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VENTING AND FLARING

ON MID AND DOWNSTREAM GAS INFRASTRUCTURES

TECHNICAL RECOMMENDATIONS BASED ON BEST PRACTICES APPLIED BY EUROPEAN GAS OPERATORS

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ABOUT MARCOGAZ

Founded in 1968, MARCOGAZ represents 29 member organisations from 20 countries. Its mission encompasses monitoring and policy advisory activities related to the European technical regulation, standardisation and certification with respect to safety and integrity of gas systems and equipment, rational use of energy as well as environment, health and safety issues. It is registered in Brussels under number BE0877 785 464.

DISCLAIMER

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1 Executive Summary

On October 14th, 2020, in the context of the European Green Deal, the European Commission released a communication on the EU strategy to reduce methane emissions – COM (2020) 663 final.

Regarding this strategy, the Commission will consider new legislation on routine venting and flaring in the coming months.

MARCOGAZ recognises the importance of environmental protection and the need to minimise the emission of CO_2 and methane especially. MARCOGAZ, together with representatives of the entire gas chain, are committed to building a culture towards net zero methane emissions. Reduction and wherever possible elimination of venting and flaring contributes to that aim.

The present document developed by MARCOGAZ presents the experience and current practices of the midstream and downstream gas industry in Europe. The definitions related to venting and flaring and especially for routine have to be reconsidered for the mid/downstream sector.

GIE and MARCOGAZ prepared a questionnaire that was submitted to TSOs (Transmission System Operators), DSOs (Distribution System Operators), operators of UGSs (Underground Gas Storages) and LNG Terminals within MARCOGAZ, GIE and ENTSOG (European Network of Transmission System Operators for Gas).

With this questionnaire information about the **best available techniques** (BATs) and mitigation measures implemented, current policies, costs and feasibility of methane emission reduction was collected. The answers gathered represent 17 TSOs, 14 DSOs, 10 UGSs operators and 10 LNG Terminal operators[1]. These companies operate in 16 countries. This document leverages the answers received during the survey, which happened in February and March 2021.

The main findings and conclusions from this document are the following:

1. In the mid and downstream sector, **there is no reason to vent or flare to balance production and demand**. None of the gas in mid and downstream infrastructures has to be vented or flared because it cannot be dispatched to the market.

2. **Safety and security of supply** are of highest importance and **should not be jeopardized** by restrictive legislation.

3. Routine venting and flaring are not entirely avoidable, neither is non-routine venting & flaring entirely unavoidable. **Each type of venting and flaring (routine, safety, and non-routine) is subject to specific conditions that are to be considered**.

   An important aspect of the definitions of MARCOGAZ is the notion of proportionality criteria as it is essential to distinguish operations which could lead to a reduction of emissions at a reasonable cost and operations requiring a heavy investment for small volumes of methane avoided. Therefore, the **proposal** is to **introduce proportionality criteria**, allowing to consider **small amounts of venting and flaring as non-material.** The proportionality criteria definition is a complex task that cannot be covered in this preliminary document.

[1] More detail is provided in the appendix.

4. Most of the vented emissions in mid/downstream are related to operational activities as well as to incidents (e.g. emergency stop vents, third party damage related leaks). Methane emissions from incomplete combustion (i.e. flaring) are a negligible part of methane emissions from the mid/downstream gas industry.

   Operational emissions provide the largest opportunity for emission reduction; however, these reductions can only be realized **under suitable technical and economical/regulatory conditions**.

   The industry puts maximum efforts into avoiding incidents. The related emissions are often due to vents to avoid further impacts on safety and cannot be avoided. As incident mitigation is already covered by regulation for safety purposes, it should not be included in methane emission potential legislation, apart from reporting obligations.

5. The **implementation of best available techniques** (BATs) requires certain conditions (technical maturity, cost effectiveness and costs recognised by National Regulatory Authorities, etc).

   Many of these BATs require significant investments and are not easy and/or quick to implement. Some BATs are specifically identified as **quick wins**[2].

   Some BATs are commonly used to mitigate different types of emissions (e. g. mobile compressors, pressure reduction, recover & re-use…). As they are universally used, operators should look at those first as they appear to be **the most effective.**

6. Because of the large variety in scale and type of components, activities, continuous technical developments, and the different degree of maturity of the mid and downstream companies in methane emissions mitigation and management, **it is recommended to ensure that industry has flexibility in term of choice and scope of mitigation measures**.

7. The **current mitigation techniques and best practices should be better leveraged across the European infrastructure operators to be more broadly applied**. Future legislation should be targeting this goal.

8. The potential **legislation** about venting and flaring **should stimulate further emissions reduction while considering proportionality, the investments and providing reasonable timeframes** to allow the industry to implement the necessary measures.

   The survey shows that 80% of the respondents already perform venting reduction for environmental reasons on a voluntary basis, based on a few BATs, despite the lack of clear legislative framework. In order to get more commitments of operators, **it is recommended that future legislations provide clear incentives for the development and implementation of mitigation techniques**, low emission oriented operational procedures and quantification methodologies.

[2] See chapter 7

Operational costs and investments should be recognized by National Regulatory Authorities and their recovery should be allowed.

9. Flared gas volumes in the mid and downstream sector are very small and close to negligible. Flaring when used, is mostly for safety or environmental reasons. **It is recommended that potential legislation on methane emissions covering the gas mid/downstream sector focuses on venting, but not on flaring.**

2 Introduction

This report explores and summarizes the current practices on venting and flaring carried out by the European mid and down gas industry. It aims to share knowledge on the identified ’quick wins’ of mitigation measures that allow a higher emission reduction at a lower cost. In addition, this report includes an analysis of the opportunities and constraints faced by the midstream and downstream European gas industry in reducing methane emissions from venting and flaring.

This document is based on a survey sent out to the members of MARCOGAZ – GIE – ENTSOG, covering a large part of the European mid and downstream sector.

This report can be used by the European commission to figure out the attention points to be considered for a future legislation on methane emissions.

2.1 About MARCOGAZ

MARCOGAZ’s chief mission is to serve its members as the European window for any technical issue regarding natural gas.

In this context, although emissions are very low already, proper reporting and further reduction of methane emission is a top priority within MARCOGAZ.

As the Technical Association of the European Gas Industry, it aims at monitoring and taking influence when needed on European technical regulation, standardisation, and certification with respect to safety and integrity of gas systems and equipment, and rational use of energy. Furthermore, environment, health & safety issues related to gas systems and utilisation are also of great importance for MARCOGAZ.

MARCOGAZ represents 29 members in 20 countries.

2.2 Main purpose of the document

This document presents current practices, as well as challenges and key elements on reducing methane emissions from venting and flaring in the European midstream gas industry (TSO, UGS, LNG Terminal) as well as the downstream industry (DSO). Fugitive emissions are not in the scope of this report.

It is clear that mid/downstream industry do not face the same kind of emissions from venting and flaring as the upstream industry. By the nature of operations, differences exist and hence lead to differences in the way of treating the subject.

One difference emerges when it comes to the upstream definition of “routine flaring” used by the World Bank:

“Routine flaring of gas at oil production facilities is flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to re-inject the produced gas, utilize it on-site, or dispatch it to a market.

Routine flaring does not include safety flaring, even when continuous. "

MARCOGAZ would like to point out that extending this definition to mid and downstream, leads to the ascertainment that in the mid and downstream sector, routine venting and flaring is not applied: none of the gas in mid/downstream infrastructures has to be vented or flared to balance production and demand**.** As the routine venting / flaring definition must be adapted to the mid/downstream sector, the approach chosen in this report is different.

The objective of this report is to identify which venting and flaring methane emissions are avoidable and which are unavoidable in the mid/downstream European sector and furthermore, when avoidable, to what extent and at which conditions.

2.3 European context

On October 14th, 2020, in the context of the European Green Deal, the European Commission released a communication on the EU strategy to reduce methane emissions – COM (2020) 663 final.

Regarding this strategy, the Commission will consider proposing new legislation on the matters of routine venting and flaring in the coming months.

The present document is a proposal which considers the experience and current practices of the midstream and downstream gas industry in Europe.

To gather information about the best available techniques and mitigation measures implemented, current policies, costs and feasibility of methane emission reduction a questionnaire was submitted to different TSOs, DSOs and operators of UGSs & LNG Terminals within GIE, MARCOGAZ and ENTSOG. The answers gathered represent 17 TSOs, 14 DSOs, 10 UGSs operators and 6 LNG Terminal operators[3]. These companies operate in 16 countries. This document leverages the answers received during the survey, which happened in February and March 2021.

2.4 Structure of this report

To identify the relevant activities where venting and flaring occur and in order to reduce methane emissions and participate in the common climate goals set by the European Union the report is organised as follows.

First, it details five key definitions. More specifically the aim is to define what is understood by "routine venting/flaring" and what is falling under the scope of safety and non-routine venting and flaring[4].

Secondly, the report will bring forward which of venting or flaring is avoidable or unavoidable[5] , which best available technique could apply to reduce these emissions and how effective they are. The result

[3] More detail is provided in the appendix.
[4] See chapter 3
[5] See chapter 5.2

of this analysis will put under the spotlight the "quick wins" allowing emission reduction in the short term and at reasonable cost[6].

Finally, the report will point out some key issues to be considered when drafting a legislation on methane emissions, meaning:

- Materiality (volume of emissions that have to be considered as significant)
- Technical and safety constraints
- Security of supply

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[6] See chapter 7

3 Definitions

In order to draw a precise scope of possible reductions in methane emissions some definitions are discussed in this chapter.

The five most relevant definitions[7] to this goal are:

- Vented emissions
- Flaring
- Routine venting/flaring
- Safety venting/flaring
- Non-routine venting/flaring

The purpose is to underline the nuances to add and the differences the industry has with the initial definitions proposed by the Commission in the "EU strategy to reduce methane emissions"[8].

Furthermore, this report aims to explain that these definitions do not correspond one to one with "avoidable" and "unavoidable".

Indeed, some routine emissions may be not avoidable under certain technical and economic conditions, and some non-routine emissions may become avoidable under given conditions.

3.1 Venting and vented emissions

In the Methane Strategy the Commission proposed the following definition:

Venting is the controlled release of unburned gases directly into the atmosphere.

The definition is applicable, but generally speaking the consequences of using this definition in a legislation could lead to disproportional requirements, for example when considering venting for limited duration and limited volumes.

- The elimination of some limited emissions demands additional costs and techniques which are hard to justify considering the avoided volumes. For example, when DSOs change house gas meters, they need to release small volumes for a short period of time. This is one example among others, but the issue can occur also in other situations. Therefore, legislation which would oblige DSOs to recover these volumes would strongly increase costs and result in a loss of productivity and very low environmental benefit. Meaning, that the total costs for society incurred by the methane emitted, will be (much) lower than the costs to be made to prevent or recover them. This would make prevention or recovery unjustifiable to society. To resolve this issue MARCOGAZ proposes to introduce a key notion essential to be integrated in the potential EU legislation to regulate methane emissions, the notion of "proportionality criteria***"***. It is to be considered that either small volumes and/or limited venting time should be exempted from the legislation to come

[7] For further definition please see the MARCOGAZ - GIE - IOGP - IPIECA Glossary
[8] https://ec.europa.eu/energy/sites/ener/files/eu_methane_strategy.pdf

as being non-material below a given threshold. Defining the proportionality criteria is a complex task that cannot be covered in this preliminary document.

- A second remark is that vented emissions can be controlled **and** uncontrolled, therefore the term "controlled" can be removed as it brings unnecessary complexity into the definition. A typical example of uncontrolled venting are incidents caused by third party damages.

MARCOGAZ – GIE therefore proposes the following enhanced definition, for vented emissions in the midstream and downstream gas industry:

« Vented emissions - Gas released into the atmosphere intentionally from processes or activities/devices that are designed to do it, or unintentionally when equipment malfunctions or operations are not normal[9]. »

3.2 Flaring

In its strategy to reduce methane emissions the Commission proposed the following definition:

Flaring is the controlled burning of gases produced or released in association with fossil-fuel extraction and transportation; and certain agricultural and waste practices.

The main issue raised by the proposed definition is the implication that flaring concerns fossil fuels. In the view of MARCOGAZ, flaring has a broader scope. In general, all kinds of gases can be flared, not only fossil fuels. Furthermore, it is useful to stress that flaring is mainly done for safety reasons.

MARCOGAZ-GIE proposes the following enhanced definition for flaring in the gas industry.

« Flaring - Controlled burning of gases (for disposal) mainly for safety reasons[10]. »

In addition, one should consider that flaring is sometimes seen as a best available technique to avoid venting. However, it needs some specific conditions as for example in urban areas for safety and operational reasons. This is why MARCOGAZ would like to point out that it agrees with the following point of the EU strategy to reduce methane emissions:

"Venting is arguably more harmful to the environment as the released gas typically contains high-levels of CH_4, whereas flaring converts the CH_4 into less harmful CO_2. "

[9] Note In the case of transmission and distribution grids, unintentional vented emissions during not normal operation cover also vents due to external interference (third-party damage), ground movements, over pressure, etc. This definition is in line with the MARCOGAZ-GIE-IPIECA-IOGP Glossary. Accessible at: WG_ME-736

[10] This definition is in line with the definition in the MARCOGAZ-GIE-IPIECA-IOGP Glossary. Accessible at: WG_ME-736

Some situations may lead to flaring (instead of venting) because of difficulties in recovering/reusing gas. (e.g. not enough time or volume to recompress or reinject the gas quantities).

3.3 Routine venting/flaring

The EU strategy to reduce methane emissions states that "*the Commission will examine the options available in view of proposing legislation on eliminating routine venting and flaring in the energy sector".*

Based on the survey and in order to try to find a definition that makes sense for mid/downstream and is a logical extension to the principle applied by the World Bank for production facilities, MARCOGAZ – GIE proposes the following definition on **routine venting/flaring**.

« Routine venting/flaring – Operational release of gas carried out on a regular and/or periodic basis. Routine flaring does not include safety flaring, even when continuous. »

This definition implies that the following examples are considered as routine, they emphasize that routine is not by definition avoidable[11]:

- Emissions from technical devices such as gas driven pneumatic equipment.
- Residual gas emissions from analysers.
- Dry gas seals secondary stage vent.

Legislation on emissions should not assume that all routine emissions can be avoided.

3.4 Safety venting/flaring

Safety venting and flaring is rarely avoidable by definition, as safety of employees and third parties is of the highest importance for the gas industry. In line with this idea, the following definition for safety venting/flaring in the gas industry is proposed.

"Safety venting/flaring - Safety venting/flaring of gas is venting/flaring to ensure safe operations."

The following examples illustrate less obvious cases to be considered for safety reasons:

- Continuous pilot flames as they are part of safety flares to ensure quick ignition when required (concerns small volumes where complete combustion is assumed).
- Pneumatic controllers are generally considered as routine venting/flaring.

[11]See chapter 5 on avoidable – unavoidable definitions

- But vented gas from pneumatic valves operated for safety reasons (by definition rarely operated so rarely emitting) are considered as safety venting (in that case the gas pressure is the best way to insure a fast enough and safe operation).

3.5 Non-routine venting/flaring

To complete the last two definitions (routine and safety), a third one describes activities which do not fall into the two first definitions. This third definition concerns “Non-routine venting/flaring”.

MARCOGAZ proposes the following definition:

“Non-routine venting/flaring - Non-routine venting/flaring of gas is all venting/flaring other than routine and safety flaring.”

This can also be illustrated by examples bringing useful understanding to the scope of this definition:

- Temporary (partial) failure of equipment that handles the gas during normal operations, until its repair or replacement – as well as gas stemming from an incident – is non-routine venting/flaring.
- Depressurisation due to maintenance, repair activities and other interventions of the infrastructure is non-routine venting or flaring.
- Construction and de-commissioning activities are to be considered as non-routine as they occur on a non-regular basis.

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4 Security of Supply

Safety is paramount but security of supply is also essential.

To maintain security of supply venting is sometimes unavoidable. There are situations in which gas cannot not be re-routed via other gas pipe sections without jeopardising delivery of gas to the domestic market, industries, and export. Also, time constraints can be the reason for venting / flaring instead of other options like re-compression or buffering.

Security of supply may also depend on the emitting equipment. Pneumatic devices can be replaced with air driven or electrical components, or with low-bleed models, but sometimes this is not possible, because gas is the reliable way to ensure continuity of operation (e.g. the security of electricity supply is less than the security of supply of gas). For these reasons, it is not always possible or acceptable to replace emitting equipment by non-emitting equipment.

New legislation should not prohibit vented emissions in situations of security of supply.

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5 Emissions characteristics

5.1 Types of emissions

In addition to fugitive emissions, methane emissions can be categorized by types of emissions:

Types of emissions				
Vented				Incomplete combustion (flaring)
Operational emissions			Incidents	
Purging/venting for works, commissioning, and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		

Table 1 - Methane emissions by type

Two main types of emissions are concerned when considering venting and flaring: vents and incomplete combustion. In the European Gas Infrastructure context "Operational emissions" and "Incidents" are the main types. The third one, "Incomplete combustions" accounts for a very small proportion of methane emissions.

Operational emissions can be divided into three further categories:

- Purging/venting for works, commissioning, and de- commissioning
- Regular emissions of technical devices (e.g. pneumatic)
- Start & Stop

The table below details the emissions by type and asset: white cells indicate that emissions might occur for the given asset in the category of the given type.

This table focuses on venting and flaring emissions, as fugitive emissions are outside the scope of this report and only incomplete combustion emissions related to flaring are considered.

		Types of emissions				
		Vented				Incomplete combustion (flaring)
		Operational emissions			Incidents	
		Purging/venting for works, commissioning, and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Groups of assets	Main lines					
	Service lines					
	Connections (flanges, seals, joints)					
	Measurement devices					
	Valve stations					
	Pressure / Flow regulators					
	Safety valves					
	Combustion devices : Turbines, Engines, Boilers					
	Compressors & compressor seals					
	Flares for safety reasons					
	Flares (others)					

Table 2 - Framework to monitor emissions in mid/downstream gas industry
Note: White cells indicate that emissions might occur for the given asset in the category of the given emission type.

5.2 Avoidable and unavoidable emissions

Following the framework presented in *Table 2* above, the following sections will detail the reduction potential of each emission type crossed with the different assets.

According to the survey carried out by MARCOGAZ – GIE, two statuses of the potential reduction by type and by asset were identified.

- **Avoidable:** The gas emission can be avoided under certain conditions (e.g. costs/benefits, time and impact of asset unavailability, security of supply, safety, etc). However sometimes due to some technical constraints only a certain share of the emission can be avoided.
- **Unavoidable:** The reduction of emissions is not possible or leads to significant technical and economic challenges and/or technical solutions do not exist (yet).

In the detail per activity given in the next section, an important observation is **that routine and non-routine are not synonyms of avoidable and unavoidable emissions. Although there is a correlation,**

some routine emissions are unavoidable as well as there are non-routine emissions which are avoidable[12].

The section 7 of this report will go in further detail of the different mitigation techniques mentioned in this section.

5.3 Vented emissions

5.3.1 Purging/venting for works, commissioning, and de-commissioning

The emissions from purging and venting for works as well as commissioning and decommissioning are operations where improvement in emission reduction is often possible, however much is already done by the operators.

On the following assets emissions can be **avoidable** under specific circumstances:

- Main lines
- Valve stations
- Compressors & compressor seals

Techniques to mitigate these emissions are, among others, reducing pressure before venting, use of mobile compressors, stationary compressors, and flaring. Although these solutions exist, they induce significant costs and cannot be put in place systematically within the current framework of regulation and socially acceptable economic parameters.

Mitigation measures on service lines[13] require a disproportionate level of efforts, as these lines are low pressure, short length, and small diameter.

5.3.2 Regular emissions of technical devices

Emissions from technical devices are covering methane emitted by design from a device (e.g. dry gas seal, gas chromatograph, etc).

Regular emissions of technical devices can also be **avoidable** under specific circumstances.

- Occasionally, regular emissions from measurement devices can be reduced but difficult to eliminate[14]. The technology is often not yet commercially available. Furthermore, these solutions could be possible on the long term but difficult on a short-term basis.
- Mitigation techniques which can be used in the case of emissions from pressure and flow regulators consist of replacing pneumatic valves with electric valves, compressed air valves or low emitting devices. The replacement of these valves entails complex operations, they can

[12] See definitions in chapter 3
[13] See MARCOGAZ-GIE-IPIECA-IOGP Glossary
[14] Emissions from measurement devices (e.g. chromatographs) can be reduced, for instance, by adjusting the gas flow to the minimum volume specified by the manufacturer. However, although emission reduction is feasible, 100% avoidance (such as recovery of gas) is difficult to put in place, especially in remote areas.

only be done on the long term and require large investments and implementation periods affecting grid unavailability. Some technical constraints can make such mitigation techniques inapplicable.
- Mitigation of emissions from compressor seals also lead to major hurdles in cost and time, either in replacing wet seals by dry gas seals or by recovering and recompressing the emitted gas.

5.3.3 Starts & stops

Some start & stop emissions can also be **avoidable** under specific circumstances:

- The most common mitigation technique of emissions from start & stops from combustion devices is the replacement of the remaining gas starter motors by electric devices (only applicable for gas turbines).
- Starts & stops emissions from flares are **difficult to avoid**. A pilot flame may ensure a quick ignition of gas and limit emission during starting. Only more effective and innovative flaring devices can reduce the methane emissions in this operation.
- A depressurised stop of a compressor can have its emission recovered under specific circumstances by recompression.
- Gas turbine/engine/compressor purging at start is unavoidable and impossible to recover due to air gas mix.

5.3.4 Incidents

Incidents are by definition **unavoidable**. The industry is however working on minimizing the number of incidents, through different actions.

Few techniques exist and have a limited impact. The main BAT being a proper work permitting system for third parties in place.

5.4 Flare's incomplete combustion

The survey led to very few answers, hence it is not possible to categorise this type as avoidable or not with certainty. This is understandable as the associated emission volumes are negligible in mid/downstream gas activities in Europe.

According to MARCOGAZ's experience, incomplete combustion should be considered as unavoidable.

5.5 Volumes of emissions

MARCOGAZ – GIE conducted a survey which gave the following results in terms of venting and flaring methane emission related volumes.

The main conclusion is that operational emissions are by far the largest type of venting and flaring related emissions from midstream and downstream activities in Europe.

The emissions from incomplete combustion (i.e. flaring) represent very small volumes.

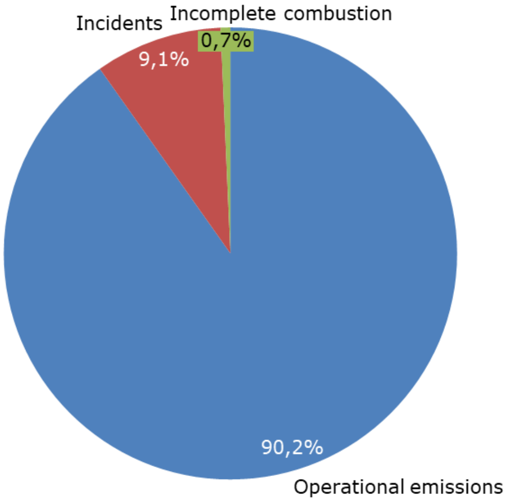

Figure 1 – Origin of venting and flaring emissions according to MARCOGAZ survey[15]

The figures from incomplete combustion do include emissions from gas engines in the UGS sector and not only from flaring. The share of emissions from gas engines was not available in the collected data but flaring is assumed to be only a small part of the total incomplete combustion emissions.

Following the survey, MARCOGAZ – GIE extrapolated the data. The method of extrapolation is a normalisation based on the kilometres of TSO and DSO lines, the number of terminals and UGS installations in the EU (based on EU28 figures).

[15] Note : Answers from the survey come from
- 15/17 TSOs answers
- 8/9 UGS operators' answers
- 5/6 LNG Terminals operators answers
- 4/5 answers representing 14 DSOs

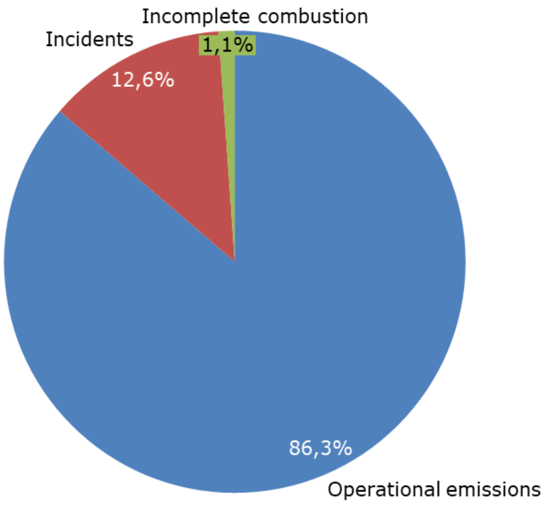

Figure 2 - Origin of venting and flaring emissions according to MARCOGAZ – extrapolated EU 28

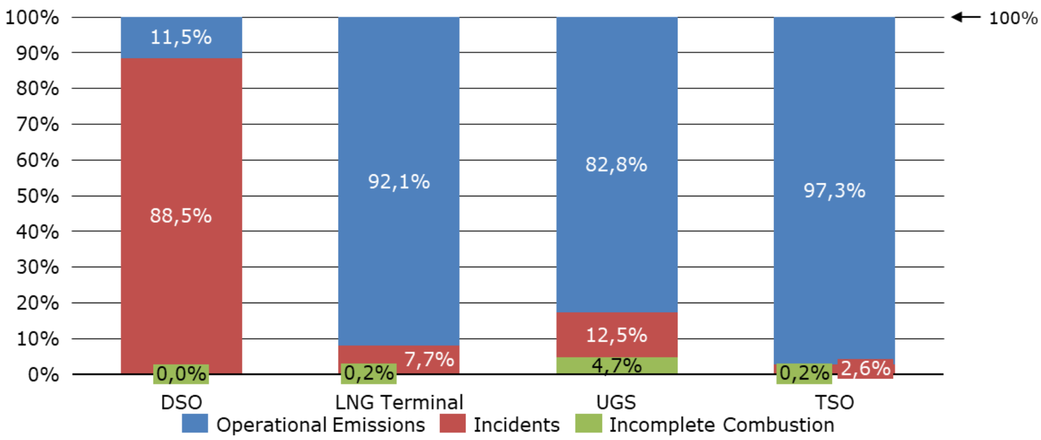

Figure 3 – Origin of venting and flaring emissions by activity according to MARCOGAZ survey[16]

This analysis shows that the biggest methane emissions come from operational emissions for midstream activities and from incidents in downstream activities.

The emissions from flaring incomplete combustion are negligible.

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[16] UGS's incomplete combustion include gas engines.

6 Quantification

As for the other types of emissions, as described in the MARCOGAZ Methane Emission Assessment Report[17], venting and flaring emissions can be quantified either by direct measurement, using of emission factors or engineering calculation[18].

Generally speaking, direct measurements should be considered first. However, it is important to highlight that depending on the type of vents:

- In a lot of cases, a calculation is particularly relevant (and may be more accurate than a measurement). Typically, when the pressure in and the volumes of the vented asset are known or when fixed flow rate is set (e.g. gas compressor stops, asset/pipeline depressurization for maintenance, third party damage, emission from measurement device sampling flow...).
- In some cases, the use of measurement-based emission factors together with proven engineering calculations can be the only feasible approach. For example, in case of pneumatic devices (extensive population of small emitters).
- In some cases, measurements are not possible because of unsafe situations.
- Direct measurements are impossible in case of emergency (i.e. incidents).

As flaring is negligible in the mid/downstream, it should only be quantified using generic emission factors in order to confirm that flaring is non-material.

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[17] https://www.marcogaz.org/publications-1/documents/

[18] OGMP 2.0 is currently developing Technical Guidance Documents which will contain detailed information on how to quantify the different types of methane emissions, as well as CEN under the TC234 WG14 through a specific technical specification.

7 Mitigation measures to reduce methane emissions

This chapter takes a closer look at the mitigation techniques and will detail their potential to avoid a given emission as well as their respective efficiency.

According to the discussion in the chapter 5.2 the following table shows where emissions seem avoidable and unavoidable according to the survey results. This does not mean that the emissions can be avoided or not as a rule, as mitigation possibilities can be subject to specific conditions[19].

For operational emissions, the survey shows that they are avoidable under conditions for the vast majority of the assets.

In most cases, incidents emissions are unavoidable, yet under rare conditions some mitigation may be possible. The main BAT being a proper work permitting system for third parties.

According to the MARCOGAZ experience, incomplete combustion from flare should be considered as unavoidable.

		Types of emissions				
		Vented				Incomplete combustion (flaring)
		Operational emissions			Incidents	
		Purging/venting for works, commissioning, and de- commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Groups of assets	Main lines					
	Service lines					
	Connections					
	Measurement devices					
	Valve stations					
	Pressure / Flow regulators					
	Safety valves					
	Combustion devices: Turbines, Engines, Boilers			[20]		
	Compressors & compressor seals					
	Flares for safety reasons					
	Flares (others)					

[19] See 5.2, avoidable/unavoidable definitions
[20] Only avoidable under specific conditions for gas turbines

Table 3 - Avoidability and unavoidability by asset and type and emission

7.1 Best practices / Technical recommendations

The respondents of the survey identified 32 BATs, some of these techniques are very similar and some were mentioned only once. This chapter will detail the 5 most cited ones as they represent the most common solutions to mitigate methane emissions. This gives a good indication of the techniques that are considered as the most effective.

These 5 “Best Available Techniques” are:

- Reduce pressure before venting (or before using a compressor to recover the gas).
- Recover and recompress emission in the grid/process gas: using a stationary compressor.
- Recover and recompress emission in the grid/process gas: using a mobile compressor.
- Recover and reuse emissions in another device (boiler…).
- Flaring as replacement of venting (to reduce the environmental impact).

The following paragraphs will detail the results of the MARCOGAZ survey.

7.1.1 Reduce pressure before venting (or before using a compressor)

Reduction of pressure to minimize venting impact is an often-used mitigation technique to avoid emissions, especially for assets which are purged/ vented for works or for commissioning and de-commissioning. The pressure reduction is achieved by using the gas consumption from the customers.

The efficiency of this technique is variable, according to the MARCOGAZ survey emissions could be reduced by roughly 40-50 % depending on the asset and emission type involved.

7.1.2 Recover and recompress emission in the grid/process gas: using a stationary compressor

This technique consists in recompressing the vents that would be at low/atmospheric pressure to re-inject them in the process gas. It can be done with auxiliary stationary compressors on sites as compressor stations, LNG terminals or gas storages.

Recovery and recompression of emissions can be applied on a range of vented operational emissions as far as the potentially saved volume is sufficient to justify it.

According to the MARCOGAZ survey, the efficiency of this technique varies with the kind of operation and asset it is applied to. On average 70% of emissions can be saved when this technique applies[21].

[21] See case study number 2 – MGP Reduction methane emissions best practice guide transmission, storage, LNG terminals and distribution: see case study number 2 – MGP Reduction methane emissions best practice guide transmission, storage, LNG terminals and distribution: https://methaneguidingprinciples.org/wp-content/uploads/2020/09/Reducing-Methane-Emissions-transmission-storage-LNG-terminals-and-distribution-Guide.pdf

7.1.3 Recover and recompress emission in the grid/process gas: using a mobile compressor

This technique consists in recompressing the vents to re-inject them in the process gas. In that case it is done with temporarily installed mobile compressors, when needed along the gas grid or on specific site, typically to recover the gas otherwise vented prior to maintenance or commissioning/ de-commissioning.

Recovery and recompression of gas instead of venting (purging/venting) from works, commissioning and de-commissioning can be applied as far as the potentially saved volume is sufficient to justify it and the timeslot is sufficient not to compromise security of supply.

Their efficiency to reduce emissions ranges, in most situations, from 70 to 90%. It is a valuable technique to be considered in the concerned situations.

However, one should consider that they represent investments of roughly 2 million euros per compressor plus operational expenditures.

Mobile compressors are already used by several TSOs in Europe. However, their substantial investment makes them sometimes difficult to justify[22].

7.1.4 Recover and reuse emissions in another device

This technique consists of capturing the vented volumes at low pressure to re-inject them in possibly available combustion devices used for site utilities or heating of building.

Recovery and reuse of emissions can be applied on a range of vented operational emissions as long as the potentially saved volume is sufficient to justify it.

Often this technique is also applicable where the recompression techniques[23] can be used. This technique should be preferred (compared to compression) when feasible as the gas will be reused and no compression energy is needed. It happens normally at lower pressure than recompression, but as for recompression, an infrastructure is needed to re-inject gas.

According to the MARCOGAZ survey, it can be less efficient than the previous techniques, averaging on a reduction of roughly 50% (depending on the recovered gas usage).

Example: In compressor stations the compressor seals vents (continuous) can be used for the boilers heating buildings or gas turbine fuel gas without any recompression.

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[22] See case study number 1 – MGP Reduction methane emissions best practice guide transmission, storage, LNG terminals and distribution: https://methaneguidingprinciples.org/wp-content/uploads/2020/09/Reducing-Methane-Emissions-transmission-storage-LNG-terminals-and-distribution-Guide.pdf .

[23] See 5.1.2

7.1.5 Flaring as replacement of venting (to reduce the environmental impact)

Flaring is a mitigation technique which can be applied instead of various venting activities when purging for maintenance, commissioning, and de-commissioning.

Flaring instead of venting reduces the climate impact by a factor 10 depending on the flare combustion efficiency. The efficiency of this mitigation measure varies with the operation and asset concerned.

When used, flaring is often the only alternative to venting.

When gas is recompressed prior to pipeline maintenance the recovery of the last bars of pressure in the pipeline is costly in energy and time. It is then most of the time preferable to flare the remaining gas using portable flare instead of venting it[24].

7.2 Further detail on BATs per emission type & Quick Wins

Based on the MARCOGAZ – GIE survey, this chapter presents for each avoidable combination of asset group and type of emission (green cells in table 3) the most used best available techniques. Only the BATs appearing more than once for each type of emission are shown. For a complete overview see the appendix 2.

For each available technique, an assessment is made whether it can be considered as a quick win under specific circumstances, or not.

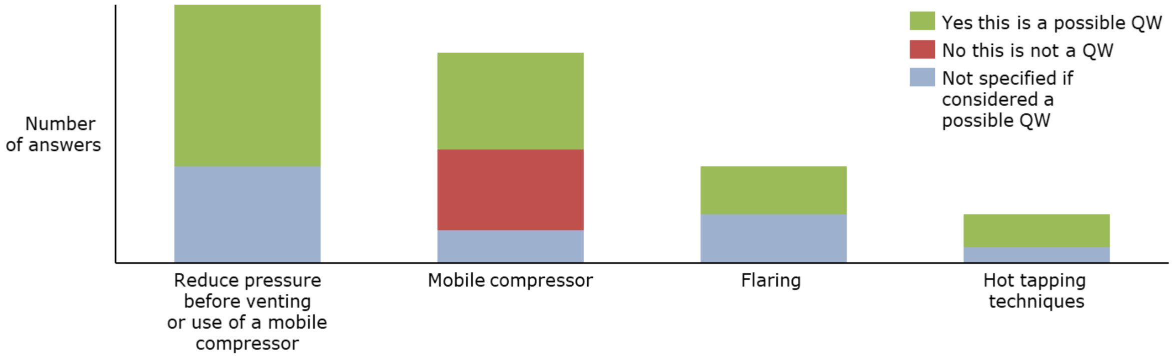
Many BATs are not considered as quick wins probably because they involve considerable investments and planning efforts (i.e. unavailability / security of supply).

[24] See case study number 1 – MGP Reduction methane emissions best practice guide transmission, storage, LNG terminals and distribution : https://methaneguidingprinciples.org/wp-content/uploads/2020/09/Reducing-Methane-Emissions-transmission-storage-LNG-terminals-and-distribution-Guide.pdf

7.2.1 Purging/venting for works, commissioning, and de- commissioning

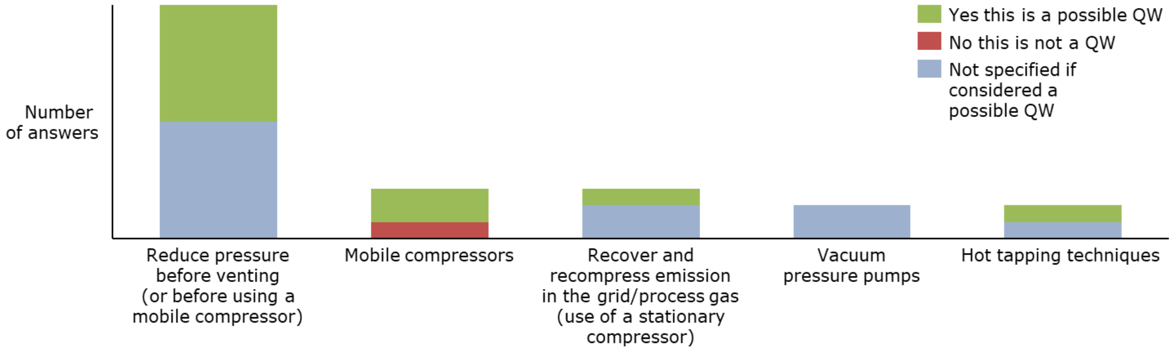
7.2.1.1 Main lines

Frequency of BATs cited and considered a possible Quick Win or not



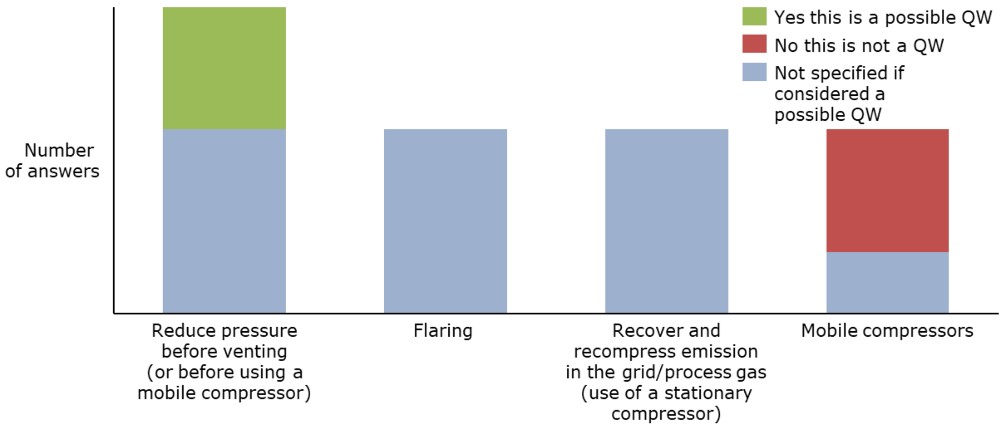
7.2.1.2 Service lines

Frequency of BATs cited and considered a possible Quick Win or not



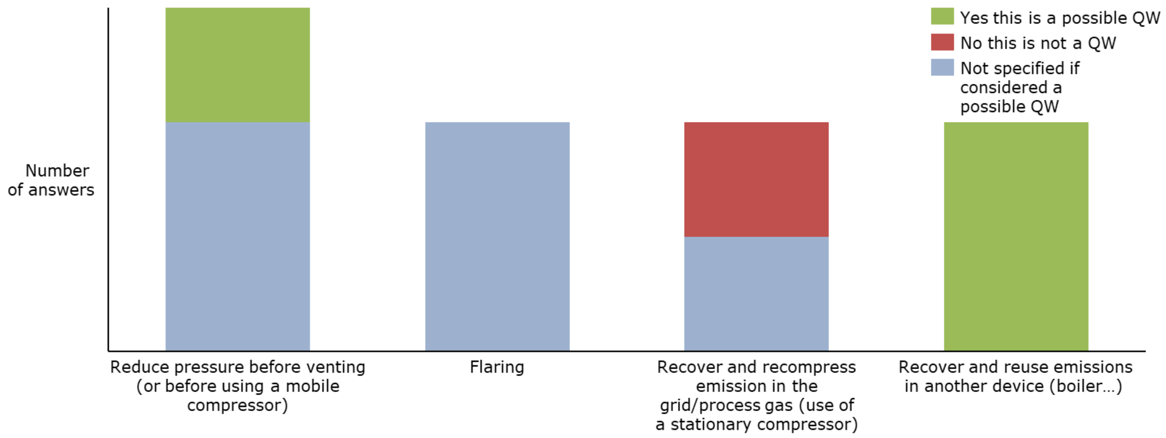
7.2.1.3 Valve stations

Frequency of BATs cited and considered a possible Quick Win or not



7.2.1.4 Combustion devices (turbines, engines, boilers)

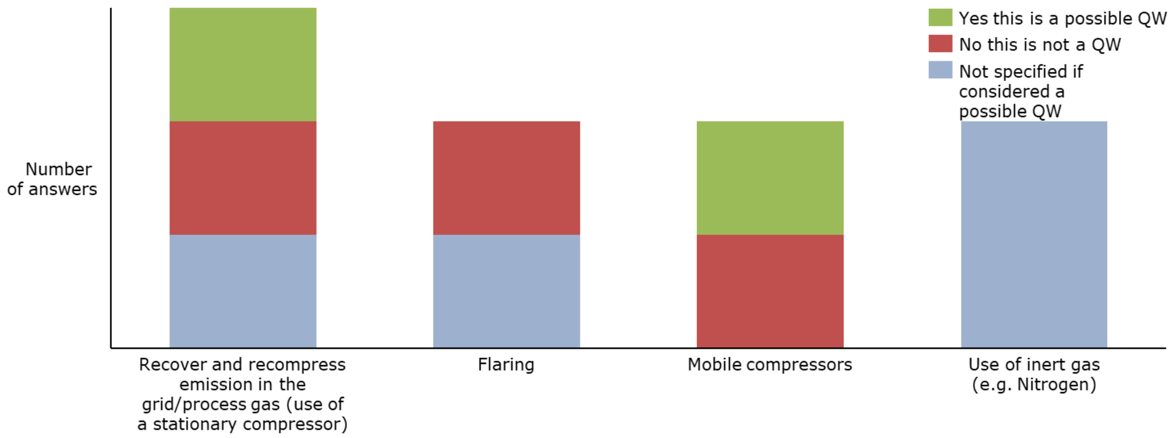
Frequency of BATs cited and considered a possible Quick Win or not



Disclaimer: The reported BATs here have been understood as applicable for compressor sets including the combustion devices and are not specific to the combustion devices itself.

7.2.1.5 Compressor & compressor seals

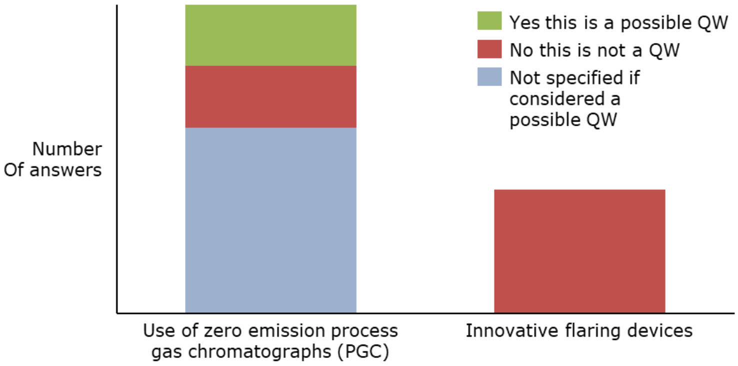
Frequency of BATs cited and considered a possible Quick Win or not



7.2.2 Regular emissions of technical devices (e.g. pneumatic)

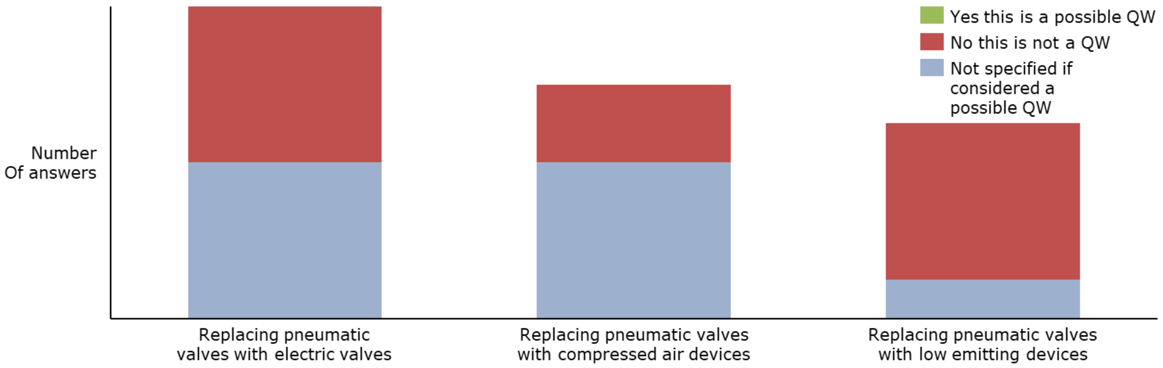
7.2.2.1 Measurement devices

Frequency of BATs cited and considered a possible Quick Win or not



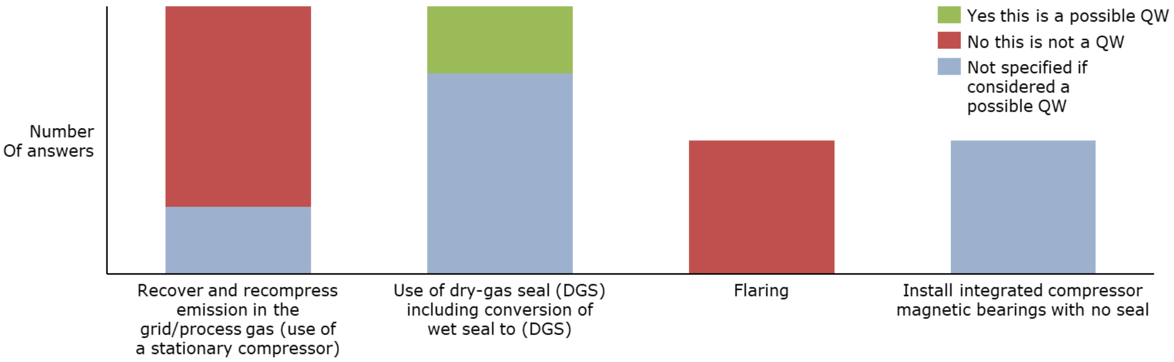
7.2.2.2 Pressure / flow regulators

Frequency of BATs cited and considered a possible Quick Win or not



7.2.2.3 Compressors & compressor seals

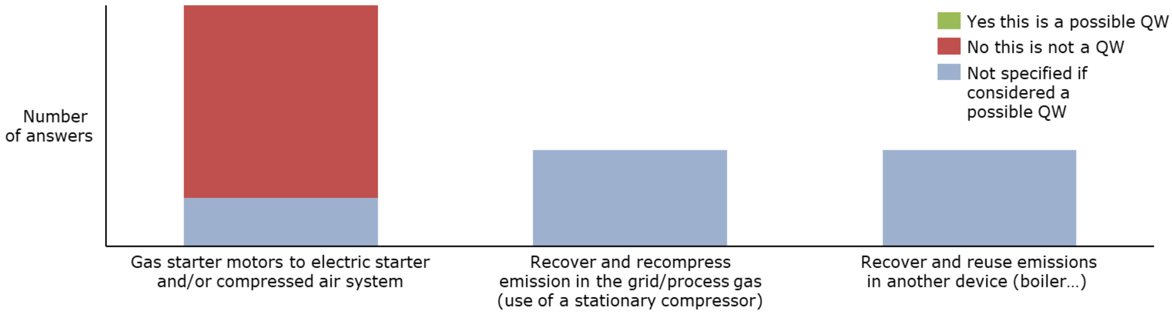
Frequency of BATs cited and considered a possible Quick Win or not



7.2.3 Start & Stop

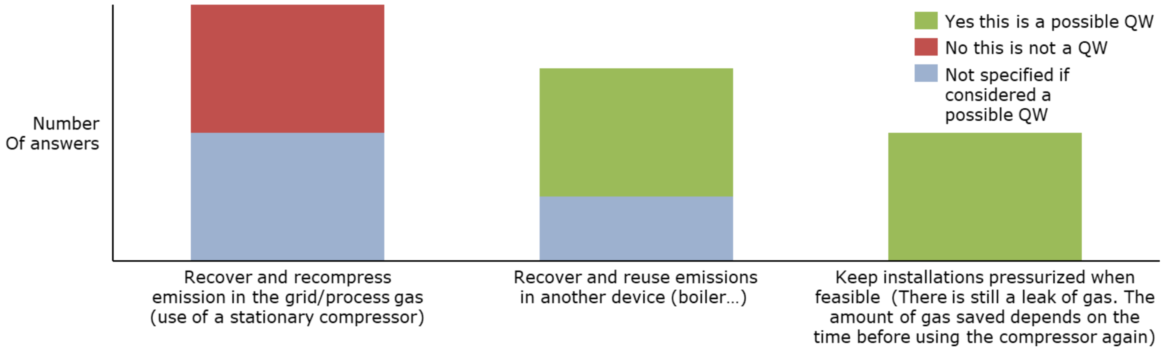
7.2.3.1 Combustion devices

Frequency of BATs cited and considered a possible Quick Win or not



7.2.3.2 Compressor & compressor seals

Frequency of BATs cited and considered a possible Quick Win or not



7.3 Conclusion

There is a vast variety of techniques. The respondents of the MARCOGAZ – GIE survey identified 32 techniques (some of which are very similar one to another) available to mitigate methane emissions. These BATs may be applicable on a case-by-case basis but not universally for each sector of the gas value chain.

Some BATs are used to mitigate different types of emissions (e. g. mobile compressors, pressure reduction, recover & re-use…). As they are the most commonly used, operators should look at those first as they appear to be the most effective.

Mobile compressors, pressure reduction, recover and re-use the gas in other devices and hot tapping … when applicable are, considered as quick wins (highly dependent on volume and pressure). Many other BATs are not considered as quick wins because they involve considerable investments and planning efforts (i.e. unavailability). For instance, the replacement of pneumatic valves by other types is not considered a quick win.

In some situations, flaring is the only reasonable solution to reduce venting climate impact. In such case the avoided volumes are quite low and as such the flaring will not be considered as a significant quick win. This illustrates how little flaring is impacting the mid/downstream methane emissions.

The efficiency from the BATs cannot be accurately extrapolated from the survey as it is extremely dependent on the situation.

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8 Costs and Legislation Conditions

Cost and efforts needed to reduce venting and flaring in the mid/downstream section (TSO/DSO) appear to be highly variable and circumstance dependent Also, there exists no uniform method and metric) for calculating the costs.

In the MARCOGAZ – GIE survey, answers concerning costs were given only by 9 companies (from 7 countries) and on few BATs. A large variation of costs was mentioned. They vary from a few ten thousand to several millions of euros per year. Even when harmonised to the size of companies, large differences remain per BAT or when expressed as an annual cost.

The reduction of venting and flaring is neither regulated nor incentivised in most European countries[25]. The MARCOGAZ – GIE survey found that almost 80% of respondents perform, voluntarily, venting and flaring emission reduction efforts for environmental purposes, systematically or on a regular basis. Companies are already putting effort in reducing methane emissions.

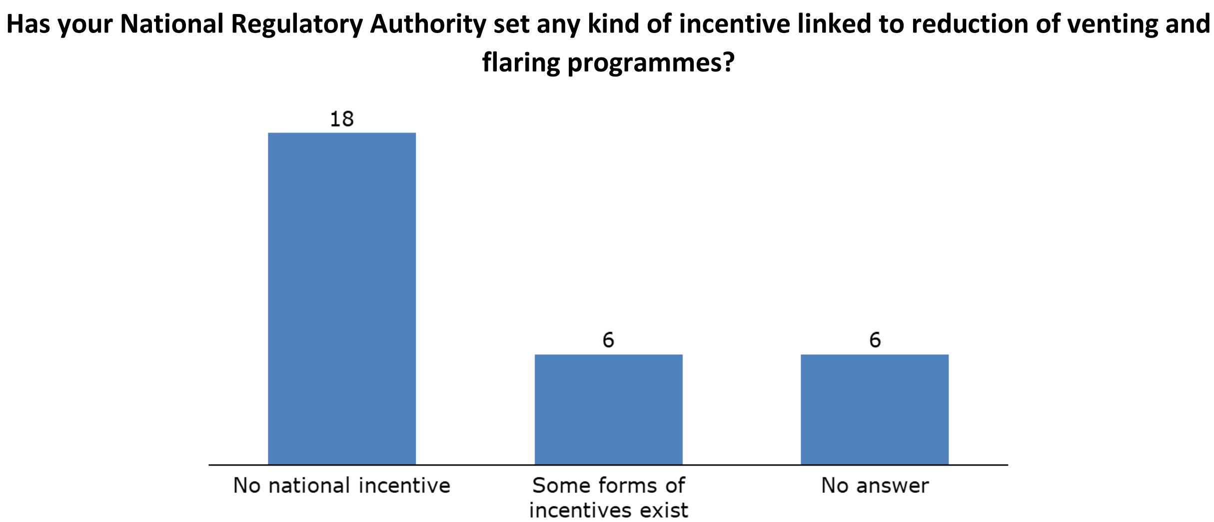

Figure 4 - Has your National Regulatory Authority set any kind of incentive linked to reduction of venting and flaring programmes? - MARCOGAZ - GIE Survey

National incentives from the regulator remain rather the exception.

Operational expenses to reduce methane emissions are implicitly included in the regulated asset base when companies are regulated (as part of the maintenance cost). Further mitigation techniques are often not applied because of the disproportional effort/investment they require in combination with the lack of incentives to do so. The future legislation has to make sure that all costs can be recognised in the regulated revenues.

[25]See figure 4

In order to avoid high costs for a too small gain in emission reduction, MARCOGAZ proposes that small amount of methane venting is exempted from legislation, considering their materiality (proportionality criteria to be considered).

It is difficult to derive an exhaustive list of these unavoidable small venting operations from the survey, but these include maintenance and repair of components of minor size and capacity, the commissioning of service lines, gas meter exchange, filter replacements, gas quality measurement, etc.

New legislation should not block the possibility to vent when safety or security of supply is compromised[26].

*

*   *

[26] *See chapter 4*

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9 Conclusions / Recommendations

The main findings and conclusions from this document are the following:

1. In the mid and downstream sector, **there is no reason to vent or flare to balance production and demand**. None of the gas in mid and downstream infrastructures has to be vented or flared because it cannot be dispatched to the market.

2. **Safety and security of supply** are of highest importance and **should not be jeopardized** by restrictive legislation.

3. Routine venting and flaring are not entirely avoidable, neither is non-routine venting & flaring entirely unavoidable. **Each type of venting and flaring (routine, safety, and non-routine) is subject to specific conditions that are to be considered**.

   An important aspect of the definitions of MARCOGAZ is the notion of proportionality criteria as it is essential to distinguish operations which could lead to a reduction of emissions at a reasonable cost and operations requiring a heavy investment for small volumes of methane avoided. Therefore, the **proposal** is to **introduce proportionality criteria**, allowing to consider **small amounts of venting and flaring as non-material.** The proportionality criteria definition is a complex task that cannot be covered in this preliminary document.

4. Most of the vented emissions in mid/downstream are related to operational activities as well as to incidents (e.g. emergency stop vents, third party damage related leaks). Methane emissions from incomplete combustion (i.e. flaring) are a negligible part of methane emissions from the mid/downstream gas industry.

   Operational emissions provide the largest opportunity for emission reduction; however, these reductions can only be realized **under suitable technical and economical/regulatory conditions**.

   The industry puts maximum efforts into avoiding incidents. The related emissions are often due to vents to avoid further impacts on safety and cannot be avoided. As incident mitigation is already covered by regulation for safety purposes, it should not be included in methane emission potential legislation, apart from reporting obligations.

5. The **implementation of best available techniques** (BATs) requires certain conditions (technical maturity, cost effectiveness and costs recognised by National Regulatory Authorities, etc).

   Many of these BATs require significant investments and are not easy and/or quick to implement. Some BATs are specifically identified as **quick wins**[27].

[27] See chapter 7

Some BATs are commonly used to mitigate different types of emissions (e. g. mobile compressors, pressure reduction, recover & re-use…). As they are universally used, operators should look at those first as they appear to be **the most effective.**

6. Because of the large variety in scale and type of components, activities, continuous technical developments, and the different degree of maturity of the mid and downstream companies in methane emissions mitigation and management, **it is recommended to ensure that industry has flexibility in term of choice and scope of mitigation measures**.

7. The **current mitigation techniques and best practices should be better leveraged across the European infrastructure operators to be more broadly applied**. Future legislation should be targeting this goal.

8. The potential **legislation** about venting and flaring **should stimulate further emissions reduction while considering proportionality, the investments and providing reasonable timeframes** to allow the industry to implement the necessary measures.

   The survey shows that 80% of the respondents already perform venting reduction for environmental reasons on a voluntary basis, based on a few BATs, despite the lack of clear legislative framework. In order to get more commitments of operators, **it is recommended that future legislations provide clear incentives for the development and implementation of mitigation techniques**, low emission oriented operational procedures and quantification methodologies.

   Operational costs and investments should be recognized by National Regulatory Authorities and their recovery should be allowed.

9. Flared gas volumes in the mid and downstream sector are very small and close to negligible. Flaring when used, is mostly for safety or environmental reasons**. It is recommended that potential legislation on methane emissions covering the gas mid/downstream sector focuses on venting, but not on flaring.**

10 Glossary

The MARCOGAZ – GIE – IOGP - IPIECA glossary is applicable to this document and available at the following address: MARCOGAZ – GIE – IOGP – IPIECA Glossary

11 List of acronyms

ACER: Agency for the Cooperation of Energy Regulators

BAT: Best Available Technique

CEER: Council of European Energy Regulators

DSO: Distribution System Operator

ENTSOG: European Network of Transmission System Operators for Gas

GIE: Gas Infrastructure Europe

LNG Terminal: Liquefied Natural Gas Terminal

NRA: National Regulatory Authority

TSO: Transmission System Operator

UGS: Underground Gas Storage

Appendix

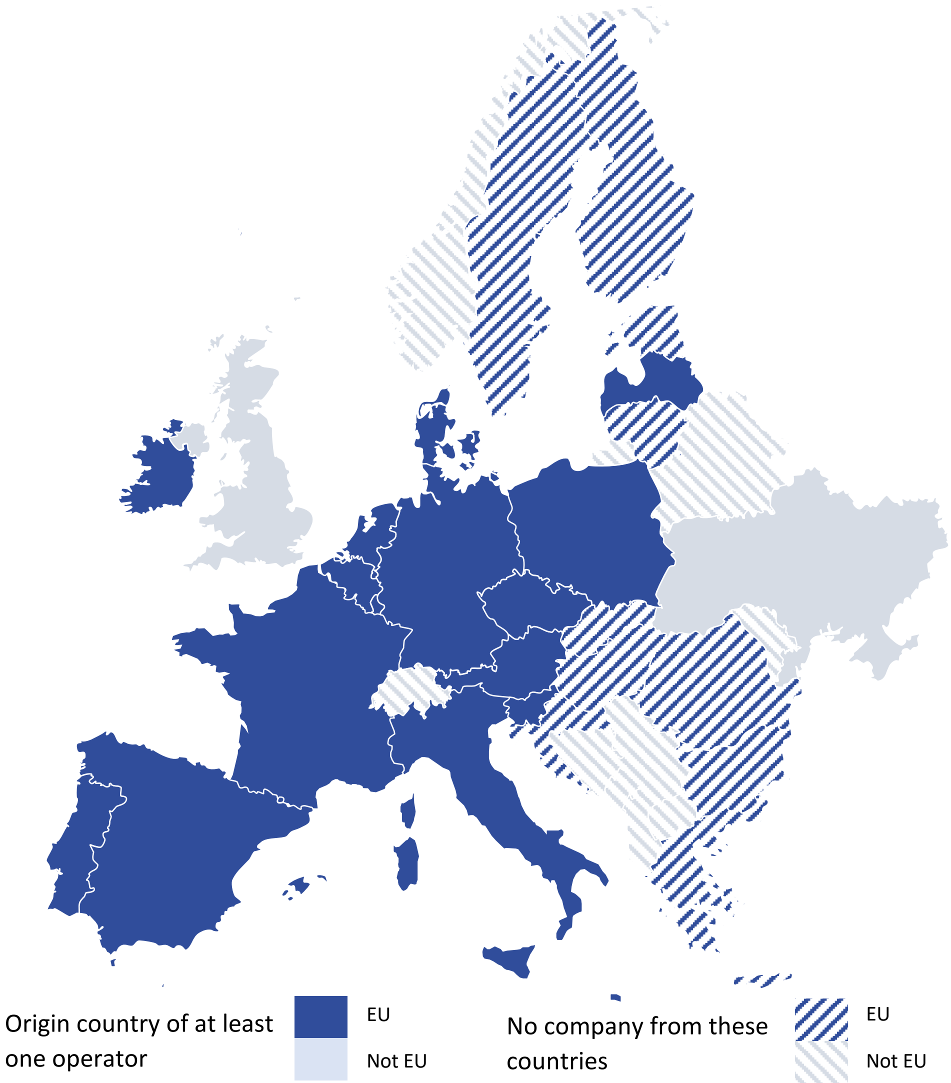
1. Participants of the MARCOGAZ – GIE Survey

The result of the survey is the compilation of 31 completed questionnaires, from actors in the gas industry:

- 17 TSOs answers
- 10 UGS operators answers
- 6 LNG Terminal operators answers
- 5 answers representing 14 DSOs

These companies represent[28]:

- 401.723 km of DSO main lines and 125.718 km of DSO service lines (out of 1.390.667 km)
- 138 546 km of TSO transmission lines (out of 203.030 km)
- 191 TSO transmission compressor stations
- 10 LNG terminals (out of 36)
- 38 UGS stations (out of 124)



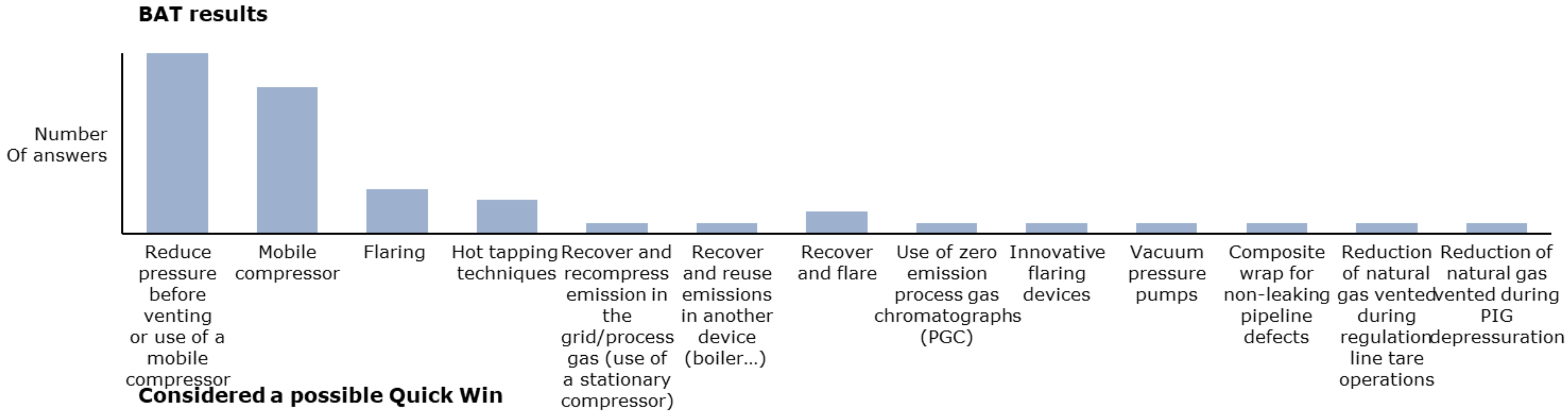
[28] Data are estimates EU28

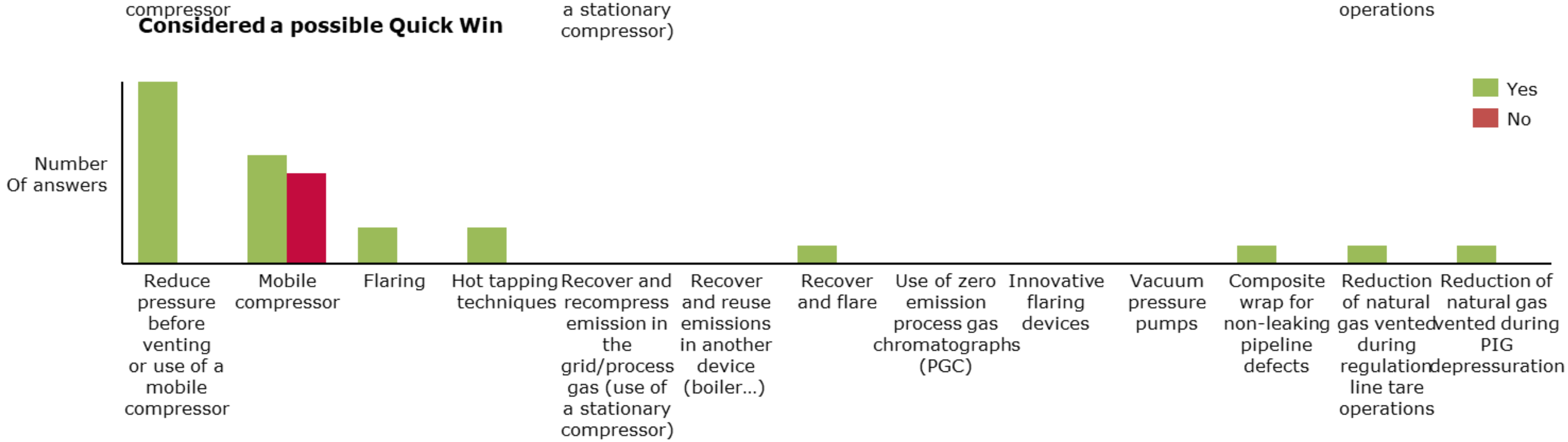
2. Complete results about the cited BATs in the MARCOGAZ – GIE survey

This appendix shows the raw data from the survey. Some cited BAT for one type of emission could be equivalent to another.

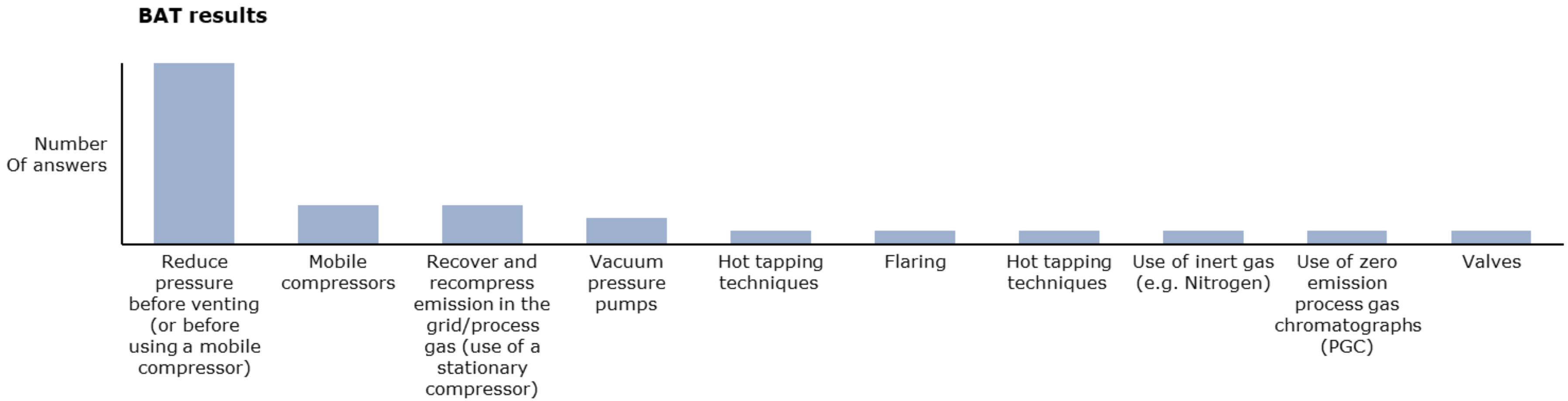
2.1 Purging/venting for works, commissioning, and de-commissioning

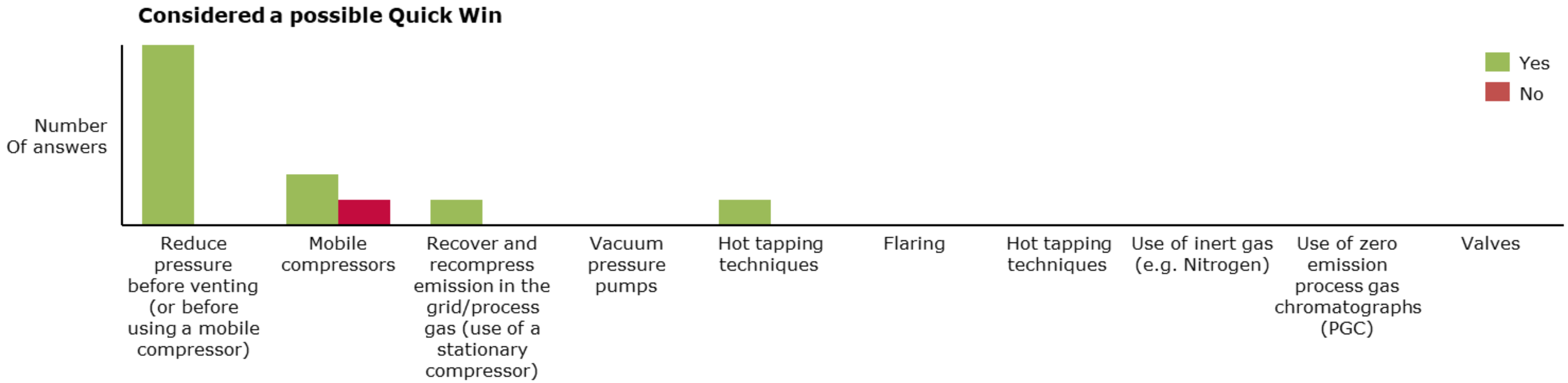
2.1.1 Main/Transmission lines



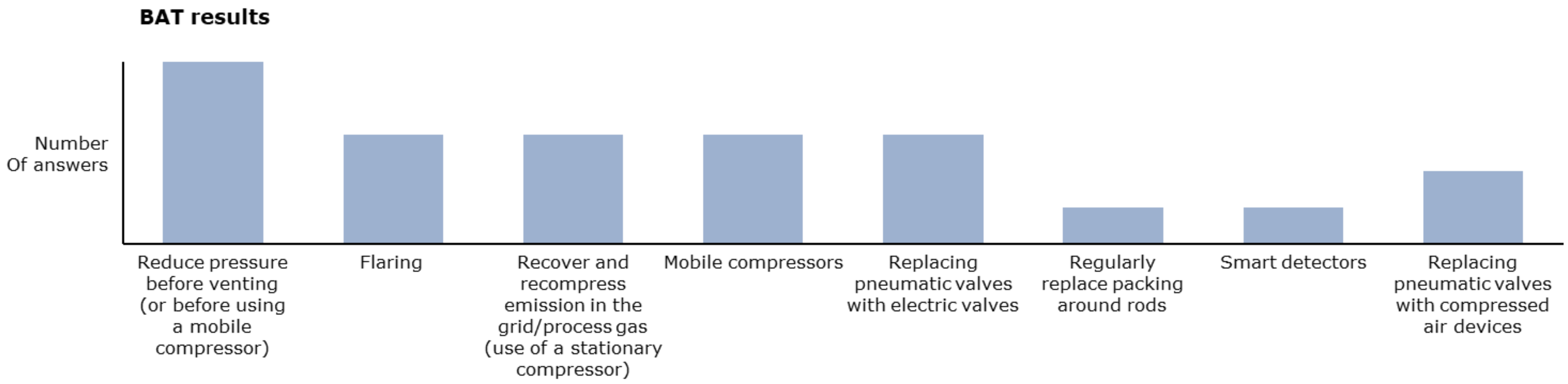


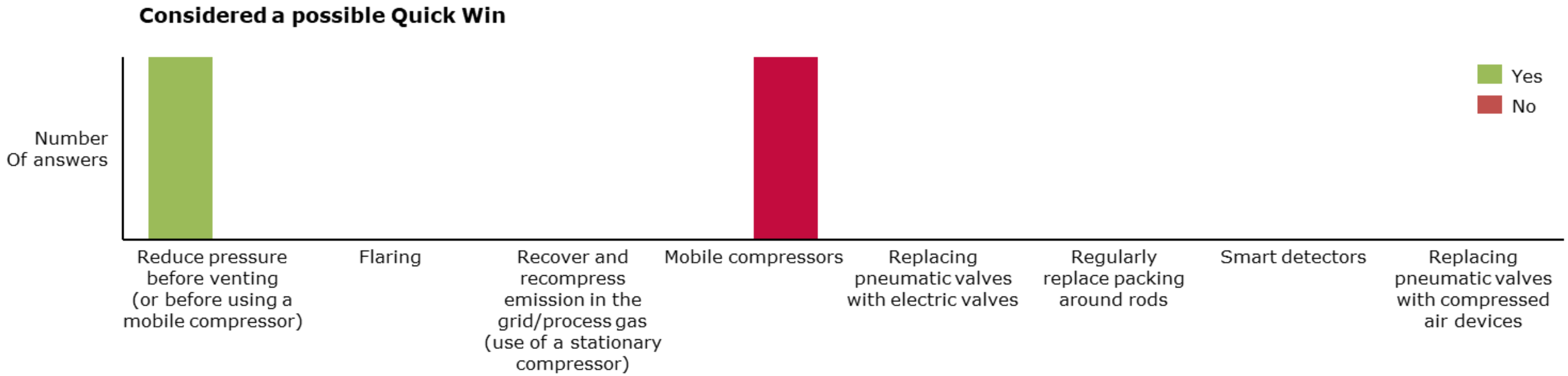
2.1.2 Service lines



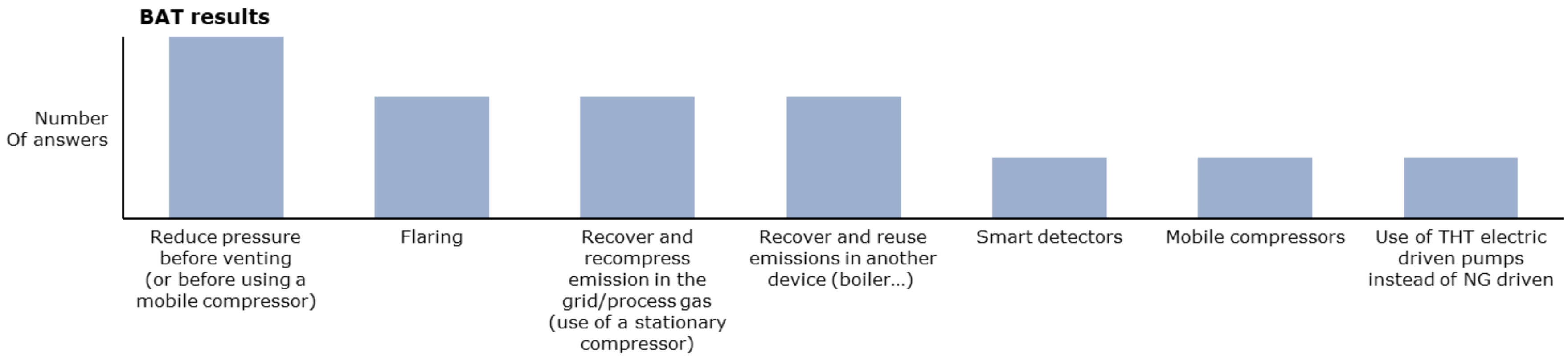


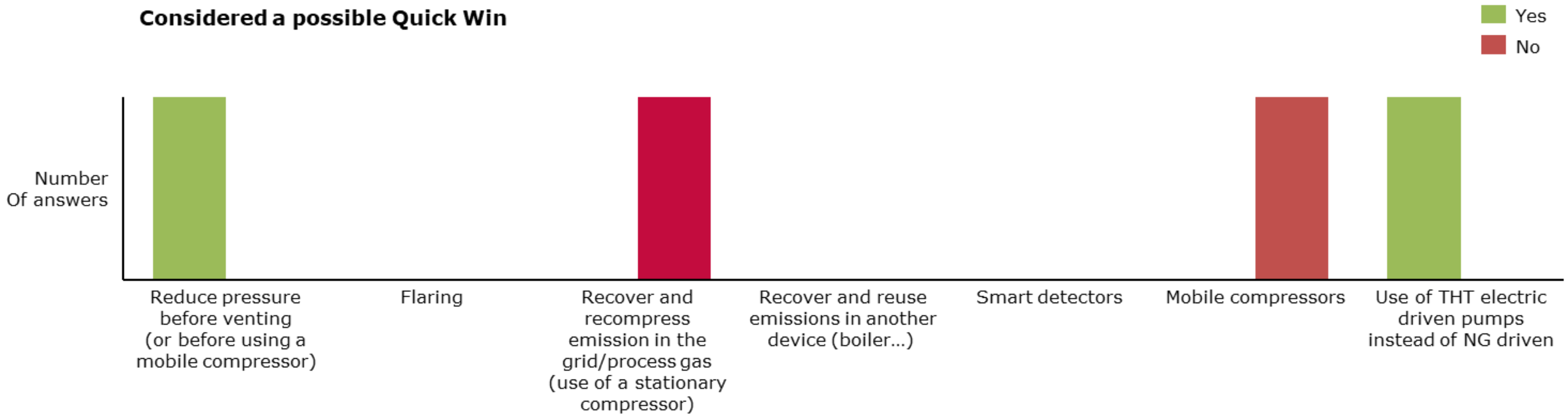
2.1.3 Valve stations



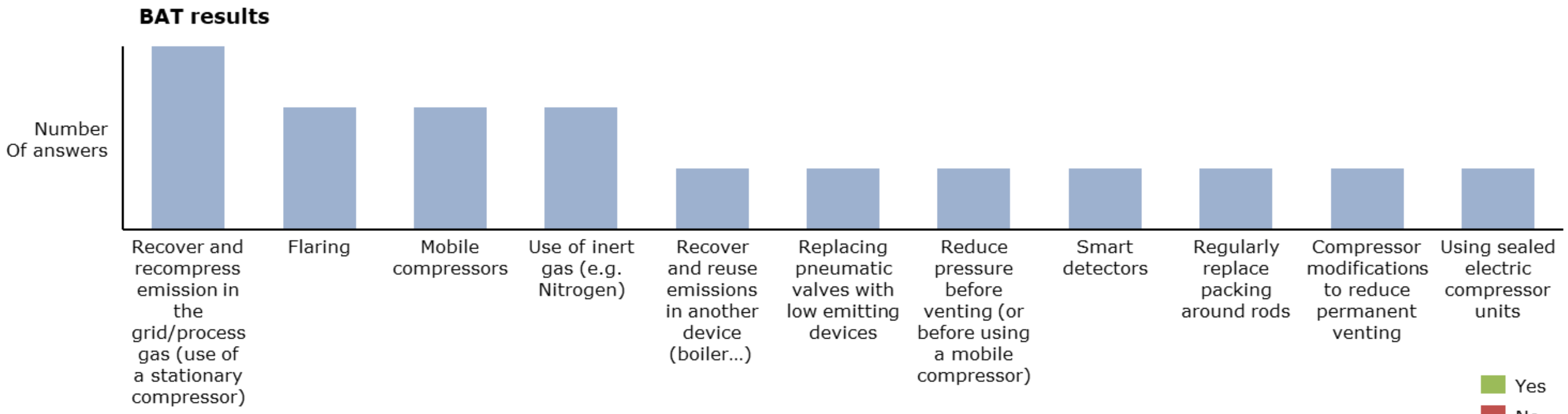


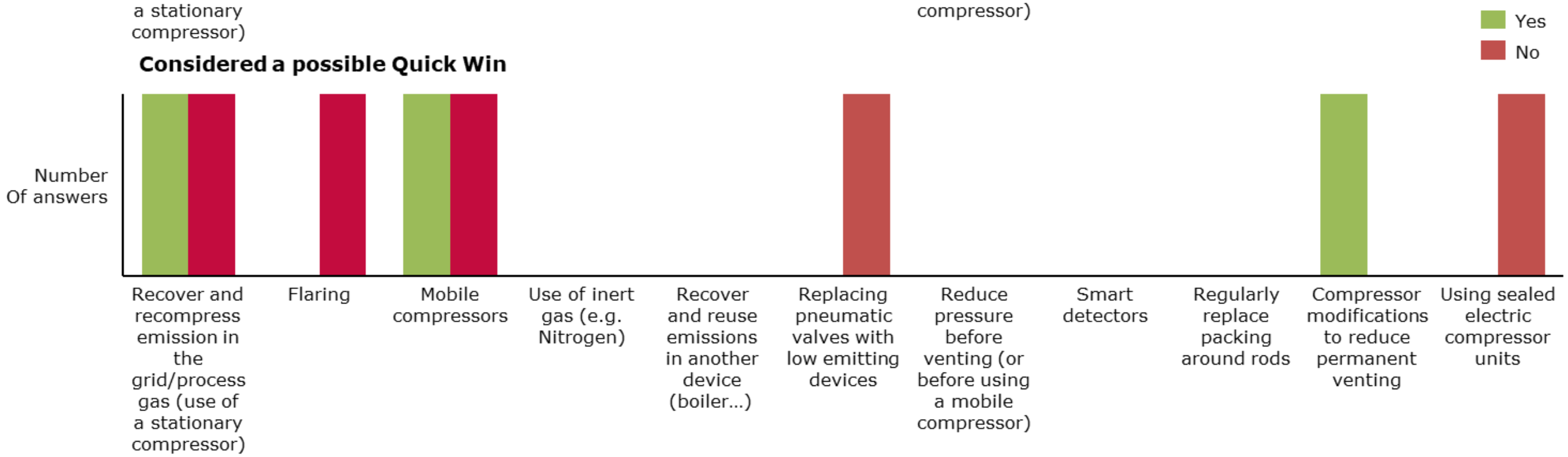
2.1.4 Combustion devices (turbines, engines, boilers…),





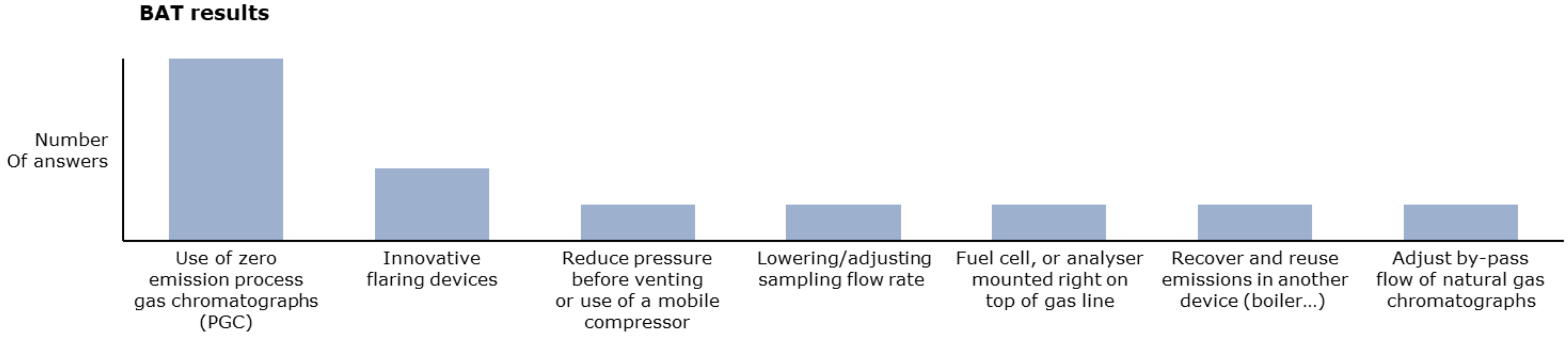
2.1.5 Compressors & compressor seals

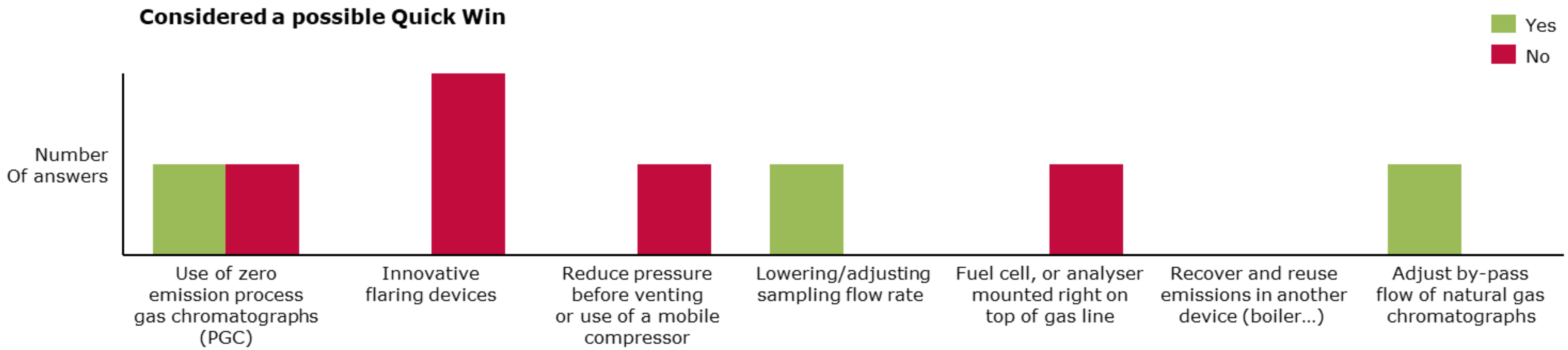




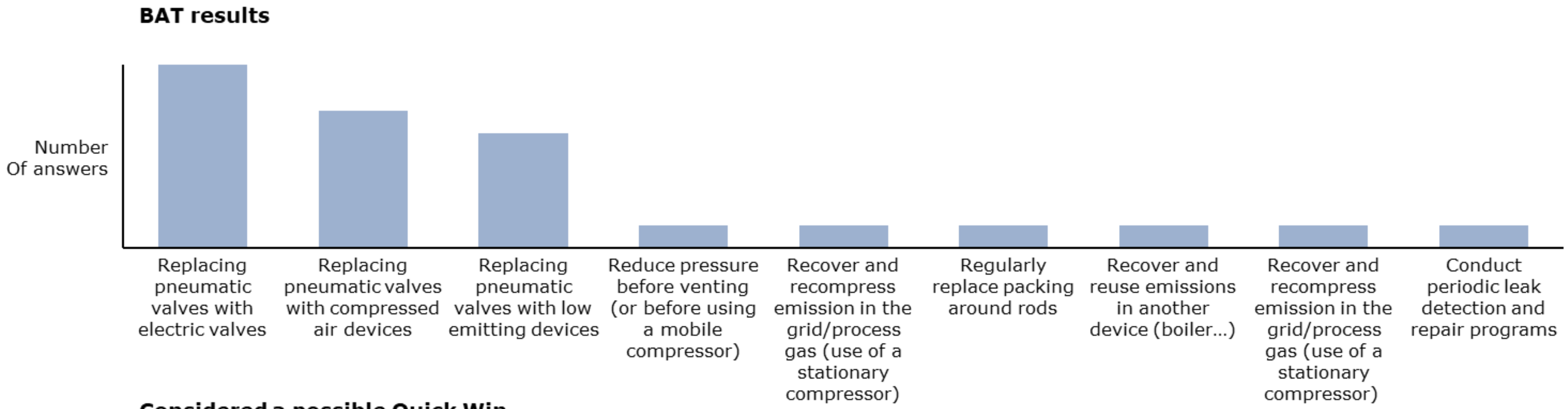
2.2 Regular emissions of technical devices (e.g. pneumatic)

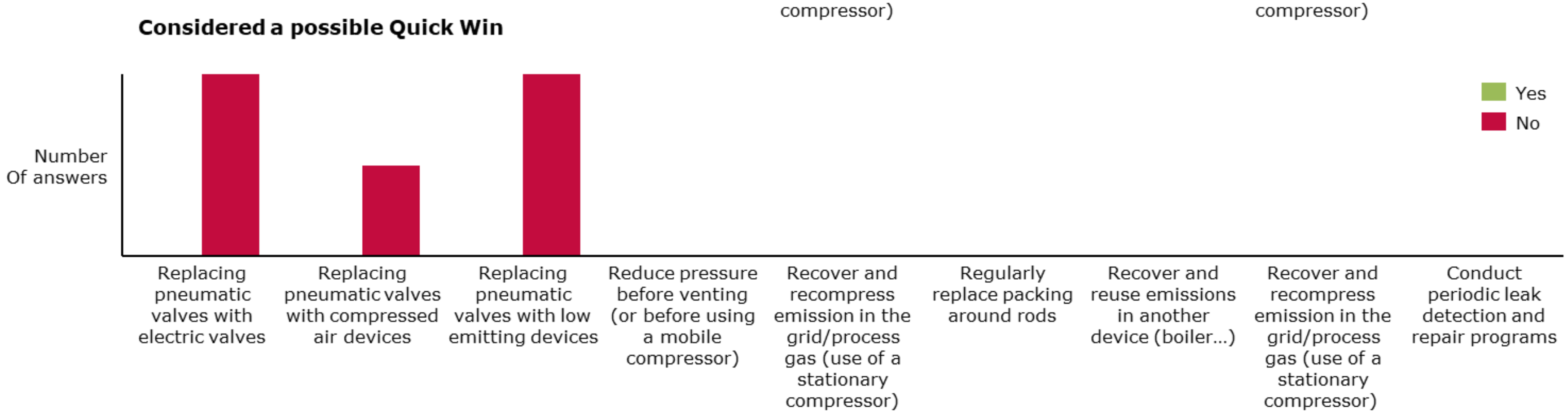
2.2.1 Measurement devices (chromatographs, analysers …)



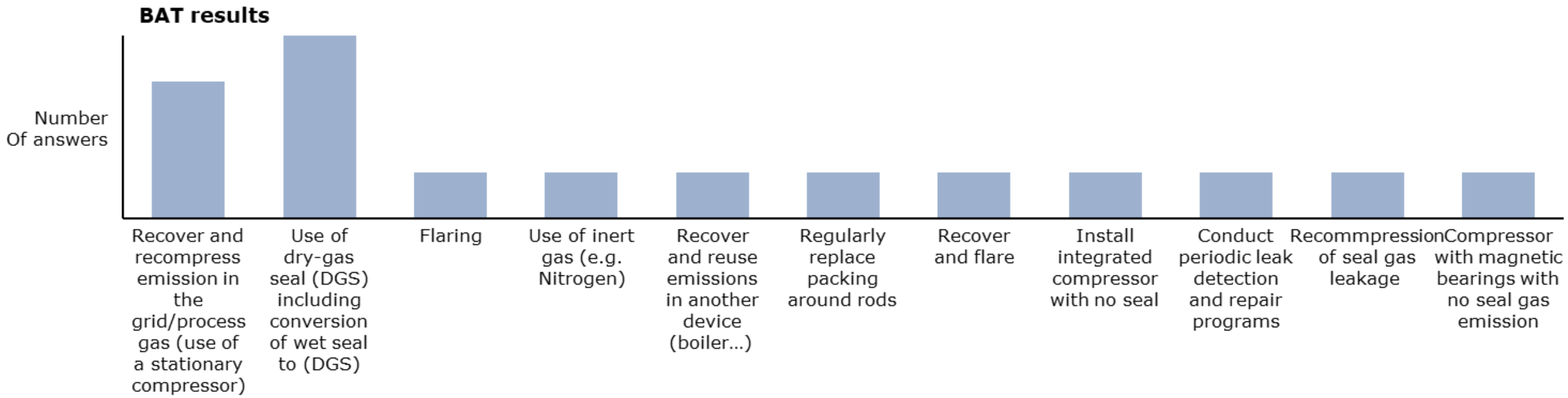


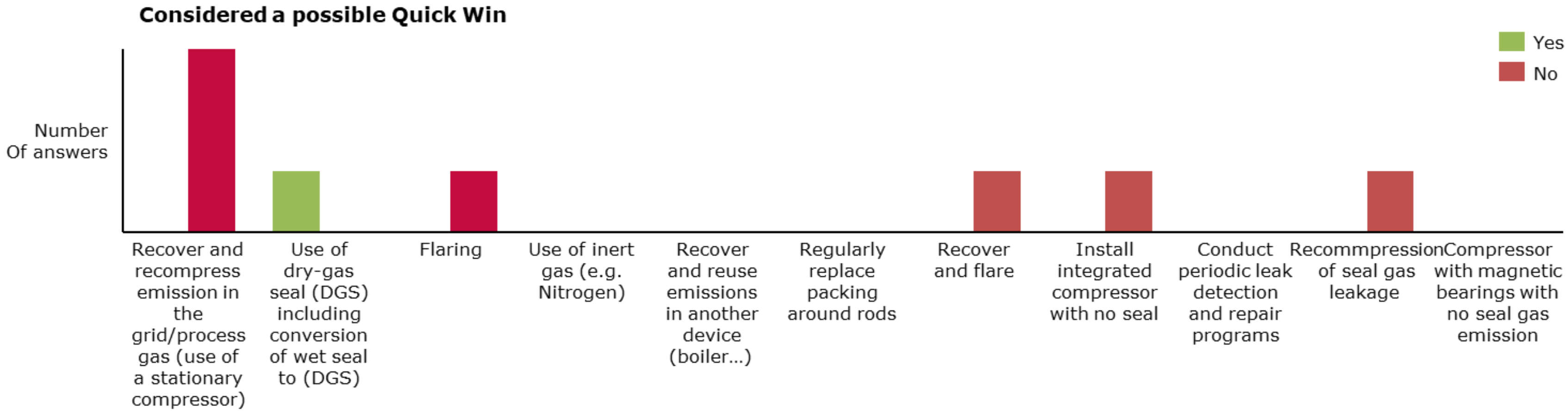
2.2.2 Flow regulators





2.2.3 Compressors & compressor seals,





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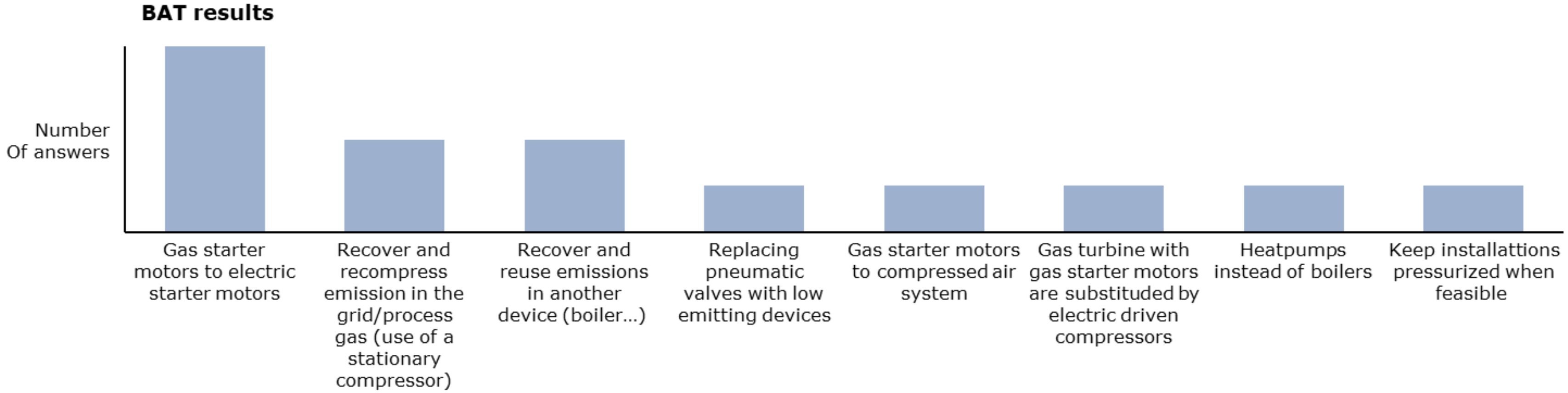
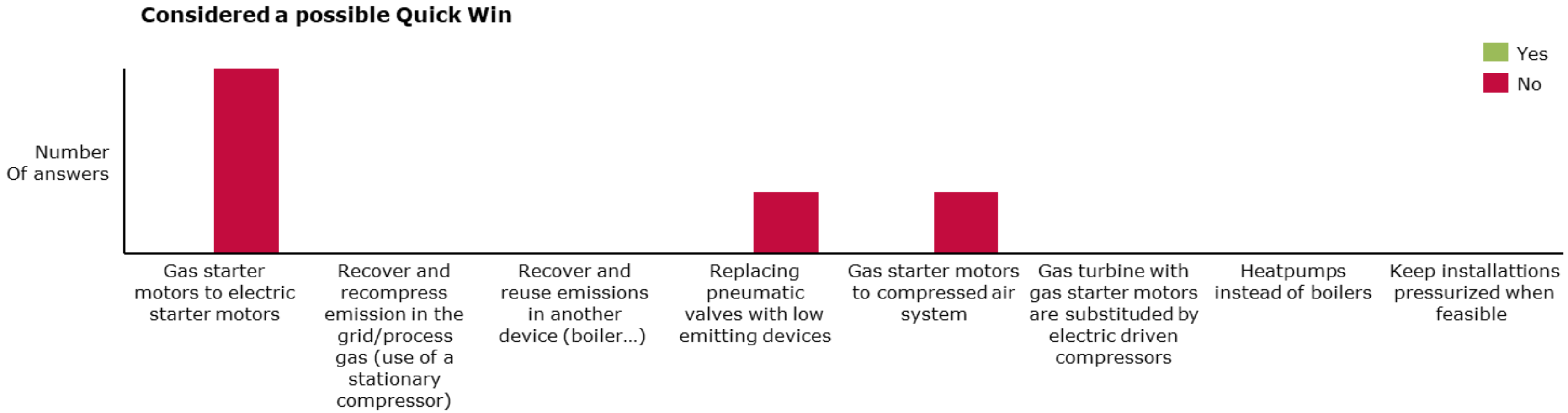
2.3 Start & Stop

2.3.1 Combustion devices (turbines, engines, boilers…)





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2.3.2 Compressors & compressor seals