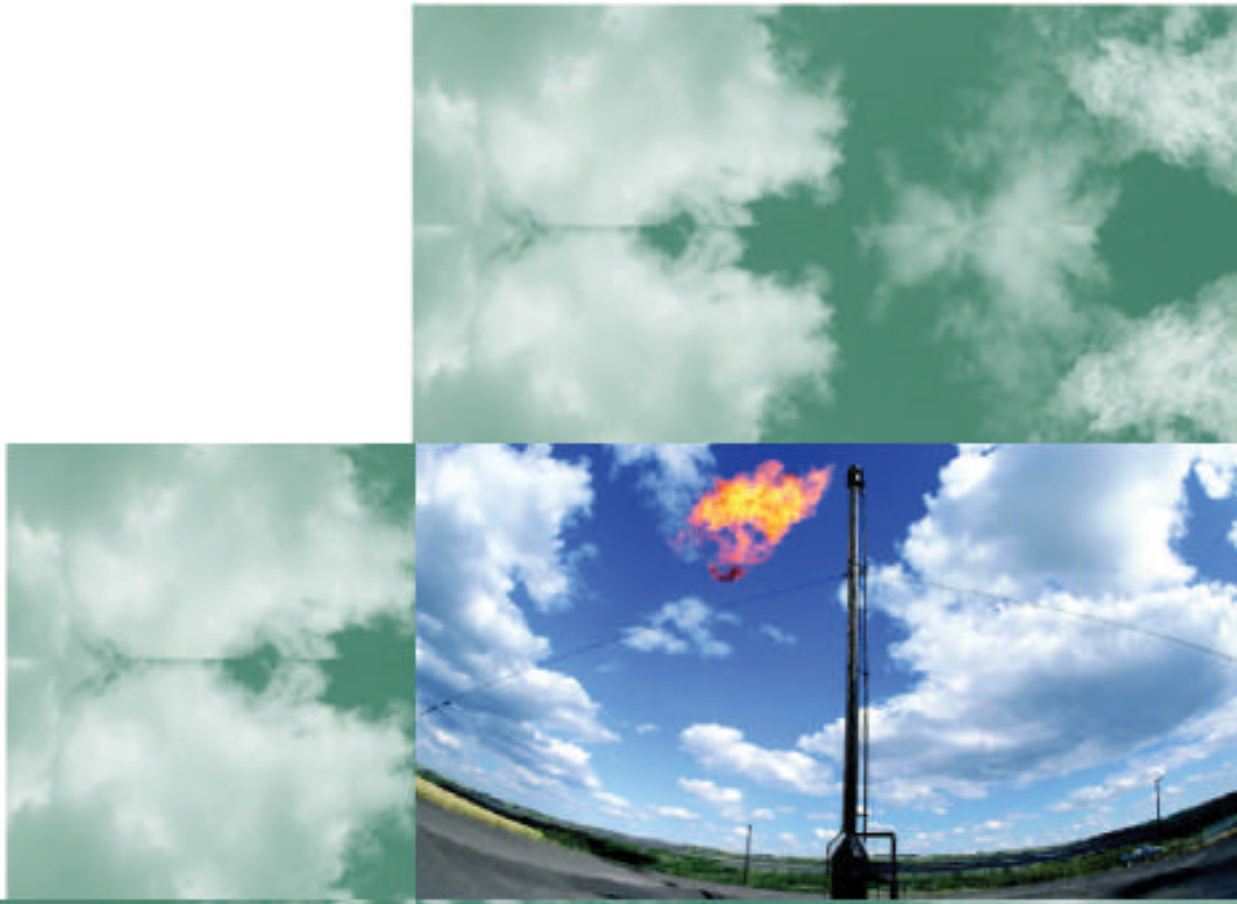
Regulation of Associated Gas Flaring and Venting

A Global Overview and Lessons from International Experience



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Regulation of Associated Gas Flaring and Venting

A Global Overview and Lessons from International Experience

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Acknowledgments

This report is one of the outputs of the Global Initiative on Gas Flaring Reduction. The Initiative was transformed into the Global Gas Flaring Reduction Public-Private Partnership (GGFR)[1] at the World Summit on Sustainable Development (WSSD) held in Johannesburg in August 2002. The GGFR aims to support national governments and the petroleum industry in their efforts to reduce flaring and venting of gas associated with the extraction of crude oil.

The existing partners at the time of the WSSD were the Bank, Shell, BP, Sonatrach of Algeria, and the governments of Ecuador, Nigeria, and Norway. Since then, the governments of Angola, Cameroon, Equatorial Guinea, Indonesia, and the United States, as well as Chevron Texaco, ExxonMobil, Norsk Hydro, Statoil, ENI, and TOTAL, have joined the GGFR.

This report provides a global overview of regulatory practices on gas flaring and venting and draws relevant lessons and conclusions from international experience on how best to reduce flare and venting volumes.

This report benefited from a capacity building workshop hosted by the Energy and Utilities Board (EUB) of Alberta (Canada) in October 2003 on its experience with regulating gas flaring and venting.[2]

This report was authored by Franz Gerner, regulatory expert, Oil and Gas Policy Division (COCPO), and Bent Svensson, GGFR program manager, based on a survey from IHS Energy Group and originally financed by the Energy Sector Management Assistance Programme (ESMAP) and later updated by GGFR. William Porter, consultant; Masami Kojima, lead energy specialist; Sascha Djumena, energy specialist; and Jacob Broekhuijsen, GGFR adviser, from the World Bank supplied many helpful comments. Esther Petrilli and Vince Minhas provided editorial support.

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[1] Other reports in this series include the Report on Consultations with Stakeholders and the Kyoto Mechanisms for Flaring Reductions. These reports can be found on the Partnership's web page at **www.worldbank.org/ggfr**.

[2] International delegates from Algeria, Angola, Cameroon, Indonesia, Italy, Nigeria, and the World Bank attended the workshop, where EUB staff shared Alberta's experience with reducing gas flaring and venting volumes and the role of regulation. Further details on the workshop are on the GFFR website at **www.worldbank.org/ggfr**.

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List of Abbreviations and Acronyms

AFR	Annual Field Report
ANP	National Petroleum Agency of Brazil
ANPE	National Environmental Protection Agency of Tunisia
API	American Petroleum Institute (United States)
ARPEL	Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean
BAT	Best available technique
BATNEEC	Best available technology net entailing excessive costs
BECA	Bangladesh Environment Conservation Act
BEP	Best environmental practice
BLM	Bureau of Land Management (United States)
CASA	The Clean Air Strategic Alliance (Alberta, Canada)
CDM	Clean Development Mechanism
CH_4	Methane
CNOOC	China National Offshore Oil Corporation
CO	Carbon monoxide
CO_2	Carbon dioxide
COS	Carbonyl sulfide
CRF	Common Reporting Format
CS_2	Carbon disulfide
DEFRA	Department for Environment, Food, and Rural Affairs
DGPC	Directorate General of Petroleum Concessions (Pakistan)
DPR	Department of Petroleum Resources (Nigeria)
DTI	Department of Trade and Industry (United Kingdom.)
E&P	Exploration and production
EC	European Community
ECR	Environmental Conservation Rules
EEAA	Egyptian Environmental Affairs Authority
EEZ	Exclusive Economic Zone
EGPC	Egyptian General Petroleum Corporation
EIA	Environmental impact assessment
ENGO	Environmental nongovernmental organizations
EPA	Environmental Protection Agency (United States)
EPEA	Environmental Protection and Enhancement Act (Alberta, Canada)
ESMAP	Energy Sector Management Assistance Programme
EU	European Union
EUB	Alberta Energy and Utilities Board
FDP	Field Development Program
FEPA	Federal Environmental Protection Agency (Nigeria)
FTPTS	Voluntary Flare Transfer Pilot Trading Scheme
GGFR	Global Initiative on Natural Gas Flaring Reduction
GHG	Greenhouse gas
H_2O	Water

H_2S	Hydrogen sulfide
HAP	Hazardous air pollutant
IBAMA	Brazilian Institute of Environmental and Renewable Natural Resources
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MARNR	Ministry of Environment and Renewable Natural Resources (Venezuela)
MMAA	Ministry of Municipal Affairs and Agriculture (Qatar)
MMS	Minerals Management Service (U.S.A.)
MPE	Ministry of Petroleum and Energy (Norway)
NAMR	National Agency for Mineral Resources (Romania)
NCS	Norwegian Continental Shelf
NEB	National Energy Board
NEPA	National Environmental Protection Agency (China)
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NGL	Natural gas liquid
NGO	Nongovernmental organization
NNPC	Nigeria National Petroleum Corporation
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
NOC	National Oil Corporation
NOCC	National Oil Company of China
NOCL	National Oil Corporation of Libya
NOK	Norwegian Kroner
NPD	Norwegian Petroleum Directorate
NPI	National Pollutant Inventory
NPV	Net present value
NSPS	New Source Performance Standards
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic aromatic hydrocarbons
PDO	Plan for Development and Operation
PDVSA	Petroleos de Venezuela SA
PIO	Plan for Installation and Operation
PSC	Production Sharing Contract
PTT	Petroleum Authority of Thailand
QGPC	Qatar General Petroleum Corporation
SFT	State Pollution Control Authority (Norway)
SMA	Sub-Secretariat for Environmental Protection (Ecuador)
SO_2	Sulfur dioxide
SOA	State Oceanic Administration (China)
SOCAR	The National Petroleum Agency (Azerbaijan)
SPT	Special Petroleum Tax
TPA	Third-party access
U.K.	United Kingdom
UKETS	U.K. Emission Trading Scheme
UKCS	United Kingdom Continental Shelf

UKOOA	United Kingdom Offshore Operators Association
VOCs	Volatile organic compounds
WAGP	West Africa Gas Pipeline
WSSD	World Summit on Sustainable Development

Units of Measure

bcm	billion cubic meters
btu	British thermal units
kmol	kilomole
kw	kilowatt
lb/h	pound/hour
m^2	square meters
m^3	cubic meters
mcf	million cubic feet
mcfd	million cubic feet per day
mcm	million cubic meters
mg	milligram
mol(e)	the amount of a substance
m/s	meters per second
ppm	parts per million
scm of oe	standard cubic meters of oil equivalent
tcm	thousand cubic meters
TWh	terawatt hours
µg	microgravitational acceleration

1 Introduction and Executive Summary

The World Bank has estimated that the annual volume of associated gas being flared and vented is about 110 billion cubic meters (bcm), enough fuel to provide the combined annual natural gas consumption of Germany and France. Flaring in Africa (37 bcm in 2000) could produce 200 Terawatt hours (TWh) of electricity, which is about 50 percent of the current power consumption of the African continent and more than twice the level of power consumption in Sub-Saharan Africa (excluding the Republic of South Africa) .[3]

It is widely acknowledged that flaring and venting of associated gas[4] contributes significantly to greenhouse gas (GHG) emissions and has negative impacts on the environment. Associated gas is a blend of hydrocarbons that is released when crude oil is brought to the surface. Gas flaring and venting also occurs at gas plants, during drilling and testing of oil and gas wells, and from natural gas pipelines during emergencies and equipment failures and maintenance shutdowns. This report focuses on associated gas related to the crude oil extraction.

Most governments in oil-producing countries have acknowledged the role gas flaring and venting reductions can play in achieving overall environmental objectives and emission targets. Natural gas prices have increased substantially since the early 1970s, and governments and industry increasingly recognize the potential economic benefits of using associated gas and so reduce gas flaring and venting.[5]

However, only a few oil-producing countries have significantly reduced associated gas flaring and venting volumes, and in most jurisdictions flaring and venting volumes continue to rise with increased oil production.[6]

Regulation can play an important role in reducing flaring and venting, and this report provides a general description of associated gas flaring and venting regulations adopted in oil-producing countries around the globe.

The report also identifies nonregulatory aspects that affect the volume of gas flared and vented in the countries profiled and sets out some general conclusions and recommendations on how best to reduce flaring and venting volumes.

In analyzing regulatory regimes around the world, the following key issues have been addressed:

- The role of government in defining flaring and venting policies

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[3] Global Gas Flaring Reduction Initiative, Report on Consultations with Stakeholders, The World Bank, and the Government of Norway.

[4] Flaring refers to the burning of associated gas, and venting is the release of associated gas into the atmosphere.

[5] Gas usage in this context means any use of associated gas other than for flaring and venting, including for reinjection into fields to increase oil production and for selling in downstream energy markets.

[6] Real flare and vent reductions are achieved when the volumes of associated gas flared and vented decrease or remain constant with increased crude oil production.

- The institutional characteristics of flaring and venting regulation
- The adopted operational processes and regulatory procedures

Other relevant factors that affect flaring and venting volumes have been identified. They include:

- The role of standards
- The impact of financial incentives
- The effects of contractual rights and the structure of the downstream energy markets.

The analysis is based on 44 country profiles, which have been attached as an appendix to this report. Countries profiled include oil-producing jurisdictions in both developing and industrial countries.

A detailed analysis was carried out for the Canadian province of Alberta, Norway, and the United Kingdom. These jurisdictions have reduced flaring and venting volumes over the past few years by using a combination of regulations and nonregulatory incentives, such as fiscal policies and gas market reform.

This report concludes that regulation can and should play an important role in achieving reductions in flaring and venting volumes in developing countries and it recommends that:

- Governments develop policies that specify the role that flare and vent reductions should play to achieve a country's environmental objectives
- Relevant primary and secondary legislation be established that empowers regulators to deal effectively with gas flaring and venting
- Regulators have clearly defined responsibilities with no overlapping or conflicting mandates—most importantly, that regulators be independent from regulated operators to avoid any conflict of interest
- Regulators develop and adopt clear and efficient operational processes concerning gas flaring and venting
- Regulators are properly staffed and financed to be able to enforce compliance with regulations
- Circumstances when operators can flare and vent associated gas *without* prior regulatory approval be clearly defined
- Transparent gas flaring and venting application and approval procedures be established
- Effective flaring and venting measurement and reporting procedures be established to supervise regulatory compliance
- Regulators have adequate monitoring and enforcement powers.

Other factors that affect operators' decisions to use or flare and vent gas include:

- International industry standards, particularly in the area of setting improvement targets of flaring and venting and standardizing monitoring and reporting procedures
- Fiscal policies related to the oil and gas sector, including royalty payments and taxes
- The structure of downstream energy markets and the existence of efficient and transparent regulatory and legal frameworks that provide for fair and nondiscriminatory access to network and customers.

2 Flaring and Venting Policy

Only a few countries have introduced gas flaring and venting targets to date. Of the oil-producing countries that are signatories to the Kyoto Protocol and that are profiled in this report, only 18 out of 44 have set overall emission targets, and only 3 have developed policy guidelines or specific emission targets for gas flaring and venting.[7] Table 2.1 provides an overview of the 44 countries profiled in this report that have set overall emission and/or specific gas flaring and venting targets.

Table 2.1: Countries Profiled with Emission or Flaring and Venting Targets

Countries	Overall Emission Targets	Flaring and Venting Targets
Argentina	✓	
Bolivia	✓	
Brazil	✓	
(Alberta) Canada	✓	✓
Denmark	✓	
Ecuador	✓	
Italy	✓	
Malaysia	✓	
New Zealand	✓	
Netherlands	✓	
Nigeria		✓
Norway	✓	
Peru		✓
Poland	✓	
Romania	✓	
Thailand	✓	
Trinidad and Tobago	✓	
United Kingdom	✓	
Uzbekistan	✓	
Vietnam	✓	

[7] The Kyoto Protocol was created in December 1997, and by the end of 2003, 61 developing and industrialized countries had signed it. Among the countries profiled in this report, Argentina, Bolivia, Brazil, Canada, Denmark, Ecuador, Italy, Malaysia, New Zealand, Norway, Peru, Poland, Romania, Thailand, Trinidad and Tobago, the United Kingdom, Uzbekistan, and Vietnam are signatories.

One jurisdiction that has imposed strict targets and limits for annual gas flaring volumes and is currently in the process of defining gas volume venting targets is the Canadian province of Alberta.[8] Some developing countries have also set flare targets, including Nigeria and Peru. In Nigeria, maximum natural gas emission levels for all upstream operations are set, and gas flare emission limits have been determined within those levels.[9] The Nigerian government has announced a target to end all nonoperational gas flaring by 2008. In Peru there are no emission and air quality standards, but the Ministry of Energy has set specific emission ceilings in relation to gas flaring and venting.[10]

Despite some success in a few jurisdictions in setting and achieving emission and flaring and venting targets, most oil-producing countries lack clear emission policies and guidelines. This includes large oil-producing nations such as Algeria, Angola, Indonesia, and the Russian Federation, which do not have specific guidelines.

In some cases, countries that have set flare and vent reduction targets have not yet implemented an efficient gas sector strategy and regulatory framework required to achieve real reductions in flare and vent volumes. Nigeria is currently developing a relevant strategy and framework.

It is the responsibility of government to set out a country's resource management and environmental policy. As part of developing a relevant policy, it is recommended that the government specify the strategy and the role flare and vent reductions can and should play to achieve overall environmental and resource management objectives.

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[8] The Alberta gas flaring limit in 2002 was 670 million cubic meters (mcm) per year, and if associated gas flared exceeded that limit, the regulator imposed reductions that stipulated maximum associated gas flaring limits for individual operating sites.

[9] The maximum natural gas emission levels for upstream operations are 5,000 μg m^{-3}, with a flaring emission limit of 5 mg/m^3 hydrocarbons.

[10] Emission ceilings and operational standards are set out in *Supreme Decree No. 045-93-EM* and relate to flaring and venting (for example, SO_2 limited to 300 ug/m^3; NO_2 limited to 200 ug/m^3; CO limited to 35 ug/m^3).

3 Regulation of Gas Flaring and Venting

3.1 Gas Flaring and Venting Legislation

Resource management and environmental policies form the basis for establishing relevant legislation and regulations, which ensure that government policies relating to gas flaring and venting are being achieved efficiently and effectively.

In principle, legal powers on gas flaring and venting can either be embedded in primary legislation (in relevant petroleum and hydrocarbon laws, for example) or secondary legal instruments (such as regulations, codes, licenses, and guidelines).

Most countries profiled in this report have established relevant primary legislation, such as hydrocarbon and environmental laws. Primary legislation often gives relevant regulatory institutions legal powers to carry out natural resource management functions and environmental policies without explicitly referring to gas flaring and venting.

Jurisdictions and countries profiled that have developed gas flaring and venting policies or targets tend to adopt secondary legislation, such as codes, guidelines, and licenses, to regulate flaring and venting. The extent of secondary legislation and gas flaring and venting regulations adopted varies among countries. The Canadian province of Alberta has the most comprehensive and transparent gas flaring and venting regulatory regime among all the countries profiled.[11] Other countries that have adopted secondary legislation to address flaring and venting include Alberta, Argentina, Peru, and the United Kingdom.[12]

The advantage of incorporating detailed gas flaring and venting regulations in secondary legal instruments, rather than in primary legislation, is that those instruments are more flexible and adaptable to the ever-changing conditions of oil production and natural resource management.[13]

Most oil-producing countries have established relevant primary legislation that provides regulatory agencies overall power to deal with gas flaring and venting. However, to date, only a few countries have introduced detailed secondary legislation, such as codes and guidelines, that is necessary to effectively regulate flaring and venting of associated gas.

3.2 Who Regulates Gas Flaring and Venting?

Associated gas flaring and venting forms part of upstream oil production. Oil production is a competitive activity that does not require ongoing price regulation of an operator's

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[11] For a detailed description of Alberta's regime, refer to Appendix A.

[12] For example, Argentina (Resolution 236/93 on Gas Flaring and Venting); Alberta (*Guide 60: Upstream Petroleum Industry Flaring, Incinerating and Venting*).

[13] In some jurisdictions gas flaring and venting laws and regulations are backed up by "voluntary" standards or guidelines issued by the oil industry or a relevant industry association.

business. In contrast, network businesses, such as transmission and distribution, that are natural monopolies are subject to tariff regulation.

Technical regulation of oil production and gas flaring and venting aims only to set standards and guidelines on the way oil production has to be conducted to achieve environmental, safety, and health objectives. Technical regulation of gas flaring and venting is inherently different from the concept of economic regulation of network industries. The main difference between economic and technical regulation is the ongoing tariff regulation of monopolies' transportation activities. It has impacts on the institutional requirements for carrying out gas flaring and venting regulation.

Economic regulation of networks requires a clear separation between policy and regulation and the establishment of an independent regulatory institution to ensure that political considerations do not influence the setting of gas transportation tariffs and hence affect the financial viability of the industry.

Technical regulation of gas flaring and venting does not require the establishment of an independent regulator. There is no best practice for determining which institution should carry out that function, and worldwide practices on the institutional responsibilities relating to gas flaring and venting regulation vary widely.

In most oil-producing countries profiled, the ministry responsible for managing a country's hydrocarbon resources has the primary responsibility of regulating gas flaring and venting as part of its overall obligation to oversee oil production. Examples are Nigeria's Ministry of Petroleum Resources, the Department of Trade and Industry in the United Kingdom, and the National Energy Department in Bolivia.[14]

Regulatory tasks are often carried out with other government institutions, such as environmental authorities, that have specific responsibilities relating to a country's management and usage of natural resources, including assessing the environmental impact of flaring and venting of associated gas. In such cases, energy ministries often consult and cooperate with environmental authorities before issuing flare permits or approving oil field development. In some countries environmental agencies are responsible for setting and enforcing gas flaring and venting regulation: for example, the Egyptian Environmental Affairs Authority (EEAA), the Italian Ministry of Environment, the Indonesian Ministry of Environment, and Thailand's Ministry of Science, Technology and Environment.[15]

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[14] That is also the case in Argentina (Ministry of Energy), Azerbaijan (National Petroleum Agency), Ecuador (Ministry of Energy and Mines), Gabon (Ministry of Mines, Energy and Petroleum), India (Ministry of Petroleum and Natural Gas), Kazakhstan (Ministry of Energy and Natural Resources), Namibia (Ministry of Mines and Energy), Netherlands (Oil and Gas Directive), New Zealand (Ministry of Commerce, Energy and Resources Division), Norway (Norwegian Petroleum Directorate), Oman (Ministry of Oil and Gas), Pakistan (Ministry of Petroleum and Natural Resources), Qatar (Ministry of Energy and Industry), Romania (National Agency for Mineral Resources), Syria (Ministry of Petroleum and Mineral Resources), and Trinidad and Tobago (Ministry of Energy and Energy Industries).

[15] Others include the National Environment Protection Agency (ANPE) of Tunisia, Ministry of Environment (Columbia), Ministry of Environment and Renewable Natural Resources (Venezuela), Environmental Protection Agency (Australia), National Environmental Protection Agency (China), Ministry of Environment (Indonesia), and Department of Environment (Malaysia).

In the Canadian province of Alberta, gas flaring and venting regulation is carried out by an independent regulatory institution that is also responsible for the downstream regulation of Alberta's energy markets.[16] In some countries, state-owned petroleum companies continue to carry out some or all of the regulatory functions and responsibilities in relation to gas flaring and venting. That is the case in Algeria, Bangladesh, Brazil, China, Egypt, Libya, Malaysia, Mexico, Peru, and Vietnam.[17]

Although there is no best practice for the institution or institutions that carry out gas flaring and venting regulation, certain minimum criteria must be met to ensure that gas flaring and venting regulation is carried out in a transparent and efficient manner.

These criteria include:

- Independence of the institutions that carry out gas flaring and venting regulation from the companies they regulate
- Clearly defined regulatory responsibilities for regulatory agencies
- Transparent and enforceable regulatory procedures and operational processes
- No conflicting or overlapping responsibilities among regulating institutions
- Ability to enforce compliance by being properly staffed and financed.

There is no international best practice or generally accepted theory as to who should regulate gas flaring and venting. In most developing countries profiled, institutional responsibilities for gas flaring and venting are often nontransparent, conflicting, and ineffective.

It is recommended that in order to ensure effective and efficient gas flaring and venting volume reductions, regulatory institutions should have clearly defined responsibilities with no overlapping or conflicting mandates. Institutions that regulate must be fully independent from the operators they regulate to avoid any conflict of interest and must be properly staffed and financed to be able to enforce compliance.

3.3 How Has Regulation Been Conducted?

The question of how regulation has been conducted refers to the translation of flaring and venting reduction policies into detailed technical regulations that best ensure those policy objectives are being achieved in an efficient and effective manner.

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[16] Alberta Energy and Utilities Board (EUB) on **www.eub.gov.ab.ca.**

[17] Sonatrach (Algeria), National Oil Corporation (NOC) of Libya, Egyptian General Petroleum Corporation (EGPC), Petrobas (Brazil), Perupetro (Peru), Petrobangla (Bangladesh), NOC of China, Petronas (Malaysia), and PetroVietnam all carry out regulatory functions relating to gas flaring and venting.

There are primarily two regulatory approaches to achieve flaring and venting reductions:

- A “prescriptive” approach
- A “performance-based” approach

The prescriptive approach is based on specific and detailed gas flaring and venting regulations established by the regulator and to be met by operators. Detailed prescriptions of regulatory procedures and operational processes make it clear what is required and how it is to be achieved. Stringent enforcement procedures give operators incentives to comply with gas flaring and venting regulations.

In theory, this approach makes it relatively easy for the regulator to set targets and determine whether an operator is meeting the gas flaring and venting requirements. In practice, imposing detailed technical regulations on gas flaring and venting is a challenging and complicated task. For example, measuring flare and vent volumes and monitoring compliance on each oil production site may be impractical and costly.

Consequently, most countries profiled opt for a more performance-based approach to achieve flaring and venting reductions. Such an approach places a greater emphasis on consensus and cooperation between the industry and the regulator in setting objectives and targets for gas flaring and venting. It is then the responsibility of the operator to define strategies for achieving these targets and provide evidence demonstrating it is complying with the agreement. To make regulation effective, the regulator still requires enforcement powers to ensure compliance.

In practice, the demarcation line between these two types of approaches is not sharp, and countries that have adopted effective gas flaring and venting regulations often use a hybrid approach.

Irrespective of the approach adopted, to establish an efficient and effective regulatory regime for gas flaring and venting, the following two key areas have to be addressed:

- Operational processes
- Regulatory procedures

Each of the above will be discussed in more detail below.

3.4 Operational Processes

A main function of technical regulation is to specify operational processes to ensure environmental, health, and safety standards are being met when operators flare and vent associated gas.

Flaring and venting is an important safety measure at oil production facilities. It safely disposes of gas during emergencies, power and equipment failures, or other upsets in oil production that might otherwise pose hazards to workers or nearby residents and sites.

Flaring and venting operations may be subject to a variety of conditions, and some developing countries have adopted operational standards and guidelines, including Ecuador, Egypt, Nigeria, Pakistan, Peru, and Qatar, often with mixed results.

Operational standards and guidelines typically include the following aspects:

- **Burn technologies and practices—**equipment and operating processes may be specified to ensure burning of "clean" gas and efficient combustion;[18]
- **Timing—**the maximum duration of continuous flaring may be **limited**;[19]
- **Flare location—**the flare typically will have to be located a safe distance from other facilities, accommodation units, and populated areas;[20]
- **Heat and noise generation—**upper limits may be set at specified distances from flaring operations;[21] and
- **Smoke and noxious odor—**limits also may be imposed on the opacity of smoke generated by flaring and noxious odors.[22]

Over the years, technological improvements and operational changes in processes and equipment have reduced the need for flaring and venting in many instances. For example, operational changes in practices and equipment, and use of new well-testing methods, can reduce the duration of flaring. In Alberta and the United Kingdom, some plants have been reconfigured to reprocess nonassociated gas that does not meet pipeline specifications. In the past, this "nonspec" gas was flared. Remote controls also allow plant operators to reduce or shut down production and pipelines rather than flare or vent it.

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[18] In Ecuador, for example, burners must be fitted with a terminal designed to provide a good mix with air, flame stability, and a rate of less than 18 m/s for gases with a calorific value under 1,000 British thermal units (BTU) per cubic foot, or a rate less than 120 m/s for gases with a calorific value of more than 1,000 BTU per cubic foot. The burner must have a continuously burning pilot system or other automatic lighting system that ensures that it lights and gives the operator immediate warning if it fails to operate. Total sulphite emissions, excluding oxides of sulphide, from all the chimneys may not exceed 4 pounds per hour (lb/h). In the case of vertical burners, the minimum height must be 6 meters; for higher emissions, special requirements apply. Other burner technologies, such as horizontal design, may be used according to the characteristics of the gas to be burned, in which case it must be demonstrated that it is a better alternative from an environmental point of view. Oman regulations specify that sulfur recovery units must be at least 95 percent efficient, and emissions of hydrogen sulfide must not exceed 5 parts per million (ppm) by volume.

[19] For example, in Malaysia flaring cannot take place for longer than 72 hours at a time.

[20] Nigerian regulations require that a maximum sterilized approach distance of 60 meters radius, measured from the base of the stack, shall be maintained and no other equipment except that related to the flare itself shall be located within this area. In the case of Ecuador, burners that burn gases containing more than 24 ppm by volume (ppmv) of sulfide, chlorine, or components containing either of these elements must be sited at least half a kilometer away from any recreational or residential area.

[21] In Nigeria, the allowable heat radiation at ground level is 6.31 kw/m^2 during maximum flaring at a distance of 60 meters from the base of the flame. The regulation further specifies that the noise levels for unprotected ears shall be well within the threshold of pain (80—100 acoustic decibels).

[22] The Ringlemann Scale is a measure of opacity grading the density of smoke from gas flaring. For example, Nigerian regulations require that the relative density of emitted smoke from gas flaring shall not exceed shade 2 on the Ringlemann Scale, which is related to 40 percent of smoke density and 60 percent of light transmission through smoke—observed over a period of one year. Oman regulations specify that products of combustion must not emit smoke as dark, or darker, than shade 1 on the Ringlemann Scale, which is 20 percent opacity. Qatar regulations specify that all flares (onshore and offshore) should operate free of smoke except in emergency conditions.

Flare efficiency has been improved in many countries profiled, including Alberta,[23] Nigeria, Oman, and Qatar. An efficiently burning flare does not produce visible smoke. Black smoke from a flare indicates incomplete combustion, which can be caused by wind, water, impurities in the fuel, or poor mixing with air.[24] Flare efficiency can be improved further by ensuring that flare systems are appropriately designed, constructed, maintained, and operated.

Another new technology uses small gas-fired, mini-turbine generators to produce electricity from associated gas that would otherwise be flared. To encourage this practice, the province of Alberta has exempted such operations from provincial royalties. Cameroon is currently assessing the financial viability of such generators to reduce flaring and venting volumes. In Russia, several technologies are under development to use associated gas for even larger volumes.

An operator's compliance with flaring and venting guidelines depends mainly on the effectiveness of regulatory procedures. Regulatory procedures refer to a regulator's ability to monitor gas flaring and venting operations at oil production sites, measure actual flare and vent volumes, and enforce compliance with operational guidelines. To date, most developing countries that have adopted operational processes for gas flaring and venting lack effective regulatory procedures for monitoring, measuring, and enforcing.

Most developing countries profiled in this report have not established any operational requirements for gas flaring and venting. Operators in these jurisdictions tend to follow their own operational practices, often based on vague references in production contracts to "international best practices for oil production." That is the case in Algeria, Angola, Gabon, India, Indonesia, Uzbekistan, Venezuela, and others.[25]

To effectively achieve health, safety, and environmental standards and objectives, countries should adopt clear operational processes and regulatory procedures for gas flaring and venting.

3.5 Regulatory Procedures

Regulatory gas flaring and venting procedures refer to dealings among the institution that regulates gas flaring and venting, the operators, and other interested parties.

Regulatory procedures relating to gas flaring and venting are given legal effect, binding on all parties, pursuant to powers of the regulating entity provided in relevant primary and secondary legislation. Gas flaring and venting procedures must be made public to help achieve the objectives of openness (ability to take part in a proceeding) and

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[23] The EUB's flaring guide states that the goal should be continuous improvement in combustion efficiency, aiming for 98 percent or higher.

[24] Incomplete combustion can produce carbon monoxide; unburned hydrodcarbons; volatile organic compounds (VOCs) such as benzene, toluene, and xylene; and other organic compounds known as polycyclic aromatic hydrocarbons (PAH).

[25] Argentina, Azerbaijan, Bangladesh, Bolivia, Brazil, China, Columbia, Kazakhstan, Libya, Malaysia, Namibia, Poland, Romania, Syria, Thailand, Trinidad and Tobago, Uzbekistan, and Venezuela.

transparency (ability to understand policies, laws, regulations, and related decisionmaking procedures).

Regulatory gas flaring and venting procedures refer mainly to the following procedures:

- Application and approval
- Measuring and reporting
- Monitoring and enforcing.

Each procedure will be discussed in more detail below.

Application and Approval

One can distinguish between flaring and venting of associated gas with or without prior approval by the relevant regulator.

a. Gas Flaring and Venting *without* Regulatory Approval

Most countries profiled permit the flaring and venting of associated gas under the following circumstances:

- For safety reasons (for example, flaring in safety burner pilots to maintain positive pressure)
- For unavoidable technical reasons (such as purge venting)
- During well testing and startup of operations
- In emergencies (emergency production stops, compression, and others)

Flaring and venting under these circumstances normally does not require regulatory approval. The permission tends to be part of the operating rights granted to operators under production licenses (or contracts) or field development plan approvals.

However, "unavoidable technical reasons," "emergencies," and "safety reasons" are vaguely defined terms that can be interpreted widely. Only a few countries profiled have clearly defined the circumstances and events that justify unauthorized gas flaring and venting. These countries include Brazil[26] and the United Kingdom.[27]

Most developing countries profiled in this report have not defined the circumstances under which flaring and venting is allowed without prior approval. This decision is often left to the discretion of operators with reference to good oil field engineering practices and utilization principles.

It is recommended that the circumstances *under which operators can flare and vent associated gas without prior approval from the relevant regulatory authority be clearly defined in regulation.*

b. Gas Flaring and Venting *with* Regulatory Approval

In most countries profiled, unauthorized flaring and venting of associated gas is prohibited other than for technical, safety, and emergency situations. In all other cases, regulatory approval is required.

The application and approval procedures for flaring and venting of associated gas can take place in a number of different ways, including:

- As part of an overall field development approval
- As a separate flare and vent permit or environmental license.

A common practice is to authorize flaring and venting by means of approving upstream oil field development and production plans. Flaring and venting authorizations form an integral part of the overall license (or contract) for field development. These tend to be one-time approvals but include provisions for review upon a change in the scope of approved operations, including flare and vent volumes.

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[26] Burning and release of natural gas in Brazil for the following reasons do not require prior approval of the National Petroleum Agency (ANP):

- Burning or release of natural gas that corresponds to 3 percent of the monthly production of the associated gas
- Burning during well testing, during the exploratory phase, with a flow period of 72 hours or less per interval tested
- Burning for safety reasons limited to 15,000 m^3 per month for the equipment burner pilots, 30,000 m^3 per month for pilots of land-based flares, and 60,000 m^3 per month for the pilots of flares on installations at sea
- Burning of gas in fields that produce 150,000 m^3 or less per month, or in fields with a gas-petroleum ratio of less than 20 m^3/m^3
- Burning of gas vapors in land-based tanks or storage ships limited by the solubility of 15/m^3 or less
- Burning for emergency reasons resulting from emergency stoppages of production or accidents caused by uncontrollable events.

[27] Regulatory approval is not required for any flaring that follows an unforeseeable event the licensee did not have time to deal with other than by flaring to remove or reduce risk or injury to persons in the vicinity of the well in question, or to maintain a flow of petroleum from that or any other well.

Often field development approvals do not make specific references to gas flaring and venting but more generally require operators to follow best oil production practices. That is the case in Angola, Cameroon, India, Indonesia, and Pakistan, among others.

Some jurisdictions, including Argentina, Nigeria, Norway, and the United Kingdom, issue separate flare permits. Permits are often issued for a limited duration (for example, one year) and require regulatory applications and approval for extension. Alberta requires special permits for sour gas flaring.[28]

In Brazil, Colombia, and Venezuela, the responsibility for authorizing flaring and venting is under the jurisdiction of environmental authorities, and the operator's permission to flare and vent is granted by virtue of an environmental license.

Before approving flaring and venting volumes, regulatory agencies often require the operator to provide evidence of the likely impact that flaring and venting will have on the environment. This information is typically provided in an environmental impact assessment (EIA) that must be submitted as part of the flare permit or field development application process. EIAs increasingly form an intrinsic part of the regulatory approval procedures and help set conditions under which flaring and venting is authorized. This is already the case in the Australia, Indonesia, Malaysia, Nigeria, Peru, Thailand, and the United Kingdom.

Some countries profiled have additional requirements and conditions for approving flaring and venting of associated gas. In Argentina, the issuance of flaring and venting approvals depends on the gas-to-oil ratio of an oil field. Wells and production facilities that exceed a specified gas-to-oil ratio are prohibited from flaring and venting.[29] However, the Secretariat of Energy does allow exceptions and may authorize flaring and venting where the operator can demonstrate a lack of technically and economically feasible alternatives.

As part of the approval procedure, regulatory agencies increasingly look at the economics of associated gas and require operators to prove that it is uneconomic to use gas before issuing authorizations. Explicit references have been made in relevant laws and regulations in Alberta, Algeria, Bangladesh, Brazil, Malaysia, the United Kingdom, and the United States.

Some jurisdictions make it mandatory that operators satisfy the regulatory authority that they have investigated all reasonable alternatives to flaring and venting, including reinjection for improved oil recovery or for storage or gas gathering, treatment, and sale in downstream energy markets. [30]

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[28] Sour gas is natural gas containing hydrogen sulfide (H_2S). H_2S is flammable, has a strong rotten-egg odor, and is poisonous to animals and humans. In contrast, sweet gas contains little or no H_2S.

[29] Since January 1, 1994 the venting of natural gas is prohibited from wells with a gas-to-oil ratio exceeding $100 m^3/m^3$.

[30] In the United Kingdom, the Department of Trade and Industry (DTI) states that if it is not economic to bring gas to shore, the licensees should carefully consider: (a) its use as a fuel, (b) it as a means of improving oil recovery, (c) converting it to other fuels, (d) injecting it for disposal, (e) selling it to a neighboring development, or (f) flaring/venting. The option that maximizes the economic recovery of the field would normally be selected.

Regulators generally adopt an "incremental" approach, meaning operators are allowed to flare or vent only if they can prove that the incremental benefits of using associated gas are lower than the incremental costs. In Alberta, for example, the Alberta Energy and Utilities Board (EUB) considers a project as being economic if the incremental economics of gas conservation (that is, use) generates a discounted net present value (NPV) before tax greater than zero.

An alternative approach is the "integrated" approach, in which the economics of associated gas are determined as part of the initial oil development approval. Under this approach, flaring and venting of associated gas is considered a negative externality of oil production, and the costs of that externality will be fully included in assessing the viability of oil production in a field. The integrated approach tends to further reduce gas flaring and venting compared with an incremental approach, but it also increases the costs of developing an oil field that could have major implications on marginal oil fields in developing countries.

To date, the integrated approach has not been adopted by any regulator or country profiled in this report, but some operators have introduced this concept for the development of new oil fields on a voluntary basis.

Flaring and venting authorizations are often subject to a variety of additional conditions. These include air emission limits for pollutants released into the atmosphere and operational restrictions that are typically imposed to ensure the safe flaring and venting of gas with limited environmental impacts. Some countries profiled also have introduced specific requirements: for example, the regulator may require operators to have recovered natural gasoline and other liquids in any associated gas before it is flared or vented. This is the case in Trinidad and Tobago.[31] The economic value of condensates and liquefied petroleum gas (LPG) encourages operators to recover these liquids before reinjecting associated gas into oil fields.

Regulatory practices related to the authorization and approval procedures adopted vary in the countries profiled. In principle, it is less important whether separate flare and vent permits are being issued or whether gas flaring and venting is being approved and authorized via the field development plan. What is important is that regulators can monitor and enforce compliance with its regulations and operational guidelines to ensure that operators limit flaring and venting to the approved volumes.

It is recommended that countries establish clear and transparent gas flaring and venting application and approval procedures, either as part of an overall field development approval or as separate flare and vent permits.

Table 3.1 provides an overview of the various instruments used to authorize gas flaring and venting in the countries profiled.

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[31] This is the case in Trinidad and Tobago, where gas flaring is permitted provided that the operator has reinjected as much gas for storage as is consistent with best good petroleum industry practice and has taken reasonable measures, in agreement with the minister, to recover natural gasoline and other liquids contained in the gas.

Measuring and Reporting

The effectiveness of any regulatory regime for gas flaring and venting depends on accurate measuring and reporting of volumes flared and vented (in combination with regulatory enforcement powers).

The main objective of measuring and reporting is to provide accurate information and data about gas flaring and venting volumes to the regulator that allows the regulator to verify operators' compliance with flaring and venting objectives and targets.

There are two options for measuring gas flaring and venting volumes:

- Gas flaring and venting metering
- Estimating flare and vent volumes

Gas flaring and venting metering has long been a contentious issue. Oil-producing countries have thousands of oil and gas wells, and installing accurate flare and vent meters for every flare stack can be costly and impractical, especially at smaller production sites. In addition, under normal operating conditions the gas to be flared and vented is flowing at a very low velocity, and under such conditions flow gas meters do not always provide accurate and reliable metering data.

The recent development of ultrasonic gas meters has made it easier to accurately measure gas flare and vent volumes, and this type of meter now has an extensive track record in the North Sea, both in the U.K. continental shelf (UKCS) and the Norwegian shelf (NCS). However, ultrasonic meters tend to be expensive to install, especially for smaller production facilities (as measured per unit of gas flared).

Table 3.1: Types of Flaring and Venting Authorization

Country	Flare/Vent Permit	Development Plan	Environmental License
Alberta (Canada)	✓	✓	
Algeria	✓		
Angola		✓	
Argentina	✓		
Australia (offshore)		✓	
Azerbaijan		✓	
Bangladesh		✓	
Bolivia		✓	
Brazil			✓
China		✓	
Colombia			✓
Denmark	✓		
Ecuador	✓		
Egypt	✓		
Gabon		✓	
India		✓	
Indonesia		✓	
Italy	✓		
Kazakhstan		✓	
Libya		✓	
Malaysia		✓	
Namibia		✓	
Netherlands		✓	
New Zealand		✓	
Nigeria	✓		
Norway	✓		
Oman	✓		
Pakistan		✓	
Peru		✓	
Poland		✓	
Qatar		✓	
Romania		✓	
Syria		✓	
Thailand		✓	
Trinidad and Tobago		✓	
Tunisia		✓	
United Kingdom	✓	✓	
Uzbekistan		✓	
Venezuela		✓	✓
Vietnam		✓	

Regulators tend to prefer accurate meter readings from calibrated meter installations, but the technical challenges and the associated costs have prevented regulatory agencies in all the countries profiled from making the installation of certain types of meters at operation

sites mandatory. Regulators normally require operators to report flared and vented volumes accurately and leave it up to operators whether they install meters (and the type of meter installation) or provide estimates.[32] However, some regulators require meter installations for certain hazardous

types of flaring and venting and if certain volume thresholds are exceeded.[33] If it is not practical to meter flared or vented gas, regulatory agencies in the countries profiled tend to accept estimates. Estimates are based on engineering calculations, and operators must adopt estimating procedures and software packages that have been widely tested and approved.

In many countries, operators are required to maintain flaring and venting registers that are subject to audit and to report those data to the regulatory authority on a regular basis. Different practices relating to reporting flaring and venting volumes apply. For new field developments, operators often have to estimate flaring and venting volumes as part of their application process for field development.[34] For existing fields, operators often have to produce an Annual Field Report (AFR) that sets out production data, including gas flared and vented.[35] In advanced regulatory regimes, regulatory agencies have developed auditing procedures for flaring and venting measurement (that is, submitted meter data or estimates) and reporting and defined consequences for errors in flare and vent measurement and reporting.[36]

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[32] For example, in Alberta, the EUB emphasises the need to report flared and vented volumes accurately, and the regulator recommends that flared and vented gas be metered with equipment suited to source-flow conditions. However, the regulator acknowledges the technical difficulties and costs involved in metering gas flaring and venting and stresses that accurate engineering estimates may be accepted where meters are not practical and the measurement requirements can be met.

[33] For example, in Alberta, flare meters are required for (a) flaring at oil and gas production facilities, including gas plants, if the volume flared is larger than 0.5 $10^3 m^3$ per day and (b) flaring of acid gas, either continuously or in emergencies, regardless of volume. In Norway, operators are responsible for metering CO_2 emissions during the operational phase and are obliged to establish an internal control system that ensures that regulation requirements are met.

[34] In the United Kingdom, as part of the assessment process of a new field development, the operator is required to provide a spreadsheet called the "Common Reporting Format" (CRF), which provides detailed information on the new field, including projections about annual gas flaring/venting. This information will help DTI decide whether to approve a field development.

[35] In Alaska, gas disposition must be compiled by production facilities and reported monthly on the Producer's Report of Gas Disposition (Form 10-422). The categories of gas disposition reported are (a) sold; (b) reinjected, flared, and/or vented; (c) used for lease operations (other than flared and vented); and (d) other. If a facility's production comes from multiple pools, the operator allocates production between each producing pool as a percentage of the total monthly gas volume handled by the facility. A written supplement must be reported for any flaring and venting incident exceeding one hour. The supplement must describe why the gas was flared or vented, list the beginning and ending time of the flaring and venting, report the volume of gas flared and vented, and describe the actions taken to comply with the regulations.

[36] In Australia, the volume of associated gas flared or vented offshore must be reported on a monthly basis. In the United States, operators must keep detailed flaring records, which must be reported to the Minerals Management Service (MMS) as a part of monthly production statements and are subject to MMS inspection.

Measuring and reporting is an important part of any regulatory regime, and practices in the countries profiled vary widely. Industrial countries tend to have more sophisticated measuring and reporting procedures. Most developing countries profiled lack clear rules and guidelines relating to measuring and reporting gas flared and vented.

To ensure compliance *with gas flaring and venting objectives, it is recommended that countries establish transparent and effective measuring and reporting procedures for flaring and venting volumes.*

Monitoring and Enforcing

Most regulatory agencies have acknowledged that operating processes and regulatory procedures are not effective without adequate monitoring of flaring and venting volumes and enforcement powers in case of noncompliance.

Because of the technical and financial restrictions on monitoring all flaring and venting sites, site inspections form an integral part of more advanced regulatory regimes. The characteristics of oil production make it impossible to inspect every site and installation. Considering the potential costs involved and the requirement of qualified personnel to carry out such site visits, monitoring has been applied mostly in jurisdictions in industrial countries such as Alberta,[37] the United Kingdom, and the United States. Some regulators have developed methods and criteria to preselect installation sites that most likely require close regulatory scrutiny.[38]

Many developing countries lack the financial resources and technical expertise to introduce a comprehensive monitoring program for oil production (and gas flaring and venting) and often require operators to keep a register showing the amounts and volumes flared and vented from oil production facilities.[39] Based on those data, the regulator can determine sites for inspection.[40]

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[37] In 2002, the Alberta EUB carried out 8,255 inspections of oil and gas production facilities. In its 2002 annual report, the EUB states that it is particularly concerned with fugitive emissions, noise from compressors, black smoke, and flaring, and hence has increased its inspections of gas-producing facilities only to 2,170 in 2002. Along with site inspections, EUB surveillance staff use two mobile air monitoring units to identify installations that emit fugitive H_2S and SO_2 emissions.

[38] The EUB, for example, has developed criteria for selecting sites to be inspected. Those criteria are based on (a) operator performance and noncompliance history, (b) sensitivity of the area (public proximity and environmental sensitivity), and (c) inherent risk of the operation (potential impact level).

[39] The Egyptian Environmental Affairs Authority (EEAA) is also responsible for compliance checking, emissions monitoring, and enforcement, although some degree of internal control has been introduced by the requirement that the operator keep a register showing the impact of activity on the environment. In Qatar, a Standards Manual stipulates emission-monitoring requirements. For example, periods of smoky, high-volume, emergency, and salt gas flaring must be recorded in a log book, to be submitted to Qatar's Environmental Affairs Department on a monthly basis.

[40] Because of these challenges, some oil-producing countries have developed monitoring and enforcement measures that typically involve a strong element of consultation and joint effort between the regulatory agency and industry.

Legislation and contractual provisions in many countries profiled tend to impose sanctions (enforcement actions) on operators for noncompliance with flaring and venting regulations. The sanctions are typically in the form of:

- Penalties and fines
- Withdrawal of the production/operation license.

In most countries, noncompliance with gas flaring regulations or other license conditions may constitute grounds for revoking a production license.[41] However, the lack of monitoring or enforcing of regulations in most developing countries profiled means there is little chance that a license will be revoked for noncompliance. Some countries have established fines and penalty regimes to create incentives for operators to comply with gas flaring and venting regulations, with mixed results. Many countries that have imposed fines for noncompliance do not create sufficient incentives for operators to comply, either because fines are insignificant in relation to the commercial value of oil production or because monitoring and reporting facilities are ineffective. Some of the most severe penalties are in Latin America, where both companies and individuals can be fined for noncompliance.[42]

The Canadian province of Alberta has the most transparent and comprehensive enforcement rules in case operators fail to comply with gas flaring and venting regulations. The EUB has established an "enforcement ladder system" to address noncompliance with regulatory requirements, including noncompliance with flaring and venting regulations. The enforcement ladder is based on the appropriate response to the seriousness of the noncompliance and provides for escalating consequences if timely remedial actions are not taken or if repeat noncompliance occurs. The enforcement action depends mostly on the nature of the noncompliance. Minor noncompliance[43] normally incurs only a written notification by the regulator requiring that corrective action be taken within a certain period. Serious noncompliance, which includes an operator failing to comply with written notifications and flaring of sour gas without permission, leads to production license suspension.[44]

In most oil-producing countries profiled, regulatory agencies do not have adequate power to monitor and enforce compliance with gas flaring and venting regulations. To

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[41] That is the case in Algeria, Argentina, Ecuador, Egypt, Malaysia, Russia, United Kingdom, and most other jurisdictions.

[42] Under Venezuelan environmental legislation, fines (and even custodial sentences) can be imposed on individuals in civil liability proceedings. In Italy, companies operating a plant without a valid emission permit are liable to a prison term of two months to two years or fines. Unauthorized emissions of gas are punishable with imprisonment up to one month or a fine.

[43] Minor noncompliance related to gas flaring and venting includes noncompliance with flare spacing requirements, not reporting gas usage, not conforming flare stack heights to regulatory standards, and others.

[44] The EUB reported that noncompliance resulted in 128 shutdowns of drilling rigs, well-service rigs, oil production batteries, gas production batteries, pipeline construction projects, and operating pipelines. One of the most common reasons for suspending oil and gas production facilities is H_2S emissions associated with sour gas venting and equipment leaks.

ensure compliance with operating *processes and regulatory procedures, an efficient regulatory regime requires sufficient monitoring and enforcement powers.*

4 Other Relevant Factors

Technical regulation is only one aspect and cannot be isolated from the broader issues and measures that directly or indirectly affect the volume of associated gas flared and vented in a country. Although it is beyond the scope of this study to analyze those factors in any great detail on a country-by-country basis, it is important to set out the main areas, as they have major implications on operators' incentives to either use gas or flare and vent.

There are three main nonregulatory factors that affect the economics of associated gas:

- Standards
- Financial incentives
- Contractual rights and the structure of downstream energy markets

Each of these aspects will be discussed in more detail below.

4.1 Standards

Gas flaring and venting regulation can be supplemented by national or international standards that often cover aspects not easily achieved by conventional legislation and regulation. Standards can form an important part of reducing gas flaring and venting regulation and are particularly important in the areas of:

- Setting improved flaring and venting targets
- Standardizing monitoring and reporting procedures.

Standards tend to be jointly developed by operators, sometimes in consultation with governments and nongovernmental organizations (NGOs), and are often combined with public reporting, which provides an incentive to adhere to these voluntary agreements, despite their being legally nonbinding.

At the national level, the U.K. Offshore Operators Association (UKOOA) has issued guidelines to help operators reduce emissions, including gas flaring and venting.[45]

At an international level, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Commission is in the process of expanding descriptions of best available techniques (BATs) and best environmental practice (BEP) related to the flaring of oil and gas condensate from well testing.[46]

National and international *standards can play an important role in improving gas flaring and venting operations and regulatory procedures, such as monitoring and reporting of*

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[45] *Guidelines on Reducing Atmospheric Emissions from Oil and Gas Facilities 1995* and *Guidelines on Atmospheric Emissions Inventory 1995*.

[46] A draft OSPAR recommendation on BAT and BET for flaring of oil, condensate, and gas from well testing is due to be presented for discussion to the Offshore Industry Committee in 2004.

flare and vent volumes, and can provide a valuable supplement to conventional technical regulation.

The GGFR is establishing a voluntary global venting and flaring reduction standard to assist governments and oil producers worldwide in their efforts to reduce the flaring and venting of associated gas. With these guidelines, the GGFR hopes to:

- Provide the oil and gas industry with a common framework to encourage consistent objectives and approaches to reducing and eliminating venting and flaring of associated gas
- Provide common guidelines that could help countries achieve their objectives with respect to flaring and venting
- Encourage cooperation between industry and governments by defining mutually agreeable and consistent gas flaring and venting policies and targets.

4.2 Financial Incentives

The economic value of associated gas is the main factor that influences an operator's decision to use or flare and vent. In theory, if the benefits of using associated gas are higher than its costs, operators will refrain from flaring and venting. In practice, this is not always the case, as many developing countries focus on producing crude oil, and often consider finding ways to use associated gas a hindrance to crude oil production.

There are two factors that influence the economics of associated gas:

- Natural gas market development based on nonassociated gas
- Government fiscal policies related to oil and gas

Natural Gas Market Development Based on Nonassociated Gas

In many countries, gas development prospects have been hindered by the low valuation placed on natural gas compared with other energy sources, in particular oil and coal.

This low valuation was initially reflected in very low natural gas prices either determined by the market or set by governments. In addition, energy sources have often been subsidized (mainly nuclear, hydropower, and coal, resulting in low prices for competing fuels), which has hindered the development of the upstream and downstream gas industry in many developing and industrial countries.

The steady increase of international oil and natural gas prices since the early 1970s changed the perception of the value of natural gas (and hence associated gas) in many oil-producing countries. Governments aimed to diversify their energy sources to increase supply security and reduce environmental externalities through increased usage of alternative fuels such as natural gas.

The higher economic value of natural gas prompted many industrial countries to reconsider flaring and venting of associated gas and to seek opportunities to sell gas in downstream energy markets. Higher gas prices also encouraged governments and

companies to develop downstream gas networks and markets that eventually provided opportunities to use associated gas and so reduce gas flaring and venting.

Encouraged by the rising economic value of associated gas, some developing countries, in public-private partnerships with industry, are looking at financially viable options to build downstream gas network to use associated gas. A prominent example is the West Africa Gas Pipeline (WAGP), which aims to reduce gas flaring in Nigeria by exporting associated gas to the neighboring countries of Benin, Togo, and Ghana. Angola and Nigeria are also considering expanding liquefied natural gas (LNG) terminals that not only allow for the export of natural gas from gas fields but also use associated gas from oil fields and so reduce gas flaring and venting.[47] Many oil-producing countries, including Saudi Arabia, Egypt, and Algeria, have developed a domestic gas market.

Governments in developing countries are also increasingly phasing out subsidies for various energy sources and allowing operators to sell associated gas at actual costs in downstream markets.

Increasing natural gas prices, reforming pricing arrangements, and creating a level playing field in the energy sector by phasing out subsidies will have positive effects on the development of domestic gas markets and will create opportunities for operators to use associated gas.

Government Fiscal Policies Related to the Oil and Gas Sector

Petroleum fiscal incentives that directly or indirectly affect gas flaring and venting volumes include royalty payments, taxes, government share in Production Sharing Contracts (PSCs), and duties. This is often referred to as total government take.

Governments take their share of the petroleum revenues from the companies for the right to explore and produce oil and gas resources in a country. Some governments have actively promoted gas production and provided larger fiscal incentives for gas compared with oil production. A preferential treatment of gas production, through lower taxes and royalties compared with oil production, for example, provides a positive incentive to produce gas and develop downstream gas network and markets. This eventually provides opportunities for operators of oil fields to market associated gas. Nigeria has adopted such an approach to encourage the development of a gas network.

Some jurisdictions have applied royalty waivers as a financial instrument to improve the economics of associated gas. For example, Alberta's Ministry of Energy introduced a royalty waiver program in 1998 to create additional incentives for operators to use associated gas. Under the program, regulatory changes have been made to provide a

[47] Nigerian National Petroleum Company (NNPC) has recently announced that it aims to build a second LNG facility by 2008, which will open strategic opportunities to reduce gas flaring in Nigeria. Angola is planning to build a LNG plant by 2007, which will allow the country to use and export associated gas and natural gas.

royalty waiver on associated gas currently being flared because it is uneconomic to use the gas.[48]

In some countries, taxes are used as an incentive to reduce gas flaring and venting. Although not widely used, some countries, most notably Nigeria[49] and Norway[50], have adopted tax regimes that aim to discourage flaring and venting of associated gas. Algeria[51] and Brazil[52] are considering implementing a similar tax regime. The Clean Development Mechanism (CDM) under the Kyoto Protocol can also create new markets on the emissions of CO_2 and other GHGs that could allow an operator to sell carbon credits to assist the financing of gas flaring reduction projects.[53]

Fiscal policies can have a major impact on the gas volumes flared and vented by operators. However, fiscal incentives, such as taxes, tend to be effective only if they are high enough compared with the overall value of oil production in a field. In addition, if alternative usage of associated gas is not available, such as downstream gas markets or LNG facilities for export, the only effect of a tax on gas flared and vented is to increase the cost of oil production and potentially reduce the financial viability of a field.

4.3 Contractual Rights and Structure of Downstream Energy Markets

The characteristics of a country's downstream energy markets have major implications on an operator's decision to use or flare and vent associated gas. To use associated gas, operators must be able to sell that gas in a country's domestic gas market or to export markets in other countries (for example through LNG facilities or export-oriented pipelines).

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[48] Information Letter (IL), 99-19 : Otherwise Flared Solution Gas Royalty Waiver Program, Department of Energy, June 11, 1999.

[49] The Nigerian gas flaring tax was imposed some 20 years ago at a time when as much as 95 percent of associated gas was being flared. Despite the tax, a significant proportion of associated gas continues to be flared. The Nigerian government has since acknowledged that taxes are insufficient to deter operators from flaring and venting and that policy would have to place more emphasis on creating a downstream gas market that provides opportunities for operators to market associated gas.

[50] Norway introduced a carbon tax in 1991, payable by operators for all petroleum operations generating CO_2 emissions, including oil fields. The tax was imposed as part of an economywide drive to address the environmental impacts of CO_2 emissions and was not, unlike the Nigerian tax, targeted specifically at gas flaring.

[51] Algeria released a draft hydrocarbons law in 2000. The draft requires operators to pay a nondeductible tax equivalent to US$100 per 1,000 m3 of gas flared. The World Bank understands that the law has not been passed by the parliament.

[52] Brazil plans to introduce tax legislation for upstream petroleum operations. Under the plan, a 10 percent royalty is imposed on gas produced that is either sold or flared in excess of reasonable and notified safety requirements. The World Bank understands that the legislation has yet to be passed and implemented.

[53] For further discussion refer to the GGFR report Number 2 on *Kyoto Mechanisms for Flaring Reductions* at www.worldbank.org/ggfr.

There are two main issues that affect the usage of associated gas in many countries profiled in the report:

- Contractual rights to associated gas
- Structure of downstream energy markets

These issues are discussed in greater detail below.

Contractual Rights to Associated Gas

Contractual rights refer to provisions in oil production contracts (or licenses) that govern the rights and obligations of operators and governments in regard to associated gas. There are two main aspects that have to be distinguished in this context:

- Associated gas used for field operations
- Associated gas used for marketing and sale in downstream markets

Contractual provisions in production contracts related to associated gas vary considerably. However, most contracts recognize that associated gas can be used by operators within oil field operations to optimize oil production through reinjection to improve oil recovery rates and to use gas to generate power for operation or to fuel equipment among other operational processes.

In contrast, the right of operators to sell associated gas in downstream gas markets has traditionally been constrained by so-called "preemptive rights." A preemptive right gives the government an exclusive right to market associated gas not used for oil field operation.[54] Preemptive rights are a common contractual feature for upstream oil production in many developing countries such as Algeria, Angola, China, Egypt, Venezuela, and Vietnam.

Under those traditional arrangements the government has a legal right to take associated gas that the operator does not use, often free of charge or at highly deflated prices. Some of these contracts allow the government to determine the price for that gas irrespective of market price, with the consequence that operators have to provide nonflared or nonvented associated gas below cost. At the same time, governments often do not have the financial means to build downstream networks to use that gas, which often leads to high volumes of gas being flared and vented.

Although many of these traditional contractual arrangements have been modified in recent years and operators are no longer subject to government preemptive rights, they are still common in many developing countries.

Structure of Downstream Energy Markets

In many developing countries the prospects for using associated gas in the downstream energy market are hindered by monopolistic market structures, a lack of a transparent

[54] This also applies to the export of associated gas to third countries, which is often allowed only to the extent that domestic requirements have been fulfilled.

legal and regulatory framework, and restrictions on accessing downstream transportation network and final customers.

Australia, Canada, Singapore, the United States, and countries in the European Union (EU) have liberalized their gas markets and encourage private participation and competition in gas supply. Regulatory institutions ensure that pipeline operators are able to recover their investment costs through regulated transportation tariffs and provide open access to pipeline networks for third parties. These market liberalization steps have substantially increased the opportunities for the operator to market and sell associated gas in the downstream market. Some developing countries, such as Argentina, Brazil, Chile, China, Indonesia, Malaysia, and Mexico, have carried out market reforms in the past, but with the exception of Argentina most developing countries are at an early stage of liberalizing and restructuring their downstream energy markets. Monopoly structures, combined with a lack of network, continue to affect the economics of associated gas adversely.[55]

To improve the economics of associated gas and create suitable opportunities for operators to use gas rather than flare and vent, governments must not only create efficient technical regulations, but also develop competitive downstream markets and transparent and efficient regulatory and legal frameworks that provide access to network and customers.

[55] The importance of creating downstream gas markets for the use of associated gas and reducing flaring and venting is best documented in the case of Nigeria. A recent study carried out by Nexant on gas flaring for the Bureau of Public Enterprises of Nigeria has estimated that the country loses between US$500 million and US$2.5 billion annually to gas flaring because operators are not encouraged to use and commercialize associated gas. The report identified inappropriate pricing, lack of gas sector policy, and lack of infrastructure for transmission and distribution as the main issues hampering the development of the gas sector. It recommended the establishment of a gas and electricity regulatory agency that efficiently regulates the natural monopolies of transmission and distribution and implements open access rules to gas network to foster competition and provide opportunities to market associated gas downstream.

5 Summary and Recommendations

Reducing associated gas flaring and venting is an increasingly important objective of many oil-producing countries around the globe. Flaring and venting reduction not only makes environmental sense, it also lessens the waste of a economic valuable commodity.

While one must recognize that flaring and venting is an important safety measure in oil production facilities, the current level of flaring and venting in many developing and industrial countries goes far beyond operational levels and is mostly caused by a lack of an effective regulatory regime and the fact that operators are not encouraged or able to market associated gas.

Regulation can and should play a prominent role in reducing flaring and venting volumes. To this end, it is recommended that:

a. Governments develop policies that specify the role flare and vent reductions can and should play to achieve a country's environmental objectives

b. Relevant primary and secondary legislation be established that gives regulators the power to deal effectively with gas flaring and venting

c. Regulators have clearly defined responsibilities with no overlapping or conflicting mandates—most importantly, regulators must be independent from operators regulated to avoid any conflict of interest

d. Regulators develop and adopt clear and efficient operational processes for gas flaring and venting

e. Regulators be properly staffed and financed to be able to enforce compliance with regulations

f. The circumstances when operators can flare and vent associated gas *without* prior regulatory approval be clearly defined

g. Transparent gas flaring and venting application and approval procedures be established

h. Effective flaring and venting measurement and reporting procedures be established to supervise regulatory compliance

i. Regulators have adequate monitoring and enforcement powers.

Relevant factors that affect an operator's decision to use or flare and vent gas include:

- International industry standards, particularly in the areas of setting improvement targets for flaring and venting and standardizing monitoring and reporting procedures
- Fiscal policies related to the oil and gas sector, including royalty payments and taxes

- The structure of downstream energy markets and the existence of efficient and transparent regulatory and legal frameworks that provide for fair and non-discriminatory access to network and customers.

One objective of the GGFR is to assist developing countries in reducing gas flaring and venting by providing technical assistance related to establishing an efficient regulatory framework and to provide support in:

- Developing relevant gas flaring and venting strategies and policies
- Formulating efficient operational processes and regulatory procedures
- Providing institutional capacity-building capabilities
- Advising on adequate fiscal policies
- Developing efficient natural gas markets.

Appendix A: Country Regulatory Profiles

Table A.1: List of Countries Profiled

Detailed Country Profiles	
Region	**Country**
North America and Europe	Alberta (Canada), Norway, United Kingdom
Overview of Countries' Regulatory Profiles	
Region	**Country**
North Africa	Algeria, Egypt, Libya, Tunisia
Sub-Saharan Africa	Angola, Cameroon, Gabon, Namibia, Nigeria
Middle East	Oman, Qatar, Syria
Latin American and Caribbean	Argentina, Bolivia, Brazil, Colombia, Ecuador, México, Peru, Trinidad and Tobago, Venezuela
Europe and Central Asia	Azerbaijan, Denmark, Italy, Kazakhstan, Netherlands, Poland, Romania, Russia, Uzbekistan
Far East and Australia	Australia, Bangladesh, China, India, Indonesia, Malaysia, New Zealand, Pakistan, Thailand, Vietnam
North America	United States

A.1 Province of Alberta (Canada)

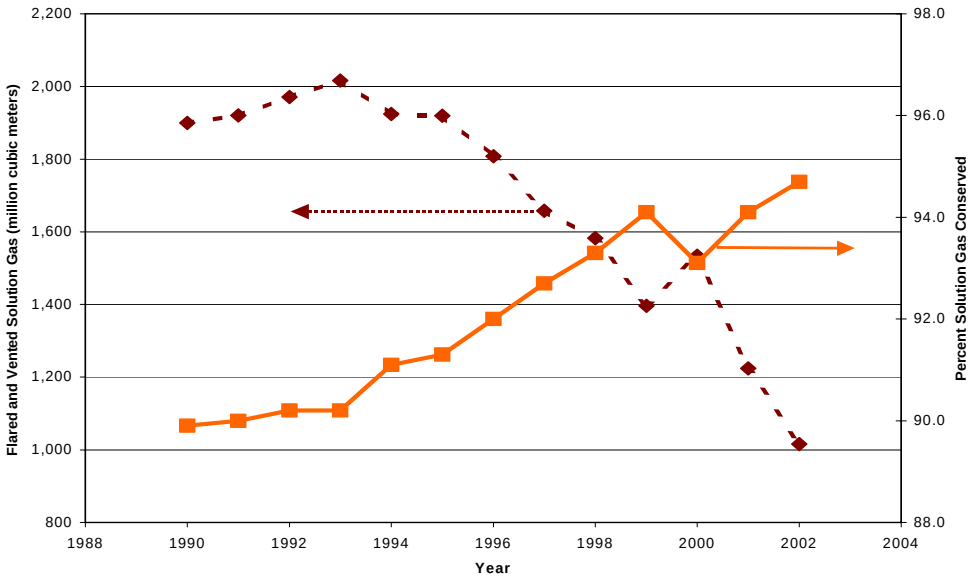
Overview of Onshore Gas Flaring and Venting in Alberta

The energy industry in Alberta has made considerable progress in reducing flaring and venting volumes from upstream oil sources.[56]

By 2002, the flaring of solution gas had been reduced by 62 percent from the 1996 flaring baseline of 1,340 million cubic meters (mcm).[57] Solution gas venting has been reduced by 29 percent from the 2000 venting baseline of 704 mcm. The volume of solution gas flared and vented has declined from the 1996 volume of 1,808 mcm to 1,010 mcm in 2002, an overall decrease of 44 percent.[58]

Figure A.1 shows the percentage of solution gas conserved and the volume flared and vented for each year from 1992 to 2002.[59]

Figure A.1: Solution Gas Conserved and Volume Flared and Vented



[56] Alberta is landlocked and does not have offshore production.

[57] Alberta uses the terminology "solution gas and gas conservation" to describe natural gas contained in crude oil using natural gas. In other jurisdictions and in this report it is generally referred to as "associated gas and gas use."

[58] *Upstream Petroleum Industry Flaring and Venting Report, Industry Performance for Year Ending December 31, 2002*, September 2003.

[59] Conservation refers to the use of solution gas as fuel for production facilities, for reinjection into an oil or gas pool, or for sale in the downstream market (for example, for power generators).

Flared and Vented Solution Gas in Alberta

Alberta's Government Policy on Gas Flaring and Venting

Gas flaring and venting in Canada is generally a matter of provincial jurisdiction. The Environmental Protection and Enhancement Act (EPEA) provides for the development of guidelines and environmental quality objectives for the province of Alberta. Alberta's air quality guidelines (Alberta Ambient Air Quality Guidelines) are established under EPEA.[60] The air quality guidelines specify parameters such as maximum concentrations of water (H_2O), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO).

Alberta Environment,[61] a government body, regulates air emissions in the province of Alberta and is responsible for setting emissions and air quality standards. These standards are subsequently applied by the Alberta Energy and Utilities Board (EUB) to set upstream petroleum industry gas flaring and venting targets.

Alberta allows industry, public, environmental nongovernmental organizations (ENGOs), and regulators to participate in assessing air quality issues and recommending management actions. The Clean Air Strategic Alliance (CASA)[62] is a multistakeholder forum sponsored by the government of Alberta that provides recommendations on policy and regulation related to air quality. Although CASA does not have legislative authority, agencies such as Alberta Environment and the EUB receive CASA recommendations and implement subsequent regulations and guidelines, as appropriate. The CASA process is viewed as being constructive and including interested parties, and the consensus built helps to forge a strong commitment to implement resulting recommendations. The petroleum industry and the EUB initiated CASA teams to make consensus recommendations on gas flaring and venting management in 1998 and 2002.

Who Regulates Gas Flaring and Venting in Alberta?

The EUB[63] has the primary responsibility for regulating the upstream petroleum industry in the province[64] and for conserving solution gas, and has consolidated its requirements in *Guide 60: Upstream Petroleum Industry Flaring, Incinerating and Venting*.[65] It provides

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[60] Refer to Section 14 of EPEA.

[61] **http://www3.gov.ab.ca/env**.

[62] CASA is a nonprofit association composed of diverse stakeholders from government, industry, and nongovernmental organizations (such as health and environmental groups). Senior representatives from each of the three sectors are committed to developing and applying a comprehensive quality management system for the people of Alberta through a consensus-based process.

[63] **http://www.eub.gov.ab.ca**.

[64] The EUB also regulates crude oil and natural gas pipelines within Alberta, while the National Energy Board (NEB) regulates energy transportation across interprovincial and international borders and must approve exports, transportation charges, and operation of facilities.

[65] The guide is now in its second iteration and incorporates consensus recommendations of a joint committee of industry, environmental nongovernment organizations, and regulatory agency representatives. A copy of the guide is available on **www.eub.gov.ab.ca/bbs/products/guides/g60/g60-draft.pdf**.

regulatory guidelines for flaring, incinerating,[66] and venting in Alberta, as well as procedural information for flare permit applications and the measuring and reporting of flared and vented gas. In addition to upstream petroleum industry facilities, the guidelines also apply to gas transmission facilities licensed by the EUB. *Guide 60* is based on CASA recommendations on gas flaring and venting.

Following recommendations of CASA, in 1999 the EUB established a solution gas flaring reduction target for Alberta for the year 2001, with the objective of reducing flaring by 25 percent of the flared volume in 1996. Actual reductions in 2000 were more than double the industry target, and the requirements for 2002 held solution gas flaring to not more than 50 percent of the volume flared in 1996. Flaring of solution gas has been reduced by approximately 62 percent from 1996.

For 2002, the EUB had the following targets and limits for gas flaring in Alberta:

a. 670 mcm;[67] and

b. if solution gas flaring exceeds the 670 mcm limit in a year, the EUB will impose reductions that will stipulate maximum solution gas flaring limits for individual operating sites based on analysis of the most current annual data.

A summary of the targets of the past four years is given below.

Table A.2: Solution Gas Flaring Reduction Schedule

Year	Firm target reduction (%)	Actual reduction (%)
1999	None established	30
2000	15	38
2001	25	53
2002	50	62
2003	no target set	data to be released*

*Data are expected to be released in the second quarter of 2004.

The above figures show that progress has been made in reducing solution gas flaring. Other reductions reported in 2002 include:[68]

- Solution gas flaring was reduced to 514 mcm, 18 percent less than in 2002

The other western Canadian provinces (British Columbia and Saskatchewan) often refer to Alberta practices in the development of provincial requirements. The NEB has consulted the EUB on upstream industry requirements and has used this information in its regulatory development processes.

[66] For the purposes of associated gas management and reporting, incinerated gas is considered flared gas.

[67] That is 50 percent of the revised 1996 baseline of 1,340 million cubic meters.

[68] EUB News Release 2002 Flaring and Venting Industry Performance Report: Solution Gas Flaring Reduced by 62 percent since 1996**.**

- Solution gas venting decreased by 98 thousand cubic meters (tcm), or 16 percent
- Well-test flaring decreased by 46 mcm, or 14 percent; 8 percent less
- Gas plants flared or vented a total of 127 mcm; a decrease of 32 mcm, or 20 percent
- Industry achieved a 94.7 percent solution gas conservation rate in 2002, compared with 94.1 percent in 2001. This is the best conservation rate achieved to date.

In 2002, the CASA team decided that before setting new reduction targets for 2003, an economic evaluation of gas conservation in Alberta should be carried out. CASA and the EUB are in the process of analyzing economic evaluation data and are in the midst of developing the next round of targets.

The EUB is currently not setting venting reduction targets, and gas vented increased from 459 mcm in 1999 to 704 mcm in 2000. The venting increase was found to result both from start-up of new, significant heavy oil operations and from improved reporting of gas venting. The former resulted from the commencement of oil production before gas conservation systems were complete. A greater regulatory and industry focus on measurement and reporting of vented gas as a result of the 1999 introduction of the EUB's flaring guide was a key factor in better reporting of vented volumes. Table A.3 provides an overview of gas flared and vented between 1999 and 2002.

Table A.3: Breakdown of Gas Flaring and Venting (in mcm)

Year	Flaring	Venting
1999	937	459
2000	831	704
2001	624	600
2002	514	502

To counter the problem of increasing venting volumes, the EUB has initiated a number of measures designed to achieve a reduction of gas venting. The measures include a requirement that all existing sources of vented gas greater than 500 m^3/day be evaluated by December 31, 2003, and if economic to do so, be conserved by December 2004. In addition, all proposed new vent sources must be evaluated as part of the project planning and application process.[69]

The EUB does not consider venting an acceptable alternative to flaring. CASA is currently considering making recommendations in this regard. This will ensure that companies will not be able to decrease their flare volumes by increasing their venting volumes.

[69] Further details can be found in *General Bulletin GB 2002–2005*, May 16, 2002, EUB.

How Has Gas Flaring and Venting Regulation Been Conducted?

Guide 60 provides regulatory requirements and guidelines for gas flaring and venting in Alberta, as well as procedural information for flare permit applications and the measuring and reporting of flared and vented gas.[70]

The key elements of gas flaring and venting regulation in Alberta include:

- The gas flaring and venting management framework and decision tree
- Economic evaluation of gas conservation
- Gas flaring and venting performance requirements
- Measurement and reporting of gas flaring and venting
- The enforcement ladder.

Each element will be discussed in more detail below.

Gas Flaring and Venting Management Framework and Decision Tree

Regulation of flaring and venting in Alberta seeks not only to address solution gas conservation, but also to prevent adverse health and environmental impacts related to flare and venting emissions.

The EUB has adopted CASA's objective hierarchy and its framework for managing routine solution gas flaring and has extended its application to include flaring and venting of gas in general.[71] Alberta requirements are founded on a framework that requires operators of petroleum production facilities to:

- Evaluate opportunities to eliminate flaring and venting
- Assess opportunities to reduce flaring and venting if the activity cannot be feasibly eliminated
- Ensure that any residual flaring and venting is conducted in compliance with performance requirements.

All proposed flares and vents must be evaluated by oil producers using the flaring and venting management framework[72] (figure A.2) and decision-tree process (figure A.3).

Economic Evaluation of Gas Conservation

A key concept regulation is the economic evaluation of gas conservation, and companies are required to evaluate opportunities to conserve flared and vented gas. EUB's policy is that gas must be conserved if conservation is determined to be economic. The evaluation

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[70] In addition to upstream petroleum facilities, the guide also applies to gas transmission facilities licensed by the EUB.

[71] *Management of Routine Solution Gas Flaring in Alberta: Report and Recommendations of the Flaring Report Team*, CASA, 1998, and *Gas Flaring, Incinerating and Venting in Alberta: Report and Recommendations for Upstream Petroleum Industry by the Flaring/Venting Project Team*, CASA, 2002.

[72] Production, pipeline, and gas processing facilities must also comply with the flaring management framework.

is conducted using an incremental rather than an integrated basis. The EUB does not require solution gas conservation if it is not economic to do so.

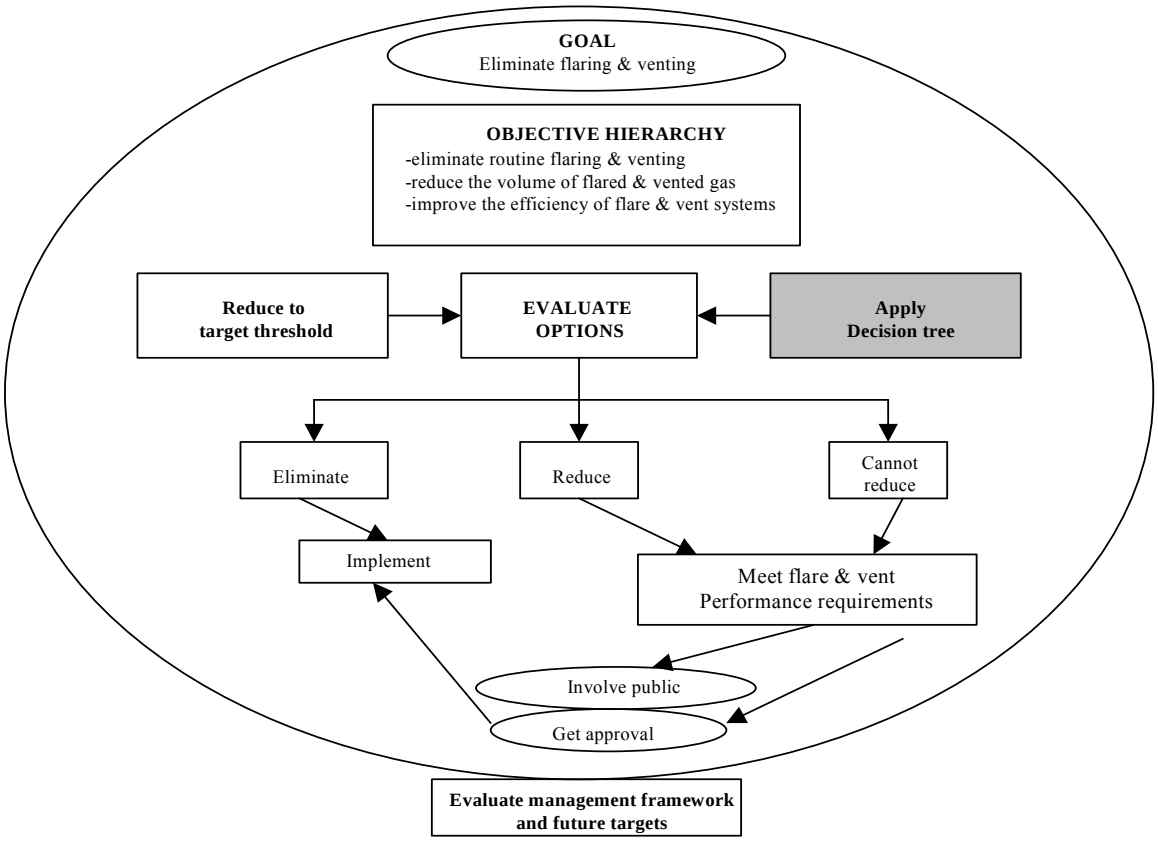
In principle, a project is considered economic if the incremental economics of gas conservation generates a net present value before tax greater than zero. The EUB has specified economic evaluation procedures, assumptions, and parameters for evaluating gas flaring and venting in *Guide 60*.[73] These criteria define costs and gas prices that can be used in the evaluation as well as the discount interest rate (prime plus 3 percent).

If a licensee determines that gas conservation is uneconomic, the complete decision-tree analysis and economic evaluation must be available for audit by the EUB. In addition, the EUB may request the following:

- Licensees to provide additional information to demonstrate that all practical options for gas conservation have been thoroughly evaluated
- Reevaluation if it appears that cost estimates are excessive or based on inappropriate technology

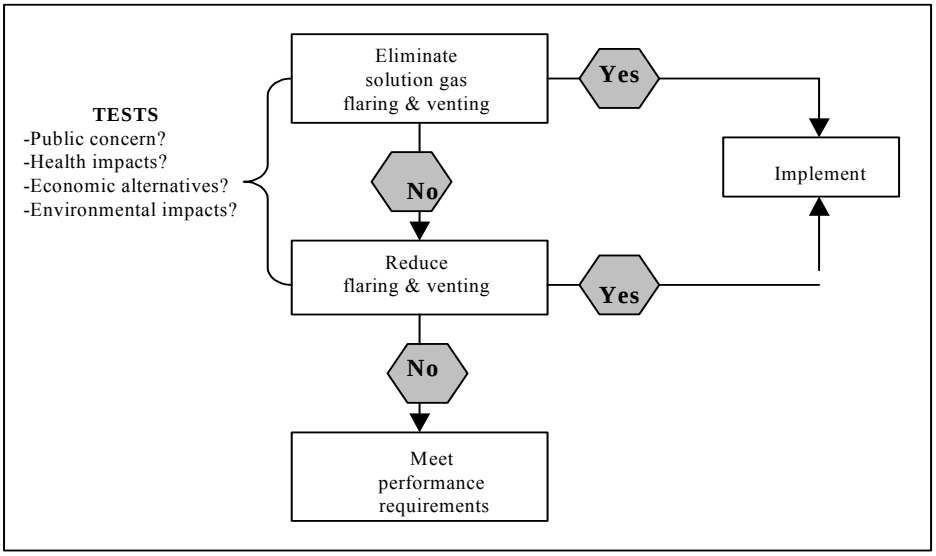
Audits of flare evaluations are in the form of random audits and targeted audits of sites flaring larger volumes, and there is no specific approval for each flare evaluation.

Figure A.2: Solution Gas Flaring/Venting Management Framework



[73] Refer to section 2.7, Economic Evaluation of Gas Conservation.

Figure A.3: Solution Gas Flaring and Venting Decision Tree



Performance Requirements

After a company has evaluated its gas flaring and venting options following the management framework and decision tree as described above, it may conclude that it is uneconomic to conserve gas. If that is the case, and if it has been approved by the EUB, the company will have to follow performance requirements for gas flaring and venting. *Guide 60* provides detailed regulatory requirements (including permit applications) for:

- Temporary and well-test flaring
- Gas battery flaring and venting
- Gas plant flaring and venting
- Pipeline flaring and venting
- Gas combustion requirements
- Venting and fugitive emissions management requirements.

These requirements include measures to ensure adequate flare ignition, liquid separation, and sour gas plume dispersion. The guide also describes limitations on venting unburned gas and includes strictly enforced requirements to prevent off lease odors.

Limited flaring of new gas wells for clean up and testing is permitted in Alberta. Regulatory permits (flare permits) are required in situations where temporary equipment is used (almost exclusively in testing of new wells), if the gas contains more than 5 percent hydrogen sulfide (H_2S), or if significant volumes are involved (that is, greater than 600 tcm for an exploration well). Flaring of sour gas is permitted only after operators can demonstrate that the flaring will comply with Alberta Ambient Air Quality Guidelines for H_2S and sulfur dioxide (SO_2). Operators are required to use the flaring management framework to assess opportunities to avoid or reduce well-test flaring (that is, prebuilt pipelines to connect new wells).

Design and operation of flares in permanent facilities such as gas processing plants are addressed as part of the application and approval processes for those facilities.

In addition, maximum annual flaring limits are imposed on gas plants, and there is a new pending requirement to limit the frequency of upset flaring events (that is, plant operators must improve facility reliability if more than six upset flaring events occur within a six-month period).

Measuring and Reporting

EUB measurement and accuracy requirements[74] for gas flaring and venting include:

- Reports of gas volumes greater than 0.1 tcm per month flared or vented by licensees of oil, bitumen, and natural gas production and processing facilities (including well tests). This includes reporting all emissions from routine operations; emergency conditions; and the depressurizing of pipeline, compression, and processing systems.
- Demonstrations by operators that gas volumes are accurately and consistently captured.
- Recommendations by the EUB that flared and vented gas be metered with equipment suited to source flow conditions.

Accurate engineering estimates may be accepted where meters are not practical and the measurement requirements can be met.

The EUB emphasizes the need to report flared and vented volumes accurately. All flared and vented gas must be reported to the EUB. This information is used to evaluate compliance with flaring reduction targets and to identify significant flaring sites for investigation. The information is also used in an annual public report published by the EUB. The EUB compiles these annual data from monthly production data operators are required to submit.

The annual report:

- Provides data and information of flared and vented gas and volumes for the various oil and gas industry sectors (well tests; gas plants; gas gathering systems; and oil, bitumen, and gas batteries)
- Reports in detail the volume of solution gas (gas from oil and bitumen batteries) conserved, flared, and vented on an annual basis
- Ranks operators according to the volume of solution gas flared, solution gas vented, total solution gas produced, and total oil from crude oil and bitumen batteries
- Reflects trends in conservation and initiatives being carried out

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[74] EUB *Guide 60*, Section 10, summarizes measurement and reporting requirements for flared and vented gas. The EUB requires comprehensive reporting of oil and gas production and disposition (EUB *Guide 7: Production Accounting Handbook*).

- Aims to increase awareness of flaring and venting volumes throughout Alberta and to encourage further gas conservation.

Before the annual report is published, operators have the opportunity to verify the volumes of solution gas flared and vented submitted to the EUB.

Enforcement of Gas Flaring and Venting Regulations

Sound flaring management rules are not effective without adequate monitoring and enforcement. The EUB inspects and audits wells and production facilities that it licenses, as well as responds to public complaints related to petroleum industry operations.[75] The characteristics of oil production make it impossible to establish continuous surveillance of each field at the same time.

The EUB's criteria for selecting sites to be inspected are based on:

- Operator performance and noncompliance history
- Sensitivity of the area (public proximity and environmental sensitivity)
- Inherent risk of the operation (potential impact level).

The monitoring process will ensure that operators with a noncompliant inspection history (for example, on gas flaring and venting) will be inspected more frequently than operators in good standing.

The EUB has established an "enforcement ladder system" to address noncompliance with regulatory requirements. The enforcement ladder is based on appropriate responses to the seriousness of the noncompliance and provides for escalating consequences if timely remedial actions are not taken or if repeat noncompliance occurs. The EUB's generic enforcement ladder is summarized in Table A.4.

[75] The EUB is responsible for inspecting the over 110,000 operating wells, 15,911 oil batteries and associated satellites, 456 sweet gas plants, 247 sour gas plants, and over 300,000 km of pipelines that form the core of Alberta's energy infrastructure.

Table A.4: Enforcement Ladder

Enforcement Level	Nature of Noncompliance	Enforcement Action
Level 1	Minor noncompliance[76] with reporting, measurement, or less significant facility requirements.	Written notification of noncompliance requesting that corrective action be taken within 30 days and that confirmation be provided to the EUB.
Level 2	Major noncompliance[77] that has an immediate or potential threat to public safety, the environment, or resource conservation. Failure to respond to Level 1 enforcement.	Written notification to senior company management of noncompliance requesting: • Noncompliance be corrected in 30 days • Written explanation of cause • Plan to ensure event does not recur • Confirmation that the noncompliance will not occur at other sites operated by the company. Facility licenses may be suspended (that is, ordered to shut down) if necessary to protect public safety or the environment.
Level 3	Serious noncompliance[78] involving a "major" item and demonstrated disregard for regulations. Failure to respond to Level 2 enforcement. Repeat major noncompliance at any site operated by the company.	Suspension of the license until written approval is received from the EUB. Require that the suspension remain in effect until written approval is received from the EUB. This will not occur until a senior company representative provides, in writing, at a meeting, the following: • Confirmation of compliance at this and all similar sites and operations • An explanation of why the company demonstrates disregard for EUB requirements • An action plan that could include third-party reviews at the company's expense to ensure this disregard for requirements does not recur.

[76] Minor noncompliance related to gas flaring and venting includes noncompliance with flare spacing requirements, gas usage not reported or reported inaccurately to the EUB, a flare stack height that does not conform to EUB requirements, and so forth.

[77] Major noncompliance includes failure to comply with any condition or permit or approval (well-test permits, volume exceeding approvals); exceeding the allowable annual flare volumes at a gas plant; and decision-tree process not completed for new, existing, and temporary flares and vents as required.

[78] Serious events include no attempt to comply with notifications, or consultations and flaring sour gas containing more than 50 mol/kmol H_2S, or flaring gas from a critical sour gas well without the required permit.

Enforcement Level	Nature of Noncompliance	Enforcement Action
Level 4	Failure to respond to Level 3 enforcement. Repeat serious noncompliance by the company within 12 months.	Per Level 2 and 3 (that is, potential license suspension), plus: • Formal order to comply • Enact "refer" status. "Refer" status results in greater scrutiny of the company and is considered by the EUB in determining whether pending and future applications for wells and facilities should be approved.

EUB reported[79] that 324 of 8,255 inspections in 2002 resulted in major or serious noncompliance assessments and that the noncompliance resulted in some 128 shutdowns of:

- Drilling rigs (14)
- Well-service rigs (1)
- Oil production batteries (45)
- Gas production facilities (16)
- Pipeline construction projects (11)
- Operating pipelines (41)

One of the most common reasons for the suspension of oil and gas production facilities is H_2S emissions (odors) associated with sour gas venting and equipment leaks. Typically, the shut-downs or suspensions remain in effect until the operator rectifies the noncompliance condition.

Other Measures That Affect Gas Flaring/Venting Volumes in Alberta

The characteristics of the upstream and downstream gas markets have significant impacts on the economics of gas flaring and venting. In principle, access to upstream and downstream gas transportation facilities, as well as direct access to customers, substantially decreases a producer's gas conservation costs.

Alberta's gas and electricity markets are fully liberalized and have the following characteristics:

- A competitive power generation market with approximately one-third of the total installed generation capacity sourced from natural gas
- Open access to upstream and downstream gas pipeline network

[79] EUB *Field Surveillance Provincial Summary* (report ST 57), **http://www.eub.gov.ab.ca/bbs/products/STs/st57-2003.pdf**.

- Full wholesale and retail competition in the gas market that allows gas producers to either sell solution gas to gas purchasers or supply industrial and retail customers in their own right

As an additional incentive to conserve solution gas, in 1998 the minister of energy announced a program of royalty waivers on otherwise flared solution gas.[80] The program encourages reduction in the volume of solution gas being flared. The waiver is independent of end-use of solution gas and lasts for 10 years. Solution gas conserved before the beginning of December 1998 is not eligible for this royalty waiver program.

The program can be summarized as follows:

- Regulatory changes have been made to provide a royalty waiver on solution gas currently being flared because it is uneconomic to conserve the gas.
- The program covers all methods of conserving solution gas.
- The Alberta Department of Energy has developed criteria to ensure that when gas can be economically conserved, it does not receive a royalty waiver.

As part of the application, the applicant will provide detailed evidence of the subeconomic status of the solution gas. The EUB will audit this evidence. If the EUB agrees that it is subeconomic, the department will qualify the associated wells for a royalty waiver.

All of the above facilitates access of solution gas to the downstream gas and electricity markets and improves the economics of solution gas and creates financial incentives to conserve rather than flare and vent.

[80] Information Letter (IL) 99-19: Otherwise Flared Solution Gas Royalty Waiver Program, Department of Energy, June 11, 1999.

A.2 Norway

Volumes of Associated Gas Flared on Norwegian Continental Shelf

Norway is a major oil producer, and its oil fields are located offshore in the Norwegian Continental Shelf (NCS).[81] In 2002, oil accounted for about 44 percent of Norwegian exports and 24 percent of government revenue.

In 2002, crude oil production from the NCS was 174 million standard cubic meters of oil equivalent (scm of oe). It has almost doubled since 1990 and increased sixfold since 1981, when Norway produced about 95 million and 27 million scm of oe respectively. The amount of gas flared has varied from year to year, mostly depending on the number of new fields that came into operation.[82] However, flaring volumes as a percentage of oil production has decreased substantially over the last two decades.

Figure A.4 provides an overview of crude oil production and annual flaring volumes over the last two decades.[83] It shows that, despite a steep increase in oil production, annual gas flaring volumes have remained stable or decreased. As a consequence, flaring volumes as a percentage of oil production have substantially decreased over the last two decades.

Gas Flaring and Venting Regulation

The Norwegian Petroleum Directorate (NPD), which is part of the Ministry of Petroleum and Energy (MPE), and the Norwegian Pollution Control Authority (SFT) are the two principal authorities that supervise air emissions and the petroleum activities under the Petroleum and Pollution Act, respectively. NPD is responsible for energy efficiency and safety on installations and for gas flaring and venting operations and enforces legislation concerning the carbon dioxide (CO_2) tax on the NCS. SFT has overall responsibility for emissions to the sea.

Since the beginning of oil production in Norway in 1970, the government's policy prohibited gas flaring to avoid wasting valuable energy. The pollution aspect of flaring and venting was introduced later. The Norwegian environmental policy historically has been based on direct regulation of environmentally harmful emissions and discharges. Increasingly, economic instruments such as taxes have been used.

The Norwegian authorities consider a close cooperation with the industry essential to achieve the established environmental goals, including reducing flaring and venting volumes, without imposing excessive economic cost burdens on the society. The " Miljøsok," a cooperative body, was established in 1995 to promote such collaboration with all interested parties in the petroleum industry.[84]

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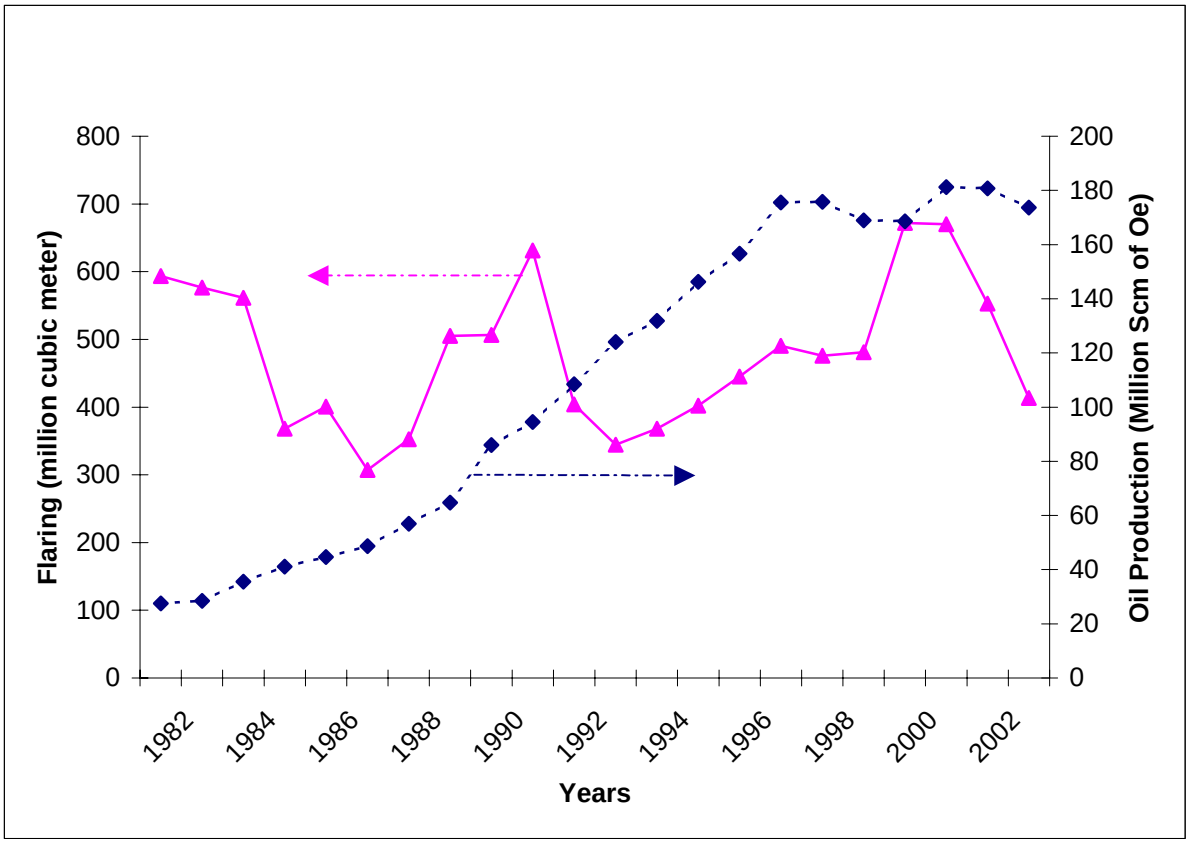
[81] The oil fields in the NCS are located in the North Sea, Norwegian Sea, and Barents Sea.

[82] *Facts 2003, The Norwegian Petroleum Sector*, Ministry of Petroleum and Energy

[83] *Environment 2003, The Norwegian Petroleum Sector*, Ministry of Petroleum and Energy

[84] Miljøsok seeks to reconcile the need for cost-effective oil and gas exploration with environmental concerns through a wide ranging cooperative body composed of government ministers, top executives in the industry, and special interest groups such the Norwegian Fishery Association.

Figure A.4: Flaring and Oil Production Volumes in Norway, 1980 and 2002



The goal of this initiative was to maintain the position of the NCS as being internationally competitive and at the same time to promote environmentally sound oil production processes and procedures. Miljøsok ended in 2000, but its recommendations have been followed up by a new collaborative organization, the "Environment Forum." The Environmental Forum has 45 members, and the director general of NPD participates in the Forum's Executive Committee.

Associated Gas Use and Permission to Flare

Operators in the NCS may lift, process, and use associated gas in operations; reinject; or flare gas, subject to relevant consents and approval of a development plan. Operators can market associated gas downstream.[85]

The Norwegian government does not set specific gas flaring and venting targets, but permission to flare gas is very restricted. Gas flaring, other than volumes necessary for safety reasons during normal operation, is not permitted under the Petroleum Act without

[85] Until 2002, gas marketing was subject to the coordination of sales by the Gas Negotiating Committee. It is now a matter of individual sales contracts by each company.

the approval of the MPE.[86] Applications for annual offshore flaring permits are evaluated directly by the NPD, and the permits are issued by MPE.

Permit applications must specify the type and level of atmospheric emissions and the technology applied to avoid or reduce pollution. Emission limits are set on a case-by-case basis, with consideration of relevant and applicable national and regional standards.

The operating company has to have a solution for using associated gas before the field development plan will be approved. As a part of the approval process, NPD and MPE also evaluate the flaring equipment and operating procedures.[87]

Gas Flaring and Venting Regulations in the Development and Production Phase

The development and production of oil fields involves continuous emissions to the air, including emissions of CO_2 from flaring. Several policy instruments are deployed by the authorities to limit the environmental impact of flaring during the operating phase. These include conditions attached to plans for development and operation and installations carbon tax, and flaring permits.

Before an operator can develop a discovery, the Petroleum Act requires that a plan for development of the operation (PDO), and possibly a plan for installation and operation (PIO), be approved by the relevant authorities.[88] As part of the PDO-PIO process, the operator must submit an environmental impact assessment (EIA). The EIA describes any environmental effects of expected emissions and discharges (including flaring and venting) and includes a systematic review of costs and benefits of any mitigating measures. Both the program and the actual impact assessment are subject to public consultation.

The NPD has recently carried out an assessment of opportunities for achieving further reductions in greenhouse gas emissions from flaring.[89] The authority has concluded that important technical measures have largely been implemented and further reductions of flaring can most likely be achieved through a stronger focus on better operating routines and fewer unplanned shutdowns.

Carbon Dioxide Tax and Gas Flaring

Increased energy utilization and reduced flaring have contributed to the reduction of emissions. This can be attributed partly to general improvements in technology but also to measures that create incentives to reduce emissions, such as a carbon tax on emissions.

The government introduced a CO_2 tax to encourage operators to reduce gas flaring volumes. The bulk of CO_2 emissions by the petroleum sector derives from offshore

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[86] Petroleum Act 1996, Article (§ 4-4).

[87] At an international level the OSPAR Commission is in the process of expanding descriptions of best available techniques (BATs) and best environmental practice (BEP) related to oil and gas condensate flaring from well testing. A draft OSPAR recommendation on BATs and BEP for oil, condensate, and gas flaring from well testing is due to be presented for discussion at the meeting of the Offshore Industry Committee in 2004.

[88] *Offshore Norway*, The Norwegian Petroleum Directorate, Annual Report 2002.

[89] *Low Level of Flaring on the Norwegian Shelf*, NPT, June 2003.

production installations.[90] Virtually all CO_2 emissions from installations on the NCS derive from gas turbines and flaring and burning of diesel as part of the oil production process.

On January 1, 1991, Norway introduced a tax on CO_2 emissions from offshore platforms.[91] This tax is levied on all fossil fuels, primarily natural gas and diesel, which emits CO_2, and also includes gas flaring. The CO_2 tax is assessed on the volume of gas flared, on the volume of natural gas vented, and on CO_2 separated from petroleum and vented on platforms or other installations used for production or transportation of petroleum. The tax is levied both in territorial waters and on the continental shelf but only in quantities corresponding to Norwegian ownership in fields that extend into foreign jurisdictions.

The tax rate is reviewed periodically, and as of January 1, 2003, the tax rate on the NCS is Norwegian Kroner (NOK) 0.75 per m³ of gas (or US$0.1066 per m³). Although not deductible against royalty or SPT (Special Petroleum Tax, 50 percent), it is deductible as a cost for corporate income tax purposes.

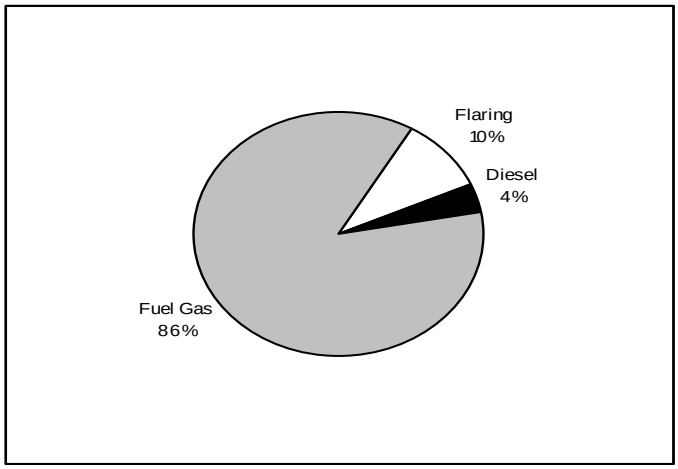
Fuel and flare figures for payment of the CO_2 tax must be reported to the NPD every six months using a standard form. Vented gas also has to be metered and reported along with gas-to-fuel and flaring, but it is a relatively small amount of gas compared with fuel and flare.

Each year, the NPD compiles historical emission data and prepares forecasts for the activities, including gas flaring and venting. Figure A.5 shows that the major oil and gas production CO_2 emission sources include fuel gas, flaring, and diesel. Turbines, flaring, and diesel engines on installations represent major offshore sources. In 2002, 10 percent of the CO_2 tax revenue collected came from flaring of associated gas.

[90] Other sources include gas receiving terminals.

[91] Act No. 72, relating to Carbon Dioxide Tax in Petroleum Activities.

Figure A.5: Taxed CO_2 Emission from Oil and Gas Production, 2002



The CO_2 tax has undoubtedly created financial incentives for operators to reduce gas flaring. In addition, an extensive offshore gas pipeline network that is connected to the Norwegian mainland, continental Europe (Germany), and the United Kingdom has enabled operators to market associated gas in these markets.

The Norwegian government is now aiming to align the CO_2 tax with EU and global emission trading schemes. It is envisaged that the CO_2 tax will eventually be abolished and replaced by tradable emission quotas that companies will either use themselves or sell or trade to others that may have overused their own quota.

Measuring and Reporting

The authorities have acknowledged that environmental objectives can be achieved only if emissions are effectively measured and monitored. Supervising environmental measures and activities is an integral function of the NPD. The NPD also supervises internal control systems for operators to ensure that the activities are planned and implemented in accordance with the authorities' requirements and the companies' acceptance criteria goals.

The NPD supervises the use of equipment that measures fuel consumption and the quantity of gas used for flaring and venting. It also collects the CO_2 tax on the shelf, and the Directorate evaluates the companies annually to assess the impact of the tax on CO_2 emissions.

Operators are responsible for metering gas-to-fuel, flare, and venting during the operational phase and are obliged to establish an internal control system that ensures that the requirements of the regulations are met. These responsibilities include the obligation to check sensor calibration every six months.

Operators are required to keep an emissions inventory, which must be submitted to the NPD with a copy to the SFT, before March 1 of each year.

The amount of gas to the flare system is measured through a metering system with an accuracy of plus or minus 5 percent. This system is subject to audits from the authorities. The operating company has to operate within the flaring permit and reports the amount of flared gas daily. The operating company has to notify the authorities if it reaches the permit's limits. For tax purposes, the amount of gas to flare is reported every six months.

A.3 The United Kingdom

Overview of Onshore and Offshore Gas Flaring and Venting in the United Kingdom

The U.K. Offshore Operators Association (UKOOA)[92] calculates quantities of waste gases produced by its members, including oil and gas operators. Using 2001 data, it calculated that the oil and gas operators' CO_2 emissions represent some 4.5 percent of overall U.K. emissions. Out of that percentage, about 71 percent of offshore CO_2 emissions are from gas consumed in turbines (that is, fuel gas), with an additional 20 percent from flaring. Venting accounts for only 0.05 percent of the industry's total atmospheric emissions.

Table A.5 shows how gas flaring fell between 1996 and 2001 by about 20 percent.

Table A.5:Gas Flared Onshore and Offshore 1996–2001

Year	Gas flared (tons)		
	Onshore	**Offshore**	**Total**
1996	253,686	2,054,542	2,308,228
1997	182,586	1,860,947	2,043,533
1998	169,177	1,886,572	2,055,749
1999	179,736	1,768,184	1,947,920
2000	282,488	1,688,512	1,971,000
2001	265,424	1,561,694	1,827,118

Source: UKOOA

U.K.'s Government Policy on Gas Flaring and Venting

The U.K.'s government policy on gas flaring and venting has to be assessed within its overall policy objectives in regard to:

- Maximizing economic recovery of the U.K.'s oil and gas reserves
- Reducing greenhouse gas emissions.

Under the Kyoto Protocol the United Kingdom has a legally binding target to reduce a basket of six greenhouse gases by 12.5 percent below 1990 levels in the period 2008–2012. The United Kingdom further set a domestic goal to cut CO_2 emissions by 20 percent below 1990 levels by 2010.

[92] UKOOA is the representative organization for the U.K. offshore oil and gas industry. Its members are companies licensed by the government to explore for and produce oil and gas in U.K. waters. UKOOA currently has over 30 members, including all major oil and gas companies.

To achieve those targets the U.K. government issued a policy statement in November 2000[93] specifying detailed policies and measures and containing a balanced package across all sectors to tackle climate change and emission reductions.

At the same time the government not only has policy objectives to achieve environmental targets, but also to maximize economic recovery of the United Kingdom's oil and gas resources. Hence, in assessing proposals for new field development, the government considers the following policy objectives:[94]

- Ensuring the recovery of all economic hydrocarbon reserves
- Ensuring adequate and competitive provision of pipelines and facilities
- Taking proper account of environmental impacts and the interests of other users of the sea.

The government specifies that no single policy objective takes precedence, and where a conflict arises, the relative merits of each will be viewed in light of particular facts of the oil and gas field proposal on a "case-to-case basis."

Who Regulates Gas Flaring and Venting in the United Kingdom?

The Licensing and Consents Unit of the Department of Trade and Industry (DTI)[95] is responsible for developing and coordinating government policy related to:

- The oil and gas fields on the land territory of Great Britain (onshore)
- The U.K.'s territorial waters and on the U.K. Continental Shelf (UKCS) (offshore).

DTI is responsible not only for policy issues but also for regulating the upstream gas and oil markets through powers given in the Petroleum Act.[96] These responsibilities include regulating and supervising gas flaring and venting. Under the Energy Act 1976, *consent* of the secretary of state for trade and industry[97] is required for the disposal of natural gas (whether at source or elsewhere) by flaring or by releasing it unignited into the atmosphere (venting).[98] This applies to all onshore hydrocarbon fields as well as offshore fields.

There are also other departments and government institutions that have responsibilities in regard to gas flaring and venting, including local authorities that assess the likely impact

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[93] *Climate Change: The U.K. Programme*, Department for the Environment, Transport and the Regions, November 2000

[94] Guidance Notes on Procedures for Regulating Offshore Oil and Gas Field Development.

[95] www.og.dti.gov.uk.

[96] Petroleum Act 1998. "Petroleum" as defined under the Act includes any mineral oil or relative hydrocarbon and natural gas existing in its natural condition in strata. Please refer to Chapter 17, Section 1, of the Act.

[97] The secretary of state for Trade and Industry has the overall responsibility for the Department.

[98] Consent for flaring is also required under The Petroleum (Current Model Clauses) Order 1999.

of "noise and vibration" of onshore gas flaring.[99] However, the ultimate responsibility of issuing gas flaring and venting consents lies with DTI.

The Environment Agency and the Scottish Environment Agency also issue stringent consents regarding emissions from onshore operations.

How Has Gas Flaring and Venting Regulation Been Conducted?

The question of how regulation is being conducted refers to the translation of government policy objectives into detailed regulations that best ensure that those objectives are achieved in an efficient and transparent manner.

Issues that have been addressed in this context are:

- In which legislation has gas flaring/venting been embedded?
- What types of regulation have been implemented?
- Which processes and procedures have been adopted?

Gas Flaring and Venting Legislation

The following laws and regulations govern gas flaring and venting in the United Kingdom:

- *Primary legislation:* Energy Act 1976**,** Petroleum Act 1998; Petroleum (Current Model Clauses) Order 1999; Environmental Legislation applicable to the Onshore Hydrocarbon Industry (England, Scotland, and Wales); The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999
- *Key instruments for invoking primary legislation:* Onshore (that is, Petroleum Exploration and Development Licenses); Offshore (that is, Exploration[100] and Production Licenses[101]); Guidance Notes on Procedures for Regulating Offshore Oil and Gas Field Developments; Field Development Program; Venting and Flaring Consents; Offshore Pipeline Works Authorizations.

Primary legislation gives DTI the power to regulate onshore and offshore gas production and exploration and gas flaring and venting. It also gives DTI the power to approve and issue flare and gas consents for onshore and offshore fields. Other agencies, such as local authorities, also have powers under primary legislation. For example, environmental legislation specifies that new onshore developments will be assessed by the local authorities on the likely impacts of "noise and vibration" of gas flaring and venting as part of the overall planning approval process.

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[99] Environmental legislation applicable to the Onshore Hydrocarbon Industry (England, Scotland, and Wales).

[100] Production, or any drilling deeper than 350m, is not permitted under an Exploration License.

[101] The main type of offshore license is the Seaward License, of which DTI has now granted more than a thousand.

Types of Regulations

Flare and Venting Consent

The flare and venting consent is a key regulatory instrument applied by DTI to control the volume of gas flared and vented and approve the amount of gas each facility and site can flare and vent each year.

DTI issues licenses and is responsible for authorizing the development of new gas and oil fields.[102] Licensees submit a Field Development Plan for approval. Operators are given the opportunity to make representations about relevant technical and financial factors before DTI determines whether to grant approval. If approved, a Production and Development consent will be issued.

Before startup, operators must submit a written application for the consent to flare and vent gas, specifying the proposed date the flaring or use of gas is to commence. This date must be not less than two months from the date the application is submitted, unless DTI notifies the operator of a shorter period as a consequence of the development plan approval procedure.

Consents are given mainly in the context of development plan approvals. Prior consents are not required for unanticipated flaring that is necessary to avoid personal injury. DTI requires licensees to keep flaring to the minimum that is technically and economically justified, including the flaring of gas during extended well tests. These may also require consent. Particular attention will be given to the facility's design, the potential for gas reinjection, and in the facility's commissioning program to ensure that all steps are taken to reduce the need for flaring.

For fields in the commissioning stage, or where there have been particular problems, operators are required to submit regular reports to DTI regarding the amounts being flared. Operators are also required to submit details of production and flare rates. These are published on the DTI website following a three-month confidentiality period.

There are currently no financial penalties for gas flaring and venting in breach of a consent. However, a breach of a consent is considered grounds for revoking an operator's license.

Field operators on short-term consents are required to provide DTI with detailed reports (weekly or monthly or at longer intervals as agreed) of production, flaring, efficiency of the plant, any technical problems, and so forth. Operators then have to justify their application for the next consent period. These consents are considered on a case-by-case basis. For companies on annual consents DTI will not issue a consent for the following year until it is satisfied that the amounts being requested are justified from a technical and economic point of view. Though production consents and venting may be issued to cover several years, the maximum offshore flaring consent is one year.

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[102] As with any licensing system, many of the detailed regulatory provisions are laid down in conditions attached to the licenses. The Petroleum Act is rather unusual in that these conditions ("Model Clauses") are published in secondary legislation.

Technical and Operational Regulations and Restrictions

Technical and operational regulations typically apply to:

- Burn technology and practices
- Timing of burning and venting
- Location of flaring and venting
- Heat and noise generation.

In the United Kingdom., technical and operational requirements are set out in guidelines and codes of conduct issued by the oil industry. The UKOOA publishes guidelines on reducing emissions and maintaining flaring and venting safety.

Regulatory Processes and Procedures

Field Development Program

The documentation required for new oil and gas field authorizations is the Field Development Program (FDP).[103] The FDP provides a summary description of the actual field development and the principles and objectives that will govern its management. The FDP includes provision of how the operator plans to deal with flaring and venting of gas.

As part of the assessment process of a new field development, the operator is required to provide a spreadsheet called the Common Reporting Format (CRF), which provides detailed information on the new field and will help DTI to make an efficient assessment. The spreadsheet includes projections of annual gas flaring and venting in the field.[104]

A new field development will be authorized once the secretary of state is satisfied that the FDP meets the government's policy objectives and the Environmental Impact Assessment (EIA)[105] process has been completed successfully. An EIA is mandatory for all developments where the level of oil production is intended to exceed 500 metric tons a day (3,750 barrels per day).[106]

For new oil field developments, DTI expects that where, over the life of the field, the value of the produced gas is higher than the costs of bringing it to the market, the licensees will make provisions for its processing and transportation to shore. In

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[103] The norm for Field Development Program documentation for all fields is a maximum of about 15 pages of text plus associated figures.

[104] A copy is available on www.og.dti.gov.uk/upstream/field_development/CommonReportingFormat.xls.

[105] The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 came into force on March 14, 1999. These regulations implement the European Council Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment insofar as it relates to certain offshore oil and gas projects' effects on the environment. Please note that the public has the right to comment on the Environmental Statement, and the secretary of state must be satisfied that the regulations' requirements relating to publicity and consultation have been substantially met.

[106] Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999.

considering whether the gas should be brought to the market, DTI will regard the overall costs and benefits that may not reflect the commercial positions of individual licensees.[107]

If it is not economic to bring gas to shore, the licensees should carefully consider:

- Its use as a fuel
- It as a means of improving oil recovery
- Conversion to other fuels
- Injection for disposal
- Sale to a neighboring development
- Flaring/venting.

The option that maximizes the economic recovery of the field would normally be selected.

Gas Flaring and Venting during Commissioning

Appendix 9 of the Guidance Notes[108] provides further details on the procedures for dealing with gas flaring and venting during the commissioning phase of new field developments.

It is DTI's policy that gas flaring during commissioning should be kept to its lowest level that is consistent with the safe and efficient commissioning of oil- and gas-related plants.

To achieve this the operator should:

- Take the initiative in keeping in close contact with DTI at all stages, from design through construction (during the commissioning process, DTI will insist on regular meetings).
- Demonstrate that all reasonable steps have been taken to keep flaring and venting to a minimum.

The following points should be noted in this respect.

a. Plant design

Should the operator propose any venting of hydrocarbons, for example, from low-pressure drains, rather than disposing of them via the flare system, this should be discussed with DTI at the earliest opportunity.

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[107] In this context, where gas transportation and processing involves the use of third-party infrastructure, in the first instance, access to those facilities is a matter of commercial negotiations. The secretary of state may, however, use his or her discretionary powers under the Petroleum Act 1998 to set charges or to require access to infrastructure if the parties cannot agree.

[108] Guidance Notes on Procedures for Regulating Offshore Oil and Gas Field Development.

b. Hookup and installation planning

All gas plants must be complete, fully leak tested, and otherwise tested and commissioned as far as is practicable, and able to receive gas, before First Oil. A gas flaring consent will not be issued until DTI is satisfied that the system is ready to receive gas as soon as stabilized flow is achieved.

c. Commissioning gas flaring and venting consent applications

These should be submitted at least two months before First Oil and should contain the following:

- A summary of the main points in the application.
- A summary of the main flaring assumptions.
- A detailed description of the plant startup procedures and philosophy.
- The commissioning schedule.
- Flaring calculations—to include flaring on a daily basis and total quantities. Where the gas stream contains a significant proportion of nonhydrocarbon gas a Venting Consent may also be required. The quantities of gas stated in the Venting Consent application should be on the same basis as the hydrocarbon gas in the Flaring Consent application.
- Commissioning gas flaring consents.

Initially, these consents are short term, generally given on a monthly basis until stable plant operation is achieved. During the consent period, the operator is required to e-mail to DTI the following information every Monday relating to the previous week:

- A short technical summary of the gas handling plant's performance, highlighting any features that have affected or could affect the plant's operation
- Daily rates of oil production, gas production, gas export, gas used for fuel, and of gas flare
- Cumulative average for production and flare
- Weekly calculations of gas compression plant efficiency

DTI issued the following gas flaring and venting guidelines:

- During the commissioning of production facilities, flaring consents will usually be restricted to between one and three months and will be for a fixed quantity of gas based on an auditable program.[109]

[109] During the initial commissioning period, monthly reports may be requested, in which case the data should be presented on a monthly basis with rolling averages for the year to date. In regard to gas flaring, reasons must be given for any deviations from the production target flare figure and measures taken to minimize wasteful flaring and venting of gas.

- Once stable operating conditions have been achieved, the duration of the consent will be increased to 12 months and will be subject to an agreed cumulative maximum for the period.

Gas Flaring and Venting at Existing Fields

A policy requirement for checking gas flaring and venting at existing fields is the Annual Field Report (AFR). Annual Field Reports ensure that operators are carrying out the work agreed in the Field Development Plan and highlight any new plans for the coming year. Production and flare figures are mentioned in the AFRs, but the main objective of the AFR is to supplement the Field Development Plan. Reporting periods for existing fields are annual, and production data, including gas flared and vented, are included in the Annual Field Reports.

Although Appendix 6 of the Guidance Notes[110] illustrate how to prepare an AFR,[111] most operators have been using their own definitions of production metrics, loss analysis, and reporting formats.

To measure the performance of all the fields against a common and consistent set of performance indicators, DTI has recently issued a consultation paper[112] that proposes a wide range of performance indicators for measuring the production efficiency of UKCS offshore oil and gas production facilities. For gas flaring and venting, the following proposed measurements are of particular relevance:

- **Gas Use Efficiency**

$$1 - \left(\frac{\text{volume of gas flared in 12 months}}{\text{volume of gas produced in 12 months}} \right) = X\%$$

- **Flare Ratio**

$$1 - \left(\frac{\text{daily volume gas flared}}{\text{daily volume of gas produced}} \right) = X\%$$

This will be expressed as a daily percentage and presented graphically over the 12-month reporting period. Flaring-related metrics would require daily production and flaring data to be recorded.

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[110] Guidance Notes on Procedures for Regulating Offshore Oil and Gas Field Developments.

[111] A field report normally will be required annually, but for simple or well-understood mature fields with minimal flaring, the reporting should become less frequent.

[112] Performance Metrics for Measuring the Production Efficiency of UKCS Offshore Oil and Gas Production Facilities.

Flare Transfer Pilot Trading Scheme

The above sections describe the current regulatory framework for gas flaring and venting in the United Kingdom and show that over the last decade the U.K. oil industry has achieved substantial reductions in gas flaring without compromising oil production. These reductions have been achieved mostly by regulation of gas flaring and venting, increased plant efficiency, adoption of best working practices, and an increased awareness of the environment.

The government recognized that if the downward trend in flare volumes released was to continue, a further mechanism that created economic incentives for companies to reduce gas flaring would be needed. This consideration has led to the development of the Flare Transfer Pilot Trading Scheme (FTPTS).

Launch of FTPTS

The FTPTS is a voluntary scheme arising from an industry-government initiative and currently encompasses about 50 percent of the commissioned fields within the UKCS.[113]

The aim was to develop a flexible and economically efficient mechanism to create incentives for oil companies to further reduce gas flaring beyond the annual flare consent.

The FTPTS is aligned, as far as possible, with the U.K. Emission Trading Scheme (UKETS),[114] and a longer-term possibility could be to integrate this flare transfer system with the wider domestic and international emission trading schemes. As a consequence, any credits would need to be acceptable in the domestic and international carbon market.

A Rules Book[115] was issued in October 2000 (updated annually) that set out the governance of the scheme and definitions of the transfer mechanisms between "buyer" and "seller," and the FTPTS was officially launched on January 1, 2001.

Two Trading Schemes

Two scenarios exist under which the scheme operates, and both are made possible through a voluntary agreement between operators, including:

- Transfer of flare by assets operating within flare gas volume consents
- Transfer of flare gas volume by revision of flare consents.

Flare consents, which are issued on a field-by-field basis, typically contain an element for safety purposes and for unforeseen contingencies. It is in this contingency element where further flare reductions can be found. The flare-trading scheme provides the framework

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[113] Onshore fields were not included because they were already covered by the UKETS run by Department for Environment, Food and Rural Affairs (DEFRA). This scheme involves monetary trades, while the FTPTS is purely voluntary and was introduced to get companies used to the benefits of trading while ensuring that the overall consent amount for those in the scheme was not raised. DTI is currently considering whether onshore terminals should be included in the scheme.

[114] DEFRA, The U.K. Emission Trading Scheme, October 2002

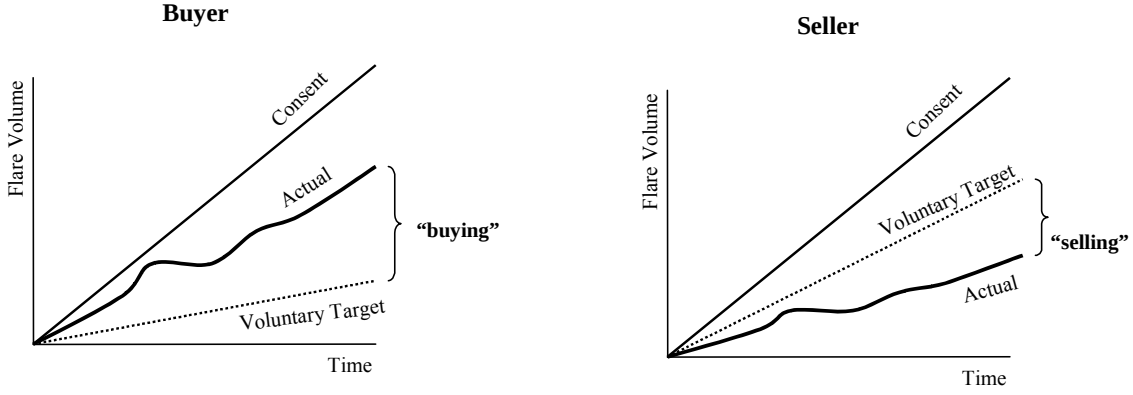
[115] In 2000 several workshops were held at which industry representatives met with the government to determine the price mechanisms for governing the scheme.

for operators to trade their unused contingency, while maintaining the flare consent and oil production targets from their fields.

As a first step, "voluntary asset targets" are set by individual companies for their own assets.[116] Those voluntary targets are below the flare consent agreed on with DTI. Voluntary targets set by each company are publicly available. Both consent and voluntary targets may be changed if trades take place. One benefit of the scheme is that companies do not have to come to DTI to justify why an increase in their consent may be necessary, but they can obtain the necessary amounts from members. DTI brokers the transfer and issues the revised legal consents.

Because of a complex operating environment for oil exploration and production, actual flaring might be higher or lower than the voluntary target but still lower than the flare consent agreed with DTI. The scheme provides flexibility for those companies that are below or above the target to transfer (buy and sell) flare between sites and companies. Figure A.6 illustrates how the scheme works.

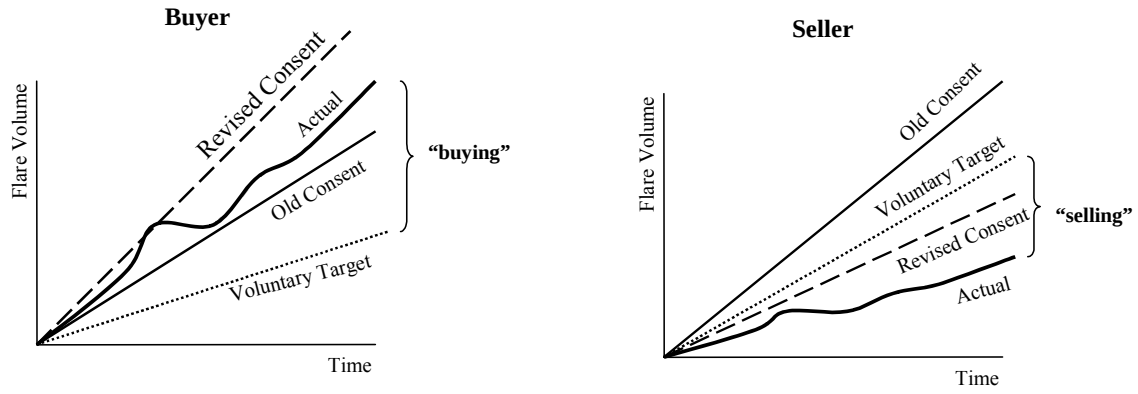
Figure A.6: Flare Transfer by Assets Operating within Flare Consents



The above scenario describes a situation where companies remain within their department-approved flare consent. The FTPTS scheme also has provisions for the scenario whereby an operator anticipates that the flare consent could be exceeded because of unforeseen operational upsets. The scheme allows for one or more operators to agree to transfer flare volume to another flare consent, provided the sellers reduce their flare consent by the commensurate amount. As the flare consents regime requires legal compliance, any consent revision requires official approval by the regulator (DTI). Figure A.7 illustrates that scenario.

[116] Operators use internal methodologies to determine the level of contingency element built into their voluntary consents that could be used to contribute to reducing flare volumes below the flare consent issued by the department.

Figure A.7: Flare Transfer by Consent Revision



Monitoring and Measurement

Currently, a consultation process is being held with the objective of producing guidance for measurement and verification of the FTPTS. A document was produced that proposed three measurement categories be defined, each relating to how accurately a quantity of flared gas can be determined.[117] By applying such categories, a financial incentive is inferred on measuring flare gas more accurately and should warrant an economic case for installing more accurate technology, thereby encouraging more efficient trading.

Other Measures That Affect Gas Flaring and Venting Volumes in the United Kingdom

The United Kingdom government has created incentives in the upstream and downstream gas market that have improved the economics of gas flaring and venting.[118] Those incentives include:

- Restructuring and unbundling of the downstream gas market
- Third-party access (TPA) to the upstream gas pipeline network
- Wholesale and retail competition in downstream gas and electricity markets.

Restructuring of the U.K. gas market started in 1986 with the privatization of British Gas in 1986. Since then the industry has been fully unbundled into a legally separate network company and shippers and suppliers. In 1996 domestic gas customers were for the first time able to switch suppliers. With the 1998 opening of the Interconnector gas pipeline between Bacton (U.K.) and Zeebrugge (Belgium), the U.K. gas market was connected to the European gas market.

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[117] Proposal for a Measurement, Verification and Discount Scheme.

[118] The U.K government has not provided any direct fiscal incentives, such as tax breaks, to oil companies to reduce flaring and venting.

About the same time the privatization and liberalization of the U.K. electricity market was carried out, which increased the number of gas-fired power generators and created a new market for the U.K. gas industry.

Open access and competition in downstream markets reduces the cost of shipping gas from oil fields to downstream facilities. This implies that producers not only have potential access to upstream and downstream gas pipeline network, but they also can either sell gas directly to importers or act as a shipper in their own rights and supply industrial and domestic customers directly.

Restructuring and liberalization of downstream gas and electricity markets have positive effects on upstream oil and gas exploration and production, improves the economics of associated gas, and creates incentives to reduce gas flaring and venting.

A.4 North Africa

Algeria

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with Sonatrach, the national oil company, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare associated gas, subject to relevant consents.

Permission to Flare

Sonatrach grants permission to flare gas that cannot be marketed and that exceeds operational requirements. It is understood that permissions are granted on a case-by-case basis.

Flaring Restrictions and Penalties

To date, no air quality or emission standards have been issued by the government. Instead, Sonatrach issues emission standards on a case-by-case basis. Operational restrictions, too, will be imposed on a case-by-case basis. Noncompliance with any flaring restrictions may constitute grounds for revoking the operator's rights. Currently, no financial penalties are imposed.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Laws 86-14 and 91-21 on Exploration and Production (E&P); Decrees 87-158, 87-159, and 96-118
- Environmental legislation: Law No. 83-03 on Environmental Protection, Order No. 93-163; Decree No. 90-78 on Environmental Impact Assessment; Executive Decree No. 93-165 on Regulating Atmospheric Emissions of Smoke, Gases, Dust, Odors, and Particulates

Regulating Agencies

Sonatrach is responsible for regulating gas flaring and venting in Algeria.

In 2000 the Ministry of Energy published a draft hydrocarbons law. Under the proposed new law, a new authority called Alnaft would be responsible for flaring and venting issues, awarding upstream contracts, and approving development plans. A preliminary draft of the law was submitted to parliament in September 2002 for debate and approval but has yet to be passed.

Egypt

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with Egyptian General Petroleum Company (EGPC), the national oil company, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to consents.

Priority is given to gas used to optimize oil production. EGPC has preemptive rights to purchase gas from the operator.

Permission to Flare

EGPC grants permission to flare gas that cannot be marketed and that exceeds operational requirements. Permission is given in the context of approval of an Environmental Impact Assessment (EIA) at each operational stage, including well testing. It is understood that as a result of oil sector efforts to minimize both flaring and venting, the EGPC does not perceive them to be a major environmental concern.

Flaring Restrictions and Penalties

Where flaring and venting are necessary, pollutant emission levels must not exceed the maximum permitted limits, set in relation to international standards as approved by EGPC. Generally, operators must ensure that the emissions of noxious and harmful smoke, gases, and fumes are within the following limits: 2,500 mg/m^3 for SO_2, 300 mg/m^3 for NO_x, and 200 mg/m^3 for particulates. Measures must be taken to ensure the complete incineration of gas (for example, optimum size and number of burning nozzles, introduction of additional air, or the use of diesel fuel to enhance the incineration). The Egyptian Environmental Affairs Authority (EEAA) is responsible for compliance checking, emissions monitoring, and enforcement, although some degree of internal control has been introduced by the requirement that the operator keep a register showing the impact of activity on the environment. Noncompliance with any flaring restrictions may constitute grounds for revoking the operator's rights.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Concession Agreement
- Environmental legislation: Law No. 4 of January 27, 1994, concerning the Environment; Decree No. 338 of February 18, 1995, on Regulations for the Law of the Environment

Regulating Agencies

- Egyptian General Petroleum Corporation
- Egyptian Environmental Affairs Authority

Libya

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with the National Oil Company of Libya (NOCL), the national oil corporation, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to gas used to optimize oil production. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the minister after review by the operator's management committee, that is, NOCL. Permissions are issued on a case-by-case basis.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: Model Petroleum Contract

Regulating Agencies

- National Oil Corporation of Libya

Tunisia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Delivery of associated gas to the domestic market is to be given priority over exports. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements. Gas is taken at the outlet of the hydrocarbon separation and processing station. The state will pay for any equipment required to take the gas.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry of the National Economy. Permission is given in

the context of approval of the Environmental Impact Assessment at each operational stage, including well testing and the field development plan.

Flaring Restrictions and Penalties

Gas must be flared using "green burn" technologies to ensure full and effective incineration. These technologies include using the optimum size and number of burning nozzles, introducing additional air, or using diesel fuel to enhance the incineration of heavy crude oil. There are no emission standards for E&P activities.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons Code: Petroleum Law (Law 99-93 of 1999) and Regulations; Model Petroleum Contract
- Environmental legislation: Law No. 88-91 of August 2, 1988, concerning the Creation of a National Environmental Protection Agency; Decree No. 90-2273 of December 25, 1990, concerning the functions of Expert Inspectors of the National Environmental Protection Agency; Decree No. 91-363 of March 13, 1991, concerning Environmental Impact Studies

Regulating Agencies

- Ministry of the National Economy
- National Environment Protection Agency (ANPE)

A.5 Sub-Saharan Africa

Angola

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to separate agreement with Sonangol, the national oil company
- Use associated gas in operations or reinject or flare gas, subject to consents.

The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements. Gas is taken at the separation point.

Permission to Flare

Except for short-term flaring necessary for testing or other operations, permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry of Petroleum. Permission may or may not be granted and is subject to:

- The alternatives to flaring that have been considered
- The quantity and quality of the gas in question
- The duration of the flaring period requested.

In 1995, the minister of petroleum revealed a plan to use associated gas domestically, especially for fertilizer production and to discourage gas flaring. An industrial park (FUTILA) that may be supplied with associated gas from offshore fields is being investigated. More recently, emphasis has been placed on reinjection and the development of an LNG plant to use associated gas for export.

Flaring Restrictions and Penalties

Atmospheric emission standards for flaring have not been specified to date.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Petroleum Law 13/78; 1991 Model Concession Decree; 1976 Concession Decree; Deep Water Model Production Sharing Contract (1991); Model Petroleum Contract (1989)
- Environmental legislation: General Environmental Law 1998; Decree 39-00 concerning Environmental Protection in the Petroleum Industry

Regulating Agencies

- Ministry of Petroleum

Cameroon

Associated Gas Usage

Under the Petroleum Act 1999, the operator and the state may:

- Lift, process, and market associated gas
- Use associated gas in operations or reinject or flare gas that is uneconomic to commercialize, subject to relevant consent.

Associated gas volume exceeding that required for operations and that, in the operator's judgment, has no commercial value can be lifted by the state at any time at the separator outlet and compressed, processed, or piped away at the state's expense.

Permission to Flare

Operators who started oil production in Cameroon before the passing of the Petroleum Code 1999 are required to carry out their upstream operations (including flaring and venting of associated gas) in a manner that is compatible with best international practice for operation applied in the petroleum industry.

Associated gas (and nonassociated gas) can be employed by operators to support various efforts related to oil production, such as gas-lift, fuel for generators, gas for instrumentation, and gas injection for reservoir pressure maintenance. Operators are allowed to flare any excess associated gas without prior approval by the relevant ministry.

Ever since the Petroleum Code was passed, practices have evolved and changed in Cameroon. Contracts signed after 1999 require that excess associated gas that is not used to assist crude oil production be "commercialized" if there is a market or reinjected if that will improve oil recovery.

If commercialization or reinjection for oil recovery is considered uneconomic, then operators are allowed to flare excess associated gas. This has to be approved by the government ministry in charge of hydrocarbon, in a process to be defined by the ministry.

Flaring Restrictions and Penalties

Cameroon currently does not have any emission targets or flaring and venting limits. Operational processes for flaring and venting have to be consistent with best international practice applied in the oil industry.

Legislation

Gas flaring and venting regulation and legislation is still in its infancy in Cameroon, although it has evolved over the years. The following legislation is most relevant to gas flaring and venting:

- *Petroleum Code 1999.* No secondary legislation (such as codes, guidelines) that deals specifically with operational processes or regulatory procedures related to gas flaring and venting currently exists.

- *Gas Code 2002.* The Gas Code of December 2002 and implementing texts (decrees, regulations) cover the downstream side of the gas industry, such as transportation, distribution, transformation, importation, exportation, tariffs, and so forth.

Regulating Agencies

- The ministry in charge of hydrocarbons.

Gabon

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to separate agreement with the minister
- Use associated gas in operations or reinject or flare gas, subject to relevant consent.

The state is entitled to take associated gas that is not marketed by the contractor and that exceeds operational requirements, on terms to be agreed.

Permission to Flare

Consent to flare gas may be granted by the minister as part of the production license conditions on a case-by-case basis.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract 1998
- Environmental legislation: Environmental Law 1993

Regulating Agencies

- Ministry of Mines, Energy, and Petroleum

Namibia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use gas in operations or reinject or flare gas, subject to relevant consents.

The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements. Gas is taken at the downstream flange of the separator on the production platform or other agreed delivery point at the collecting and inlet system. The state will pay for any equipment required to take the gas.

Permission to Flare

It is preferred that associated gas be reinjected. Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the ministry. Written approval is required.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: Model Petroleum Contract

Regulating Agencies

- Ministry of Mines and Energy

Nigeria

Associated Gas Usage

The operator may:

- Produce, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents (not to be unreasonably withheld).

Priority is given to gas used to optimize oil production. A development plan for any associated gas not required for operations must be submitted to the Department of Petroleum Resources (DPR) no later than two years after the startup of crude production from the contract area. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

The Department of Petroleum Resources grants permission to flare gas that cannot be marketed and that exceeds operational requirements by issuing an Associated Gas Flaring Permit. The Associated Gas Reinjection Act 1979 required all operators to prepare programs for gas utilization or reinjection and strictly limited the grounds on which flaring could be permitted. These goals proved to be unrealistic, and in 1984 the legislation was relaxed to provide for continued flaring of associated gas under permits issued by the minister but subject to payment of a penalty.

With the implementation of Decree No. 86 of 1992, EIAs have become an integral part of the planning process and are mandatory for the development of oil and gas fields. Permits to flare are, therefore, now granted in the context of EIA procedures, which are overseen

by the Federal Environmental Protection Agency (FEPA) and the DPR. FEPA's *EIA Guidelines for Exploration and Production (E&P) Projects 1994* state that mitigating measures to preserve air quality must specifically include the minimization of venting during production.

In effect, petroleum operators are subject to two sets of regulatory provisions, with no clear precedence of one over the other having been established. Jurisdictional conflicts between FEPA and the Environmental Branch of the Department of Petroleum Resources are currently being addressed. The DPR's Environmental Branch now operates in conjunction with FEPA and it is understood that FEPA has played an active role in the review of the draft *Environmental Guidelines for the Petroleum Industry*. FEPA and DPR have the right to carry out inspections of industrial installations where reasonable grounds exist for believing that environmental degradation is taking place. Furthermore, FEPA and DPR are the competent authorities with regard to managing the EIA procedure.

Flaring Restrictions and Penalties

The issue of atmospheric emissions must be addressed in the EIA prepared in support of the overall production plan. Standards for gaseous emissions from E&P activities are prescribed by the Effluent Limitation Regulations 1991. In summary, the maximum natural gas emission levels for upstream operations are set at 5,000 $\mu g\ m^{-3}$, with a flaring emission limit of 5 mg/m^3 hydrocarbons. Other operational restrictions are included in guidelines.

In accordance with the Associated Gas Reinjection Act 1979, a fee is charged for flaring. This was first set at 0.50 Naira per million cubic feet (mcf) but effective January 1998 is 10 Naira per mcf, which at November 2003 exchange rates is equivalent to US$0.076 per mcf. This sum is payable in the same way as royalty—in foreign currency into the designated foreign account into which royalties are paid. It is worthwhile noting that in recent years oil companies in Nigeria have been charged a total of between 20 million and 50 million Naira (or US$150,000–370,000) annually for flaring associated gas. However, this has to be seen in the overall context of gas flared. A recent study carried out for the Bureau of Public Enterprises of Nigeria estimated that each year the country loses between US$500 million and US$2.5 billion to gas flaring.

In 1992, the Nigerian government announced its plan to adopt a new approach to atmospheric emissions from E&P operations, with an emphasis on encouraging gas utilization rather than penalizing gas flaring. The government says it aims to end all gas flaring in Nigeria by 2008.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: 1969 Petroleum Act and Regulations, as amended; Model Petroleum Contract; Associated Gas Reinjection Act 1979; Associated Gas Reinjection (Continued Flaring of Gas) Regulations 1985; The Petroleum (Drilling and Production) Amendment Decree 1988

- Environmental legislation: Effluent Limitation Regulations 1991; DPR Environmental Guidelines and Standards for the Petroleum Industry 1991; FEPA EIA Guidelines for E&P Projects 1994, Decree No. 58/88

Regulating Agencies

- Ministry of Petroleum Resources, through the Department of Petroleum Resources

A.6 Middle East

Oman

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with the national oil company, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the minister's written consent. Permission is not required to flare during normal well testing.

Flaring Restrictions and Penalties

The ministry may impose volumetric controls via the flaring and venting consent procedure. Emission standards are prescribed by Ministerial Decision 5/86 of May 17, 1986. These standards apply to petroleum operations in which petroleum, associated gas, or condensate is handled, stored, or refined. Products of combustion must not emit smoke as dark, or darker, than shade 1 on the Ringlemann Scale (2 percent opacity). Sulfur recovery units must be at least 95 percent efficient, and emissions of hydrogen sulfide must not exceed 5 ppm by volume. No information regarding penalties is available.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: Royal Decree 10/82 (general environmental law); Regulations for Air Pollution Control from Stationary Sources (MD 5/86) (general)

Regulating Agencies

- Ministry of Oil and Gas

Qatar

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with Qatar General Petroleum Corporation (QGPC), the national oil company, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to gas used to optimize oil production. QGPC is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements at the separation point. The state may require the operator to install and operate gathering and transportation facilities to bring gas ashore. The operator is reimbursed for all costs, subject to separate agreement.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the minister. Flaring must be consistent with good petroleum industry practice.

Flaring Restrictions and Penalties

Ministry of Municipal Affairs and Agriculture's (MMAA) Environmental Protection Management Standards state that flares are regulated at the permitting stage and must be smokeless and efficient so that ambient air quality criteria are not violated.

Flaring controls are stipulated in Attachment 8 of QGPC's *Standards Manual*. For onshore operations, flares should be of the ground-level type and should be enclosed. All flares (onshore and offshore) should operate free of smoke except in emergency conditions. Except for drilling operations, sour gas should not be burned in flares except in an emergency, and then, for limited periods only. Attachment 8 also specifies that:

- Emissions during normal operations should be free from visible smoke, and emissions of acid soot should be prevented at all times
- Emissions of hydrogen sulfide should not exceed $5mg/m^3$
- All emissions should be free from offensive odors
- Unconfined combustion is prohibited (for example, burn pits, refuse, or waste disposal).

The *Standards Manual* also stipulates emission monitoring requirements. For example, periods of smoky, high volume, emergency, and salt gas flaring must be recorded in a log book, to be submitted to QGPC's Environmental Affairs Department on a monthly basis.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: MMAA's Environmental Protection Management Standards; QGPC's *Standards Manual*

Regulating Agencies

- Ministry of Energy and Industry

Syria

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

The state has preemptive rights to purchase gas from the operator for domestic use. Otherwise the operator may export gas. Some E&P contracts, however, have guaranteed preferential export rights at the time of signing, while others have provided for the operator to sell gas directly to domestic users.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the minister.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: Model Petroleum Contract

Regulating Agencies

- Ministry of Petroleum and Mineral Resources

A.7 Latin America and the Caribbean

Argentina

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Gas del Estado, the national gas company, has first option to purchase natural gas for domestic use.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the secretariat of energy.

In August 1993 the secretariat of energy tightened flaring and venting provisions. As of January 1, 1994, the venting of natural gas is prohibited from wells with a gas-oil ratio exceeding $100 m^3/m^3$. The prohibition is being extended to wells with lower gas-oil ratios, as shown in table A.6.

Table A.6: Gas-Oil Ratios for Flaring

From January 1	Gas/oil ratio (m^3/m^3)
1995	75
1996	50
1998	25
2000	1

Certain temporary exceptions from the venting prohibition may be allowed by the energy secretariat. In general, temporary exemptions are granted for any of the following reasons:

- Public interest
- Where improvements that have been required are being implemented
- When the venting results from the testing of wells after their completion or repair
- Where pumps must be unblocked when no pipelines are hooked up
- Where the venting takes place in remote and low-productivity areas
- Where associated gas is contaminated with hydrogen sulfide, nitrogen, carbonic acid gas, and other gases, be they inert or toxic.

Applications must include a technical and economic study that justifies the concept of "remote area"; that is, that underlines the inadvisability, from a technical and economic point of view, of reinjecting, treating, or transporting the gas produced.

National data indicate that between 1994 and 1997 flaring volumes were reduced slightly, even though oil production volumes increased steadily over the same period.

Flaring Restrictions and Penalties

Certain standards apply to the size and structure of the flare terminal and separator gas outlet.

Compliance checking is the responsibility of the secretariat and, where appropriate, the competent provincial authorities. Operators must monitor the quality and the volumes of gas vented at each point of venting. The data must be entered into a computerized data base and must be made available to the secretariat.

Noncompliance with the above conditions can result in the closure of the wells in violation. In general, the penalties established under the hydrocarbons law apply. In severe cases, the exploitation concession can be revoked.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Law No. 17,319 (Hydrocarbons Law)
- Environmental legislation: Resolution 236/93 on Gas Flaring and Venting

Regulating Agencies

- Energy Secretariat

Bolivia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the National Energy Department. Prior authorization is required except in the case of an emergency. Flaring for gas must be allowed when it is the only remaining alternative.

Flaring Restrictions and Penalties

Supreme Decree No. 24176/1995 fixes emission standards for mobile and stationary sources.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: 1996 Hydrocarbons Law
- Environmental legislation: 1992 Environmental Law; Supreme Decree No. 24176/1995 (Regulations for Atmospheric Pollution); 1996 Environmental Regulation for the Hydrocarbons Section (general operational controls relating to the control of atmospheric emissions)

Regulating Agencies

- National Energy Department

Brazil

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Permission to Flare

Every year in the Annual Production Program the National Petroleum Agency (ANP) approves the volume of natural gas that may be flared or released for each field and defines which quantities are not subject to royalty payments. The volume of natural gas flared in each field must not exceed 15 percent of the level approved for the month and 10 percent of the level approved for the year in the Annual Production Program.

Natural gas may be burned or released for the following reasons:

- Safety (flaring in safety burner pilots to maintain positive pressure)
- Emergency (emergency stops of production, accidental emptying of production, compression, transportation, and transfer installations)
- Operational limitations (with prior ANP approval)
- Planned maintenance (with prior ANP approval)
- Approval work in progress (where an installation for the use of natural gas is being built) (with prior ANP approval)
- Low production of natural gas (levels of associated natural gas production are insufficient for such gas to be used)

- Approved contamination (associated gas contains levels of contaminating substances that make it impossible to use) (with prior ANP approval)
- Approved economic viability (when the use or injection of associated gas would make the field economically not viable) (with prior ANP approval)
- Well testing

Burning and release of natural gas for the following reasons does not require prior ANP authorization:

- Burning or release of natural gas that corresponds to 3 percent of the monthly production of the associated gas
- Burning during well testing, during the exploratory phase, with a flow period of 72 hours or less per interval tested
- Burning for safety reasons limited to 15,000 m^3 per month for the equipment burner pilots, 30,000 m^3 per month for pilots of land-based flares, and 60,000 m^3 per month for the pilots of flares on installations at sea
- Burning of gas in fields that produce 150,000 m^3 or less per month, or in fields with a gas-petroleum ratio of less than 20 m^3/m^3
- Burning of gas vapors in land-based tanks or storage ships limited by the solubility ratio of 15 m^3/m^3 or less
- Burning for emergency reasons resulting from emergency stoppages of production or accidents caused by uncontrollable events

Flaring Restrictions and Penalties

The flaring or release of natural gas is subject to a royalty payment unless it is undertaken for the following reasons:

- safety reasons
- proven operational need, which includes the following instances: emergency reasons ; or well testing during the exploration phase for a continuous or noncontinuous flow of up to 72 hours.

The state authorities may set air pollution standards without notifying the federal authorities.

Air quality and emission limits set out in Conama Resolution No. 003/90 and Conama Resolution No. 008/90 can be applied on a case-by-case basis to E&P operations.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: 1997 Hydrocarbons Law
- Administrative Ordinance No. 249 of 2000 concerning the technical norms for the flaring or release of natural gas

Regulating Agencies

- The National Petroleum Agency
- Brazilian Institute of Environmental and Renewable Natural Resources (IBAMA)
- Petrobras

Colombia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development program
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Associated gas rights revert to Ecopetrol when the contractor does not submit a utilization plan within two years of commencing field production.

Permission to Flare

Flaring and venting require a permit from the Ministry of Environment. Permits must be obtained for:

- The incineration of solid, liquid, or gaseous wastes
- The operation of furnaces or incinerators.

Flaring Restrictions and Penalties

In the case of atmospheric emissions from E&P activities, the environmental license will contain all relevant restrictions, terms, and conditions and all necessary emission permits.

Legislation

- Hydrocarbons legislation: 1974 Petroleum Decree; Model Association Contract

Regulating Agencies

- Ministry of Environment

Ecuador

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to a development agreement negotiated with Petroecuador (the national oil company)
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Permission to Flare

Flaring or venting is not permitted without authorization. Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the sub-secretariat for environmental protection (SMA) of the Ministry of Energy and Mines.

Flaring Restrictions and Penalties

Relevant international standards such as those adopted by the Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL) have been taken into account in setting emission and ambient air quality standards. However, the framework for setting operating standards is provided by Decree No. 2982/1995. It is understood that additional requirements can be imposed on a case-by-case basis if warranted by the environmental conditions.

In the event of noncompliance, financial penalties may be imposed both under the hydrocarbons legislation (the sums involved are insignificant) and environmental legislation. Noncompliance may also constitute grounds for revoking the operator's rights.

Legislation

- Hydrocarbons legislation: 1992 Hydrocarbons Law, Decree on Contract Bases
- Environmental legislation: Decree No. 2982 of August 17, 1995, on Environmental Regulations for Hydrocarbon Operations; Ministerial Accord No. 1743 of August 5, 1988, on Norms for the Prevention, Control and Rehabilitation of the Environment from Hydrocarbon Exploration and Exploitation Activities in National Parks and similar Areas; Ministerial Accord No. 11336-A of July 15, 1991, on Regulations on the Establishment of Air Quality Standards and Monitoring Methods

Regulating Agencies

- Ministry of Energy and Mines, specifically the subsecretariat for environmental protection within the ministry

Mexico

Associated Gas Usage

Pemex produces, processes, and markets associated gas in accordance with its own development plan. Priority is given to oil production. However, Pemex hopes to maximize associated gas utilization in accordance with best international practice and has achieved substantial reduction in gas flaring and venting, in particular from Sonda de Campeche oil production fields.

Calculations carried out by Pemex show a 47.4 percent reduction in associated gas flared and vented between 1998 and 2001, from 6,821 million m^3 to 3,586 million m^3.

Permission to Flare

Pemex does not require any permission to flare associated gas.

Flaring Restrictions and Penalties

Mexico does not have any restrictions on or penalties for flaring associated gas, and no limits have been set on the amounts of gas being flared.

Legislation

There is currently no specific legislation or regulation in place that deals with gas flaring and venting.

Regulating Agencies

- Pemex

Peru

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Permission to Flare

Authorization from the Ministry of Energy and Mines is required to flare gas. The issue is considered on a case-by-case basis via the EIA and permitting process. International standards are applied.

Flaring Restrictions and Penalties

Emission limits are set on a case-by-case basis using ARPEL guidelines. No specific emission or air quality standards exist. However, the Ministry of Energy and Mines has adopted sector-specific guidelines and standards. Emission ceilings and operational standards are set out in Supreme Decree No. 045-93-EM and relate to flaring and venting (for example, SO_2 is limited to 300 ug/m^3; NO_2 limited to 200 ug/m^3; CO limited to 35 ug/m^3). The decree also sets out details of a monitoring program that the operator must undertake.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Hydrocarbons Law 1993; Model Petroleum
- Environmental legislation: Environment Code 1990

Regulating Agencies

- Ministry of Energy and Mines
- Perupetro

Trinidad and Tobago

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Delivery of gas to the domestic market has priority over exports. The state exercises a near monopoly of the purchase and sale of gas for domestic use through the National Gas Company of Trinidad and Tobago Ltd. For exports to be approved the operator must demonstrate that the price of gas at the measurement point:

- Represents fair market value, taking into account fair market transport costs to the user
- Is equal to or exceeds the reasonable replacement cost of gas to supply the internal market from the lowest-cost new sources, on the basis of those costs for the five years following the expected start of the export project.

The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry of Energy. Gas flaring is permitted provided that the operator has reinjected as much gas for storage as is consistent with good petroleum industry practice and has taken reasonable measures in agreement with the minister to recover natural gasoline and other liquids contained in the gas.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: 1969 Petroleum Act and 1969 Regulations, Model Petroleum Contract

Regulating Agencies

- Ministry of Energy and Energy Industries

Venezuela

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with PDVSA (the national oil company), subject to approval of a development plan and negotiation of a gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry of Environment and Renewable Natural Resources (MARNR). Permits are granted on a case-by-case basis.

Flaring Restrictions and Penalties

There are no specific regulations pertaining to flaring and venting. Instead, the MARNR sets conditions on a case-by-case basis, in accordance with Decree No. 2.225/1992, Decree No. 638/1995 (norms on Air Quality and Atmospheric Pollution), and Decree No. 883/1995. It is understood that the oil industry in Venezuela follows its own guidelines. Where applicable, appropriate international standards (for example, those of American Petroleum Institute [API] and ARPEL) are taken into account.

Broadly speaking, Venezuelan air pollution control regulations parallel U.S. regulations, in particular the U.S. Clean Air Act. Indeed, ambient air quality standards are very similar in both cases. The principal difference between U.S. and Venezuelan regulations is that Venezuela has not yet adopted technology-based requirements. Moreover, unlike in the United States, where emission standards are set out in the regulations, the Venezuelan regulations provide only a list of pollutants, leaving the setting of standards to the MARNR on a case-by-case basis.

Decree No. 638/1995 does, however, set out air quality limits and permitted maximum air emission levels for all major organic and inorganic pollutants from both fixed and mobile sources. This, of course, applies generally to all sources of atmospheric emissions. The Penal Environment Law of 1991 places breaches of emission standards and other environmental requirements within the jurisdiction of civil court judges who may impose severe penalties and terms of imprisonment on individuals and shut down operations.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Association Agreement
- Environmental legislation: Law of December 5, 1991 on penalties relating to environmental controls; Decree No. 2.225 of April 23, 1992 on Atmospheric Pollution Control; Organic Environment Law 1976, the

Penal Environment Law 1991, Decree No. 638/1995 (provides current permitting framework for atmospheric emissions), Decree No. 883/1995

Regulating Agencies

Ministry of Environment and Renewable Natural Resources

A.8 Europe and Central Asia

Azerbaijan

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan and negotiation of a gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

A draft oil and gas law requires the operator to deliver residual associated gas to the proper executive authority, free of charge. Furthermore, the operator may temporarily flare or vent the requisite amount of associated gas in the event of emergencies, equipment malfunctions, repairs or maintenance of any facilities including delivery systems, or as necessary in the event that the state does not accept delivery of the nonassociated gas.

Permission to Flare

Permission to flare gas that cannot be used in operations or marketed is granted by The National Petroleum Agency (SOCAR). Consent is granted on a case-by-case basis. Flaring offshore is subject to environmental authorization requirements.

Flaring Restrictions and Penalties

There is no legislative framework for the control of atmospheric emissions.

Legislation

The draft oil and gas law was scheduled to be passed in autumn 2001. To date, this has not occurred.

Regulating Agencies

- The National Petroleum Agency

Denmark

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

In 1989 the state relinquished preemptive rights to purchase associated gas for domestic use.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry for Environment and Energy. Gas flaring is subject to specific limits, though exemptions may be established on a case-by-case basis (for example, for the flaring of poisonous gas).

The OSPAR Commission is in the process of expanding descriptions of best available techniques (BATs) and best environmental practice (BEP) related to oil and gas condensate flaring from well testing. A draft OSPAR recommendation on BAT and BEP for oil, condensate, and gas flaring from well testing is due to be presented for discussion at the meeting of the Offshore Industry Committee in 2004.

Flaring Restrictions and Penalties

No information about emission limits and operational restrictions imposed by hydrocarbons and environmental regulation is available.

Legislation

- Hydrocarbons legislation: Use of the Underground Act; Model License for Exploration and Production

Regulating Agencies

- Ministry for Environment and Energy

Italy

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

The state has no preemptive rights to purchase associated gas for domestic use.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted in onshore areas by the competent regional authorities, after consultation with interested and affected municipal authorities. In the case of offshore operations, the Ministry of Environment issues the permits. In both cases, permits are processed on the basis of Presidential Decree 203/88.

Flaring Restrictions and Penalties

Specific conditions are set in the decree issuing the permit on a case-by-case basis. Such conditions typically include the duty to maintain a register of flaring indicating

parameters such as time, location, meteorological conditions, and duration of emissions, as well as an estimate of the amounts emitted. The startup of operations must also be communicated to the competent authorities.

It is understood that recent permits have included provisions that gas flaring for nonemergency reasons is to be curtailed and that gas be used only as a source of energy for operations where no other forms of energy are available. Particular attention is paid to regional air quality and the impact of additional fields coming onstream to overall emissions in a given area (multiple emission sources).

Gaseous emissions from oil and gas installations located in the territorial sea or on the continental shelf must be limited at the source using best available technology net entailing excessive costs (BATNEEC). Where the location of the platforms ensures the optimal dispersion of such emissions, such that adjacent centers of population are not affected, emission limits are intended as satisfied, when the flare is burning natural gas exclusively. Where such conditions do not persist, the emission limits for inorganic gaseous substances set out in the Ministerial Decree of July 12, 1990 must be observed. It specifies the following emission limits for flaring:

- CO: 100 mg/m^3
- NO_x : 350 mg/m^3
- Particulates: 10 mg/m^3
- SO_2 : 1200 mg/m^3
- H_2S : 10 mg/m^3
- VOC : 20 mg/m^3

Companies operating a plant without a valid emission permit are liable to a term of imprisonment between two months and two years or fines. Unauthorized emissions of gas are punishable with imprisonment up to one month or a fine.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Laws No. 6 1957, No. 613 1967, No. 9 1991, Ministerial Decree of August 6, 1991; Presidential Decree No. 484 94; Legislative Decree 625 1996
- Environmental legislation: Presidential Decree 203/1988 on Guidelines on Air Quality and Air Pollution from industrial plants; Ministerial Decree of July 12, 1990 on Guidelines for the Limitation of Polluting Emissions from Industrial Plants and the Fixing of Minimum Emission Limits

Regulating Agencies

- Onshore: Regional environmental authorities
- Offshore: Ministry of Environment

Kazakhstan

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan and negotiation of a gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. Rights to market gas and the treatment of gas that cannot be marketed are subject to negotiation.

Permission to Flare

Permission to flare gas that cannot be used in operations or marketed is granted by the Ministry of Energy and Natural Resources. Consent is granted on a case-by-case basis. In a recent contract the following was agreed: namely, where a reservoir contains associated gas that, in the opinion of the contractor-joint venture, has commercial value, then the development plan for the reservoir must include a plan for the development and marketing of associated gas. If the reservoir is commercial but the associated gas cannot be used commercially, then the development plan must at least include provisions for the collection, disposal, usage, reinjection, or venting of associated gas.

Flaring Restrictions and Penalties

There is no legislative framework for the control of atmospheric emissions.

Legislation

- Hydrocarbons legislation: Regulations on Licensing the Use of Natural Resources 1994

Regulating Agencies

Ministry of Energy and Natural Resources

Netherlands

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to consents.

Until the provisions of the EU Gas Directive are introduced, gas intended for use in the Netherlands must continue to be supplied to Gasunie (national gas supplier). The minister must approve the sales price of exported gas.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Oil and Gas Directorate. Associated gas may be used in petroleum operations, reinjected for storage, or commercialized. Gas may be flared and vented for normal operational safety reasons but must otherwise be approved by the ministry. The ministry imposes strict restrictions on how flaring and venting take place.

At an international level the OSPAR Commission is in the process of expanding descriptions of best available techniques (BAT) and best environmental practice (BEP) related to oil and gas condensate flaring from well testing. A draft OSPAR Recommendation on BAT and BEP for oil, condensate, and gas flaring from well testing is due to be presented for discussion at the meeting of the Offshore Industry Committee in 2004.

Flaring Restrictions and Penalties

Special emission guidelines exist for onshore and offshore operators. These are included in licenses issued for onshore operations. In the case of offshore operations, there is a voluntary covenant between operators and the state to try to meet the standards established in the guidelines. Failure to achieve this in a fixed period may result in legislative imposition of emission standards.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Royal Decree on Licensing Terms 1976
- Environmental legislation: Air Pollution Act No. 580 1970; Netherlands Emission Regulations 1992; Environmental Management Act 1993

Regulating Authority

- Oil and Gas Directorate

Poland

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

The state has the first option to acquire associated gas for domestic use. The operator may elect to participate in delivery to the domestic market. If it does not elect to participate, the state is entitled to take gas, free of charge, at the initial separation facilities.

Permission to Flare

The operator is permitted to flare gas that cannot be marketed and that exceeds operational requirements, without obtaining express permission from the licensing agency.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Geological and Mining Law 1994; Model Petroleum Agreement
- Environmental legislation: Ministerial Ordinance on Environmental Impact Assessment 1990; the Law on Environmental Protection 1980

Regulating Agencies

- Ministry of Environmental Protection, Natural Resources, and Forestry

Romania

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to gas used to optimize oil production. The state has the first option to acquire associated gas for domestic use. Otherwise, the operator may freely market gas domestically or for export. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the National Agency for Mineral Resources (NAMR).

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: Petroleum Law 1995; Model Petroleum Contract 1996

Regulating Agencies

- National Agency for Mineral Resources

Russia

Associated Gas Usage

The Russian State owns all mineral resources, and licenses, issued jointly by the Ministry of Natural Resources and the regional authorities, are required to extract oil, natural gas, and associated gas. Licensed operators may:

- Lift, process, and market associated gas
- Use associated gas in operations or reinject or flare gas.

Permission to Flare

In Russia, gas flaring restrictions vary from region to region as the federal Mineral Resource Act, which sets standard license terms, does not require the condition on associated gas flaring and usage to be included in the oil production license or license agreement.

As a result, the issue of dealing with gas flaring has been left to the regional authorities. To date, only a few regions have included special provisions on associated gas flaring and usage in their regional mineral acts. For example, under the mineral acts of Khanty-Mansijsk and Yamalo-Nenetz—two major oil- and gas-producing regions in West Siberia—the usage rate of associated gas is a mandatory license condition that the operator and the regional authorities have to agree on before signing the license agreement.

Khanty-Mansijsk went even further by setting a mandatory 5 percent cap on gas flaring (95 percent of associated gas has to be used). However, this 5 percent limit might be increased if the operator's feasibility study can prove this threshold is unrealistic. Often oil companies opt not to negotiate for a higher limit since their compliance with the gas flaring condition is unlikely to be scrupulously monitored.

Flaring Restrictions and Penalties

The Resolution of the Federal Government No. 344 from June 12, 2003, lists pollutants and corresponding pollution fees producers have to pay. The list includes SO_X, NO_X, sulfur, and ashes, but not CO_2.

Monitoring and Reporting

In theory the licensed operators are supervised by both the Ministry of Natural Resources and regional authorities, and either of the two can initiate license withdrawal in case of noncompliance with a condition stipulated in the license. To date neither regional authorities nor the ministry have revoked any license because of excessive gas flaring, which can be partly blamed on the lack of clearly defined authority (powers) as well as clearly assigned (divided) roles and responsibilities among government supervisory agencies. The lack of standardized reporting, monitoring, and enforcement procedures make the task of ensuring compliance with license conditions even more difficult.

Data on associated gas are reported to several government agencies, including the State Statistical Committee, the Ministry of Taxation, the Ministry of Energy, and the Ministry on Natural Resources, as well as to the committees within the regional governments in charge of natural resources. Since there has been little coordination among these recipients of statistical information, data are not systematically cross-checked or synchronized, and consequently they are to a large degree inconsistent. The comparison of data received and collected by different government agencies reveals that often the volume of flared gas reported by a producer to the Ministry of Natural Resources exceeds the associated gas production reported by the same producer to the Statistical Committee and the Ministry of Taxation.

The Khanty-Mansijsk government has been working on creating guidelines that, if introduced, will result in stricter requirements on associated gas measuring and reporting, and improved and standardized procedures in monitoring associated gas flaring and usage.

Legislation

At the federal level, the legislation that is most relevant to gas flaring and venting is the:

- Mineral Resource Act—Federal Law No. 2395-1 (adopted on February 21, 1992, updated on March 3, 1995; February 10, 1999; January 2, 2000; May 14, 2001; August 8, 2001; May 29, 2002; and June 6, 2003)

Examples of the regional legislation regulating gas utilization and flaring are:

- Crude Oil and Gas Act of Tyumen Oblast (adopted on February 26, 1999, updated on June 3, 1999; May 6, 2000; and June 5, 2000)
- Mineral Resource Act of Khanty-Mansijsk Autonomous Okrug
- Khanty-Mansijsk Act on Hydrocarbon Development in Autonomous Okrug (adopted June 16, 1998, updated June 20, 2000, and October 9, 2000)
- Mineral Resource Act of Yamalo-Nenetz Autonomous Okrug

Currently, no secondary legislation (such as codes, guidelines) exists at the federal level that deals specifically with operational processes or regulatory procedures related to gas flaring and venting. However, some general requirements at the regional level are in place. For example, a decision of Khanty-Mansijsk regional Environmental Committee on Environmental Protection No. 278-K dated October 15, 1997 that requires associated gas usage of not less than 95 percent.

Regulating Agencies

- Ministry of Natural Resources
- Regional authorities (departments and committees of local governments)

Uzbekistan

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan and negotiation of a gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production.

Permission to Flare

Permission to flare gas that cannot be used in operations or marketed is granted by the State Committee of Geology and Mineral Resources. Consent is granted on a case-by-case basis. It is not clear whether specific consents are required. There is, however, a general restriction that flaring must be kept to a minimum.

Flaring Restrictions and Penalties

There is no legislative framework for the control of atmospheric emissions.

Legislation

- Hydrocarbons Legislation: Model License Agreement

Regulating Agencies

- State Committee of Geology and Mineral Resources (Goskomgeologiya)

A.9 Asia and Australia

Australia (Offshore)

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to consents.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the ministry except in the case of an emergency.

Flaring Restrictions and Penalties

The Schedule on Specific Requirements as to Offshore Petroleum Exploration and Production in Waters under Commonwealth Jurisdiction 1997 under federal legislation states that the volume of gaseous petroleum flared or vented must be reported on a monthly basis.

For new petroleum activities, and from October 1, 2000, for all activities in commonwealth waters, atmospheric emissions are to be addressed as part of the Environmental Plan under the Petroleum (Submerged Lands) (Management of Environment) Regulations 1999.

In accordance with the National Pollutant Inventory (NPI and the *Emission Estimation Technique Manual for Oil & Gas Exploration & Production*, both offshore and onshore oil and gas exploration and production facilities are required to report yearly atmosphere emissions. Point-source emissions (for example, fuel combustion, flares), where the release is through single point sources into the atmosphere, as well as fugitive emissions (for example, volatilization of vapor from open vessels, and equipment leaks such as valves and flanges) must be included.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: The Petroleum Act 1967
- Environmental legislation: The Environmental Protection Impact of Proposals Act 1974; Schedule 1997; Petroleum Submerged Lands Management of Environment Regulations 1999

Regulating Agencies

- E&P licensing: Federal Department of Primary Industries and Energy
- EIA procedure: Environmental Protection Agency

Bangladesh

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. The operator's right to export gas is subject to Petrobangla's right to retain its profit gas in kind (but not more than 20 percent of total marketable gas). After 10 years of gas exports, the upper limit may be increased to 30 percent. If the contractor does not export, it may sell its gas to Petrobangla, with pricing based on cost-plus.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the minister. The contractor may flare uneconomical associated gas that Petrobangla does not wish to take provided that such flaring is included in the development plan.

Flaring Restrictions and Penalties

The Environment Conservation Rules 1997 prescribe relevant emission standards for a range of industries, but no specific standards are defined for E&P activities.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: Bangladesh Environment Conservation Act 1995 (BECA); Environmental Conservation Rules 1997 (ECR)

Regulating Agencies

- Ministry of Energy and Mineral Resources
- Petrobangla

China

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with national oil companies, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. In the event that the parties cannot agree to terms for marketing excess gas, they must continue to negotiate. Failing agreement, the National Oil Company (NOCC) retains the right to dispose of excess gas unilaterally (though the contractor may later back in to the project on payment of a premium). CNOOC (offshore) will purchase gas produced from a contract area provided that the total volume purchased is enough to supply 3.5 billion m^3 per year at prices to be agreed. In any offshore well testing, oil and gas must be thoroughly flared to prevent pollution of the marine environment.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted in the context of development plan approvals, based on agreement between the operator and the NOCC. Flaring of gas onshore is permitted in circumstances where gas recovery facilities have not been installed.

Flaring Restrictions and Penalties

Measures must be taken to ensure that the gas is incinerated efficiently.

Management of air quality and atmospheric emissions is provided by the Air Pollution Prevention and Control Law, which was amended most recently in 2000 and entered into force on September 1, 2000. Among the key provisions:

- Where atmospheric pollutants are discharged, the concentration of the said pollutants may not exceed the standards prescribed by the state and local authorities.
- An environmental impact statement on construction projects shall include an assessment of the atmospheric pollution and be submitted to the administrative department of environmental protection concerned for examination and approval.
- Units that discharge atmospheric pollutants must report to the local administrative department of environmental protection their existing discharge and treatment facilities for pollutants and the categories, quantities, and concentrations of pollutants discharged under normal operating conditions and submit to the same department relevant technical data concerning the prevention and control of atmospheric pollution.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: Regulations of the People's Republic of China Concerning Environmental Protection from Offshore Oil Exploration and Exploitation 1989; Law for the Prevention of Air Pollution 1987; Regulations for the Administration of Environmental Protection 1991
- Marine Environment Protection Law 1999; Air Pollution Prevention and Control Law 2000

Regulating Agencies

- National Oil Companies
- Environmental Regulation (onshore): National Environmental Protection Agency (NEPA)
- Environmental Regulation (offshore): State Oceanic Administration (SOA)

India

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production.

In the event of the discovery of associated gas in an oil field, operators must indicate whether they have reasonable grounds for believing that any excess over that used for operations could be commercially exploited. In this event, the oil field development plan should include the proposed associated gas exploitation plans, including estimated quantities to be flared, reinjected, and used for petroleum operations (based on the principle of full utilization and minimum flaring). If the operators wish to exploit the excess associated gas, they shall be free to explore markets for commercial exploitation and submit these proposals to the government.

If the contractor decides that the excess associated gas cannot be used commercially or is unable to find a market, the government may take and use it, free of charge, at the outlet flange of the gas and oil separation facilities. The contractor must install any facilities necessary to secure, as far as possible, an uninterrupted supply to the government. Relevant costs are recoverable via cost recovery as if they were crude oil costs. Costs beyond the outlet flange are borne by the government.

Permission to Flare

Associated gas that is not commercially developed or taken by the government must be reinjected. It may be flared only if approved in the oil field development plan and only for small quantities and as a last resort. As soon as is practicable after submission of the proposed development plan, the contractor and the government or its nominee shall meet to discuss the sale or disposal of any associated gas in a timely manner.

Flaring Restrictions and Penalties

No information about emission limits and other operational controls that may be applied under hydrocarbons or environmental regulation is available.

Legislation

- Hydrocarbons legislation: Model Petroleum Contract

Regulating Agencies

- Ministry of Petroleum and Natural Gas

Indonesia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas jointly with BP Migas, subject to a negotiated gas agreement
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. BP Migas is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the ministry in the context of development plan approvals. Sources of atmospheric pollution, including flaring and venting, would be addressed in an Environmental Impact Assessment, regulated by the Environmental Management Law 1997 and by the EIA Review Commission. Flaring is not permitted if the gas may be used to enhance secondary recovery operations.

Flaring Restrictions and Penalties

The regulation of air pollution and setting of emission standards is scattered through a number of national legislative instruments, supported by legislation introduced at a provincial level. A legislative framework, as such, does not exist. The Environmental Management Act 1982, however, provides the legislative basis for EIA requirements, and atmospheric emissions must be included within the scope of EIA studies. Sector-specific atmospheric emission standards apply, which impose an opacity limit on smoke from flaring of 20 percent from January 1, 1997, and 10 percent from January 1, 2002.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: Environmental Management Act 1982; Environmental Management Law 1997; Environmental Act No. 129/2003

Regulating Agencies

- The Ministry of Mining and Energy
- The Central EIA Review Commission is responsible for the review of EIAs submitted in support of the authorization process
- The Ministry of Environment

Malaysia

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents (not to be unreasonably withheld).

Priority is given to associated gas used to optimize oil production. The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements. This may include reinjection. If reinjection facilities are not in place, Petronas (the national oil company) may request another operator to provide them so as long as they do not interfere with petroleum operations.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by Petronas in the context of development plan approvals, provided the operator has taken measures to extract NGLs that are, in the operator's opinion, economically justifiable. The contractor may request permission to flare gas if it cannot be reinjected because of reservoir conditions or other reasons in line with acceptable international oil industry practice. Under these circumstances, Petronas shall not unreasonably withhold consent.

Flaring Restrictions and Penalties

In accordance with the national gas conservation policy, offshore production facilities are not permitted to continuously flare or vent gas for more than 72 hours.

A legislative basis for air quality standards has not yet been established, but guideline standards have been adopted for a number of pollutants. Industrial emissions are covered by the Environmental Quality (Clean Air) Regulations 1978, which include emission limits for smoke, hydrogen sulfide (H_2S), and noxious and offensive substances.

In accordance with these regulations, smoke emissions during normal operational conditions must not be darker than shade 1 on the Ringlemann Scale. The regulations also include standards for gaseous emissions, and a limit of 5 ppm is prescribed for the emission of H_2S from new installations.

Standards for atmospheric emissions in offshore areas beyond territorial waters do not currently exist. However, it is understood that the possibility of extending the Clean Air

Regulations 1978 to cover the Exclusive Economic Zone (EEZ) is under review. If this occurs, it will have a significant impact on offshore operations, particularly with regard to smoke emissions from flaring and cold process venting.

Noncompliance may constitute grounds for revoking the operator's rights under the petroleum contract. The environmental legislation also provides for a range of fines (up to about US$30,000) and terms of imprisonment for infractions of environmental permit conditions.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Model Petroleum Contract
- Environmental legislation: Environmental Quality Act 1974; Environmental Quality (Clean Air) Regulations 1978; Environmental Quality (Prescribed Activity) (Environmental Impact Assessment) Order 1988

Regulating Agencies

- Petronas
- Department of Environment is responsible for managing the EIA review and approval process

New Zealand

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Ministry of Commerce in the context of development plan approvals. Permission to flare will be granted only if the minister is satisfied that under sound engineering principles gas could not be gathered and marketed or reinjected on a commercial basis.

Flaring Restrictions and Penalties

E&P-specific atmospheric emission standards do not exist. Atmospheric emissions from flaring are regulated through resource consent requirements under the Resources Management Act 1991. They set down flaring restrictions such as:

- The operator must adopt the best practical option to prevent or minimize any actual or potential effects on the environment from flaring.

- Smoke emissions during gas flaring must be minimized through effective liquid separation and recovery.
- The consent holder must keep, and make available, logs of all flaring activities and include the time, duration, and, as far as is practical, volumes of substances flared.
- Before the burning of oil, residents within 1 kilometer of the flare station must be given 24 hours' notice of the commencement of flaring and smoke emissions.

Restrictions on the flaring duration may also be imposed. In accordance with Section 25 of the Crown Minerals (Petroleum) Regulations 1999, a permit holder may flare petroleum under any one of the following circumstances:

- The flaring of petroleum is a consequence of effecting an emergency shutdown.
- The flaring of petroleum is in connection with initial well-testing operations and the petroleum flaring does not occur on more than 30 days during initial well-testing operations.
- The flaring of petroleum occurs as a consequence of equipment failure, and the petroleum flaring does not exceed seven days
- The flaring of petroleum is in accordance with a mining permit work program approved by the minister.
- On written application by the permit holder, the secretary consents in writing to the flaring of petroleum on such terms and conditions as the secretary thinks fit.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Minerals Program for Petroleum 1995
- Environmental legislation: Resource Management Act 1991; Crown Minerals (Petroleum) Regulations 1999

Regulating Agencies

- Ministry of Commerce, Energy and Resources Division

Pakistan

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to consents.

Priority is given to associated gas used to optimize oil production. The operator is free to market associated gas as it wishes in frontier or high-risk areas, but in traditional lower-risk areas, the state may direct gas to be marketed to specified domestic entities (unless negotiations fail after a fixed period). The state is entitled to take, free of charge, associated gas that is not marketed and that exceeds operational requirements at the downstream flange of the oil and gas separation facilities.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Directorate General of Petroleum Concessions (DGPC), provided reinjection is not possible.

Flaring Restrictions and Penalties

Volumetric controls may be attached to flaring and venting permits by the DGPC on a case-by-case basis. Under the Pakistan Environmental Protection Ordinance 1997 it is prohibited to emit any air pollutant in excess of the standards set out in the National Environmental Quality Standards 1993.

These standards include:

- Smoke opacity not exceeding 40 percent (or shade 2 on the Ringlemann Scale)
- Emissions of hydrogen sulfide must not exceed 10mg/m^3
- Emissions of carbon monoxide must not exceed 800 mg/m^3
- Emissions of sulfur and nitrogen oxides must not exceed 400 mg/m^3

Under the Exploration and Production Rules 1986, a record must be kept of the quantity of gas flared. Operators must prepare an annual inventory of gaseous waste.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Petroleum Rules; Model Petroleum Contract
- Environmental legislation: Pakistan Environmental Protection Ordinance 1997

Regulating Agencies

- DGPC within the Ministry of Petroleum and Natural Resources

Thailand

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan

- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production, including that of other operators. The state has preemptive rights over excess associated gas, through Petroleum Authority of Thailand. Subject to the state's preemption rights, the operator may export gas.

Permission to Flare

Permission to flare gas that cannot be marketed and that exceeds operational requirements is granted by the Department of Mineral Resources, in the context of development plan approvals.

Flaring Restrictions and Penalties

Flaring should be carried out in accordance with international oil industry practice (for example, use of clean-burn technologies and others). To date, however, E&P sector-specific atmospheric emission standards have not been prescribed. Atmospheric emissions must be addressed in the EIA prepared as part of development plan approval. If the presence of shallow gas represents a potential drilling hazard, flaring and venting is permitted.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Mineral Regulations, Model Petroleum Contract
- Environmental legislation: National Industrial Atmospheric Emission Standards 1993

Regulating Agencies

- Department of Mineral Resources
- Office of Environmental Planning and Policy, responsible for EIA review

Vietnam

Associated Gas Usage

The operator may:

- Lift, process, and market associated gas, subject to approval of a development plan
- Use associated gas in operations or reinject or flare gas, subject to relevant consents.

Priority is given to associated gas used to optimize oil production. The operator may use associated gas collected from the contract area as fuel for petroleum operations within the field or may pump it back into the field. The Vietnamese government has the right to use, free of charge, any associated gas that the operator wishes to flare provided that there is

no interference with the operator's operations. In such cases, the operator must create favorable conditions for the above to be carried out.

Associated gas may be flared only after approval has been granted by the state administrative body in charge of petroleum. Associated gas should be flared only in the absence of other cost-effective solutions or in case of emergency or for well maintenance or appraisal, in accordance with accepted international oil industry practices.

Specific operational requirements relating to flaring and venting are defined in Decision No. 395-1998 (Article 18) and Decision No. 163-1998 (Articles 30–31), as summarized below:

- Flaring is permitted during reservoir testing for a period not exceeding 48 hours, with a flow and volume not exceeding the flow and volume required to vent the well for cleanup purposes.
- Flaring is permitted during a period of reservoir testing or well clean-up that is permitted to exceed 48 hours, with flow and volume approved by PetroVietnam, or upon completion, work over, or treatment of a well.

PetroVietnam shall have the right to dispose of, at its own risk and cost and without interfering with the operations, all the natural gas intended for flaring.

Permission to Flare

Gas may be flared only if approved by PetroVietnam. Flaring is generally dealt with via the EIA and licensing processes.

Flaring Restrictions and Penalties

There are no E&P sector-specific atmospheric emission standards. The Vietnamese authorities have prepared draft regulations on environmental protection in the petroleum industry. These regulations provide, among other things, for unused associated gas to be burned off in furnaces. The furnace must be placed in such a location that its fumes do not affect the working conditions on the installation.

Legislation

The following legislation is relevant to gas flaring and venting:

- Hydrocarbons legislation: Petroleum Law 1993; Model Petroleum Contract
- Environmental legislation: Regulations on Environmental Protection in Marine Petroleum Operations 1990; Law on Protection of the Environment 1993 and Decree on Protection of the Environment 1994; Decision Issuing Vietnamese Standards TCVN 5937-40 (1995) Air Quality; Petroleum Decree 1996; Decision No. 395-1998; Decision No. 163-1998.

Regulating Agencies

- PetroVietnam
- Ministry of Science, Technology, and Environment

A.10 North America

United States of America

Associated Gas Usage

Methane emissions, including venting from oil and gas production operations, are not regulated as a pollutant in the United States. Therefore, the Environmental Protection Agency (EPA) does not require companies to report the flared or vented methane emissions. However, the natural gas stream often contains many other constituents (that is, nonmethane volatile organic compounds and hazardous air pollutants [HAPs] such as benzene, toluene, and mixed xylenes, and H_2S gas). These substances are regulated by EPA, and, consequently, their release exceeds regulatory thresholds; reporting and flaring and controlling these releases is required.

Offshore:

Operators must either market produced gas to a pipeline company or transport the gas to shore for sale, use the gas for power generation, or temporarily reinject gas to enhance oil recovery. Gas must be produced for sale after the oil production objectives have been achieved. The Gulf of Mexico has a well-established pipeline infrastructure, and U.S. gas demand exceeds current production. Therefore, it is in the national interest to minimize flaring.

Permission to Flare

Offshore Regulations (30 CFR 250.1105):

Gas may be flared for up to 48 consecutive hours but not more than 144 hours in a calendar month as a result of equipment failures or upset conditions. Gas may be flared for up to 48 hours during well-testing or well-cleaning operations. Any longer periods of flaring require Minerals Management Service (MMS) approval.

Small volumes of gas vapors (generally less than 50 mcfd) from storage vessels or other low-pressure production vessels may also be flared or vented if the vapors cannot be economically recovered and transported.

The MMS may also allow operators to flare approved volumes of gas for periods of up to one year as necessary to install equipment that would eliminate the need for such flaring. However, operators must keep detailed flaring records, which are subject to MMS inspection.

Legislation

Offshore:

Flared gas volumes must be reported to the MMS as a part of monthly production statements.

Regulating Agencies

There are several entities that are involved in regulatory issues associated with onshore venting and flaring in the United States:

- Bureau of Land Management (BLM)—Part of the Department of the Interior, it regulates siting, drilling, and production activities on federal lands. The BLM imposes some regulatory reporting requirements on gas flaring and venting, which pertain mostly to resource conservation issues.
- The Environmental Protection Agency—The EPA regulates releases of HAPs and nonmethane volatile organic compounds (VOCs) from oil and gas production operations through National Emission Standards for Hazardous Air Pollutants (NESHAPs) and New Source Performance Standards (NSPS). See, for example, the Federal Register Notice for the NESHAP regulations. With regard to NSPS regulations, Section 111 of the Clean Air Act, "Standards of Performance of New Stationary Sources," requires the EPA to establish federal emission standards for source categories that cause or contribute significantly to air pollution. These standards are intended to promote use of the best air pollution control technologies, taking into account the cost of such technology, energy requirements, and any nonair quality, health, and environmental impact. For oil and gas operations, this often means controlling vented releases from storage tanks.
- Individual States—In addition to federal air quality regulations, many oil- and gas-producing states will often have their own set of rules and standards. In some cases, they may be more stringent than the federal standards. Some states, such as Alaska, also have reporting requirements (similar to BLM) for venting and flaring.

Offshore:

- Minerals Management Service—The MMS has very restrictive gas flaring policies, and, therefore, on a percentage basis, the volume of gas flared is very low. The MMS seeks to minimize emissions from flaring and venting.

FOR FURTHER INFORMATION REGARDING THE GLOBAL GAS FLARING REDUCTION PUBLIC-PRIVATE PARTNERSHIP (GGFR) OR THE ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAM (ESMAP) CONTACT:

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