Methane Mitigation Europe

Advancing towards reduced flaring and methane emissions

Economic and environmental synergies

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OUR STRATEGY

Always safe, high value, low carbon

Strategic focus areas

High value growth in renewables

Optimised oil & gas portfolio

New market opportunities in low carbon solutions

50

PERCENT

Reduction of operated emissions by 2030

50

PERCENT

Gross capex investments to transition by 2030

40

PERCENT

Reduction in net carbon intensity by 2035

Mitigating flaring will mitigate methane emissions

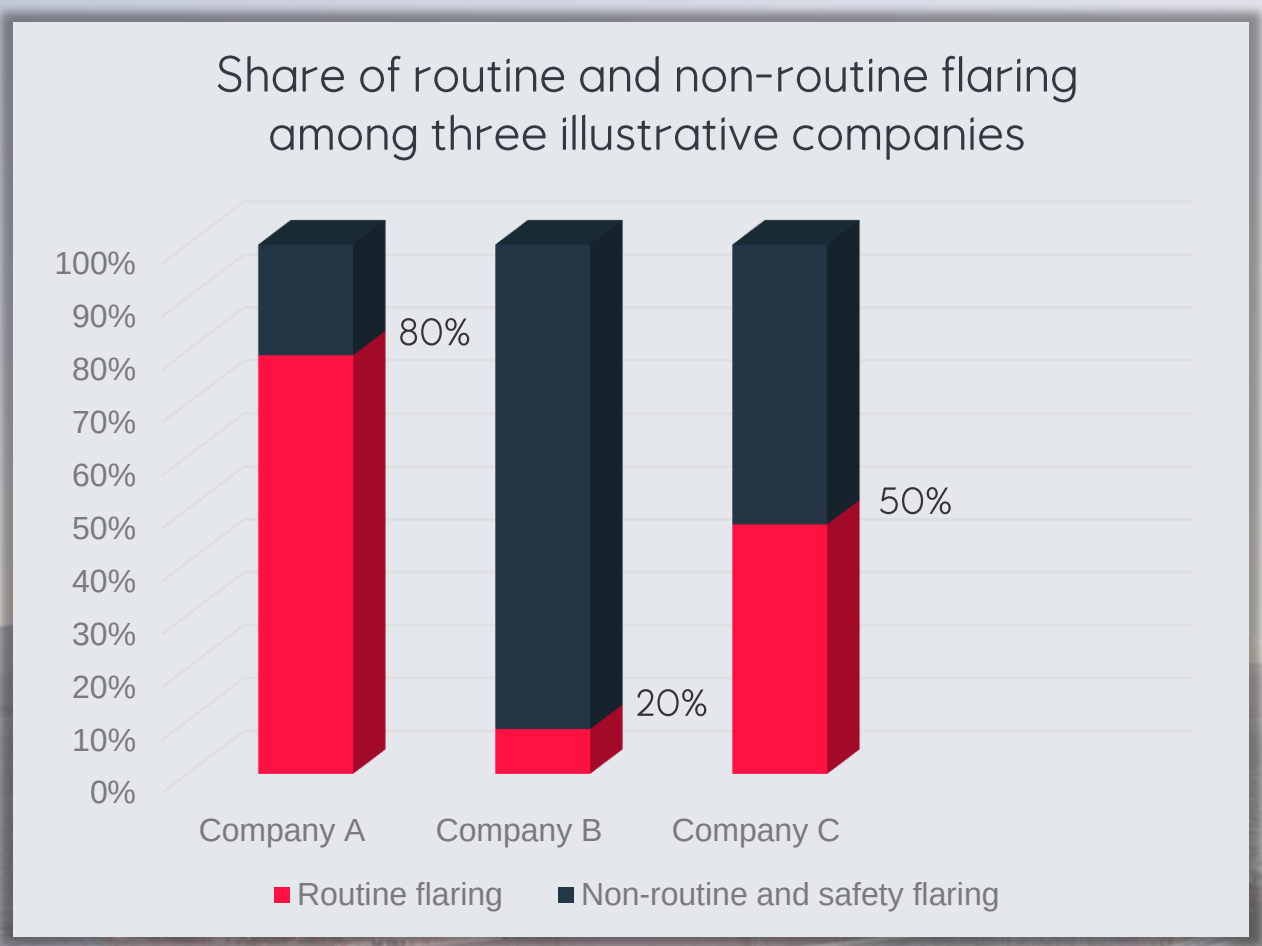
Not all gas sent to flare will be combusted to CO_2.

The **Norwegian environmental agency** recommends **3.3 g/Sm^3** as the efficiency factor for offshore flares. Since these flares have a relatively homogenous flare gas composition, a factor can be applied across assets. Operators are also allowed to use an alternative method, based on online flare rate measurements.

Comparison of emission factors used by other countries and organisations

Source	Component	g/Sm^3
EPA AP42	VOC in methane equivalents	2.6
Concawe	Methane	2.7
Norwegian regulator	Methane	3.3

Different interpretations of what is routine and safety flaring

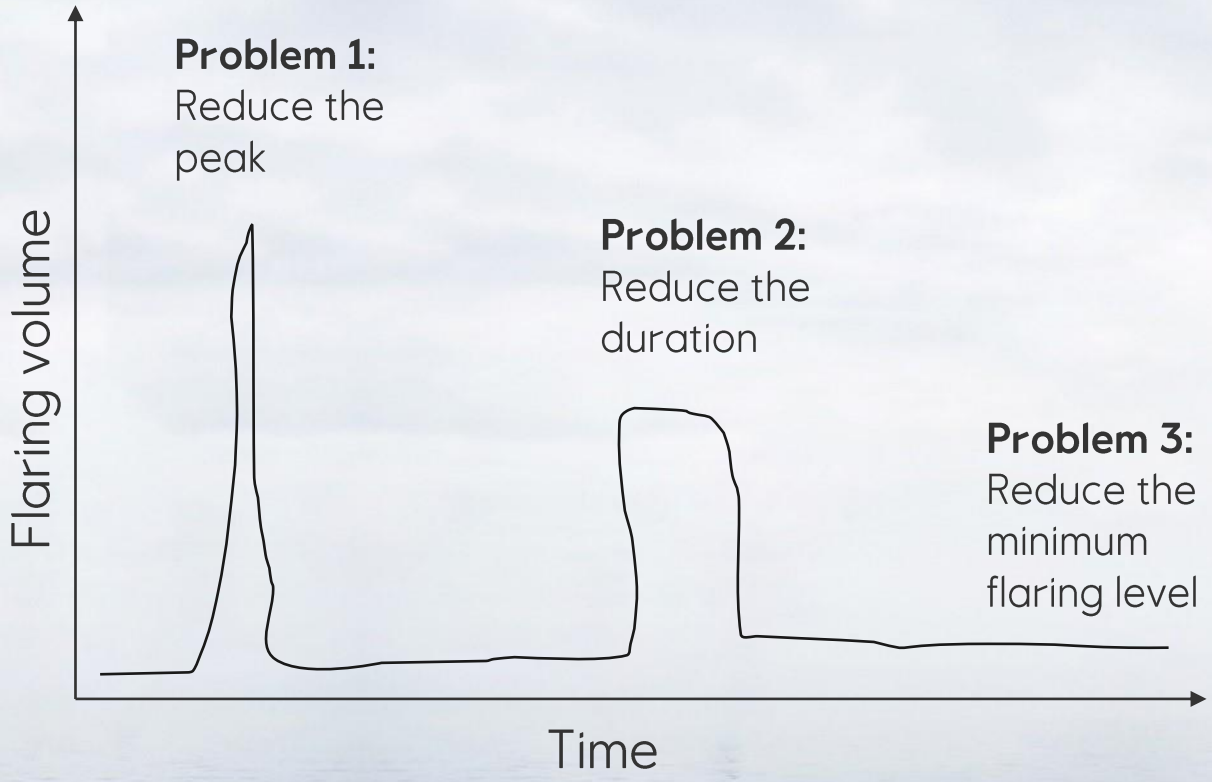


Routine flaring is only *half* of the problem!

Avoid derailing the improvement agenda by spending time on flare categories.

Focus should be on **reducing total flaring**!

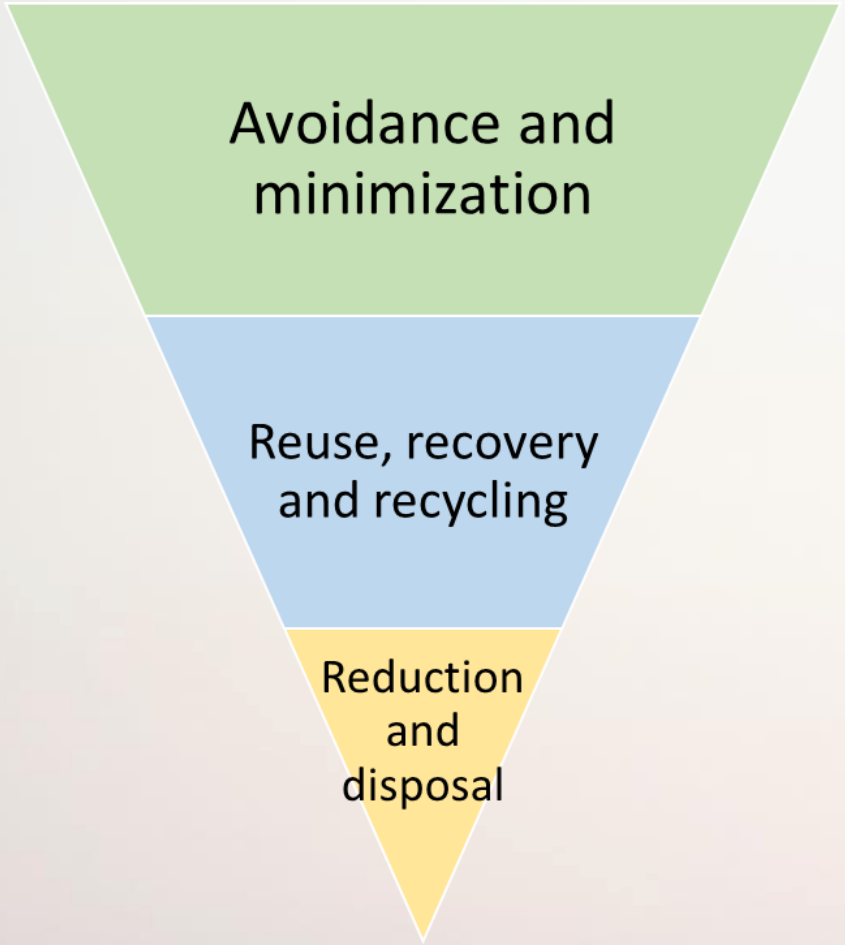
Problems to solve



Flaring is burning money. Just don't do it!

1. Shut-down production from high gas/oil ratio wells, based on prior mapping.
2. Within max 2 hours evaluate production reduction. Spare part philosophy.
3. Challenge the pilot flare tip vendor on gas use. Identify the root causes of the flaring.

Utilizing the waste hierarchy to reduce flaring and methane emissions



Premises set by Norwegian regulators
- Natural gas must be handled
- Ban on routine flaring and venting since 1971
- Carbon tax on combusted and uncombusted natural gas

Design and technology
- Reuse of natural gas at installation
- Closed flare with automatic ignition
- Pilot flares with N_2 purge
- Optimize the flare tip to production level
- Value chain optimizations

Reduction targets and max. flaring quota per installation
- Flaring is monitored in tonnes CO_2 and in USD loss
- Flare scenarios mapped per asset
- Benchmarking of assets in PowerBI

Flare – emissions reductions check list

1. **Identification of all sources**
2. **Visualization of flow rates**
3. **Recalculate from Sm^3 to money**

4. **Reduce flow from each individual gas source**:
   - Maintain high rates for gas export and/or gas injection
   - Pressure relief to process rather than to flare
   - Shut down high GOR wells quickly when problems occur
   - Plan well intervention for minimum flaring
   - Change from natural gas to N_2 where possible (blanket and purge gas etc.)
   - Lower rates to pilot flame
   - High production effectiveness => low flaring
   - Use real-time dashboards to highlight incidents of flaring
   - Do lessons learned and improve procedures based on incidents

5. **Daily focus on flare rates**

Will a flaring target reduce the production?

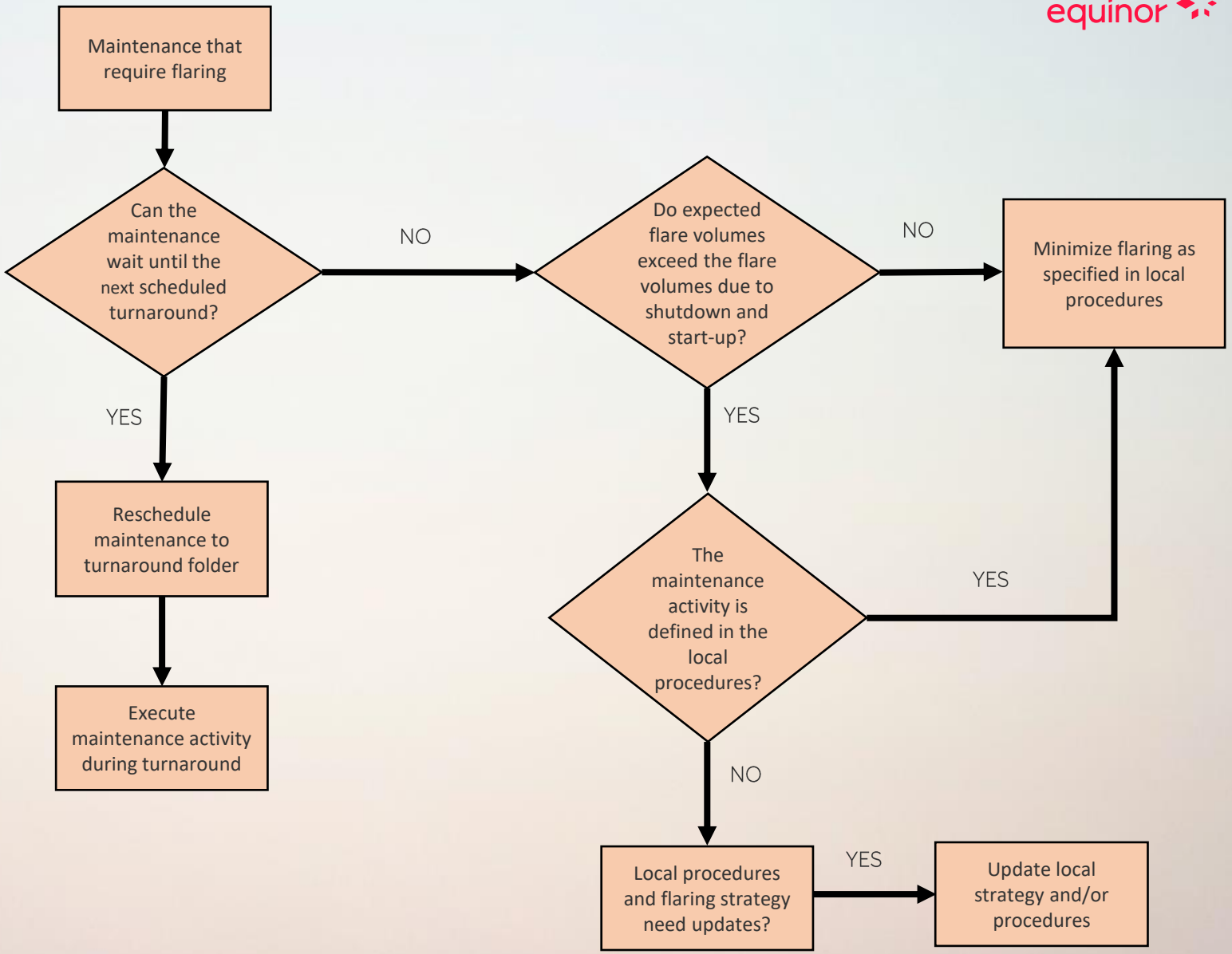
Factors that affect production:
- Regularity
- Robustness
- Planning

Factors that affect flaring:
- Regularity
- Robustness
- Planning
- Flaring and Compliance Strategy (Culture)

Establishing a target on flaring will not reduce production directly. However, it will indirectly contribute to solving integrity issues and increase the production efficiency!

Higher production efficiency will lead to an increase of production and cashflow.

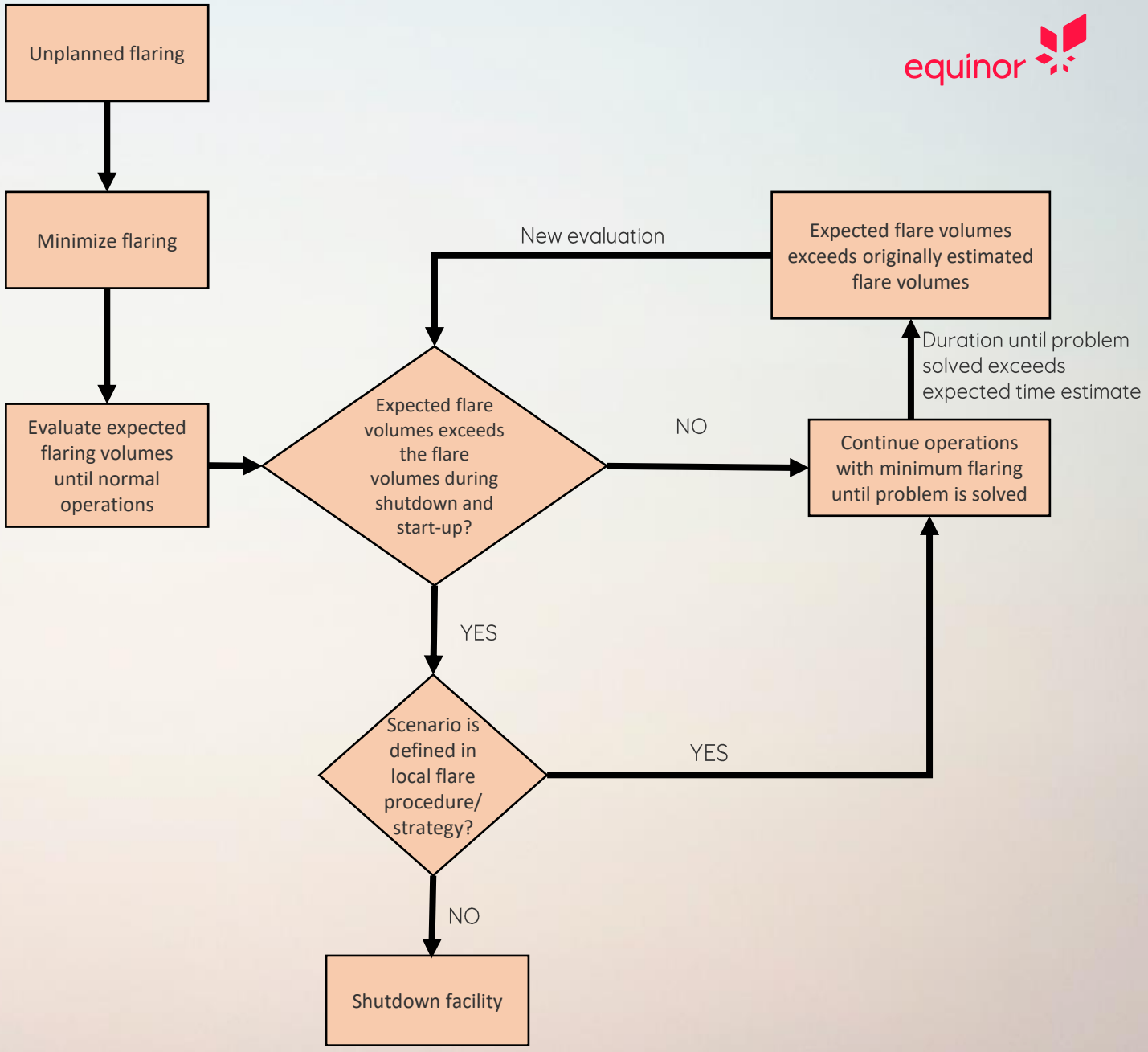
Flaring strategy for planned flaring



Examples of flaring:

* Compressor maintenance
* Planned shut-down or start-up

Flaring strategy for unplanned flaring



Examples of flaring:

- Compressor failure
- Emergency / trip

Flare evaluation – creates awareness and engagement

Target and normal flaring

- Set visible and clear targets
- Measure all flaring and show results to everyone
- Understand your «normal» flaring

Further reductions

- Evaluate start up and shut down procedures
  - Understand what is normal volumes during start up, how can this be reduced?
- Log all flare incidents
- Find the reoccurring ones and look for measures

Evaluate

- Was it useful?
- What should have been different?

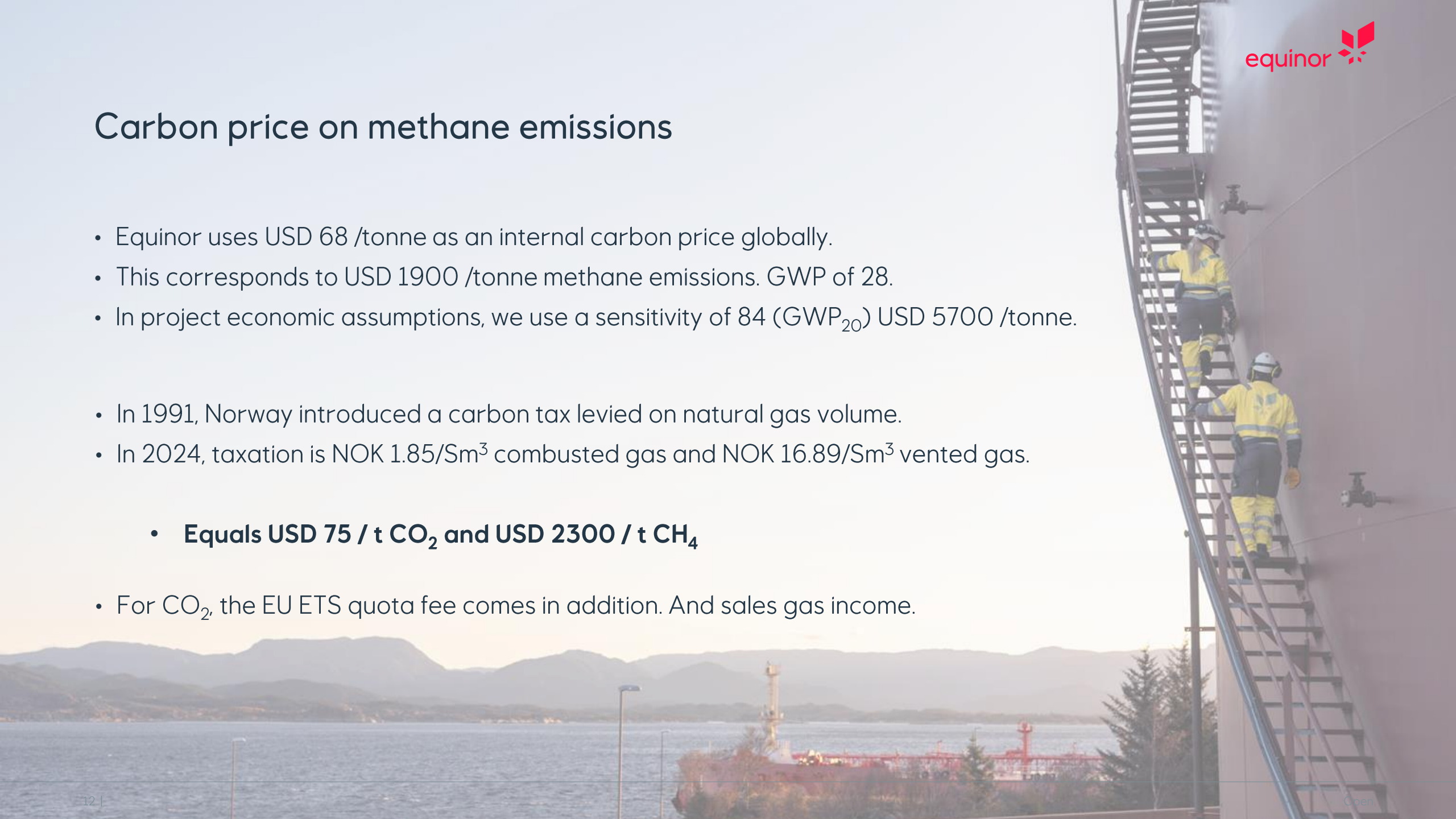
- When an idea is implemented, say Fantastic – what more can we do?

Not - Why didn't we do it before?

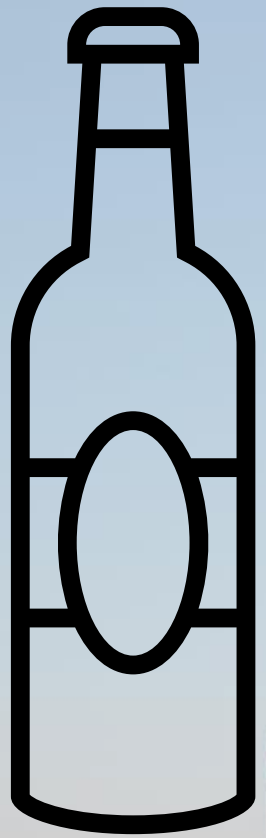
Carbon price on methane emissions

- Equinor uses USD 68 /tonne as an internal carbon price globally.
- This corresponds to USD 1900 /tonne methane emissions. GWP of 28.
- In project economic assumptions, we use a sensitivity of 84 (GWP_{20}) USD 5700 /tonne.

- In 1991, Norway introduced a carbon tax levied on natural gas volume.
- In 2024, taxation is NOK 1.85/Sm^3 combusted gas and NOK 16.89/Sm^3 vented gas.
    - **Equals USD 75 / t CO_2 and USD 2300 / t CH_4**
- For CO_2, the EU ETS quota fee comes in addition. And sales gas income.



The bottleneck of implementing mitigation measures: Prioritization matrix



Mission: To mitigate 100 CH_4 t/y

All measures are rated according to pre-defined criteria. These can be safety, environmental impact, technical integrity, production loss/gain, cost etc.

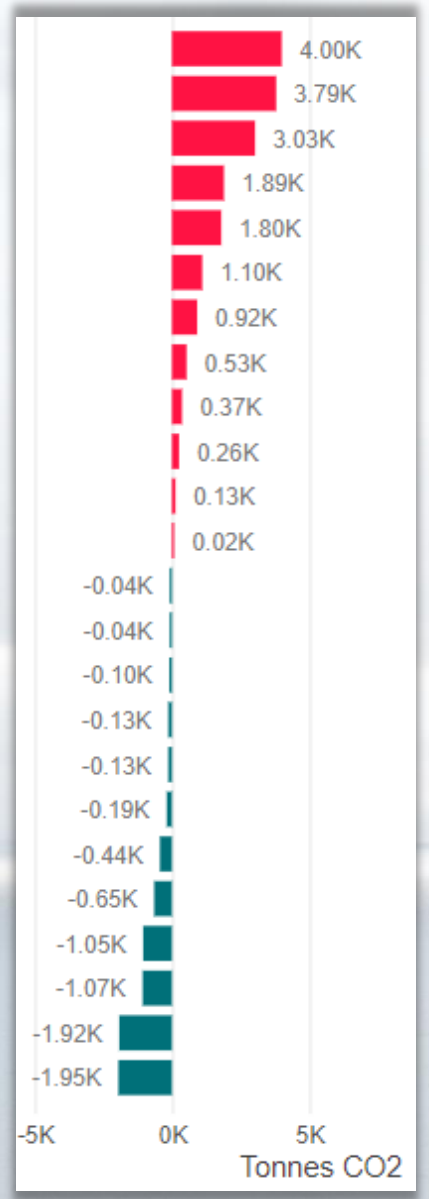
A methane mitigation measure will be scored both on environmental and cost impacts, and by this it increases the probability of being implemented.

	Very unlikely (<1% per year)	Unlikely (1-5% per year)	Less Likely (5-25% per year)	Likely (25-50% per year)	Very Likely (>50% per year)
	More than 100 years between events	20-100 years between events	4-20 years between events	1,5-4 years between events	Less than 1,5 years between events
Negligable	0	1	3	6	7
Minor	2	4	8	10	12
Moderate	5	9	11	15	17
Serious	13	14	16	20	22
Severe	18	19	21	23	24

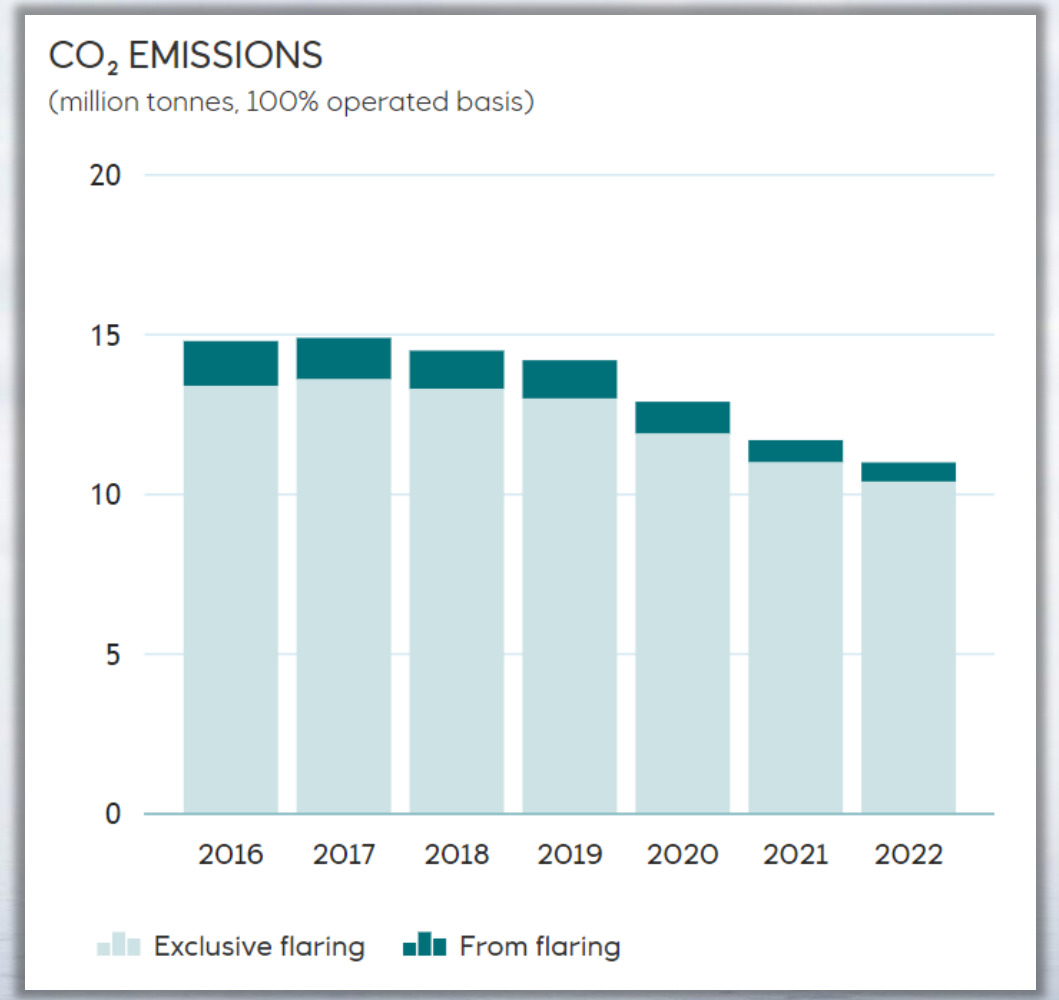
Benchmarking assets on their flaring performance

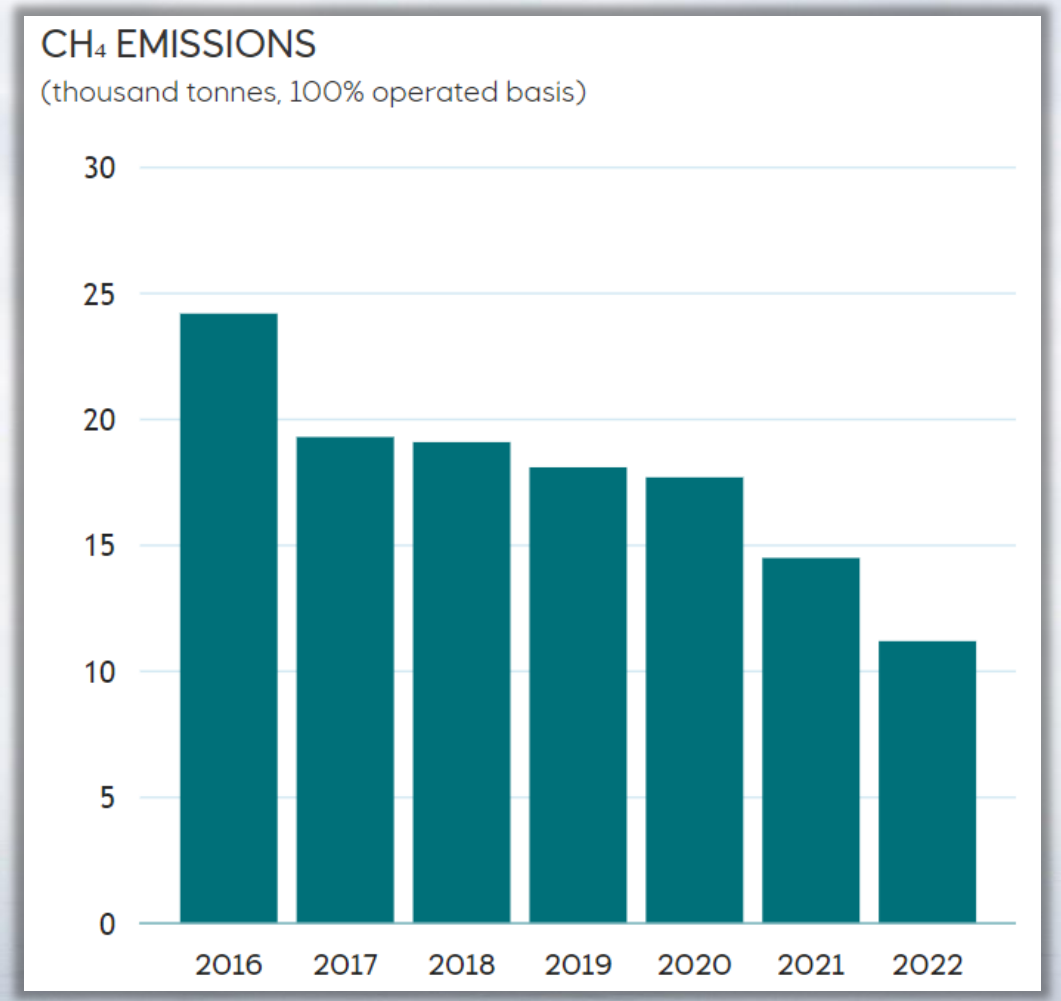
- **Priority number 1:** Set bold ambitions for the coming years
  - Include all assets and use total flaring.
  - The asset's monthly performance is compared with its target.

- **Make the benchmark available for all employees**
  - In absolute tonnes and % deviation of the asset's target.
  - Senior management to challenge poor performers to reach out to the best performers.



Flaring and methane emissions decline. Production level constant





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