ENVIRONMENTAL ISSUES GUIDE

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Table of Contents

1 Introduction 1
2 Scope and purpose 1
2.1 Scope 1
3 Definitions 1
3.1 Publication terminology 1
3.2 Technical definitions 1
4 Environmental impacts relevant to the industrial gases industry 3
4.1 General environment aspects and impacts and the links to EIGA document 3
4.2 Background 3
4.3 Environmental liability 3
4.4 Emissions to air 5
4.5 Energy use 9
4.6 Water use and minimisation 11
4.7 Discharges to water 15
4.8 Use of chemicals and hazardous substances 26
4.9 Waste 27
4.10 Waste electronic equipment 33
4.11 Landfill directive 36
5 References 37
Appendix 1 EIGA document links to ISO 14001 40
Appendix 2 Storage tank checklist 41
Appendix 3 Typical wastes in the industrial gases industry 42

Tables:

Table 1 Example best practices to minimise water usage 12
Table 2 Water sources and types 13
Table 3 Information for water balance 14

Figures:

Figure 1 Water inputs and outputs 13
Figure 2 Safe, health and environmental hazards of underground storage tank leaks 17

Amendments to 106/03

Section	Change
	Editorial to align style with IHC associations
3	Definitions added
4.3	New section
4.4.2	New data relating to Industrial Emission Directive
4.4.3	Updated for regulation
4.4.5	New section on F gases
4.5	Update for regulation
4.6	Update for regulation
4.7	Update groundwater section for regulation
4.7.6	New section on spillages
4.7.7	New section on storage of hazardous substances
4.8.2	New section
4.9	Updates for regulation
4.10	New section on waste electronic and electrical equipment
4.11	New section on landfill

NOTE Technical changes from the previous edition are underlined

1 Introduction

This publication provides general guidance on environmental issues common across all industrial gases activities.

2 Scope and purpose

2.1 Scope

This publication provides guidance for operating and technical managers on the European legislation concerning the main environmental issues relevant to the industrial gases Industry. It also provides recommendations on the good practices used to control the impacts and to comply with the legislation. In all cases the relevant national legislation should be consulted for the specific implementation in each country or region.

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicates that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Best Available Technique (BAT)

The most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole:

a) 'Techniques' includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

b) 'Available techniques' means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator.

c) 'Best' means most effective in achieving a high general level of protection of the environment as a whole.

3.2.2 Best Available Technique Reference document (BREF)

A document resulting from the exchange of information organised pursuant to Article 13 of Directive 2010/75/EU, *Industrial Emissions Directive (IED)*, drawn up for defined activities and describing applied techniques, present emissions and consumption levels, techniques considered for the determination of best available techniques as well as BAT conclusions and any emerging techniques, giving special consideration to the criteria listed in Annex III of 2010/75/EU [1].[1]

3.2.3 Environmental aspect

Elements of an organisation's activities, products or services that can interact with the environment. For example, use of energy or transportation of products.

3.2.4 Environmental impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects as per ISO 14001, *Environmental Management Systems – Requirements with Guidance for Use*, [2]. For example, the contamination of water with hazardous substances or the reduction of air emissions.

3.2.5 Electric and Electronic Equipment

Equipment falling under the categories set out in Annex I and further detailed in Annex II and is designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current.

3.2.6 Installation

A stationary technical unit within which one or more activities listed in Annex I or in Part 1 of Annex VII of Directive 2012/19/EU *on Waste Electrical and Electronic Equipment (WEEE)*, are carried out, and any other directly associated activities on the same site which have a technical connection with the activities listed in those Annexes and which could have an effect on emissions and pollution [3].

3.2.7 Making available on the market

Supply of a product for distribution, consumption or use on the market of an EU member state in the course of a commercial activity, whether in return for payment or free of charge.

3.2.8 Placing on the market

The first making available of a product on the market within the territory of an EU member state on a professional basis.

3.2.9 Polluting substances

Substances which could cause harm to human health or the environment or nuisance, including noise and heat.

3.2.10 Waste Electrical and Electronic Equipment

Electrical and Electronic Equipment (EEE), which is waste within the meaning of Article 3 of Directive 2012/19/EU including all components, subassemblies and consumables, which are part of the product at the time of discarding [3].

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

4 Environmental impacts relevant to the industrial gases industry

4.1 General environment aspects and impacts and the links to EIGA document

This publication covers the general common environmental issues impacting all industrial gases processes, with the relevant legislation. There are several linked EIGA publications that provide more details on general environmental issues, legislation for the gas industry and operational good environmental practices. A list of these linked publications and their links to ISO 14001 is provided in Appendix 1 [2].

4.2 Background

ISO 14001 clause 4.3.1 states [2]:

The organization needs to establish and maintain a procedure to identify the environmental aspects of its activities, products or services that it can control or over which it can be expected to have an influence, in order to determine those that have or can have significant impacts on the environment.

Section 4 aims to set out the main environmental impacts of the gases industry and look at the broad European legal and best practice requirements for these issues.

There are items of general environmental legislation that impact gas companies. An example includes the voluntary Eco Management and Audit Scheme (EMAS) that stipulates companies put in place an environmental management system and make an environmental statement. The impact of this general legislation is communicated to EIGA members through publications such as the EIGAzette and newsletters.

The main topics of the legislation are:

- emissions to air;
- emissions to water;
- soil and groundwater protection;
- energy and water use;
- noise, see EIGA Doc 85, *Noise Management* [4];
- use of chemicals and hazardous substances;
- waste; and
- use of suppliers and contractors

The regulations apply to both new and existing plant. New plant should be designed to minimise the environmental impact to reduce the use of hazardous substances and to facilitate the de commissioning.

4.3 Environmental liability

On 21st April 2004, the EU adopted Directive 2004/35/CE *on environmental liability with regard to the prevention and remediation of environmental damage* [5]. Far-ranging provisions on the definition of environmental damage, on the prevention and remediation as well as on the associated expenses and the necessary precautions have been incorporated.

EIGA members are affected by these provisions when producing and transporting products.

The directive required implementation into national law by the EU member states by April 30th April 2007. As on other occasions a locally adapted implementation into national laws is in place and EIGA will continue to monitor developments on the EU level.

4.3.1 Background

This directive applies to damage to protected species and natural habitats, and contamination of water and soil by a list of activities, including the emission, manufacturing, use, storage, filling, disposal and transport of dangerous substances (as defined by Regulation (EC) No 1272/2008 *on classification, labelling and packaging of substances and mixtures*) [6].

Furthermore, it covers the damage to protected species and natural habitats by any kind of activities.

The directive does not contain any retroactive liability for environmental damage caused before 30th April 2007 nor does it deal with personal injury, damage to private property or financial losses.

The liability stays with the operator. The operator can be prompted by the authorities to avoid imminent damage and is liable to contain damage incurred, and to remedy any damage in order to avoid further damage.

If remedial actions are necessary, they will be decided by the authorities after evaluation of the operator, and in principle, the operator has to bear their cost.

Currently there is no requirement to take out mandatory insurance coverage, but the member states are asked to create appropriate incentives for the development of this type of insurance.

4.3.2 Effects on the industrial gases industry

Gas producers may be affected by the directive on environmental liability as a result of the fact that these activities are under the scope of the directive in the following areas:

- production, storage, filling and in-plant transport of gases underlying regulation (EC) No 1272/2008 – for all gases that are classified as “dangerous” in accordance with this regulation [6]; and

- transport and delivery of gases.

Control procedures already exist in EIGA member companies to prevent pollution from these activities. Plans for an insurance against liability could lead to changes in the insurance field.

Since the directive expressly states that more rigorous local provisions are possible, the implementation in the EU member states can vary considerably.

4.3.3 Actions

When performing the activities mentioned in 4.3.2, EIGA member companies should ensure that:

- all respective legal requirements and relevant directives are complied with during operation of the plant;

- there are any possible negative effects on water, protected species or natural habitats are likely, given the location of the activity; and

- insurance coverage for possible damage is sufficient.

4.4 Emissions to air

4.4.1 Integrated media permits

Emissions to air water or land are usually regulated by specific permit. Some industrial gases installations come under the Industrial emissions directive (IED). This covers the permitting of industrial installations to offer a high level of protection to the environment as a whole. This considers the emissions to all media, air, water and land together as well as the use of energy, water and waste and decommissioning.

4.4.2 Industrial Emissions Directive

4.4.2.1 Overview

On 17th December 2010, the European Commission published Directive 2010/75/EU *concerning integrated pollution prevention and control (IPPC),* as the basis of a common system of environmental operating permits and supervision by the competent authorities for industrial installations where environmental impacts are considered in an integrated, holistic manner [7].

The IED came into force on 6th January 2011 This new directive replaced the IPPC directive and tightens controls over emissions. It also creates one integrated regime for pollution control by consolidating and replacing the directives on large combustion plants, titanium dioxide, waste incineration and solvent emissions.

All industrial installations, as defined in the chapters of the directive, shall have a permit to operate issued by the relevant competent authorities.

These permits cover emissions to all media (air, land, water) of any polluting substances as well as soil pollution, energy efficiency, waste minimisation, use of raw materials, water use and transportation impacts.

Industry must use Best Available Techniques (BAT) to prevent or minimise pollution and ensure that any emissions are restricted to the environmental medium where they are least damaging. These BATs include economic considerations. The European IPPC bureau in Spain coordinates the production of BAT reference documents (BREFs) that provide a framework for the setting of emission limit values and permit conditions in permits by the member states' competent authorities.

Guidance Emission Limit Values (ELVs) are to be set on the basis of the BATs, but these shall also take into account environmental quality standards in accordance with established European or international standards, depending on the environmental sensitivity of a region.

The first two chapters of the IED apply to all types of installation and therefore include common provisions, for example in areas such as the application of BAT, the processes of permitting and inspections, the primacy and obligations of the regulators, applying general binding rules, monitoring, and links to other laws such as those for waste management and emissions trading schemes. For example, the application of the waste hierarchy prescribed in the Waste Framework Directive 2008/98/EC is now included within the IED [8].

4.4.2.2 Impact of IED on EIGA members

The IED applies to industrial activities giving rise to pollution as referred to in Chapters II to VI [1]. For the industrial gases industry this means that the relevant processes are the manufacture of:

- hydrogen, syngas and carbon monoxide;
- acetylene;
- specialty gases and organometallics;

- nitrous oxide; and

- carbon dioxide.

The directive sets thresholds for some processes, but there is no threshold in the directive for any of the above processes. This means that even small plants (for example hydrogen electrolysers or small steam methane reformers for fuelling applications) may be included depending on the interpretation of the local authorities.

During the review of the directive, EIGA requested an additional threshold for hydrogen plants, based on the one that exists in the Directive 2003/87/EC *establishing a system for greenhouse gas emission allowance trading* (EU Emissions Trading Directive) [9]. However, this was not included in the revised IED.

A listing of the gas industry processes, the relevant chapters of the IED, BREFs and EIGA documents is shown in Appendix 1.

Air Separation Units (ASUs) are not considered in the scope of the IED, even though inorganic chemicals production is mentioned in the directive chapters, this is because air separation is a physical separation process rather than a chemical process.

The directive defines an installation rather than a process to be permitted. This may be misinterpreted in some member states to include on site utilities such as ASUs.

Cylinder filling and redistribution centres are also not manufacturing processes and are out of the scope of the IED, though in some cases they can lead to emissions and may handle gases that are hazardous to the environment.

These activities are regulated within the member states and subject to local planning and operating licence requirements from the standpoint of safety and community considerations.

The IED now covers cylinder painting or cleaning activities using more than 1 kg/h or 2 tonnes per year of high volatile organic compound (VOC) paints or solvents. Some larger facilities for example tank painting shops and vapour degreasing, may be affected.

4.4.2.3 Suggested actions by EIGA members

EIGA members should:

- monitor the implementation in each country via national gases associations and ensure relevant EIGA documents are also referenced in local legislation and

- ensure relevant site operations have the correct permits in pace and are complying consistently with BAT.

For cleaning and painting operations it is advisable to undertake a review to see whether the VOC producing compounds can be eliminated or substituted (for example water-based paints) without compromising safety or health. It is also best practice to control inventories of these compounds to a minimum and have written handling and control procedures. Advice on good practices for these operations can be found in EIGA Doc 88, *Good Environmental Practices for the Industrial Gases Industry* [10].

4.4.3 Use of ozone depleting substances

Several man-made substances have been identified which contribute to the depletion of the earth's ozone layer. These are principally halogenated hydrocarbons and halocarbons and include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), brominated halocarbons (Halons) and certain chlorinated solvents.

Regulation (EC) No 1005/2009 *on substances that deplete the ozone layer* implements the Montreal Protocol in Europe [11].

4.4.3.1 The ozone layer

Ozone is present in varying concentrations throughout the atmosphere, but most ozone exists in the stratosphere in a layer a few dozen kilometres above the earth. The low-level ozone, troposphere ozone, affects human health causing headache, respiratory ailments and eye irritations as well as damaging the farm crops. One main cause is the vehicle emissions.

The stratospheric ozone is beneficial since it acts as a filter to harmful ultraviolet radiation (UV-B) from the sun. In 1985 scientists identified a thinning of the ozone layer over Antarctic that nowadays also applies for the major part of the earth.

The cause was identified as Ozone Depleting Substances (ODSs) that are broken down by sunlight producing halogen atoms (chlorine, bromine, etc.) that destroy ozone. The consequences are that UV-B level increases, causing damage to human health, including skin cancer and cataracts as well as biologically affecting the aquatic and terrestrial ecosystems.

4.4.3.2 Scope and effect on EIGA members

The intention is to restrict and phase out the production and use in the EU of the ozone depleting substances and most of the member states and the industry have adopted to this situation. For example, has EIGA issued EIGA Doc 33, *Cleaning of Equipment for Oxygen Service* [12].

The impact on the gas industry is:

- the replacing of fixed fire protection systems and fire extinguishers containing halon;
- from 1st January 2015, the use of all HCFC as refrigerants prohibited;
- used controlled substances shall be recycled or recovered to minimise atmospheric release; and
- servicing of equipment containing controlled substances shall be done by authorised personnel with specific qualifications.

Furthermore, in some European countries there is national legislation using the released amount of ODS as a base for taxation, but this is not included in the directive.

4.4.3.3 Phase out schedule – Production

The production of CFCs, Halons, carbon tetrachloride, 1,1,1-tetrachloride and hydrobromofluorocarbons were prohibited under Regulation (EC) No 3093/94 *on substances that deplete the ozone layer* [13]. The phase out of the HCFC production started in 2000 with a complete production stop due in 2025.

4.4.3.4 Phase out schedule – Placing on the market and use

The placing on the market and use of CFCs, Halons, carbon tetrachloride, 1,1,1-trichloroethane and hydrobromofluorocarbons are prohibited.

At the end of 2009, the use of virgin HCFCs to service and maintain existing equipment was banned. From 1st January 2015, it has been illegal to use any HCFCs to service and maintain refrigeration and air conditioning equipment. Alternative gases should be used to retrofit or replace equipment.

The critical or essential use of controlled substances may continue under a special permit (licence) issued by the competent authority with the conditions that the:

- import of controlled substances requires a licensee; and
- import of controlled substances or products containing them from a state not party to the Montreal protocol is prohibited.

4.4.3.5 Emission control

Used controlled substances shall be recovered for recycling or destruction with approved technology. Controlled substances shall not be sold in disposal containers. All reasonable precautionary measures shall be taken to prevent leakage of controlled substances and users, service technicians, etc. shall meet qualification criteria.

NOTE When phasing out the CFC and HCFC use in refrigeration equipment there are two alternatives, to replace the whole machine or to change the cooling media only. Usually, it is economically feasible to replace the small air conditioning units and cooling machines with new ones not using any controlled substances. In bigger units the media could be changed but be aware of that this also entails rebuilding the machine. The refrigeration equipment and refrigerant suppliers should be consulted. In all cases the work should be risk assessed and carried out to ensure that there is no release of controlled substances.

4.4.3.6 Reporting

Each producer, importer and exporter shall annually report the quantities of controlled substances handled.

4.4.3.7 Minimising emissions

In addition to the European regulation the EIGA recommends minimising of the emissions as set out in this section.

Several substances have been developed as replacements for almost all uses of ODS. For example, CFCs and HCFCs previously used as refrigerants in ASUs can be replaced by other freons (HFCs) with no ozone depleting potential and low global warming potential (GWP), or with propane, ammonia or water.

All users should actively investigate the availability and suitability of these substances and technologies. The following general principles should apply:

- When choosing refrigerant consider the environmental impact including ODS and GWP, the cost, the cooling efficiency, safety and use products with no ODS when appropriate.
- Ensure that technicians repairing and maintaining refrigeration units and air conditioning units are qualified and properly trained to ensure that the ODS emission is minimised and the ODS recovered, recycled or disposed of.
- Make an inventory of all equipment containing ODS, including vehicle air conditioners and establish a leak testing and maintenance program.
- Monitor the consumption and emission of ODS.
- Consider replacing refrigeration and air conditioning units containing CFC or HCFC, alternatively to convert to a substitute refrigerant, especially if the present system requires repair (see above).
- Remove the ODS for proper recycling or disposal before the equipment is scrapped.

NOTE Advice on alternative systems can be found from United Nations Environment Programme (UNEP) [14].

4.4.4 Global warming gases

In July 2002 the EU formally ratified the Kyoto Protocol on reduction of greenhouse gas emissions [15]. This gave further legal impetus to various legal initiatives the EU on the control and reduction of greenhouse gases emissions. The EU has set itself targets for reducing its greenhouse gas emissions progressively up to 2050 and implementing measures include restrictions on the emissions of greenhouse gases, emissions permit trading, and tax incentives / disincentives.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal, to which the EU is a signatory.

The European initiatives on energy taxation, fluorinated gases and emissions trading have not been agreed by all member states, but several member states have acted to introduce greenhouse gas reductions measures such as taxes, covenants, trading and schemes to encourage alternative energy and energy efficiency measures.

4.4.4.1 Scope and effect on EIGA members

EIGA members are potentially impacted by all these initiatives due to the energy intensity of the air separation process, direct carbon dioxide emissions from steam reforming plants, as well as the filling, distribution and use of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), HCFCs and sulphur hexafluoride.

4.4.5 Use of fluorinated gases regulation

Fluorinated gases and gas mixtures are used for many common applications and in a wide variety of products. As part of the first phase of the European Climate Change Programme (ECCP) the EU commission proposed a regulation on fluorinated gases which was adopted in 2006 as Regulation (EC) No 842/2006 *on certain fluorinated greenhouse gases* [16]. As this is a regulation not a directive, the requirements are directly applicable to member states. The aim of the regulation was to contain, prevent and thereby reduce emissions of fluorinated greenhouse gases covered by the Kyoto Protocol [15].

In December 2013, the EU reached an agreement on a new F-gas Regulation to replace to existing Regulation (EC) No 842/2006 *on certain fluorinated greenhouse gases*, introducing wider control and a phase down of F gas use [17]. The revised F-gas Regulation (EU) No 517/2014 *on fluorinated greenhouse gases*, was published in May 2014 [18]. The regulation applies from 1st January 2015, repealing the existing regulation. The regulation sets minimum EU wide standards and is directly applicable to member states. However, member states are free to adopt more ambitious measures going beyond the regulation, for example introduce taxes at the member state level.

The revised regulation includes:

- a reduction in the amount of F-gas in the EU by 79% by 2030;
- further restrictions on the use of F-gas in refrigeration equipment including the recharging during service and maintenance of existing refrigeration equipment with a charge size of over 40 tonnes of CO2 equivalent and with an HFC GWP of 2500 or more will not be permitted from 2020 onwards; and
- bans certain products based on agreed GWP thresholds. There are no specific bans for industrial refrigeration other than a ban on the use of F-gas with a GWP of 2500 or more from 2020 as outlined in 11a of Annex III. It should be noted, however, that this ban does not apply to equipment designed to cool products to temperatures below –50 °C.

More details are found in EIGA Doc 192, *Fluorinated Gases Management* [19].

4.5 Energy use

Energy efficiency is one of the main targets of the emissions trading schemes such as the Kyoto Protocol and the European Union Emission Trading Scheme for reducing Greenhouse Gas (GHG) emissions.

The burning of fossil fuels to release energy is the major anthropogenic source of GHG. Improvement in energy efficiency can reduce greenhouse gas emissions in two ways:

- energy efficiency measures for combustion systems (for example boilers, furnaces and ovens) to reduce emissions in direct proportion to reduced amount of fuel consumed; and

- reductions in consumption of electricity, lower demand for electricity and, consequently, reduction in emissions from thermal electrical power generating stations.

Reducing energy intensity, not only improves the competitiveness of the economy, it is a very effective way for ensuring reliable energy supplies, reducing greenhouse gas emissions and promoting market development of highly energy efficient technologies. Therefore, energy is a priority issue within the European Union which has developed a common energy and climate policy.

Directive 2012/27/EU *on energy efficiency* requires [20]:

- member states set an indicative national energy efficiency target in the form they prefer (for example primary / final savings, intensity, consumption) and, from 30th April 2013, notify together with its translation in terms of an absolute level of primary energy consumption and final energy consumption in 2020;

- member states achieve a certain amount of final energy savings over the obligation period January 2014 to December 2020 by using energy efficiency obligations schemes or other targeted policy measures to drive energy efficiency improvements in households, industries and transport sectors;

- large enterprises carry out an energy audit at least every four years, with a first energy audit in 5 December 2015; and

- incentives for Small and Medium Enterprises (SMEs) to undergo energy audits to help them identify the potential for reduced energy consumption.

4.5.1 Scope and impact on the EIGA members

Some aspects to keep in mind about energy optimisation in the gas industry are to operate the plants at optimum efficiency with minimum start up and shutdowns.

4.5.1.1 Energy utilisation

Energy should be viewed as any other valuable raw material resource required for running a business. Energy has costs and environmental impacts and shall to be managed well, in order to increase the business profitability and competitiveness. By enacting energy efficiency measures organisations simultaneously save costs and reduce environmental impacts and risks.

Basis of an energy management system:

One of the most commonly used models for energy management is a plan-do-check-act (PDCA) cycle, which is often known by company management from other contexts but energy. This approach is also in line with the most commonly used management approaches and standards that are relevant to industry. Usually good energy management practices are based on a standard or a specification, for example ISO 9001, *Quality Management Systems – Requirements*, and the related environmental management standard ISO 14001, the EU Eco-Management and Audit Scheme (EMAS) and ISO 50001, *Energy Management* [2, 21, 22]. Features of a successful energy management system to comply with the IED are included in Appendix A.

Successful implementation of energy management requires commitment by company management, conducting an energy audit, analysis and target setting, setting up a monitoring / measuring system, motivating staff and having management reviews. Finally, it is necessary to implement the energy

management system with a corresponding structure throughout the company on a permanent basis to ensure the continuous follow up and improvement of energy efficiency.

Integrating energy management with nearby facilities is another way to improve energy efficiency.

Energy management can be used in all companies because it provides a general approach and structure that offers flexibility to accommodate any specific branch of business. With respect to corporate management, this may be understood as being either the management of the holding company, or of a business unit of a site.

Energy efficiency management:

A key element to deliver energy efficiency at an installation level is a formal management approach. The techniques to achieve management of energy efficiency are applicable to all installations.

Energy management is a useful instrument to improve the efficiency of energy systems both at company and site level. Energy management does not only focus on technical possibilities but also takes into consideration the organisation, the motivation of employees, good practices, cooperation of different departments, and costs. It means structured attention to energy with objectives of continuously reducing energy consumption and improving efficiency in production and utilities and sustaining the achieved improvements. Very often energy management (for example use of renewable or non-renewable resources) is an integral part of an environmental management system or other management system.

Organisations can save energy by applying the same management principles and techniques they use elsewhere in the business for key resources such as raw materials as well as for environment and health and safety. These management practices must include full managerial accountability for energy use. The management of energy consumption and costs eliminates waste and brings in cumulative savings.

4.5.1.2 Suggested actions for EIGA members

The EIGA member companies shall make sure that they:

- comply with all regulatory demands on energy efficiency; and
- consider best practice techniques for improve and manage energy efficiency.

4.6 Water use and minimisation

In October 2000 the Directive 2000/60/*EC establishing a framework for the Community action in the field of water policy* (Water Framework Directive or WFD) was adopted [23]. The purpose of the directive was to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. There is huge potential for water saving across Europe. Europe continues to waste at least 20% of its water due to inefficiency [24].

Many of the processes used in industrial gas operations use water such as water in the cooling towers for air separation plants, water for cleaning vehicles and equipment, process water for manufacturing acetylene.

Most companies and organisations know how much water they use but may not always use this knowledge to help them reduce the amount of water consumed. By using less water, companies save money on both water supply and wastewater disposal and minimise their impact on the environment. Taking action to save water may also allow companies to recover raw materials or product previously lost in effluent streams.

4.6.1 How to minimise water

EIGA has published a number of documents that are a good basis from which to focus on issues related to water use and water minimisation:

- EIGA Doc 107, *Guidelines on Environmental Management Systems*, includes checklist in the Appendix 4 on how to conduct an initial environmental assessment on the use of water and wastewater [25];

- EIGA Doc 106, *Environmental issues guide*, Section 4.4, Energy and water use covers some of the basic issues on water use [26];

- EIGA publication series on environmental impacts for different processes and operations, for example EIGA Doc 94, *Environmental Impacts of Air Separation Units*, covers specific environmental issues related to processes [27]; and

- EIGA Doc 88, *Good Environmental Management Practices for Industrial Gas Industry* [10].

The Table 1 provides some ideas for best practice for activities that use significant quantities of water by EIGA member companies.

Table 1 Example best practices to minimise water usage

Activity using water	Examples of best practice solutions to minimise water usage and wastewater
Boiler make-up water	• Avoid excessive chemical feed through tight control of water chemistry • Run boiler at optimum concentration cycles to minimise chemical loss, wastewater discharges, and makeup water consumption • Consider using automatic blow down equipment (changing from manual to automatic can reduce boiler energy use by 2 – 5% and reduce blow down losses by up to 20%) • Consider improvements to water quality for feed water to reduce blow down rates
Cooling tower and systems make-up water	• Minimise leaks through preventive maintenance (check for excessive drift and splash) • Reduce controlled losses (for example look at bleed losses, concentration cycles) • Maintain proper level of corrosion inhibitors to extend life of equipment • Ensure all float valves are set within operating ranges • Investigate fitting variable speed drive motors to cooling tower fans so that cooling system is better matched to system heat load
Cooling tower and process boiler blow down	• Run cooling tower / boiler at optimum concentration cycles to minimise chemical loss, wastewater discharges, and make-up water consumption • Purchase water treatment chemicals in bulk or returnable containers instead of drums, where practical
Cylinder testing	• Recycle cylinder test water to the extent practical • Discharge through a permitted outfall or sewer connection
Vehicle washing	• Recycle water to the extent practical • Use non-potable water where practical • Wash vehicles in wash bays or other designated areas • Discharge through a permitted outfall or sewer connection

4.6.2 Water balance

In addition to employing good environmental practice, sites that use water should also consider developing a water balance for the site to work out how much you use. Such an approach accounts for where water enters and leaves a site and where it is used within the business. It typically contains information about the amount of water used by each main process and, for some processes, can be very detailed. Presenting a water balance as a diagram makes it easy to understand and use as a management tool.

The type of water used onsite and the type of wastewater generated by site operations / activities will determine how much a company pays for water supply and wastewater disposal. Typically, water can come from a number of sources and be discharged as wastewater in a number of ways, some examples are given in Table 2.

Table 2 Water sources and types

Water sources	Wastewater types
Municipal water supply (potable and non-potable)	Domestic wastewater (sewage)
Water from groundwater (borehole) and surface water	Industrial wastewater and process effluents
Recycled water from another industrial source	Surface drainage (roof and site run-off)
Collected rainwater	Discharge to surface water and groundwater

A very simplistic approach to water use on the site can be quickly developed by looking at inputs and outputs to the process as shown in Figure 1.

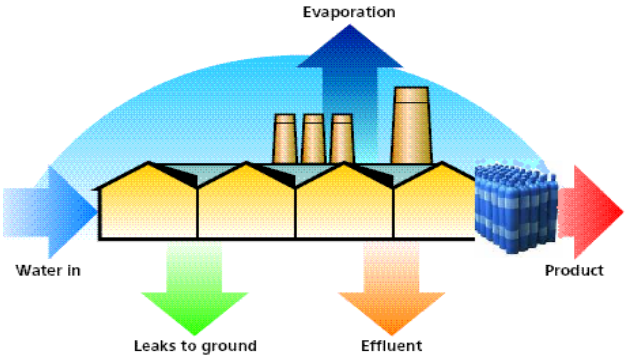

Figure 1 Water inputs and outputs

4.6.3 Action plan for water minimisation

Sites should consider developing a site action plan for water minimisation and would consider the following key points in such a plan:

Step 1: Obtaining commitment and resources

As with any environmental improvement programme, commitment from senior management is vital for success. This should be obtained at an early stage, particularly if you do not have the necessary authority to commit resources to produce a detailed water balance or to investigate and implement water saving opportunities. It may be easier to obtain senior management commitment once you have started to collect information and develop your water balance (step 2) and are in a position to highlight current costs and usage, identify the need for more information and suggest the scope for potential savings and highlight some quick win opportunities.

Step 2: Preliminary review

A preliminary site review typically consists of:

- gathering existing data, for example annual water use and costs;
- conducting a brief assessment of the major gaps in information; and
- deciding how detailed a water balance is appropriate for your company.

The preliminary review may also involve:

- estimating potential cost savings from water saving measures:
- deciding if additional budget is required for obtaining missing information; and / or
- constructing a water balance for example installing temporary water meters.

A preliminary review can be conducted relatively quickly and may involve a walkaround site or building. During the walkaround notes and sketches should be made on activities and operations that use water. Site personnel should be informed, and their views sought on water use and current practices. The walkaround of the site and the information obtained may highlight some quick win projects that will help secure senior management commitment.

A checklist may be used and or use the checklist in EIGA Doc 107 [25].

Step 3: Drawing the water balance picture to identify improvements

In order to put together a detailed picture for the site, collect information that already exists within the company. Check whether the information that appears accurate and consistent. For example, check the meter readings on your latest water bill and find out when water meter(s) was last calibrated. The type of data that should be considered is shown in Table 3.

Table 3 Information for water balance

Type of data / information	Description
Water supply and treatment costs	Water supply bills, water licence fees, pumping, chemicals, operating and labour costs
Water treatment	System type and capacity
Water and effluent quantities	Meter readings in and out of site, on individual machines / process areas Data on rainfall or groundwater inputs From water treatment reports
Water and effluent quality	Analysis of on-site water treatment and effluent samples (either in-house, by external laboratories or by water company) Equipment specifications from suppliers
Effluent treatment costs	Pumping, chemicals, operating, maintenance and labour costs
Effluent discharge costs	Industrial wastewater and sewage bills Charges for discharge to controlled waters
Effluent removed off-site in tankers	Waste disposal contractor's bills for transport, treatment and disposal Quantities and quality of tanker liquids
Site plans	Water distribution and drainage plans, including water sources and location of meters
Details of process or unit or operation	Process flow and pipe / process technical drawings, including manufacturers' specifications

4.6.4 Summary

Summary of water use and minimisation steps:

- The first step is to produce a pictorial representation of your site. All premises, whether a complex site or a single building, can be described by a series of activities or operations.
- Identify and mark on a picture:
    - major uses of water;
    - the location of on-site water meters; and
    - the points at which domestic wastewater and/or industrial wastewater and process effluent enter the site drainage system.

- For more complex sites, use a site plan and process flow diagrams to help produce a pictorial representation of the site.

- Use water balance to identity opportunities to reduce water use and effluent generation. Once a water balance has been formulated, determine projects and actions for improvements. In order to ensure focus the site may choose to regular measure and monitor usage and also set targets for improvement.

- Plans and targets should be regularly reviewed.

4.6.5 Suggested actions for EIGA members

The EIGA member companies shall ensure that:

- best practice techniques are evaluated for minimising water usage;

- water abstraction licences are complied with; and

- all regulatory discharge licences for wastewater are complied with.

4.7 Discharges to water

A special permit from authorities is normally needed to regulate wastewater discharges.

All the wastewater streams must be clearly identified and kept separate if possible, to aid treatment and reduce cost. Special attention is required for rainwater and water from firefighting activity to be separated from trade effluent. It is often beneficial to combine a water use plan with a wastewater discharge plan to reduce wastewater. Authorities may also require specific monitoring for legionella hazard. This could include periodic water sampling, legionella analysis and risk assessment study and / or periodic cleaning of the whole water network.

4.7.1 Water Framework Directive

Directive 2000/60/EC sets the goal of achieving a good status for all of Europe´s surface waters and groundwater by 2015 [23]. Article 4 states that member states shall:

- *Implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater…*;

- *Protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater status at the latest 15 years after the date of entry into force of this Directive…*; and

- *Implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant….*

4.7.2 Groundwater directive

Directive 2006/118/EC *on the protection of groundwater against pollution and deterioration* establishes a regime which sets underground water quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater [28]. The directive establishes quality criteria that takes account local characteristics and allows for further improvements to be made based on monitoring data and new scientific knowledge. The directive thus represents a proportionate and scientifically sound response to the requirements of the Water Framework Directive (WFD) as it relates to assessments on chemical status of groundwater and the identification and reversal of significant and sustained upward trends in pollutant concentrations. Member States are required to establish the standards at the most appropriate level and take into account local or regional conditions requiring:

- groundwater quality standards are established;

- pollution trend studies are carried out by using existing data and data which is mandatory by the Water Framework Directive (referred to as baseline level data obtained in 2007-2008);

- pollution trends are reversed so that environmental objectives are achieved by using the measures set out in the WFD;

- measures to prevent or limit inputs of pollutants into groundwater to be operational so that WFD environmental objectives are achieved;

- reviews of technical provisions of the directive to be carried every six years;

- compliance with good chemical status criteria (based on EU standards of nitrates and pesticides and on threshold values established by Member States).

The action at the member state level include:

- Leaching, spills, polluted runoff water, etc. should preferably be taken care of through careful designing and planning of facilities. Safeguarding of the environment could also be secured by establishing rules for certification of types of installations, oil tanks, etc. In an integrated management system such safeguarding should be an integral part of the general planning and localisation system.

- Possibilities for encouraging development and use of environmentally friendly production processes and procedures such as promotion of best available techniques, clean technology and water saving devices, etc. should be explored.

- An authorisation system should cover any point source from installations and activities that may negatively affect groundwater quality by direct or indirect discharge.

NOTE Permits issued under the IED (see 4.4.1) shall include details of the arrangements made for air, water and land protection as referred to in this directive under Article 9: *If necessary, the permit shall include appropriate requirements ensuring protection of the soil and ground waste*.

4.7.3 Scope and impact on the EIGA members

Large volumes of water containing treatment chemicals are used and discharged from many sites. This shall only be done in an approved manner in line with the regulations and with all the necessary permits in place.

There are some good practices considering soil and groundwater protection that should be studied and implemented where possible. Some examples are:

- understanding site drainage systems, a plan of the system should be available showing all underground pipework and location of all the connections;

- separate contaminated and uncontaminated water systems;

- avoiding buried tanks and installations (for example, fuel storage, see 4.7.4);

- waste storage areas having conditioned and have impervious pavement, storage containers should be fit for purpose and capable of long term storage without risk of release to the environment;

- avoiding leaks and spills during maintenance activities; and

- assessing potential sources of historic contamination and, if necessary, measures taken to prevent pollution.

Further information see EIGA ENL 19, *Site spill prevention plans* [29].

4.7.4 Use of underground storage tanks

4.7.4.1 Background

Some industrial gas sites have Underground Storage Tanks (UST). Examples include tanks for vehicle fuel, heating oil, forklift truck fuel, as well as acetone and dimethylformamide (DMF) on acetylene sites. Many of these tanks are more than 20 years old. Those tanks that are single walled and installed before 1975 are at particular risk of leakage, but all tanks shall be assessed.

Oil is a high visible form of pollution. It harms plants and animals, damage rivers, groundwater and the soil, and can destroy natural habitats and drinking water supplies. It is the most commonly reported type of water pollution and causes over 16 % of all pollution incidents annually within the EU. Oil can have a detrimental environmental impact at very low concentrations, for example one litre of oil can pollute more than one million litres of drinking water.

4.7.4.2 Risk of a product leaking from an underground storage tank

A UST can leak and pollute the soil and the water. Figure 2 shows some examples of the safety, health and environmental risks that can result from the leakage of a UST. These risks include explosion hazards and toxic vapour (1), pollution of drinking water (2) and contaminated soil (3).

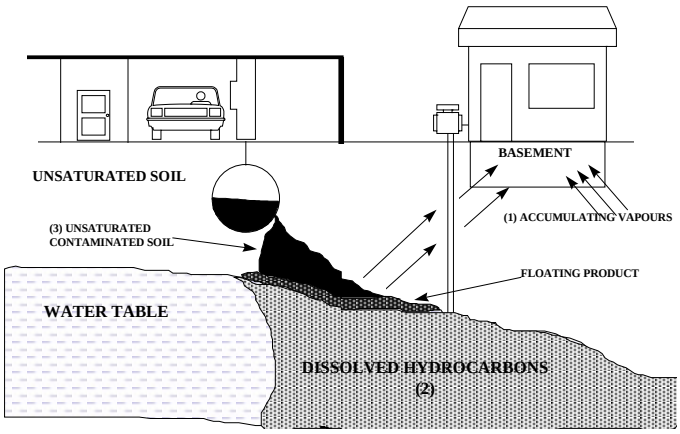

Figure 2 Safe, health and environmental hazards of underground storage tank leaks

4.7.4.3 Risk of water leaking into underground storage tanks

Several incidents have been reported where water has leaked into a UST. This may happen especially if the groundwater level is high. Corrosion of the tank and water pressure can cause water to leak into the tank. This creates operation problems and will make the tank unserviceable.

4.7.4.4 Risk factors – What to look for and how to asses underground storage tanks

From an analysis of large representative USTs, the following information is known:

- 20-25% of tanks corrode evenly and last many decades;
- 75-80% of tanks corrode much earlier, usually as a result of random corrosion caused by the soil conditions, stress or tiny discontinuities in the jacket of the tank;
- if the pH of the soil is less than or equal to 5, the first leaks may occur after about 15 years;
- underground tanks in saturated soils (high water content) can start leaking after only 10-12 years;

- soils with high sulphide content can cause leakage after 12-14 years;
- a hole in the UST doesn't necessarily imply that the product leaks, as the surrounding soil may act as a plug against the corroded part, or the corrosion may occur at the top of the tank;
- equipment fed by direct current with poor earthing nearby can speed up the corrosion of the tank;
- for soils with a pH is around 7, a tank may last over 20 years;
- from a statistical analysis of a sample population it can be shown that there is a 10% probability that tanks with an expected life of 17 years may start leaking after 14 years and a 90% probability of this happening after 20 years; and
- mechanical damage from use of a dip tube can provide a site for corrosion.

Small leaks can often go undetected but still cause widespread pollution over a long period.

The risk factors for tank and pipework leakage are:

- single walled tanks;
- soil conditions of low pH;
- high groundwater levels;
- no or poorly installed corrosion protection;
- high sulphide levels in groundwater; and
- tank not protected from stones and gravel in the surrounding soil.

4.7.4.5 Suggested prevention plan

For existing USTs:

- Inventory – Conduct a survey to see how many USTs exist and minimise the number. Testing may be necessary to find buried tanks.
- Collect data on each UST including, place, product; capacity, year of installation, material of construction, means and ease of inspection, last tightness test and mass balance of product.

Remove from service those USTs which are not strictly necessary. Empty these USTs and either fill with sand or foam, or preferably remove them altogether to avoid future liabilities. Ensure records are kept of the closure and any soil or groundwater tests to prove that there was no contamination from the UST.

Establish a procedure for UST inventory control and tightness test at a frequency appropriate at the age of the UST (increase test frequency with age). One method is to check the steadiness of the UST liquid level (when not in use) for a period spanning at least two days. Consider how to detect small leaks from joints or pipes. For UST remaining in service:

- carry out an internal visual inspection, if practicable, when UST is empty and purged, ensuring that any necessary procedures for confined space entry are followed; and
- ensure dip tubes are not used in a manner that causes mechanical damage to the tank.

For new tank installations:

- Avoid the use of USTs.
- If the installation is necessary, for example if above ground storage is not permitted by the authorities, then use double wall USTs using leak detection for example nitrogen pressure in the interspace.
- Follow all appropriate local or national regulations.

4.7.4.6 Leaking pipework

One of the most vulnerable areas for leakage is the pipework, but sometimes this is not included in the leak testing or preventive maintenance checks even though it should be.

In one case a fuel oil leak from UST pipework leaked into a nearby stream. A member of the public reported this to the authorities and the authorities issued an official warning. The total cost of cleaning up the soil and replacing the pipe was over 5000 €.

In another case a leak from UST pipework caused oil to enter the drainage system, where it was contained. The leak was caused by corrosion of the pipework as it was made from the incorrect material for the service.

4.7.4.7 Summary

These incidents were preventable and illustrate the importance of managing the inventory of USTs to eliminate or minimise the risks of leakage. Such leaks could lead to prosecution from the authorities and damage to the environment, which could result in heavy fines and considerable clean-up costs. The key recommended actions are:

- start or maintain an active programme of UST minimisation and management;
- if necessary to install new USTs, use double walled.,
- inspect and maintain all USTs carefully, including all associated equipment and pipework; and
- report incidents of leaking USTs to EIGA so that lessons are learnt for the rest of the gases industry.

4.7.5 Use of above ground storage tanks containing substances harmful to the environment

These guidelines are intended to assist those responsible for stationary above ground storage tanks containing substances harmful to the environment at sites within the industrial gas industry. This guideline does not include the storage of product in drums, though many of the same principles are applicable. The information can help to reduce pollution caused by inadequate storage in fixed tank installations above ground.

This section is a general guide, where there are regulations for specific products these shall be followed in full (for example for ammonia or chlorine). It does not give specific advice on safety issues or national regulations, which shall be also be taken into account.

In some countries, it is required to register the tanks with the authorities.

4.7.5.1 Substances hazardous to the environment

Examples of hazardous substances stored on industrial gases sites include oil, water treatment chemicals, acetone, DMF, acids and alkalis. The amount of material held on site should be kept to the lowest possible level.

4.7.5.2 Storage container

The material of construction of the tank shall be compatible with the contents.

4.7.5.3 Location

Safety, security, access and maintenance shall be taken into account when storing oil or other substances. Tanks should be positioned to minimise the risk of damage by impact.

In principle, oil or any other water endangering substance (like diesel fuel, acids, acetone and lime etc.) should not be stored in significant risk locations, within 10 metres of a watercourse or 50 metres of a well, national or local regulations may have different requirements. Where storage in risk locations is unavoidable, the tanks shall comply with stricter storage regulations unless other precautions are taken as recommended by a risk assessment.

4.7.5.4 General requirements

Substances should be stored in a tank of sufficient strength to ensure that it is unlikely to burst or leak in ordinary use. Moreover, it is recommended to use tanks with a design life above 20 years (with correct maintenance).

4.7.5.5 Tank system and design

Steel tanks or plastic tanks can be used and should have a primary container with some form of secondary containment. Using double skinned or integral bunding containers is recommended. If it is not clearly stated, contact manufacturer or local authorities to determine appropriate use of container. The following items should be taken into account:

- tanks should be tested to a recognised standard (EN, ISO , national standard etc.);
- material for tank contents are selected according to the properties of the product being stored and to protect from corrosion;
- all tanks systems (polyethylene tanks and steel tanks) should comply with national regulations;
- steel tanks and supports should be protected against corrosion;
- fire protection systems design and specification for example safety distances where applicable;
- protection from flooding, if applicable;
- specification and permeability of the concrete; and
- test foundations are suitable.

It is recommended that technicians registered with a professional scheme install tanks. Tanks should be marked with product type and tank capacity.

Before a tank is taken out of service it shall be fully drained. Qualified technicians should undertake this and hot work should never be carried out until the tank has been de-gassed and the appropriate certificate issued.

4.7.5.6 Secondary containment

Secondary containment shall be used to protect environment in the event of a leakage from the tank or ancillary equipment. All tanks and ancillary equipment should be situated within an oil-tight secondary containment system.

The risk of a leakage can be minimised by a bunded oil tank by:

- keeping the primary container as low as possible;
- Increasing the bund wall height; and
- building the bund as far away from the tank as possible to allow access for external inspection.

The containment system should be impermeable to both the contents and water. Any pipework should not pass through the bund wall, if unavoidable and permitted by the local regulations pipe should be sealed with resistant material and any valves kept locked closed.

Build-up of rainwater in the secondary containment can be avoided by putting it under cover. If this is not possible, rainwater should only be emptied following a test to show if the discharge is acceptable. It may be emptied by an automatic system or by an operator that tests for oil and chemicals to make sure it meets acceptable legal discharge requirements.

The capacity shall provide storage of at least 110% of tanks maximum capacity. If more than one container is stored, the system shall be capable of storing 110% of the biggest containers capacity or 25% of total capacity, whichever is the greater. At least the 110% principle is the minimum capacity that is required (more capacity may be required depending on the site's sensitivity to water pollution).

The 10% margin takes into account the following factors:

- loss of total contents due to accident;
- sudden tank failure, leakage;
- overfilling;
- containment of firefighting agents; and
- rainwater in the bund.

4.7.5.7 Ancillary equipment and filling

Any valve, filter, gauge, vent pipe or other equipment should be situated within the secondary containment system and arranged in that way that any discharges are contained. Top outlet draw-off pipes are preferred where possible. Other recommendations include:

- provide adequate means of measuring the quantity of oil or diesel within the tank should be provided;
- check the correct product is to be filled in the correct tank;
- use gauges and high-level alarms is recommended;
- check the operators have appropriate PPE for example gloves;
- check the earthing of the equipment and the potential for static electricity;
- sight gauges should be fitted with an automatically closing valve when not in use, it should be situated within the secondary containment system; and
- tank maximum fill capacity should be set at 95% of the full capacity.

A written procedure giving details on safe delivery and what to do in an emergency should be sited at the delivery point. The fill pipes should be sited within the secondary containment system and where the fill pipe is outside the containment system a drip tray of adequate capacity should be used to catch any spilled liquid during delivery.

Extended fill pipes may retain oil / diesel fuel following the delivery and should be fitted with a shut-off valve. An automatic overfill should be fitted if the tank and the vent pipe cannot be seen by the person controlling the delivery.

Any surface drainage from the delivery area should pass through a suitably sized oil separator of an approved design (refer to national and local regulations).

All vent pipes should, where possible, be positioned so that the can be seen during delivery. They should be within the containment system and arranged in that way that any discharge is directed vertically downwards into it.

Any pump should be

- positioned to minimise risk of collision damage;
- fitted with a non-return valve in the feed line; and
- protected from unauthorised use.

The pipework should be properly supported and adequately protected against corrosion and it should be sited above ground to make inspection and repair easier. All fill pipes; draw-off pipes and vent pipes shall be positioned away from any vehicle traffic to avoid collision damage.

In case of underground pipework use the route should be marked and protected from physical damage. The mechanical joints should be readily accessible for inspection and repair and all underground pipework shall have adequate facilities for detecting leaks (continuous leak detection device).

Flexible pipes and fittings for filling vehicles should be fitted with a tap or valve at the end that closes automatically when not in use. It shall not be possible to fix the tap or valve in the open position

In general:

- all pipework should be tested before use; and
- underground pipework shall be tested at least in accordance with national and local legislation.

4.7.5.8 General maintenance

All bunds, tanks and pipework should be inspected and checked regularly for damage. Any defects in the bund wall or lining should be repaired promptly using appropriate technique. Tank supports shall be regularly checked for defects and corrosion.

Any condensation water accumulating within the tank should be drawn off. If there is a need to remove accumulated water from the bund (for example after heavy rainfall), this should be performed with manually operated pump. The water may be contaminated and should be disposed of accordingly. Putting a roof on the facility could help to avoid this procedure. Any accumulated oil or debris within the bund should be removed and disposed of correctly.

4.7.5.9 Dealing with spills

Users are advised to consider the risk of a spillage and to prepare a contingency plan to be included in the site emergency plan. Employees should be aware of this plan and properly trained for emergency.

It is recommended to keep a stock of absorbent material (for example sand or commercial products) on site to deal with spillages.

In the case a spill occurs, immediate action should be taken to contain the liquid to prevent it entering the drains or watercourses. The environmental agency shall be notified according to national or local regulations. The used spill absorbent should be disposed of as hazardous waste.

4.7.5.10 Existing tanks

Existing tanks should be reviewed against the same requirements and a decision to upgrade or not should be based on a risk assessment. An example checklist is given in Appendix 2.

4.7.6 Spill prevention planning (deliveries and sire emergency procedure)

The soil and the underground and surface water of the installations and the surrounding area are sensitive to the pollution caused by spillage and leaks. This can be harmful to people's health and damage the environment; therefore, it is necessary to ensure that no hazardous substances enter into the environment.

4.7.6.1 Main causes for spillage

- Mishandling of containers and chemicals during transfer or delivery.
- Inadequate storage areas.
- Inadequate or poorly maintained installations and equipment.
- Faulty equipment.
- Pipes not placed correctly.
- Valves not working properly.
- Valves not shut properly.
- Collisions.
- Corrosion.
- Overpressure.
- Third party activity such as vandalism.
- Extreme weather (floods, storms).

4.7.6.2 Action plans during spillage

- Ensure your own personal safety (for example reach a safe area and make sure you have personal protection equipment).
- Identify the spill (product, label, situation, smell, etc.) without getting exposed.
- Get some help (call the local emergency team or the fire-fighting services).
- Isolate the area and alert people (prevent personnel from entering the affected area).
- Check to see if there are any injured people (can you help them without risking your own safety).
- Identify the risks (fire, explosion, pollution, etc.).
- Prepare the spill prevention equipment and materials (select according to the product and advice provide on the Safety Data Sheet).

- Stop the leak at source (for example close the valve, shut the pump, block the leak, place container in a vertical position, etc.) and control the spill (prevent the spill from spreading especially towards sewers or watercourses).

- Clean the spill (do not touch the product nor breathe it directly, make sure you have personal protection equipment, note the wind direction).

- Use the appropriate absorbent:

    - There is a large variety of absorbents which are based on their retention capacity, weight, hydrophilic and / or hydrophobic properties, corrosion resistance, formats (tubes, cushions, carpets, rolls, hardening agents, particulate matter, etc.), reuse possibility, biodegradability, etc.; and

    - Use the appropriate containers for storing absorbents and manage hazardous waste with an authorised management company.

- Decontaminate the used equipment.

- Investigate the causes and issue a report with conclusions, distribute to all other concerned sites, close the follow up actions and replace equipment if necessary.

- Contact the regulatory authorities if required to report such incidents.

4.7.7 Criteria for storing and handling hazardous substances

The onsite inventory of hazardous substances shall be minimised. Site shall have permits for all the hazardous substances stored if applicable and the full site inventory must be checked regularly against permit limits and Seveso thresholds. Refer to EIGA Doc 60, *Seveso Documents - Guidance on Applicability, Assessment and Legal Documents for Demonstrating Compliance of Industrial Gases Facilities with Seveso Directive(s)* [30].

4.7.7.1 Storage areas

Chemicals, fuels and hazardous waste should be stored based on the following guidelines. It is important to comply with the applicable legislation in each case:

- Storage should be sheltered from the wind and rain and far from the areas used by people and vehicles, and they should be properly identified and have restricted access.

- Storage should be located also be far from unroofed areas, as well as from gutters, scuppers, sewers, drainage points, etc.

- If there are outdoor storage areas, the recommendation is to install a rainwater collection system so that this water can be subsequently treated before its discharge or deliver it to an authorised management company since it may contain pollutants.

- If possible, the installations should be surfaced, in both the process areas and the storage areas and non-built up external areas. The surface should use materials that are appropriate for the type of stored substances.

- The tanks that store products or waste should have a spill prevention system (for example bunds, trays, containment buckets, sloping supports, etc.), especially when the stored products are not solid.

- Incompatible substances should be stored in independent areas. Protect the chemicals from high temperatures and, if the installations store products with a low ignition point, establish a specific area with the appropriate conditions for storing them at the right temperature.

- Those areas should have absorbing materials available nearby in order to collect the discharge in the event of spillage. There should also be firefighting equipment where appropriate and products that are appropriate for cleaning the area in the event of a spill.

- Take into account the maximum storage times of the various substances based on the applicable legislation so that packages do not corrode and leak.

- There should be protection devices (for example metal cages) that prevent the packaging from breaking when receiving blows, especially regarding the large containers.

- Hazardous chemicals should be stored in original packaging.

- The containers or packaging should be labelled properly in a clear, legible and indelible way, with a label stuck firmly to the packaging. The label should at least identify the name of the contained product and the pictograms showing risks associated with the product including the advice to prevent and handle spills.

- Develop and implement test programmes and inspections in order to prevent faults in the tanks. Those programmes include cathode protection tests, etc.

- Make sure that the underground tanks have secondary containment, overfill protection, corrosion protection and leak detection systems, see EIGA ENL 16, *Oil handling and storage* [31].

- If the installations have ponds for storing wastewater before treatment, they should be adequately waterproofed in order to prevent leaks into the soil that may pollute it.

- Ensure that condensation or steam lines do not fall directly on the floor in order to minimise corrosion.

4.7.7.2 Product handling

Chemicals, fuels, raw materials, hazardous waste and any other type of substance that can pollute the environment should be handled based on the following guidelines:

- Each product should be placed in its designated area. This prevents accidents which may lead to materials becoming unusable and turning into waste. Waste should always be deposited inside the bin and not outside.

- The packaging should be handled with care in order to prevent it from breaking or leaking and to ensure that the labels or notes identifying its content do not become deteriorated.

- Do not damage or break materials such as batteries and fluorescent lights when depositing them in the bin.

- The installations should be cleaned preferably in dry conditions.

- The oils and other residual fluids used to maintain the machinery and equipment should be transferred to the hazardous waste storage area in order to prevent spillage. They should never be eliminated by throwing them on the floor or into the sewage or rainwater networks.

- The appropriate means should be used to transport the products in order to prevent leakage and spillage. Any spills should be adequately collected.

- Vehicles should be cleaned in the designated areas in order to prevent the rainwater from being polluted by the hydrocarbons.

- There should be product work instructions accessible to personnel describing what to do in the case of a spill.

4.8 Use of chemicals and hazardous substances

4.8.1 Use of asbestos

4.8.1.1 Introduction

The areas where chrysotile asbestos was used in the past in the Industrial gases industry were in:

- gaskets, valve 'boots' and insulation for some high temperature and cryogenic applications;
- cement and insulation in buildings;
- vehicle braking systems; and
- manufacturing of mass for some acetylene cylinders.

Restrictions on the manufacture, placing on the market and use of asbestos has been undertaken in Regulation (EC) No 1907/2006 *concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)*, specifically in Annex XVII, *Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles* [32].

Existing products containing asbestos products can continue to be used until they need replacement, but new replacements cannot use asbestos. For example, asbestos gaskets cannot be used for replacement.

Exposure to asbestos can cause potentially fatal lung diseases such as asbestosis, lung cancer and mesothelioma (malignant tumours in the lungs or chest).

Legislation laying down minimum requirements for protection of workers that may be exposed to asbestos at work is in EU Directives 89/391/EEC *on the introduction of measures to encourage improvements in the safety and health of workers at work*, 2004/37/EC *on the protection of workers from the risks related to exposure to carcinogens or mutagens at work*, 2009/148/EC *on the protection of workers from the risks related to exposure to asbestos at work*, and 98/24/EC *on the protection of the health and safety of workers from the risks related to chemical agents at work* [33, 34, 35, 36].

4.8.1.2 Scope and impact on EIGA members

No more new products containing chrysotile, or any other type of asbestos shall be purchased and it is recommended not to buy these items second hand either, which may also be prohibited by local regulations.

- Asbestos gaskets on existing plants and pipelines do not have to be changed out unless they are replaced for other reasons, but new gaskets are only available for specific applications where there are no acceptable substitutes. Gaskets held in stock must be removed and disposed of by an approved route.
- Asbestos insulation and cement can also continue to be used to the end of its useful life, but new material shall not be purchased.
- Acetylene cylinders containing asbestos are no longer produced in the EU. New Acetylene cylinders containing asbestos cannot be put on the market in the EU. These are only put on the market when the cylinder itself is sold, so this does not change the position on the use of existing cylinders. Existing cylinders can still be sold second hand provided they are in good condition and where this is allowed by local legislation.

It is also recommended that:

- all sites have an inventory of their asbestos containing material;

- where there are possible hazards from removing the asbestos, such as insulation, damaged cement, and gaskets, the asbestos should be clearly identified and labelled wherever possible, where no hazard exists, such as for acetylene cylinders in normal use, then a warning label is not necessary; and

- asbestos shall only be removed by authorised specialist contractors and shall be disposed of at an authorised landfill or treatment site.

4.8.2 Use of substances under REACH

Extended SDSs under REACH may have additional information on environmental impacts and uses, if downstream use is not included in the extended SDS then the use shall be registered and exposure scenarios developed.

4.9 Waste

4.9.1 General

Management and control of waste, emissions and nuisances is an important environmental issue currently facing all organisations, including the industrial gases business. Most activities create waste in some form, either as a solid, liquid, airborne emission or as wasted energy or resource. Industry has a responsibility to minimise the risk associated with handling, transport and disposal of its wastes in order to safeguard employees, public and the environment. Effective waste, emission and nuisance management should be regarded as a key element of an organisation's environmental protection policy.

4.9.2 Waste management programme

A comprehensive programme of waste management will ensure that all wastes are safely and legally managed from the point at which they are created to the point of final disposal. In most circumstances, the final disposal of waste will not be under the direct control of the company that creates it. However, waste producers have a responsibility to take all practical steps to ensure that waste will continue to be managed properly once it leaves their custody. In practice, this will require that procedures be developed which consider the health, safety and environmental aspects of:

- waste generation;

- storage;

- onsite handling;

- selection of waste carrier/haulier;

- transfer of waste to carrier; and

- selection disposal site.

Companies shall satisfy themselves that offsite handling, transport and disposal of their waste is conducted adequately and with minimum risk to health, safety and the environment. This may require additional procedures to audit the activities of waste carriers and disposers. This programme of auditing can help to minimise the liabilities associated with waste disposal. In some countries liability for the waste is passed from the producer to the transport and disposal company on legal transfer of the waste, but in some countries the liability remains with the waste producer.

The idea of a shared responsibility for waste management as outlined above is consistent with the EU's action programmes on the environment. It is a concept that is steadily becoming embodied in EU legislation and the growing number of national laws governing waste throughout Europe.

4.9.3 Definition of waste

A waste management programme should include wastes produced from all aspects of an organisation's activities. For example, this will include manufacturing processes, materials and product handling, transportation, maintenance, research and development, design, support and office services.

Directive 2008/98/EC *on waste* defines by-products as a substance or object, resulting from a production process, the primary aim of which is not the production of that item. A substance may be regarded as not being waste referred to in point (1) of Article 5 but as being a by-product only if the following conditions are met [8]:

- further use of the substance or object is certain;
- the substance or object can be used directly without any further processing other than normal industrial practice;
- the substance or object is produced as an integral part of a production process; and
- further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

Although there are many interpretations of when an article or substance is considered to be waste, readers are advised to consult Directive 2008/98/EC for a definition of waste [8]. This directive is important in the context of waste management for many reasons. It establishes a framework of responsibilities and requirements for managing the generation, handling, storage, transfer and disposal of waste throughout the European Union. The directive is supplemented by the European Waste Catalogue (EWC) (Commission Decision 2000/532/EC *establishing a list of wastes*) that establishes a categorised list of wastes to be used in all member states of the EU [37].

Co-products such as lime can be classified as a by-product and not a waste provided if it meets the tests in EU Commission guidance COM 2007/59 *on the Interpretative Communication on waste and by-products*, see 4.9.9 [38].

4.9.4 Options for dealing with waste

Preventing, minimising and proper handling and sorting of waste can result in considerable cost savings as well as being environmentally responsible. EIGA members are encouraged to consider the following options in order of preference when deciding how to dispose of waste and thereby minimise the environmental impact of waste streams:

- elimination or reduction of waste at source;
- recovery and reuse of residues (recycling);
- treatment of waste to render harmless; and
- final disposal.

4.9.4.1 Elimination or reduction of waste at source

Eliminating waste at source through better process design can result in long term benefits to health safety and the environment, and is consistent with the preventative principle of good management; improving operating practices with a view to eliminating the generation of waste during a process can often also lead to a reduction in raw material consumption.

4.9.4.2 Recovery and reuse if residues

Waste streams from a process can often be used as an energy source or feedstock for another process. Recovery and recycling (for example spent solvents and oils) can lead to cost savings through reduction of raw materials and lower disposal costs and can reduce the quantity of material requiring ultimate disposal. Discarded waste may represent valuable product which could be sold and in certain circumstances recovered and recycled waste streams may be subject to less onerous legislation than non-recoverable waste.

4.9.4.3 Treatment

There are a number of options available for treating waste and reducing the environmental impact. These include chemical treatments such as neutralisation, oxidation / reduction and precipitation. Physical methods include de-watering, compaction and absorption. Biological methods are also available. The benefits of treatment include:

- increased safety in handling;
- reduced toxicity;
- more immediate use of waste streams as raw materials; and
- lower costs of transportation and final disposal.

4.9.4.4 Final disposal

Where it is not possible to apply recovery and reuse or waste minimisation techniques, final disposal may be the only available option for certain waste streams. Waste disposal capacity in Europe is becoming increasingly limited. In the majority of cases, incineration and landfill are the only viable disposal routes. The cost of disposal to landfill is increasing, and the availability of landfill sites is decreasing. Disposal by incineration is a preferable to landfill provided state-of-the-art incinerators are used which are equipped to meet stringent health, safety and environmental protection standards (particularly in respect of air emissions) are capable of completely destroying the particular waste being burned.

The industrial gases industry is already taking steps to minimise waste and return by-products into a useful commercial cycle. For example, compressed gas cylinders are reusable, have a long life and are ultimately recyclable, residual gas contained in returned cylinders may be recovered and recycled, certain process by-products (such as lime from acetylene manufacturing) have a commercial value and can be used as raw materials for a variety of beneficial purposes (for example acid neutralisation). Such by-products are therefore not considered as waste. Many EIGA members are engaged in energy management programmes which help to minimise energy losses and wastage, recycling of water used in cooling systems, manufacturing processes (for example acetylene manufacture) and cylinder testing is actively encouraged.

EIGA members are encouraged to ensure that they have an effective programme for managing all types of wastes, emissions and nuisances created by their activities. Waste management should address health, safety and environmental protection requirements as well as financial implications. Waste management implies a shared responsibility with others in the waste cycle the responsibility of the producer does not simply end once the waste has left his site. This requirement is embodied within European legislation concerning waste management. Effective waste management, particularly waste minimisation, can lead to cost savings.

Options for dealing with waste should follow the hierarchy of choice set out above, with reduction at source being the preferred option, EIGA members are encouraged to review their own waste, emissions and nuisances management arrangements against the guideline recommendations for all stages of activities from research, design, construction, operation and final decommissioning and disposal. They should seek, wherever practicable and economically viable, to set targets and continually improve upon these.

The reduction of the volumes of waste, and in particular hazardous waste, has long been an objective of the European Union and is part of the Waste Framework Directive 2008/98/EC [8].

Shipment of waste is regulated by Regulation (EC) No 1013/2006 *on shipments of waste* [39]. This regulation specifies under which conditions waste can be shipped between countries.

4.9.5 The framework directive on waste

4.9.5.1 Contents of the legislation

According to the framework directive 2008/98/EC, waste is *any substance or object in the categories set out in Annex 1 which the holder discards or is required to discard* [8].

Annex 1 contains 16 categories, the last one being defined as *any materials, substances or products, which are not contained in the above categories*. Such broad definitions of waste and of categories of waste make legislation itself open to many different interpretations. Gaseous effluents are excluded from the definition of waste.

List of wastes is established by Decision 2000/532/EC [37]. This decision establishes the classification system for wastes, including a distinction between hazardous and non-hazardous wastes. It is closely linked to the list of the main characteristics which render waste hazardous contained in Annex III to the Waste Framework Directive. This is amended by Commission Decision (EU) No 2014/955/EU *amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC*, and Commission Regulation (EU) No 1357/2014 *replacing Annex III to Directive 2008/98/EC* [40, 41].

The waste catalogue makes waste statistics from the member states comparable but does not solve the problem of the definition of waste. To solve the problem of the definition of waste, the Commission has set up a task force of experts from member states in order to define more precise criteria to establish the distinction between product and waste.

The introduction notes, that the EWC is an illustrative, non-exhaustive list of wastes. However, the inclusion of a material in the EWC does not mean that the material is a waste in all circumstances. Only when the material satisfies the definition of waste will the entry be relevant.

The definition of waste is therefore very important and should be considered in perspective with the objectives of the waste directive, and other directives on the same subject, when we have to decide if a cylinder and/or its content should be considered as waste.

The European Waste Catalogue (EWC) contained entries into which empty cylinders and / or their content could fit [37]:

- 15.01.04 – metallic packaging;
- 15 01 10* – packaging containing residues of or contaminated by dangerous substances;
- 15 01 11* – metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers;
- 16 05 – gases in pressure containers and discarded chemicals;
- 16 05 04* – gases in pressure containers (including halons) containing dangerous substances; and
- 16 05 05 – gases in pressure containers other than those mentioned in 16 05 04;

Where * indicates a hazardous waste.

4.9.5.2 Waste – labelling according to CLP

The legal requirements applicable to the classification, packaging, labelling, loading, stowage, placarding, documentation and transport of hazardous substances apply to hazardous wastes as they do to pure chemical substances [6]. Transport of waste shall also follow European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) [42].

4.9.6 Empty cylinders as waste

4.9.6.1 The cylinder

A gas cylinder is a packaging and it should be remembered that a packaging only becomes a waste when it cannot be reused anymore. Refillable cylinders (reusable packaging) only become waste at the end of their technical or economical life. The decision to declare that a refillable cylinder is no longer subject to reuse can only be taken by the owner of the receptacle or delegated by the owner to a competent person.

Non-refillable cylinders (such as aerosols and gas cartridges) become waste (hazardous or non-hazardous) after they have been used.

Thus, the disposal of non-refillable receptacles that have been sold is the responsibility of the gas user. Guidelines on the safe disposal of residual products can be found in EIGA Doc 30, *Disposal of Gases,* and the gas supplier can provide technical assistance [43]. Once the receptacle is cleaned out it can be recycled as scrap metal. Advice on dealing with composite cylinders is given in EIGA Doc 166, *Guidelines on the Management of Waste Gas Cylinders* [44].

4.9.6.2 The residual content of the cylinder

The holder of a refillable cylinder does not become the holder of gaseous waste simply because the cylinder is empty but still contains some residues at a pressure too low to be used.

Residues in cylinder may be reused and the decision whether or not to reuse the gas (or whether or not to discard in the jargon of the directive) cannot be taken by the user of the cylinder, but by the gas producer themselves.

The problem is completely different for non-refillable receptacles which, when empty, should be treated as waste, and according to the gas they still contain will become hazardous waste or not.

Empty cylinders (refillable or non-refillable) are described in ADR either under the denomination of the produce or as *un-cleaned empty receptacles* containing small quantities of residues (item 8 of class 2 of the ADR/RID) [42].

If residual gases are deliberately sent to a waste treatment plant for disposal, the description of the gas should include the word *waste*.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal regulates the transfer, not the transport, of waste between the states that have ratified the convention [45]. It aims at controlling transboundary movements of wastes and their disposal with a system of notification prior to shipment. These rules apply when waste is transferred across National or Regional borders.

As indicated above, empty cylinders are not transported as waste, except when a producer declares residues to be waste and sends them to a waste treatment plant.

4.9.6.3 Scope and impact on EIGA members

EIGA's view is that empty cylinders are not to be considered as waste until they have finished their technical / economic life. In that case, the entry 15.01.04 – metallic packaging, of the European Waste Catalogue should apply [37].

Empty cylinders returned to the supplier do not contain waste but residues and are not transported as waste.

4.9.7 Hazardous waste

4.9.7.1 Contents of the legislation

Articles 17 to 20 of Directive 2008/98/EC provides additional labelling, record keeping, monitoring and control obligations from the cradle to the grave, i.e. from the waste production to the final disposal or recovery [8]. In addition, mixing of hazardous waste is banned to prevent risks for the environment and human health.

The classification into hazardous and non-hazardous waste is based on the system for the classification and labelling of dangerous substances and preparations, which ensures the application of similar principles over the whole life cycle of materials. The properties which render waste hazardous are laid down in Annex III of Directive 2008/98/EC and are further specified by the Decision 2000/532/EC [8, 37].

4.9.7.2 Scope and impact on EIGA members

The intent of Directive 2008/98/EC is to ensure that waste is treated in facilities designed for the purpose, mixing incompatible wastes does not create additional hazards and pollution is prevented [8].

Industrial gas companies generally take full responsibility for the cylinder by retaining ownership and ensuring the return for reuse. If the cylinder is no longer suitable for use, it is normal practice to remove any residual gases before sending the cylinder for recycling. In the overwhelming majority of cases the cylinder when discarded (sent for recovery) it is not a hazardous waste.

The amendments in Decision 2000/532 have the consequence of including for example oxygen as a hazardous waste [37]. As the thresholds in the dangerous substance legislation are being applied, the categorisation of air (21% oxygen) as a hazardous waste is avoided, however it does mean that a mixture of 24% oxygen would be hazardous waste.

The decisions on additions / changes to the waste list are taken by a technical committee of member states experts form the national authorities.

4.9.8 Packing waste

4.9.8.1 Contents of the legislation

The aims of Directive 94/62/EC *on packaging and packaging waste* are to encourage efficient and economic design of packaging and promoting the reuse, recycling and recovery of such packaging [46].

4.9.8.2 Scope and impact on EIGA members

The directive covers packaging as defined with examples listed in Annex 1 and the requirement to re-use, recycle and recover the packaging.

All the new packaging put on the market after 1st January 1998 must meet certain essential requirements for reusability and recyclability. For packages meeting CEN or recognised national standards these requirements are deemed to be met.

The gas cylinder is a fully reusable package with an economic life well in excess of 20 years, which is fully recyclable at the end of its life. Industrial gas companies generally take full responsibility for the cylinder by retaining ownership and ensuring the return for reuse. If the cylinder is no longer suitable for use it is normal practice to remove any residual gases before sending the cylinder for recycling and recovery. The cylinder only enters the waste stream (for recovery) if it fails its periodic revalidation test.

It is thus only in exceptional circumstances that gas cylinders are landfilled, representing less than 1% of those cylinders removed from the commercial cycle due to the cylinder failing its periodic validation

test. New cylinders therefore are not to replace those going to landfill sites but represent growth in the gases business. In any case with a 20 plus year life span before recovery new cylinders are not representative of the cylinders sent now for recovery.

Acetylene cylinders represent a special case. In the past small quantities of asbestos were used in the mass and a higher proportion of these are landfilled. The principals of the waste management of these cylinders are covered in EIGA Doc 05, *Guidelines for the Management of Waste Acetylene Cylinders* [47].

In most cases, the gas cylinder remains the property of the gas company, and is rented to the customer, thus not sold. By providing a fully reusable, recyclable package and full producer responsibility for it, the industrial gas industry already exceeds the targets in the directive.

The directive (Article 11) establishes a maximum heavy metals content of packaging and packaging components. Cylinder valves can contain up to 1% lead, so that the brass can be machined, which exceeds the thresholds. However, the valves are recovered and recycled, and the lead does not enter the environment.

Directive 96/191 *on marking of packaging and on the establishment of a conformity assessment procedure for packaging* established a voluntary scheme of labelling to indicate reusability, recyclability etc. [48]. EIGA recommends that further labels on cylinders are not necessary, as they would only serve to confuse the end user.

4.9.9 Lime and waste management

Lime slurry should be considered as a product and not as a waste, because it is possible to market it for different uses (for reference see EIGA Doc 143, *Guide to Carbide Lime Applications* and ASTM Special Technical Publication STP 931, *Lime for Environmental Use*) [49, 50]. Regular analysis should be carried out to promote lime as a product.

Lime can be classified as a by-product and not a waste provided if it meets the tests in guidance COM 2007/59, for example when [38]:

- the intention is not to discard the lime from the process but to market it, the lime is produced to a specification and has a safety data sheet according to product legislation (registered or pre-registered under REACH). Lime as a by-product should enter in the scope of REACH [32].

- lime can be used directly without further processing, which should mean it is not classified as waste if it has a certain beneficial application.

In the unlikely event of no available use for the lime it shall be disposed of as waste according to Decision 2000/532/EC as regards the list of wastes (waste number 06 02 01 for $Ca(OH)_2$) [37]. Permission from competent authorities is required.

EIGA Doc 143 contains examples of the uses of lime and this demonstrates that the lime can be used directly without further processing and should not be considered a waste [49].

4.10 Waste electronic equipment

The purpose of Directive 2012/19/EU *on waste electrical and electronic equipment (WEEE)* is to contribute to sustainable production and consumption by the avoidance of waste arising from electrical and electronic equipment and, in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal [3]. This covers all electrical and electronic equipment used by consumers and equipment intended for professional use. It applies to products and producers, irrespective of the selling technique, including distance and electronic selling.

The purpose of Directive 2011/65/EU *on the restriction of the use of certain hazardous substances in electrical and electronic equipment* is to contribute to the protection of human health and the environment by forcing the restrictions of the use of hazardous substances in electrical and electronic

equipment [51]. This covers to electrical and electronic equipment falling under the categories 1 – 7 and 10 set out in Annex I of Directive 2012/19/EU and electric light bulbs and luminaries in households [3].

4.10.1 Implementation

Directive 2002/95/EC *on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)* entered into in 2003, together with Directive 2002/96/EC *on waste electrical and electronic equipment (WEEE)*, they were replaced by Directive 2012/19/EU Directive [52, 53, 3]. Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by February 2014.

Directive 2012/19/EU applies to electrical and electronic equipment (EEE) from August 2018 to EEE falling within the categories set out in Annex I [8]. Annex II contains an indicative list of EEE which falls within the categories set out in Annex I.

From August 2018 all EEE is subject to the new directive and shall be classified within the categories set out in Annex III. Annex IV contains a non-exhaustive list of EEE which falls within the categories set out in Annex III (open scope).

The following are exempted from application of the directive as detailed in Article 2:

- equipment necessary for the security of member states or intended for specifically military purposes;
- equipment which is specifically designed and installed as part of another type of equipment;
- filament bulbs;
- large scale stationary industrial tools;
- large scale fixed installations;
- equipment specifically designed solely for the purposes of research and development that is only made available on a business to business basis; and
- medical devices.

4.10.2 Separate collection

Separate collection of WEEE is a pre-condition to ensure specific treatment. Member states shall adopt appropriate measures to achieve a high level of separate collection of WEEE. The return of such waste from private households is free of charge for final holders and distributors.

Notably, the directive states that the correct collection and treatment of the following is a priority:

- temperature exchange equipment containing ozone-depleting substances and fluorinated greenhouse gases;
- fluorescent lamps containing mercury; and
- photovoltaic panels and small equipment.

4.10.3 Treatment and recovery

Best available treatment, recovery and recycling techniques should be used provided that they ensure human health and a high level of environmental protection.

Producers or third parties acting on their behalf may set up systems for treatment and recovery either on an individual or on a collective basis. As a minimum the treatment shall include the removal of all

fluids and a selective treatment in accordance with Annex VII of the Directive 2012/19/EU and storage of WEEE shall respect minimum requirements listed in Annex VIII [3]. Member states shall give priority to the reuse of the whole appliances and shall encourage the development of new technologies. Producers shall be encouraged to integrate recycled material in new equipment.

The Commission shall request the European standardisation organisations to develop European standards for the treatment, including recovery, recycling and preparing for reuse of WEEE.

Member states shall encourage establishments or undertakings which carry out treatment operations to introduce certified environmental management systems and audit scheme (EMAS).

Member states shall ensure that any establishment or undertaking carrying out treatment operations obtains a permit from the competent authorities in compliance with Article 23 of Directive 2008/98/EC [8].

Treatment operations require a permit from the competent authorities, in compliance with Article 23 of Directive 2008/98/EC [8]. Member states shall ensure that storage and treatment of WEEE is in compliance with the technical requirements set out in Annex VII and Annex VIII of the Directive 2012/19/EU [3].

Regarding WEEE sent for treatment producers shall meet increasing targets (listed in Annex V) for recovery, recycling and reuse rates by average weight per appliance, typically up to 80%.

4.10.4 Financing

There are separate provisions for the financing of WEEE collection from private households, but this is not relevant for EIGA members.

For WEEE from users other than private households (business to business), the financing of the costs for the collection, treatment, recovery and environmentally sound disposal of WEEE other than private households shall be provided for by the producers for products put on the market later than 2005. Producers and users other than private households may conclude agreements stipulating other financing methods.

4.10.5 Information

Information on component and material identification is important to facilitate the management and, in particular, the treatment and recovery of WEEE. In addition, it is indispensable for the success of the WEEE collection to give appropriate information to the users. Users of electrical and electronic equipment should be informed about:

- the requirement not to dispose of WEEE as un-sorted municipal waste and the return and collection systems available to them;
- their role in contributing to reuse and recycling; and
- the potential effects on the environment and human health as a result of the presence of hazardous substances and the meaning of the symbol shown in Annex IX of Directive 2012/19/EU [3].

Products put on the market after 2005 shall be appropriately marked with the symbol shown in Annex IX to be identified as electrical and electronic equipment. Producers shall provide reuse and treatment information for each type of new EEE put on the market within one year after the equipment is put on the market. It shall be made available to reuse centres, treatment and recycling facilities by the producers of the EEE.

Any producer of an electric or electronic appliance put on the market later than 2005 shall be clearly identifiable by a mark on the appliance. Distributors are obliged to manage electric or electronic appliances of registered producers only. If selling products of non-registered producers, the distributor has to register instead.

Pre-requisite for registration is the guarantee of environmentally sound disposal in accordance with EU waste legislation. A clearing association shall ensure that the registration is neutral and independent from any business activities.

4.10.6 Scope and impact on EIGA members

EIGA members should pay attention to which electrical and electronic equipment is purchased and sold to assure that its placing on the market and its end of life management are made in accordance with the directive.

Moreover, companies should pay attention to the purchase of electrical or electronic equipment for their own use and when it is assembled in large scale fixed installations like air separation units or food freezing equipment as they will need to be recycled under the provisions of the directive.

Typical items for which the directives on EEE and WEEE are applicable for the gas industry, where they are sold separately include:

- control panels, instrumentation and PC equipment;
- process monitoring or analytical equipment;
- gas cabinets;
- welding machines and equipment;
- oxygen concentrators and respiratory equipment; and
- portable hydrogen generators.

4.11 Landfill directive

In 2002 the EU adopted Decision 2003/33/EC *establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of the Landfill Directive 1999/31/EC* [54].

The decision established:

- procedures to determine the acceptability of waste at landfills;
- limit / threshold values and other criteria for waste acceptance in the different classes of landfills; and
- test methods to be used to determine the acceptability of waste at landfills.

Waste generated by the extractive industry that is deposited on site is exempt from the criteria and procedures set out in the Annex of the decision. In the absence of specific Community legislation, member states shall apply national criteria and procedures.

The Council Decision Annex lays down the uniform waste classification and acceptance procedure according to Annex II of Directive 1999/31/EC *on the landfill of waste* (Landfill Directive) [55]:

- Section 1 lays down the procedure to determine the acceptability of waste at landfills. This procedure consists of the basic characterisation, compliance testing and onsite verification.
- Section 2 lays down the acceptance criteria for each landfill class. Waste may be accepted at a landfill only if it fulfils the acceptance criteria of the relevant landfill class.
- Section 3 lists the methods to be used for the sampling and testing of waste.
- Appendix A defines the safety assessment to be carried out for underground storage of waste.

- Appendix B is an informative Annex providing an overview of the landfill options available within the Directive and examples of possible sub-categorisation of landfills' non-hazardous waste.

4.11.1 Scope and impact on EIGA members

EIGA members shall ensure their waste is characterised correctly for it to be accepted in the corresponding waste landfill.

For a correct characterisation:

- if possible, match up the characterisation of the waste with what is described in the European waste list;
- follow the fundamental requirements for basic characterisation of the waste described in the Decision; and
- document all the characterisation information of the waste.

If characterisation is not possible, test the waste and maintain samples in order to control the compliance of the characterisation.

The impact of this decision on some typical wastes from the industrial gases industry is shown in Appendix 3.

5 References

Unless otherwise specified, the latest edition shall apply.

[1] Directive 2010/75/EU, *Industrial Emissions Directive (IED)*, www.europa.eu.

[2] ISO 14001, *Environmental Management Systems – Requirements with Guidance for Use*, www.iso.org.

[3] Directive 2012/19/EU *on Waste Electrical and Electronic Equipment (WEEE)*, www.europa.eu.

[4] EIGA Doc 85, *Noise Management*, www.eiga.eu.

[5] Directive 2004/35/CE *on environmental liability with regard to the prevention and remediation of environmental damage*. www.europa.eu.

[6] Regulation (EC) No 1272/2008 *on classification, labelling and packaging of substances and mixtures*, www.europa.eu.

[7] Directive 2010/75/EU *concerning integrated pollution prevention and control (IPPC)*, www.europa.eu.

[8] Directive 2008/98/EC *on waste (Waste Framework Directive)*, www.eiga.eu.

[9] Directive 2003/87/EC *establishing a system for greenhouse gas emission allowance trading* (EU Emissions Trading Directive), www.europa.eu.

[10] EIGA Doc 88, *Good Environmental Practices for the Industrial Gases Industry*, www.eiga.eu.

[10] Regulation (EC) No 1005/2009 *on substances that deplete the ozone layer*, www.europa.eu.

[11] EIGA Doc 33, *Cleaning of Equipment for Oxygen Service*, www.eiga.eu.

[12] Regulation (EC) No 3093/94 *on substances that deplete the ozone layer*, www.europa.eu.

[13] United Nations Environment Programme, www.unenvironment.org.

[14] The Kyoto Protocol, www.unfccc.int.

[15] Regulation (EC) No 842/2006 *on certain fluorinated greenhouse gases*, www.europa.eu.

[16] Regulation (EC) No 842/2006 *on certain fluorinated greenhouse gases*, www.europa.eu.

[17] Regulation (EU) No 517/2014 *on fluorinated greenhouse gases*, www.europa.eu.

[18] EIGA Doc 192, *Fluorinated Gases Management*, www.eiga.eu.

[19] Directive 2012/27/EU *on energy efficiency*, www.europa.eu.

[20] ISO 9001, *Quality Management Systems – Requirements*, www.iso.org.

[21] ISO 50001, *Energy Management*, www.iso.org.

[22] Directive 2000/60/*EC establishing a framework for the Community action in the field of water policy* (Water Framework Directive), www.europa.eu.

[23] Ecologic, Report on EU water saving potential, June 2007, www.ecogic.eu.

[24] EIGA Doc 107, *Guidelines on Environmental Management Systems*, www.eiga.eu.

[25] EIGA Doc 106, *Environmental issues guide*, www.eiga.eu.

[26] EIGA Doc 94, *Environmental Impacts of Air Separation Units*, www.eiga.eu.

[27] EIGA Doc 88, *Good Environmental Management Practices for Industrial Gas Industry*, www.eiga.eu.

[28] Directive 2006/118/EC *on the protection of groundwater against pollution and deterioration* (Groundwater directive), www.eiga.eu.

[29] EIGA ENL 19, *Site spill prevention plans*, www.eiga.eu.

[30] EIGA Doc 60, *Seveso Documents - Guidance on Applicability, Assessment and Legal Documents for Demonstrating Compliance of Industrial Gases Facilities with Seveso Directive(s)*, www.eiga.eu.

[31] EIGA ENL 16, *Oil handling and storage*, www.eiga.eu.

[32] Regulation (EC) No 1907/2006 *concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)*, www.europa.eu.

[33] Directive 89/391/EEC *on the introduction of measures to encourage improvements in the safety and health of workers at work*, www.europa.eu.

[34] Directive 2004/37/EC *on the protection of workers from the risks related to exposure to carcinogens or mutagens at work*, www.europa.eu.

[35] Directive 2009/148/EC *on the protection of workers from the risks related to exposure to asbestos at work*, www.europa.eu.

[36] Directive 98/24/EC *on the protection of the health and safety of workers from the risks related to chemical agents at work*, www.europa.eu.

[37] Decision 2000/532/EC *establishing a list of wastes*. www.eiga.eu.

[38] COM 2007/59 *on the Interpretative Communication on waste and by-products*, www.eiga.eu.

[39] Regulation (EC) No 1013/2006 *on shipments of waste*, www.eiga.eu.

[40] Commission Decision (EU) No 2014/955/EU *amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC*, www.europa.eu.

[41] Commission Regulation (EU) No 1357/2014 *replacing Annex III to Directive 2008/98/EC*, www.europa.eu.

[42] European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), www.unece.org.

[43] EIGA Doc 30, *Disposal of Gases*, www.eiga.eu.

[44] EIGA Doc 166, *Guidelines on the Management of Waste Gas Cylinders*, www.eiga.eu.

[45] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, www.basel.int.

[46] Directive 94/62/EC *on packaging and packaging waste*, www.europa.eu.

[47] EIGA Doc 05, *Guidelines for the Management of Waste Acetylene Cylinders*, www.eiga.eu.

[48] Directive 96/191 *on marking of packaging and on the establishment of a conformity assessment procedure for packaging*. www.europa.eu.

[49] EIGA Doc 143, *Guide to Carbide Lime Applications*, www.eiga.eu.

[50] ASTM Special Technical Publication STP 931, *Lime for Environmental Use*, www.astm.org.

[51] Directive 2011/65/EU *on the restriction of the use of certain hazardous substances in electrical and electronic equipment*, www.europa.eu.

[52] Directive 2002/95/EC *on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)*, www.europa.eu.

[53] Directive 2002/96/EC *on waste electrical and electronic equipment (WEEE)*, www.europa.eu.

[54] Decision 2003/33/EC *establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of the Landfill Directive 1999/31/EC*, www.europa.eu.

[55] Directive 1999/31/EC *on the landfill of waste*, www.europa.eu.

[56] Directive 86/278/EEC *on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture*, www.europa.eu.

Appendix 1 EIGA document links to ISO 14001

Doc No	Title of EIGA document	ISO 14001 Sections	Clause
107	*Guidelines on Environmental Management Systems*	*General Requirements*	*4.1*
		Environmental Policy	*4.2*
		Planning	*4.3*
		Objectives, targets and programme(s)	*4.3.3*
		Implementation and operation	*4.4*
		Resources, roles, responsibility	*4.4.1*
		Competence, Training and awareness	*4.4.2*
		Communication	*4.4.3*
		Documentation	*4.4.4*
		Control of documents	*4.4.5*
		Emergency Preparedness and response	*4.4.7*
		Checking	*4.5*
		Monitoring and measurement	*4.5.1*
		Evaluation and compliance	*4.5.2*
		Non-conformity, corrective preventive action	*4.5.3*
		Control of records	*4.5.4*
		Management review	*4.6*
106	*Environmental Issues Guide*	*Environmental aspects*	*4.3.1*
108	Environmental *Legislation guide*	*Legal and other requirements*	*4.3.2*
30	*Disposal of Gases*	*Operational control*	*4.4.6*
85	*Noise Management for the industrial gas industry*	*Operational control*	*4.4.6*
88	*Good Environmental Management Practices for the industrial gas industry*	*Operational control*	*4.4.6*
109	*Environmental Impacts of Acetylene plants*	*Operational control*	*4.4.6*
84	*Calculation of Air Emissions from Acetylene Plants*	*Operational control*	*4.4.6*
05	*Guidelines for the management of waste acetylene cylinders*	*Operational control*	*4.4.6*
94	*Environmental Impacts of Air Separation Units*	*Operational control*	*4.4.6*
110	*Environmental Impacts of Cylinder Filling Plants*	*Operational control*	*4.4.6*
117	*Environmental Impacts of Customer Installations*	*Operational control*	*4.4.6*
111	*Environmental Impacts of Carbon Dioxide and Dry Ice Production*	*Operational control*	*4.4.6*
122	*Environ. Impacts of Hydrogen Plants*	*Operational control*	*4.4.6*
112	*Environ. Impacts of Nitrous Oxide Plants*	*Operational control*	*4.4.6*
113	*Environmental Impacts of Transportation of Gases*	*Operational control*	*4.4.6*
137	*Decommissioning*	*Operational control*	*4.4.6*
135	*Environmental auditing guide*	*Internal Audit*	*4.5.3*

Appendix 2 Storage tank checklist

General requirements	Yes / No	Comments
Tank conditions		
Tank location (situated more than 10 m from watercourse or 50 m from well)		
Secondary containment system		
Tank and equipment protected against impact or collision damage		
Correct labelling		
Earthing		
Secondary containment system		
Maximum storage capacity (110% of tank content is minimum requirement)		
Impermeable to water and oil		
System intact, no openings or valves for drainage		
Cracks or damages carefully repaired		
Any draw off or filling pipes pass through containment sealed adequately		
Tank ancillary equipment		
Valves, filters, gauges and vent pipes within the secondary containment system		
Sight gauges fitted with a valve that closes automatically when gauge not in use		
Draw off and fill pipes protected so that they cannot be damaged by impact or collision		
Piping protected from corrosion		
All taps and valves fixed to the tank, through which liquid can be discharged to the open, fitted with locks and locked when not in use		
Tank filling		
Fill pipe situated within the secondary containment system		
If not, is a drip tray used (adequate capacity of drip tray)		
Tank and or vent can be seen from the point where the filling operation is controlled		
If not, is the tank fitted with automatic overfill protection device		
Screw fittings or other fixed couplings being used		
Underground pipes (where applicable) for filling and/or draw-off		
Protected from physical damage		
Mechanical joints situated in a place accessible for inspection		
Adequate facilities for detecting leaks		
The permanent leak detection is maintained and tested at appropriate interval		
Pipework tested before use		
Pipework tested at appropriate intervals (refer to national or local legislation)		
Flexible draw off pipes		
Fitted with a tap or valve at the delivery end that closes automatically when draw off pipe is not in use		
Pipe kept in secondary containment system when not in use		
Lockable valve where the pipe leaves the container which is locked shut when not in use		
Pump set draw off		
Pump set fitted with a non-return valve in the feed line to the pump		
Pump set protected from unauthorized use (locked when not in use)		
Pump set located so that it cannot be damaged by an impact or a collision		

Appendix 3 Typical wastes in the industrial gases industry

Waste	EWC code	Landfill type	Can this be landfilled with treatment?	Can this be landfilled without treatment?	What is the treatment required?	What testing may be necessary?
1. Acetylene Cylinders	15 01 11*	Hazardous	Yes (may depends on local regulations)	No	Minimum removal of solvent – as per EIGA Doc 05 [47]. In some countries the cylinder shell needs to be removed for recycling.	Not applicable
2. Lime *This is normally a byproduct not a waste.*	If need be: 06 02 01*	Hazardous	Yes	No	Lower pH to acceptable level and limited heavy metals and toxic contaminants and water	Heavy metals and pH (lime meets the criteria of the Directive 86/278 CE : sewage sludge used in agriculture [56])
3. Batteries	16 06 04 Alkaline 16 01 02* Ni Cd 16 06 03* Mercury 16 06 01* Lead	Mandatory recycling	No	No	Recovery and recycling are mandatory, except for alkaline batteries, in some countries	Not applicable
4. Perlite	17 06 04	Inert	Not applicable	Yes, provided not contaminated	None	None, not leachable
5. Paint Waste	08 01 11* (organic solvents) 08 01 12	Usually incinerated	No	No	Not applicable	Not applicable
6. Sludge from paint	08 01 13* (organic solvents)	Usually incinerated	No	No	Not applicable	Not applicable

Waste	EWC code	Landfill type	Can this be landfilled with treatment?	Can this be landfilled without treatment?	What is the treatment required?	What testing may be necessary?
	08 01 14					
7. Aqueous sludge containing paint	08 01 15* (organic solvents) 08 01 16	Usually incinerated	No	No	Not applicable	Not applicable
8. Aqueous suspensions containing paint	08 01 19* (organic solvents) 08 01 20	Usually incinerated	No	No	Not applicable	Not applicable
9. Contaminated Pipework	17 04 09*	Hazardous → Non-Hazardous	Yes	No, depends on contaminants	Pipe decontaminated and metal recycled	None
10. Oil / water separator sludge	13 05 02*	Hazardous – May be incinerated	Yes	No	Wastewater treatment	Landfill of sludge subject to leachability test
11. Oil filters	16 01 07*	Hazardous - Usually incinerated	Yes, if drained	No	Draining of oil	None
12. Spent Molecular sieve (not contaminated)	15 02 03	Non-hazardous	Not applicable	Yes, provided not contaminated	None – regeneration (recycling) possible	Testing for hydrocarbons
13. Composite Cylinders	15 01 05	Recycling (metal part) – Hazardous / Non hazardous (non metallic material)	EIGA guidance to be written, recycle and recover	No	Minimum: removal of gases and cylinder materials segregation	Leachability test applied to the non-metallic material

Waste	EWC code	Landfill type	Can this be landfilled with treatment?	Can this be landfilled without treatment?	What is the treatment required?	What testing may be necessary?
14. Ferro silicate Residuals from acetylene production	06 13 99	Non hazardous	Yes	Yes, depends on the overall lime content.	Reduce the overall lime content (use of specific filtering equipment)	Leachability test
15. Raw food waste	20 01 08 (biodegradable kitchen and canteen waste)	Usually incinerated – Non-hazardous	Not applicable	Yes	Not applicable (collected as municipal wastes)	Not applicable (collected as municipal wastes)