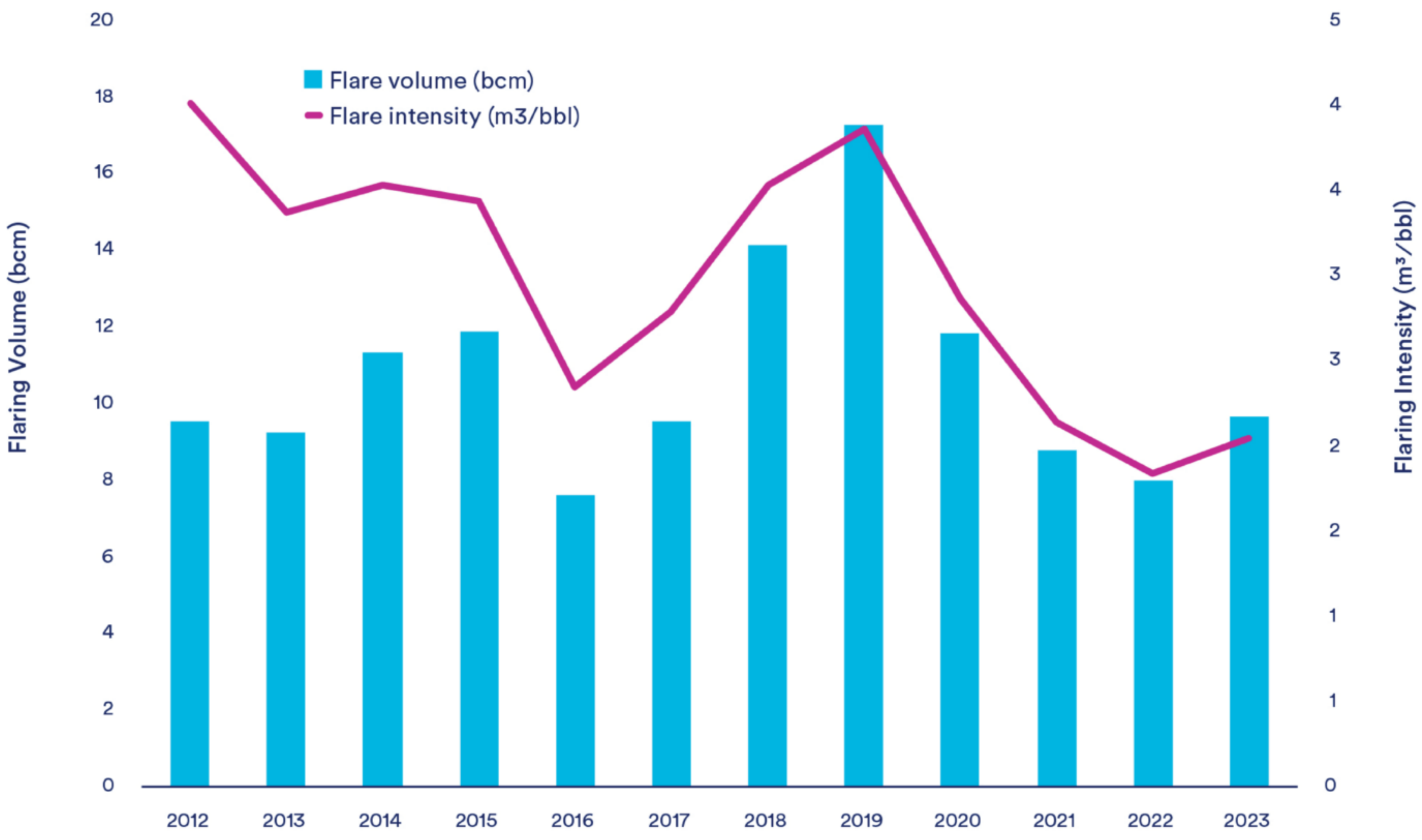


Global Flaring Statistics

Figure 7. Change in flare volume across countries where it was significant, and rest of world, 2022-23



Global Flaring Statistics

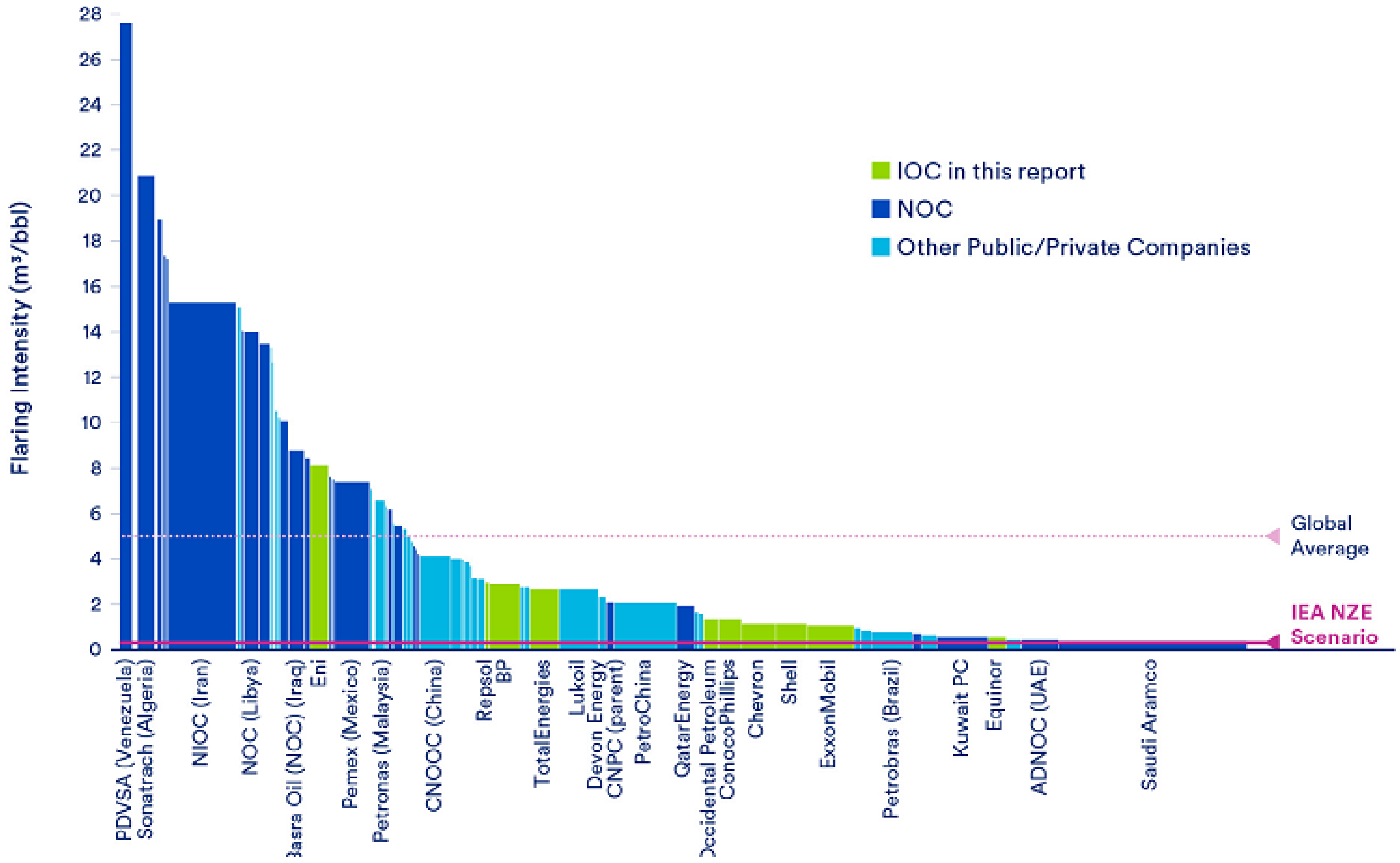


Economic Losses from Flaring

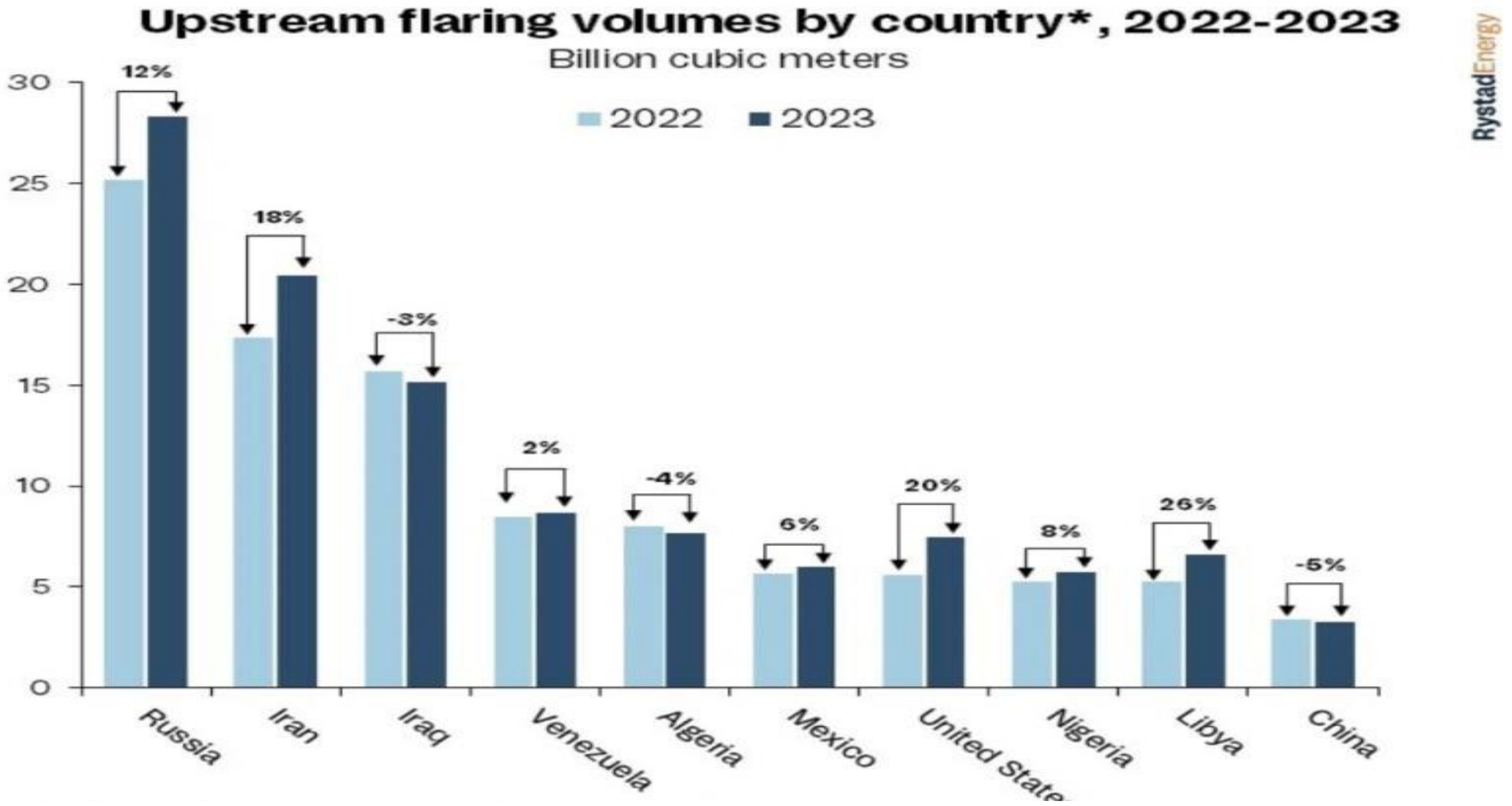
- **Key Points:**
  - Flaring wastes ~$16 billion worth of natural gas annually (World Bank).
  - Lost tax revenue and economic opportunities for producing countries.
  - Example: In 2021, Iraq lost ~$2.5 billion due to flaring.

Economic Losses from Flaring

Figure 5: Production vs Flaring Intensity for top flaring companies worldwide (excluding Russia)[3]



Economic Losses from Flaring



Benefits of Flaring Reduction

- **Environmental Benefits:** Reducing flaring can mitigate climate change impacts by reducing   emissions that could otherwise be used for energy.
- **Economic Gains:** Utilizing flared gas could generate enough energy to double the current energy supply.
- **Revenue Generation:** Captured gas can be sold or used for power generation.
- **Job Creation:** New industries for gas processing and distribution.
- **Energy Access:** Flared gas could provide electricity to millions.

•**Example:** Norway reduced flaring to near zero, generating significant revenue.

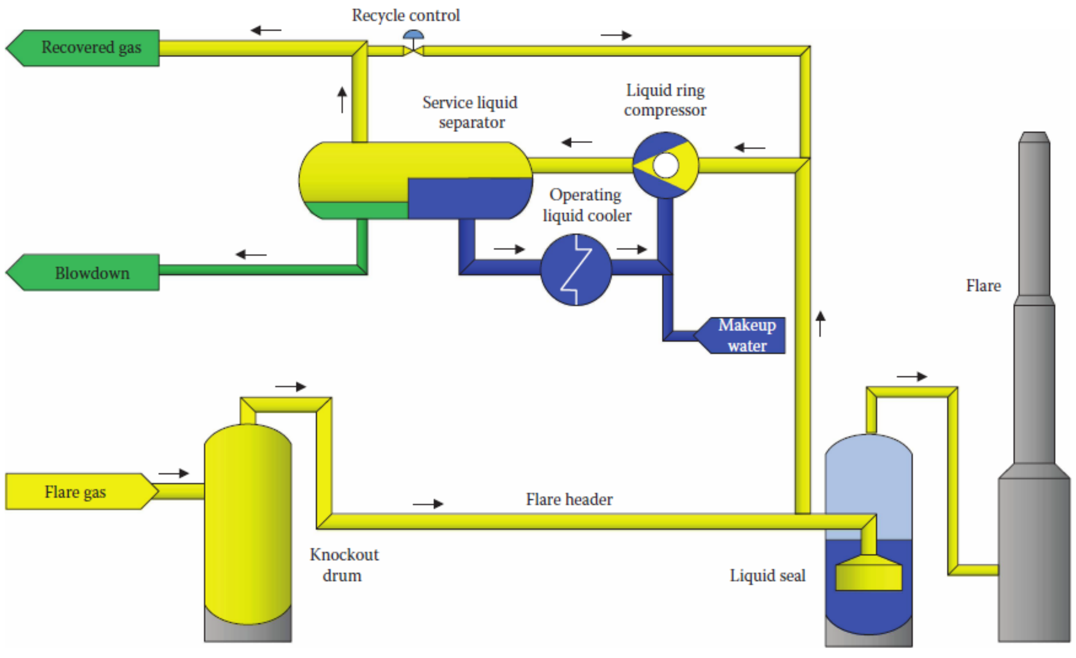
Policy and Regulatory Frameworks

- **Key Points:**
  - Carbon taxes and flaring penalties incentivize reduction.
  - Example: Norway's carbon tax reduced flaring by 90% since 1990.
  - World Bank's **Zero Routine Flaring by 2030** initiative.
- **Economic Incentives:** Tax breaks for companies investing in flaring recovery

Challenges and Barriers

- **Key Challenges:**
  - High upfront costs for flaring recovery infrastructure.
  - Lack of infrastructure in remote oil fields.
  - Low natural gas prices in some regions.
- **Solutions:**
  - Public-private partnerships.
  - International funding and grants (e.g., World Bank, GEF).

ECONOMY OF FGR OPTIONS



Gas-to-Power (GtP)

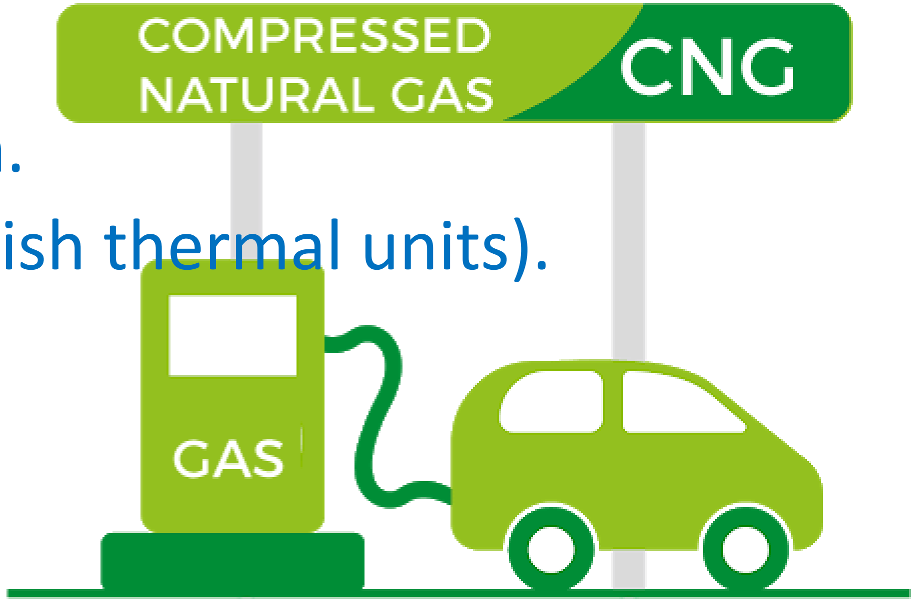
- **Description:** Converts flared gas into electricity for on-site use or grid distribution.
- **Costs:**
  - **Capital Expenditure (CapEx):** $1–3 million per MW of capacity.
  - **Operational Expenditure (OpEx):** $0.02–0.05 per kWh.
  - **Payback Period:** 2–5 years, depending on electricity prices.
- **Example:** In Nigeria, a 10 MW Gas-to-Power project costs ~20million but generates 5–10 million annually in revenue.

Compressed Natural Gas (CNG)

•**Description:** Compresses flared gas for transportation and use in vehicles or industries.

•**Costs:**

- **CapEx:** \$0.5–1.5 million per CNG station.
- **OpEx:** \$0.5–1.0 per MMBtu (million British thermal units).
- **Payback Period:** 3–7 years.



•**Example:** In the USA, CNG projects have reduced flaring while providing fuel for trucks and buses at competitive prices.

Liquefied Natural Gas (LNG)

- **Description:** Converts flared gas into LNG for export or domestic use.
- **Costs:**
    - **CapEx:** 500–1,000 per ton of LNG capacity (*e.g.*,50–100 million $ for a small-scale LNG plant).
    - **OpEx:** $2–4 per MMBtu.
    - **Payback Period:** 5–10 years.

- **Example:** In Algeria, small-scale LNG plants have been used to monetize flared gas, with export revenues exceeding $100 million annually.

Gas-to-Liquid (GTL)

- **Description:** Converts flared gas into liquid fuels like diesel or methanol.
- **Costs:**
  - **CapEx:** $50,000–100,000 per barrel per day of capacity.
  - **OpEx:** $20–30 per barrel of product.
  - **Payback Period:** 7–12 years.
- **Example:** Shell's GTL plant in Qatar processes flared gas into high-value fuels, but the high upfront costs make it less common for small-scale projects.

Pipeline Infrastructure

- **Description:** Transports flared gas to existing processing facilities or markets.
- **Costs:**
  - **CapEx:** $1–2 million per mile of pipeline.
  - **OpEx:** $0.1–0.3 per MMBtu.
  - **Payback Period:** 5–8 years.
- **Example:** In the Permian Basin (USA), pipeline networks have reduced flaring by connecting remote oil fields to gas markets.

Micro-LNG or Mini-LNG

- **Description:** Small-scale LNG plants for localized use.
- **Costs:**
  - **CapEx:** $10–20 million for a 50,000-ton-per-year plant.
  - **OpEx:** $3–5 per MMBtu.
  - **Payback Period:** 4–6 years.
- **Example:** In Russia, mini-LNG plants have been deployed to monetize flared gas in remote areas.

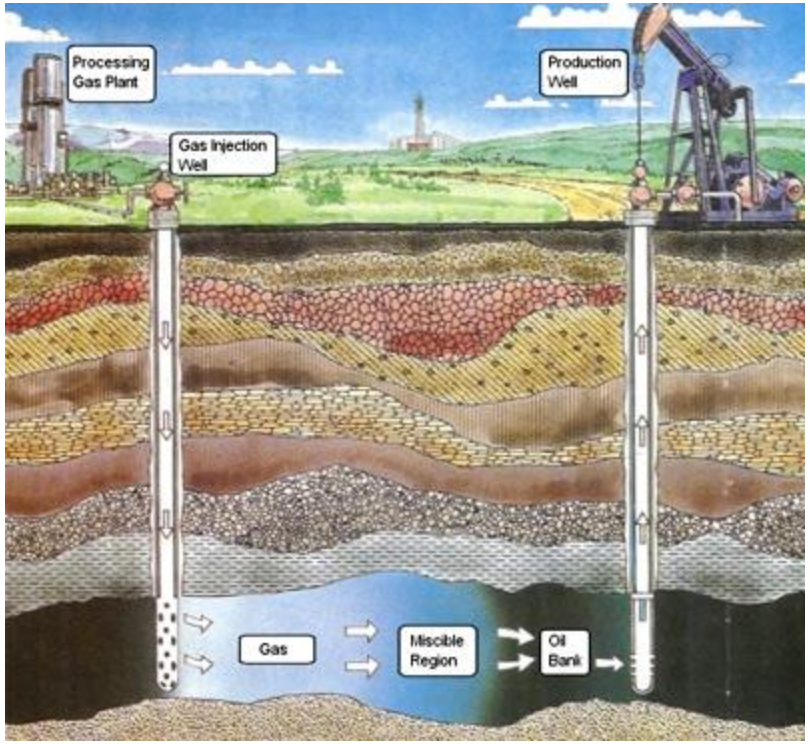
Flare Gas Re-injection

•**Description:** Re-injects flared gas into oil reservoirs for enhanced oil recovery (EOR).

•**Costs:**

- **CapEx:** $2–5 million per project.
- **OpEx:** $0.5–1.0 per MMBtu.
- **Payback Period:** 2–4 years.

•**Example:** In Norway, re-injection has reduced flaring while increasing oil production by 5–10%.



FGR ECONEMIC COMPARISON

Method	CapEx Range	OpEx Range	Payback Period	Best Use Case
Gas-to-Power (GtP)	$1–3 million/MW	$0.02–0.05/kWh	2–5 years	On-site power generation
CNG	$0.5–1.5 million/station	$0.5–1.0/MMBtu	3–7 years	Transport and industrial use
LNG	$50–100 million	$2–4/MMBtu	5–10 years	Export or domestic use
GTL	$50,000–100,000/bbl/day	$20–30/bbl	7–12 years	High-value liquid fuels
Pipeline	$1–2 million/mile	$0.1–0.3/MMBtu	5–8 years	Connecting remote fields to markets
Micro-LNG	$10–20 million	$3–5/MMBtu	4–6 years	Localized gas use
Re-injection	$2–5 million	$0.5–1.0/MMBtu	2–4 years	Enhanced oil recovery

Key Takeaways:

- **Gas-to-Power** and **Re-injection** are the most cost-effective for quick returns.
- **LNG** and **GTL** require higher upfront investment but offer long-term revenue potential.
- The choice of method depends on gas volume, location, and market access.

CARBON MARKETS for FGR PROJECTS

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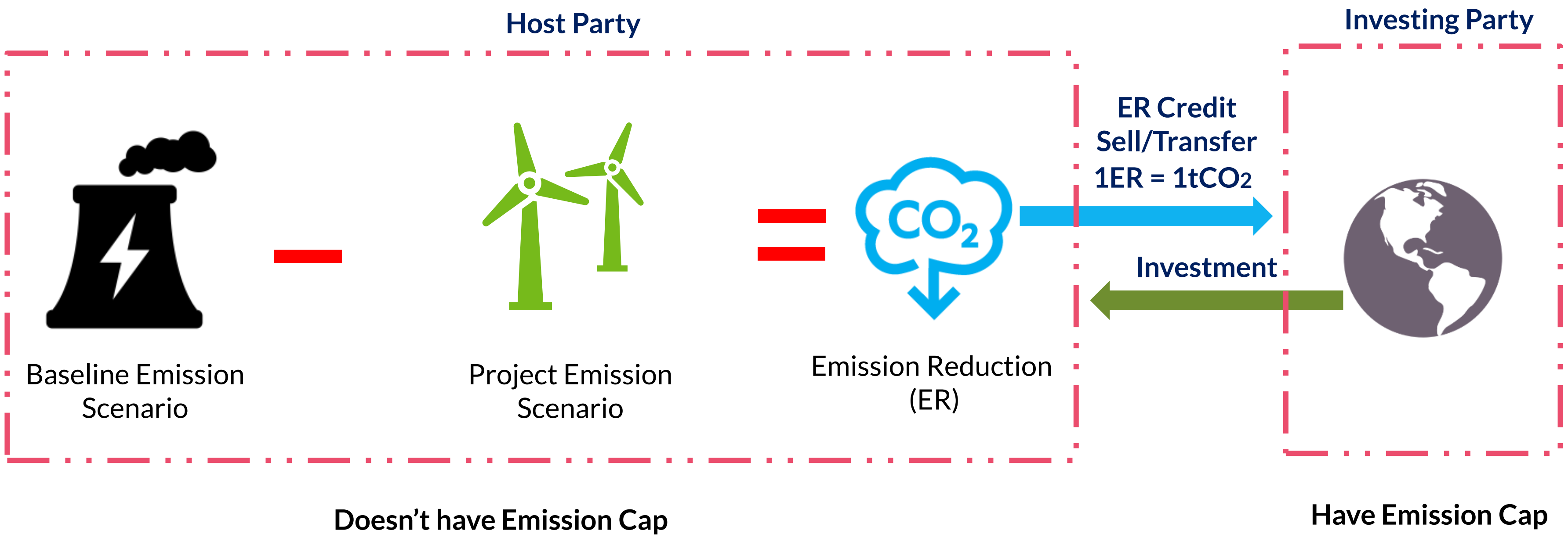
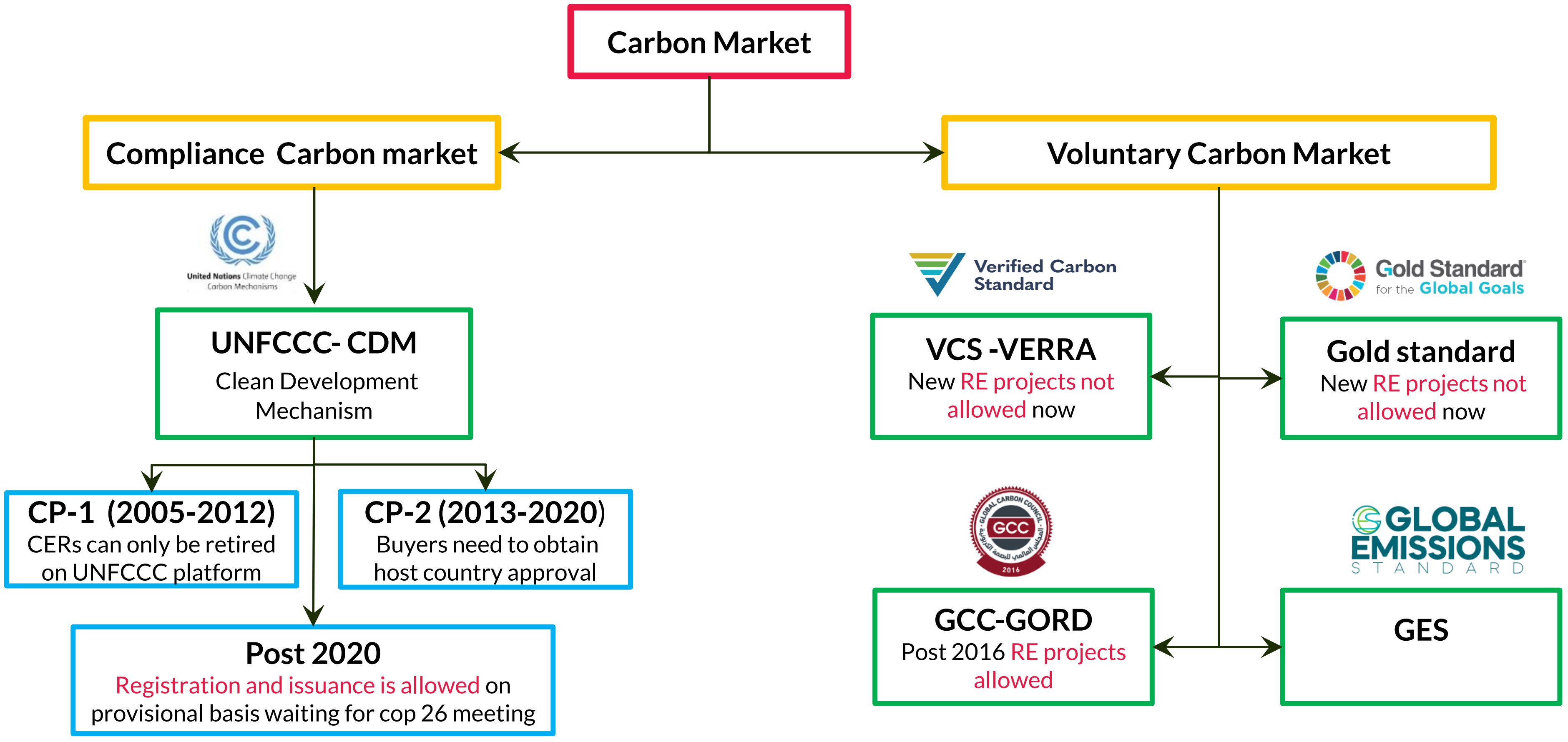
How an ideal Carbon Market Works?



1 Carbon Credit means 1 CER

1 CER (Certified Emission Reduction) = $1tCO_2$

Different type of Carbon Market Mechanism



Types of Carbon Credits

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EXHIBIT 5: Carbon offset project typology

Renewable Energy
- Solar
- Wind
- Hydropower
- Geothermal
- Biomass
- Biogas
- Others

Household & Community
- Clean water, cookstove distribution
- Lighting efficiency
- Energy efficiency
- Biogas community
- Cookstove & water purification
- Rural solar
- Others

Chemical/ Industrial
- Carbon capture & storage
- Refrigerant HFC
- Refrigerant Ozone depleting
- Fugitive Emission
- Others

Energy Efficiency
- Energy efficiency
- Fuel switching
- Energy efficiency: Industrial
- Other

Waste Disposal
- Waste incineration
- Waste gas avoidance
- Recycling
- Waste gas recycling
- Others

Agriculture
- Sustainable agriculture
- Livestock methane
- Grassland/rangeland management
- Others

Transport
- Nitrogen management
- Shipping
- Public transportation
- Others

Forestry & Land Use
- Urban forestry
- Soil carbon
- Improved forest management
- Avoided forest conversion
- Agro forestry
- Blue carbon
- REDD+
- Other

Source: Ecosystem Marketplace 2022

EXHIBIT 6: VCM transaction volumes and prices by category, 2020-21

Programs / Projects	2020		2021	
	Volume (MtCO2e)	Price (USD)	Volume (MtCO2e)	Price (USD)
Forestry & land use	57.8	5.40	227.7	5.80
Renewable energy	93.8	1.08	211.4	2.08
Chemical processes/Industrial manufacturing	1.8	2.15	17.3	3.12
Waste disposal	8.5	2.69	11.4	3.62
Energy efficiency	30.9	0.98	10.9	1.99
Household/ Community devices	8.3	4.34	8.0	5.36
Transportation	1.1	0.64	5.4	1.16
Agriculture	0.5	10.38	1.0	8.81

Source: APEC 2022

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Difference in Average Price in 2023 by **Standard**

Standard	Average Price (USD, approx.)
VCS	9.06
Gold Standard	6.25
CAR	6.58
ACR	9.50
Plan Vivo	12.49
J-Credit (Renewables)*	23.87
J-Credit (others)*	11.40
CDM (in voluntary use)	2.24

Source:
(1) Ecosystem Marketplace, State of the Voluntary Carbon Markets 2023
(2) J-credit scheme (https://japancredit.go.jp/)

* Calculated at May 2023 rate : 136JPY/USD

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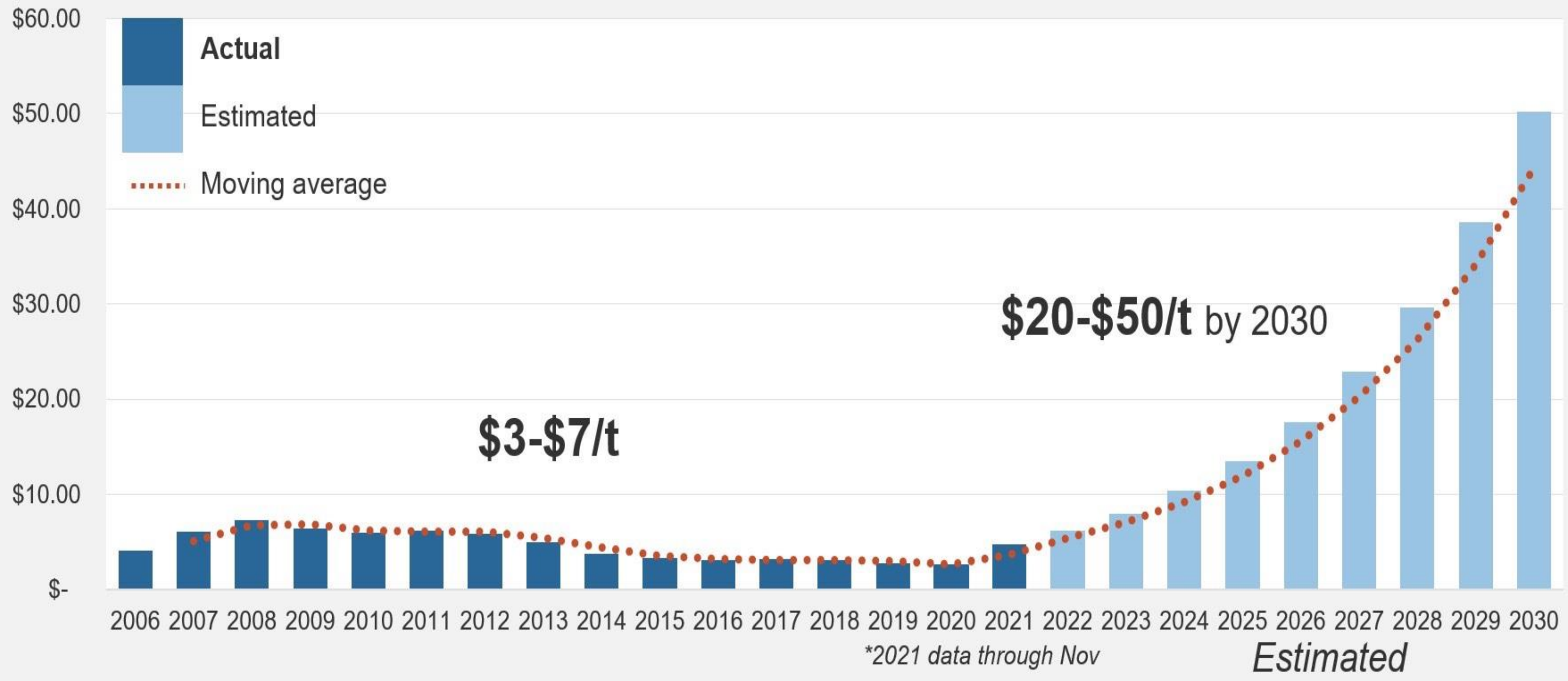
Difference in Average Price in 2023 by **Project Type**

Project Type	Average Price (USD)
Forestry & Land Use	11.21
Renewable Energy	3.97
Chemical Processing & Industrial Manufacturing (including CCS,CCUS)	**4.69**
Household / Community Devices	7.33
Energy Efficiency/ Fuel Switching	**3.69**
Waste Disposal (including flare gas utilization)	**9.00**
Agriculture	6.43

* The data is calculated with data of 11 different credit standards

Source:
Ecosystem Marketplace, State of the Voluntary Carbon Markets 2023

Voluntary Credit Prices (US$/mt CO_{2eq})



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How an ideal Carbon Market Mechanism Works ? (Project Cycle)

6 Months Approx.

1

Project Initiation

Initial idea, planning, choosing reliable Carbon Mechanism & methodology. criteria checking & contract signing

2

Make PDD, Estimated ER sheet, etc

Making of 'Project Design Document' (PDD), Calculating estimated carbon credits based on Collection of data from different entities based on chosen methodology

3

Validation

Validation by third party Carbon Auditor. Validation assures that project is valid & has potential to generate carbon credits

4

Submission of Final Validated Documents to VCS/GCC/GS

After validation by the Auditor, documents submitted to VCS/GCC/Board for registration.

*** Infinite Solutions provide tailored-made service from PROJECT INITIATION to TRADING OF CARBON CREDITS

How an ideal Carbon Market Mechanism Works ? (Project Cycle)

5 Months

5

Monitorin g

Certain parameter will be monitored as per PDD by the Plant Owner/ Municipality in order to calculate Carbon Credits.

At regular interval example-one, two, etc years (depending on no. of credits generated), in order to get credit and revenue from it.

6

Making of MR, ER sheet

Based on the data monitored by Plant Owner/ Municipality Infinite will calculate carbon credits (ERs) make Monitoring Report (MR) & (Emission Reduction) Sheet as per methodology

7

Verificatio n

Verification conducted by the third party Carbon Auditor and VCS/GCC/GS board. *It's periodic independent evaluation of monitored parameters.*

Verification means carbon credits for specific monitored period are true & certified.

8

Issuance of Credit

After verification, credit will be issued and parked in the registry (after paying issuance fee) where Plant Owner/ Municipality can sell their credits or offset/retire their own

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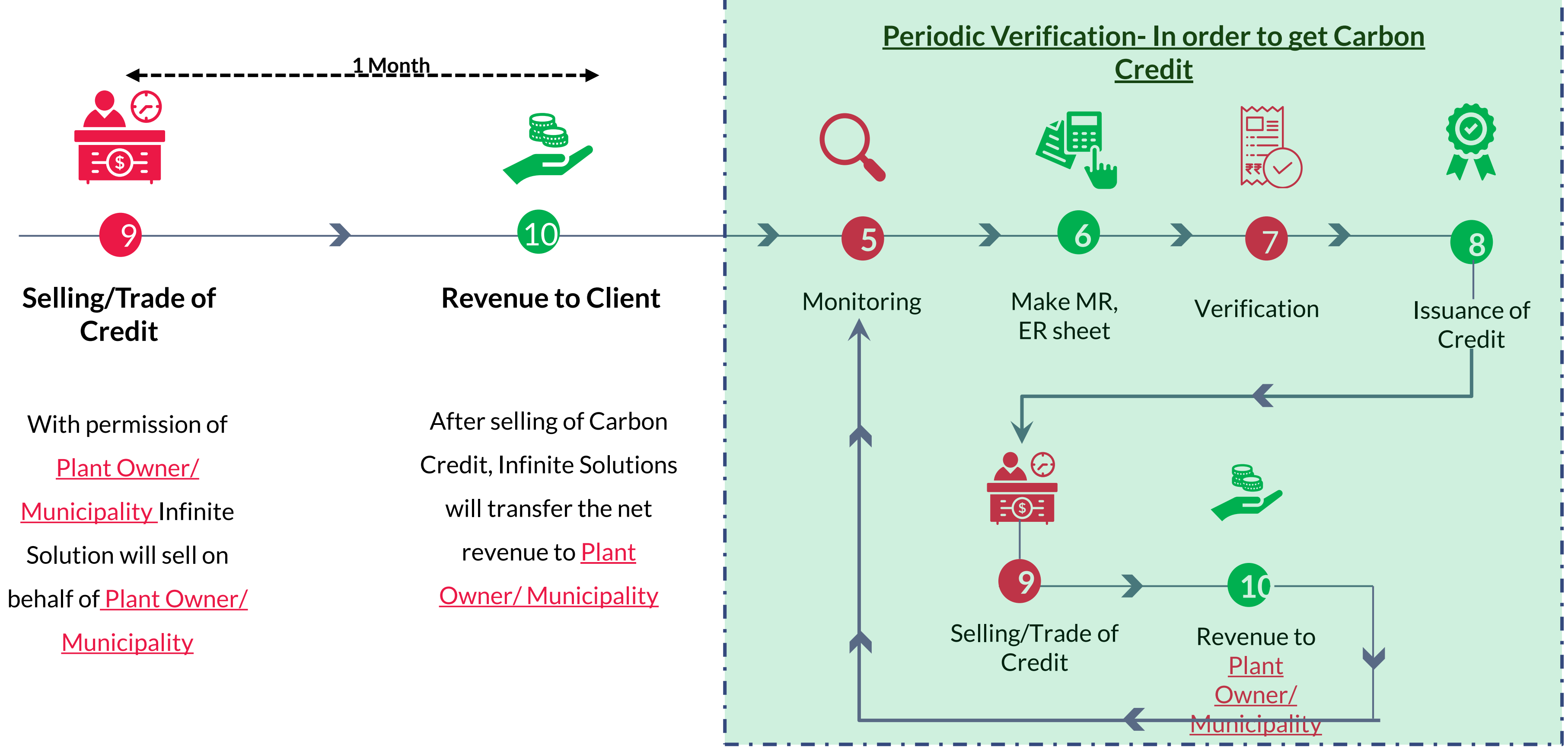
How an ideal Carbon Market Mechanism Works ? (Project Cycle)



Infinite Solutions we take care of everything from carbon project validation, registration, verification, to trading of carbon credits

PROJECT CLASSIFICATION

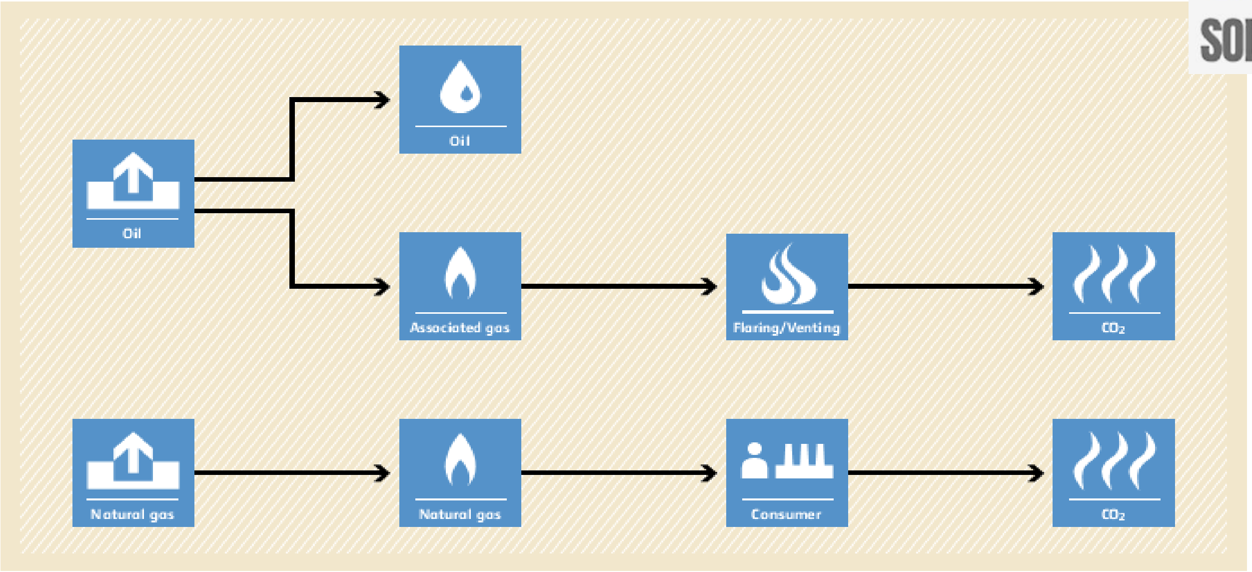
Prefereable Carbon Mechanisms	CDM	GCC	VCS	GS	Remarks
Project Eligibility criteria	6 months from date of purchase order (major equipment) need to send CDM prior consideration form.	Project commissioned in past 1 year or less and planned / futuristic projects to be considered	2 years from Commissioning Date(COD)	1 year from date of Purchase Order. Projects should be listed in registry	Detailed guidelines available publicly on each registry, link shared in separate slide.
For RE Projects	TBD (Article 6.4 under implementation)	Available	×	×	Only GCC is accepting RE projects
For Waste Management projects		Available	Available	Available	Joint Validation & Verification possible in VCS, cutting the timeframe and opportunity to get higher trade value
For Streetlight project		×	Available	×	
For Electric Vehicles		×	Available	×	Methodology available in VCS

FLARE RECOVERY METODOLGIES

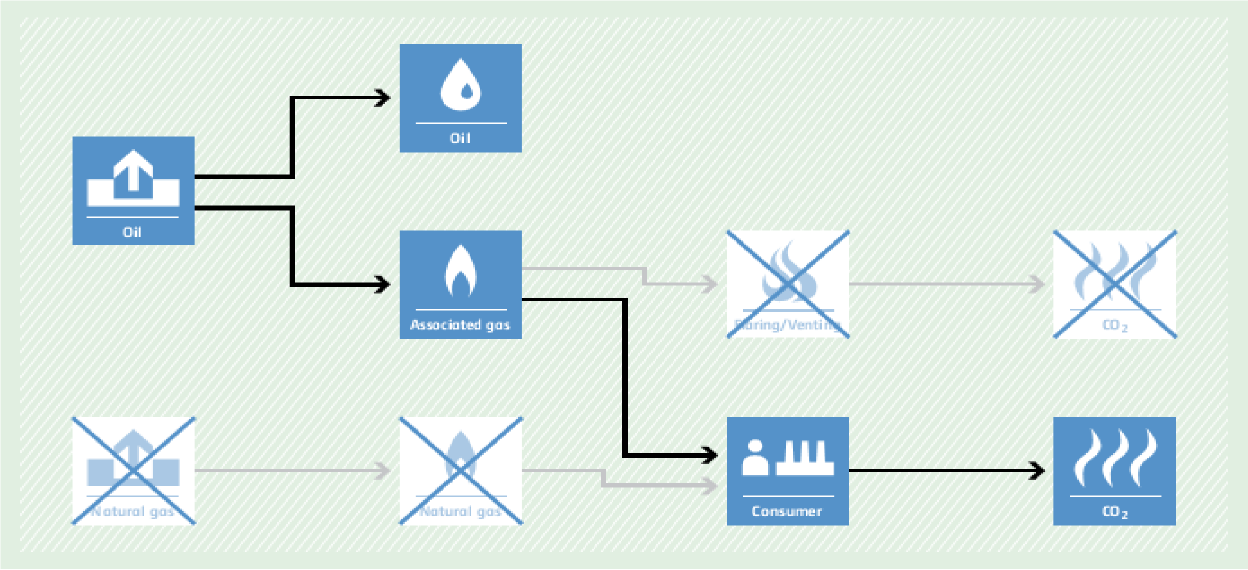
AM0009 Recovery and utilization of gas from oil fields that would otherwise be flared or vented

Typical project(s)	Associated gas from oil fields (including gas-lift gas) that was previously flared or vented is recovered and utilized.
Type of GHG emissions mitigation action	• Fuel switch. Displacement of use of other fossil fuel sources such as natural gas, dry gas, LPG, condensate etc. coming from non-associated gas by utilizing associated gas and/or gas-lift gas from oil fields.
Important conditions under which the methodology is applicable	• The recovered gas comes from oil wells that are in operation and are producing oil at the time of the recovery; • The recovered gas is transported to a gas pipeline with or without prior processing. Prior processing may include transportation to a processing plant where the recovered gas is processed into hydrocarbon products (e.g. dry gas, liquefied petroleum gas (LPG)). The dry natural gas is either: (i) transported to a gas pipeline directly; or (ii) compressed to CNG first, then transported by trailers/trucks/carriers and then decompressed again.
Important parameters	Monitored: • Quantity and net calorific value of the total recovered gas measured after pre-treatment and after the point where the recovered gas is directed for on-site use.

BASELINE SCENARIO
Associated gas from oil wells is flared or vented and non-associated gas is extracted from other gas wells.



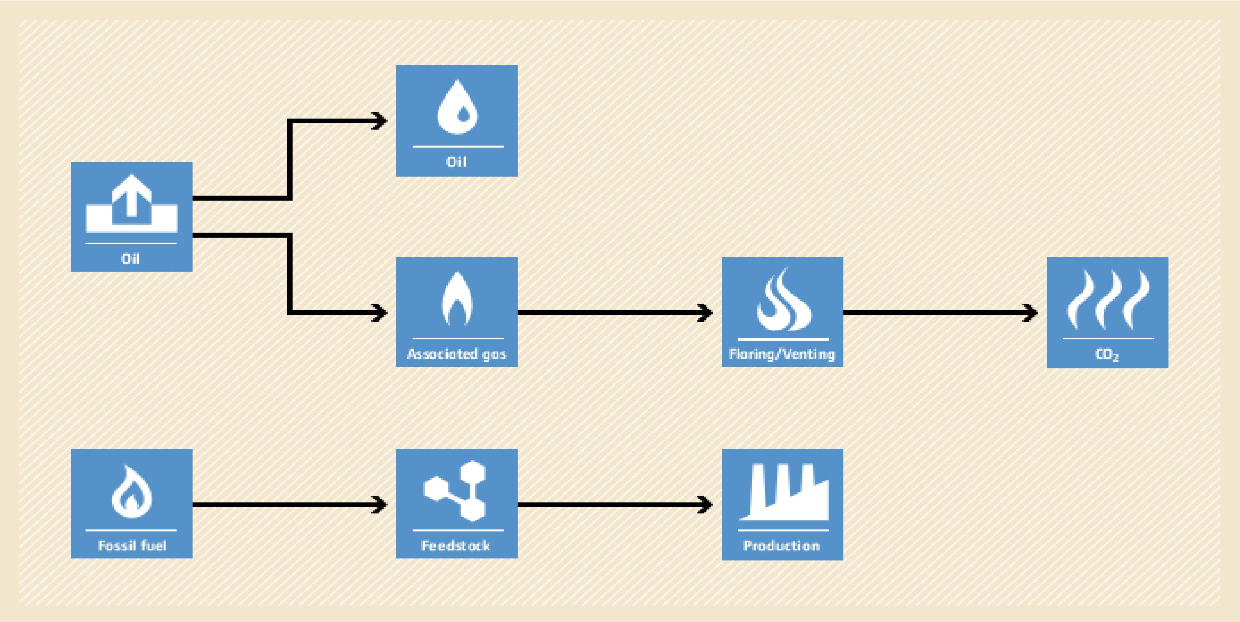
PROJECT SCENARIO
Associated gas from oil wells is recovered and utilized and non-associated gas is not extracted from other gas wells.



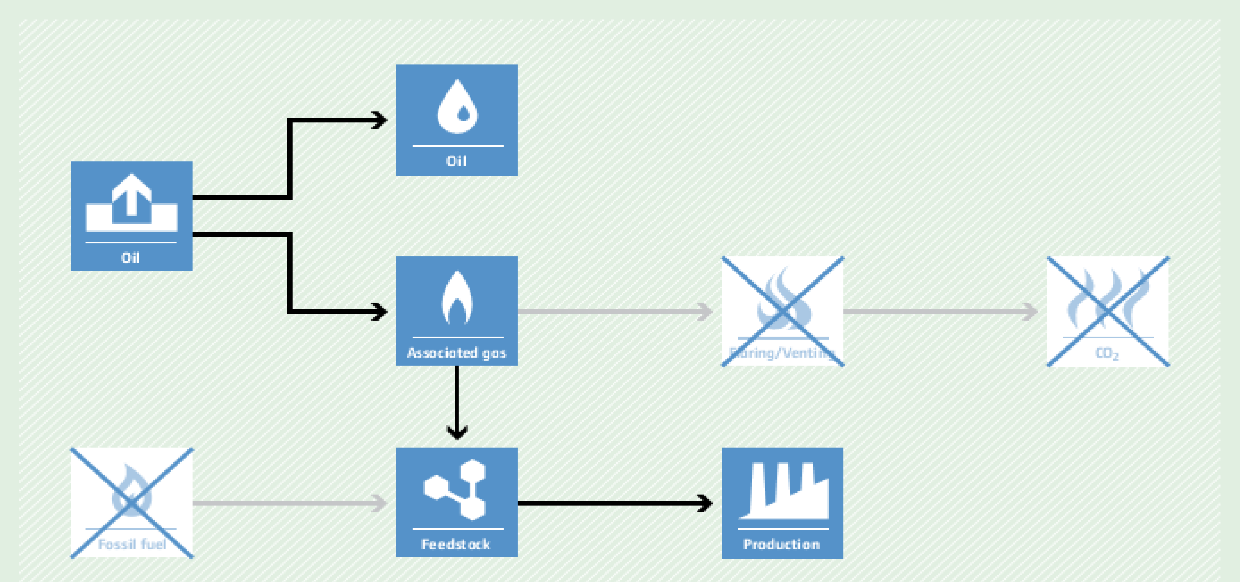
AM0037 Flare (or vent) reduction and utilization of gas from oil wells as a feedstock

Typical project(s)	Associated gas from oil wells that was previously flared or vented is recovered and utilized as a feedstock to produce a chemical product.
Type of GHG emissions mitigation action	• Feedstock switch. Avoidance of GHG emissions that would have occurred by flaring/venting the associated gas.
Important conditions under which the methodology is applicable	• The associated gas from the oil well, which is used in the project, was flared or vented for the last three years prior to the start of the project; • Under the project, the previously flared (or vented) associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene or ammonia).
Important parameters	Monitored: • Mass fraction of methane in the associated gas; • Quantity of product(s) produced in the end-use facility in the project; • Quantity and carbon content of associated gas utilized in the project, i.e. the quantity of associated gas entering the pipeline for transport to the end-use facility.

BASELINE SCENARIO
Associated gas from oil wells is flared or vented and other feedstock is used to produce a chemical product.



PROJECT SCENARIO
Associated gas from oil wells is recovered and utilized as feedstock to produce a chemical product.



AM0055 Recovery and utilization of waste gas in refinery or gas plant

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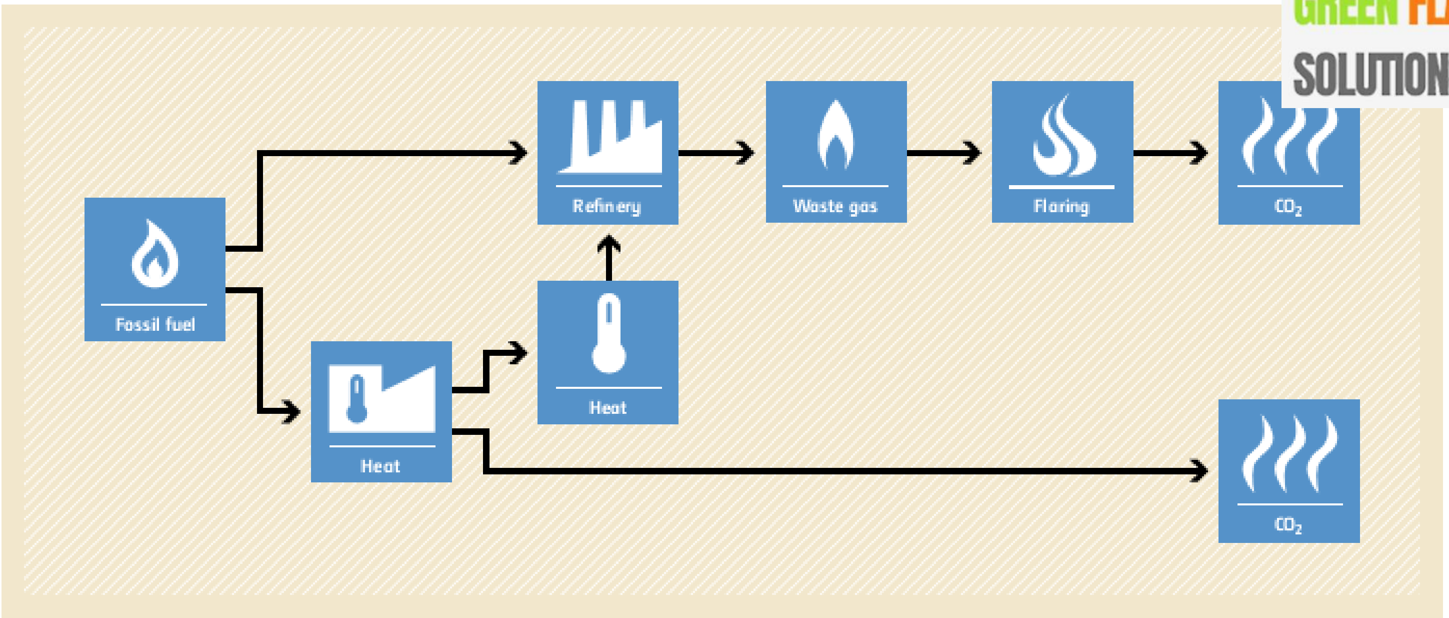
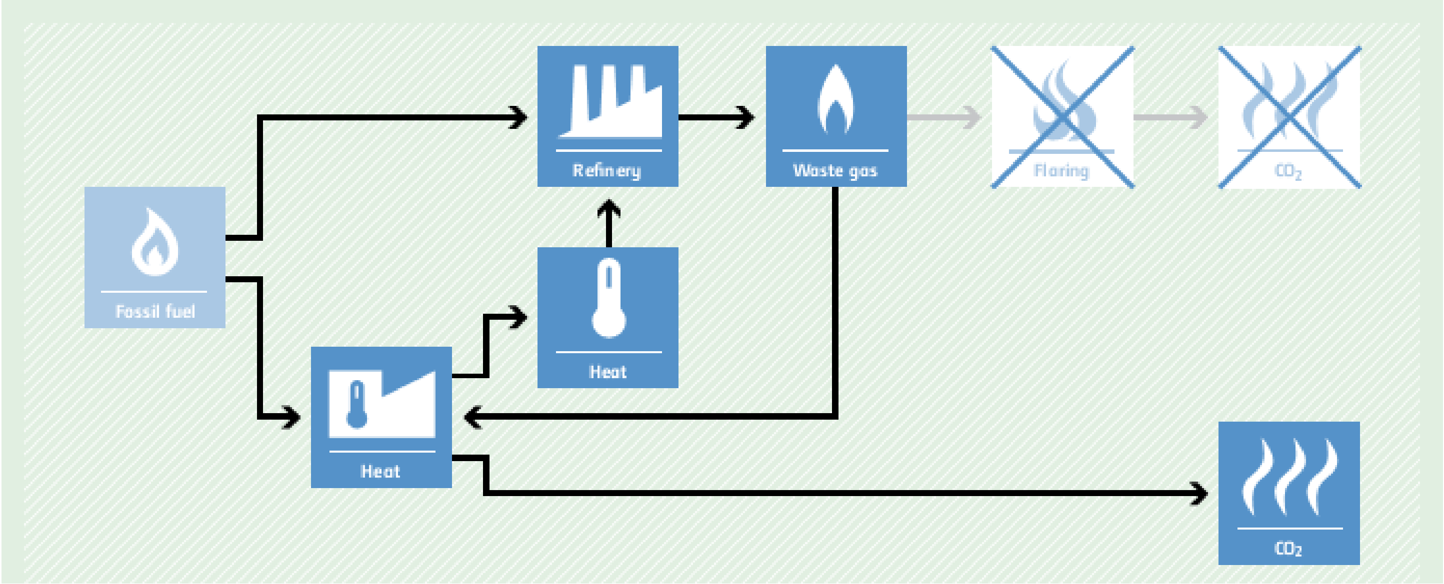
Typical project(s)	The project activity is implemented in existing refinery facilities or gas plants to recover waste gas, which is characterized by its low pressure or a low heating value and that is currently being flared to generate process heat in element process(es) (e.g. for the purpose of steam generation by a boiler or hot air generation by a furnace). Recovered waste gas is a by-product generated in several processing units of the refinery or gas plant.
Type of GHG emissions mitigation action	• Energy efficiency. Displacement of fossil fuel used for heat production by recovered waste gas.
Important conditions under which the methodology is applicable	• Waste gases from the refinery or gas plant, used under the project activity, were flared (not vented) for the last three years prior to the implementation of the project activity; • The waste gas recovery device is placed just before the flare header (with no possibility of diversions of the recovered gas flow) and after all the waste gas generation devices; • The recovered waste gas replaces fossil fuel that is used for generating heat for processes within the same refinery or gas plant; • The composition, density and flow of waste gas are measurable.
Important parameters	At validation: • Historical annual average amount of waste gas sent to flares before the project implementation.
	Monitored: • Parameters to calculate the emission factor for consumed electricity; • Amount and composition of recovered waste gas (e.g. density, LHV) and data needed to calculate the emission factor of fossil fuel used for process heating and steam generation within the refinery or gas plant.

BASELINE SCENARIO
Use of fossil fuel to generate process heat. Waste gas is flared.



PROJECT SCENARIO
Use of recovered waste gas to generate process heat. Thereby, fossil fuel usage is reduced and waste gas is not flared anymore.



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AM0077 Recovery of gas from oil wells that would otherwise be vented or flared and its delivery to specific end-users

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Typical project(s)	Associated gas from oil wells that was previously flared or vented, is recovered and processed in a new gas processing plant along with, optionally, non-associated gas. The processed gas is delivered to clearly identifiable specific end-user(s) by means of CNG mobile units and/or delivered into an existing natural gas pipeline.
Type of GHG emissions mitigation action	• Fuel switch. Recovery of associated gas from oil wells that would otherwise be flared or vented for displacement of non-associated gas in a new gas processing plant.
Important conditions under which the methodology is applicable	• The recovered gas comes from oil wells that are in operation and producing oil at the time. Records of flaring or venting of the associated gas are available for at least three years; • The processed gas is consumed in the host country(ies) only; • If the project oil wells include gas-lift systems, the gas-lift gas has to be associated gas from the oil wells within the project boundary; • The natural gas can be used only in heat generating equipment.
Important parameters	Monitored: • Quantity and carbon content of gas measured at various points, i.e. recovered associated gas, non-associated gas from natural gas wells, gas or other fossil fuel consumed on site, gas delivered to end-user(s), gas delivered to natural gas pipeline; • If applicable: quantity and net calorific value of fuel consumed in vehicles for transportation of CNG.

ACM0012 Waste energy recovery

Typical project(s)	Energy from waste heat, waste gas or waste pressure in an existing or new industrial facility is recovered and used for in-house consumption or for export, by installation of a new power and/or heat and/or mechanical energy generation equipment, or by installation of a more efficient electricity generation equipment than already existing, or by upgrade of existing equipment but with better efficiency of recovery.
Type of GHG emissions mitigation action	• Energy efficiency. Waste energy recovery in order to displace more-carbon-intensive energy/technology.
Important conditions under which the methodology is applicable	• In the absence of the project, the waste energy carrying medium would remain unutilized (e.g. flared or released to the atmosphere). In case of partial use of the waste energy carrying medium in the baseline situation, the project increases the share of used waste energy by means of enhance or improved energy recovery of the waste energy carrying medium; • For capacity expansion projects, the new capacity should be treated as new facility and therefore the applicable guidance for baseline scenario determination, capping of baseline emissions and demonstration of use of waste energy in absence of the CDM project, should be followed; • Project activities can generate electricity and/or mechanical energy beyond the maximum capacity of the pre-project equipment of existing recipient facilities.
Important parameters	Monitored: • Quantity of electricity/mechanical energy/heat supplied to the recipient plant(s); • Quantity and parameters of waste energy streams during project.

AMS-III.BI. Flare gas recovery in gas treating facilities

Typical project(s)	Off-spec gas is captured and injected into a gas sales line for transportation to the market after cleaning/processing and compressing in dedicated project facilities.
Type of GHG emissions mitigation action	• Energy efficiency. Recovering the waste off-spec gas and utilizing for useful applications.
Important conditions under which the methodology is applicable	• Off-spec gas from gas processing facilities (GPF), used by the project activity, totally or partially was flared (not vented) for at least three years, prior to the start date of the project; • Recovered off-spec gas in the project activity should be captured, compressed, and cleaned/processed in the GPF before being injected into a gas sales line for transportation to the market; • Off-spec gas volume, energy content and composition are measurable; • There shall not be any addition of fuel gas or dry gas into the off-spec gas pipeline between the point of recovery and the point where it is fed into the GPF.
Important parameters	At validation: • Quantity and composition of off-spec gases.
	Monitored: • Quantity and composition of off-spec gases utilised; • Electricity and fuel used.


Thank you