ENVIRONMENTAL MANAGEMENT FOR HOTELS

THE **INDUSTRY GUIDE** TO **SUSTAINABLE** OPERATION

International Tourism Partnership

5 AIR

5.1 THE ISSUES 2

5.1.1 Indoor air quality (IAQ) 2
5.1.2 External air emissions 2
5.1.3 Noise pollution 3

5.2 INDOOR AIR QUALITY 3

5.2.1 Why is IAQ important? 3
5.2.2 Sources of indoor air pollution 4
5.2.3 Improving indoor air quality 4
5.2.4 Diagnosing problems 6
5.2.5 Action plan to improve IAQ 6
5.2.6 Costs of improving IAQ 10
5.2.7 Applicable standards 10
5.2.8 Monitoring and evaluation 11

5.3 EXTERNAL AIR QUALITY 11

5.3.1 Sources of air emissions 11
5.3.2 Effects of air emissions 11
5.3.3 Hotels and external air pollution 12
5.3.4 Air emissions management 12
5.3.5 Actions for hotels 14
5.3.6 Emissions from burning fossil fuels/gas 14
5.3.7 Emissions from the evaporation of hydrocarbons 15
5.3.8 CFCs and refrigeration management 15
5.3.9 Odours and vapours 18
5.3.10 Bacteriological pollutants 18
5.3.11 Miscellaneous gases 18

5.4 NOISE 20

5.4.1 Sources of noise 20
5.4.2 The issues 20
5.4.3 A programme for tackling noise 22
5.4.4 The action plan 22
5.4.5 The noise audit 23
5.4.6 Practical measures to avoid noise and its effects 23
5.4.7 Investing in noise control 23
5.4.8 Evaluation 23

5.5 MORE INFORMATION 25

5.5.1 Contacts 25
5.5.2 Resources 25

APPENDIX

1 Statutory noise, odour and other nuisances 26

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Hotels have a legal responsibility to provide a safe and healthy external and indoor environment for staff, guests, customers and other building occupants

5 AIR

This section examines the key issues relating to internal and external air quality:

- *Maintaining a healthy indoor air quality for staff, guests and visitors.*
- *Ensuring that no emissions of solid, liquid or gaseous substances that are potentially hazardous to human health or detrimental to the general environment are emitted to the atmosphere.*
- *Minimising noise, both internally and externally.*

All three are of great importance to the health and well-being of staff, guests and the wider community and to the successful operation of your hotel.

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5.1 THE ISSUES

5.1.1 Indoor air quality (IAQ)

According to the **US Environmental Protection Agency**, indoor air is often more seriously polluted than outdoor air.[1] Given that many of us spend around 90 per cent of our time indoors, this is significant. For our general health, well-being and safety, human beings require a comfortable indoor temperature with air free from dust, irritants, pathogens, unpleasant odours, mould and mildew and other contaminants.

The health effects associated with poor indoor air quality (IAQ) depend on the specific pollutants and their concentration levels. Typically, minor symptoms include headaches, mucosal irritation (eye, nose and/or throat) or respiratory discomfort. Severe reactions can include nausea or asphyxiation, and prolonged exposures can lead to various systemic effects of toxic poisoning or to cancer of the lungs or other organs. In general, the main problem for hotel guests is not long-term exposure to poor IAQ, but rather acute exposure that causes annoyance, irritation, allergic reactions and other immediate illnesses. However, long-term exposure can be a problem for staff.

5.1.2 External air emissions

We need a continuous supply of air in order to exist and a minimum standard of air quality to remain healthy – an average individual requires around 10–20m^3 of air per day. The quality of the outside air we breathe can be compromised by various substances (from natural or industrial processes) which are potentially hazardous to human health or detrimental to the general environment. Potentially harmful emissions include carbon monoxide, nitrogen dioxide, sulphur dioxide, lead, ground level ozone, small particles and cancer-causing chemicals such as benzene. Even pollen is a pollutant for people who suffer from allergies such as hay-fever.

As industry developed and expanded in Europe and North America in the 19th and 20th centuries, the problem of air pollution first began to manifest itself in the urban smogs associated with big industrial cities. Problems of this kind brought about the first legal constraints on air emissions such as the restriction of coal-burning, and pollution standards for major industrial processes. Today, despite the fact that many industrialised nations have successfully reduced levels of atmospheric pollution through tighter emission standards for industry, cleaner fuels and better technology, emissions are on the rise in rapidly developing countries such as China and India, to the detriment of air quality.

Over the past 25 years we have learned much about the long-range and long-term effects of air emissions including:

- **Global warming and climate change** brought about by emissions of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). SEE SECTION 2.1.1
- **Atmospheric pollutants** that are toxic to humans and the environment. These include particulate matter, heavy metals, nitrogen dioxide NO_2 from nitrogen oxides (NO_x) and some non-methane Volatile Organic Compounds (NMVOCs).
- **Loss of species diversity** caused by acid rain. In some countries atmospheric emissions of pollutants or combinations of pollutants have upset the natural balance of acidity and nitrogen in the environment. Not only does this damage buildings, but it has affected ecosystems and influenced the diversity of species in sensitive areas, for example the death of certain tree species through acid rain in forests in Western Europe.

[1] See www.epa.gov/iaq/pubs/insidest.html#Intro1

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- **Ground level ozone.** Ozone is created by a chemical reaction between air pollutants. At ground level, it can affect people's health and can damage crops, forests and some materials.
- **Atmospheric ozone levels.** Whereas ozone at ground level is a pollutant, atmospheric ozone produced naturally in the earth's stratosphere is beneficial as it protects us from the sun's ultra-violet (UV) radiation that is known to cause skin cancer, cataracts, and impaired immune systems. However, the ozone layer is destroyed by certain man-made chemicals known as ozone-depleting substances (ODS). These include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, and methyl chloroform. Once released into the air ODS degrade very slowly and can remain intact for years as they move through the troposphere until they reach the stratosphere.

5.1.3 Noise pollution

Noise has the potential to cause psychological, physiological and physical effects on human beings and animal species and can generally reduce the quality of our lives. Aside from the general annoyance or even serious damage to health it can cause, noise pollution is significant for the hotel industry as it can reduce the value of your property, decrease employee productivity and decrease guest satisfaction.

5.2 INDOOR AIR QUALITY

Indoor air is the ambient air inside a building, to which the building's occupants (employees or the general public) are exposed. Indoor air quality (IAQ) is the quality of indoor air in terms of the proportions of normal atmospheric gases and the concentration of pollutants.

5.2.1 Why is IAQ important?

IAQ is of great importance in the hotel environment for several reasons – many of them with potentially significant financial implications:

a. It is your **legal responsibility** to ensure the safety of staff, guests and customers at all times. This includes for example the safe functioning, adequate ventilation and proper maintenance of boilers and heating systems to avoid creating toxic fumes such as carbon monoxide. In October 2006 two children died from carbon monoxide poisoning due to fumes from a defective gas appliance at their hotel bungalow in Corfu.

b. You are also **obliged not to pose a risk to public health**, for example through creating conditions for the following:

- **Legionnaires disease** – this is a rare form of pneumonia that can be contracted through the inhalation of droplets of contaminated water transmitted in the form of spray. The risks are associated with poor maintenance of air-conditioning systems, showering facilities, whirlpool and spa baths and fountains. *Legionella* bacteria are unlikely to be detected by staff or guests until someone falls seriously ill. Not only are companies that are found responsible for incubating Legionnaires disease liable to prosecution and fines, it is potentially fatal (killing around 4,000 people around the world each year) and could expose you to compensation claims. For more information. SEE SECTION 3.4.7
- Certain **moulds** such as the toxic *Stachybotrus chartarum* thrive in damp and humid conditions. They can cause hay-fever like symptoms and affect sufferers of chronic lung complaints such as **asthma**. People with lower immunity are also at risk of infection from moulds.

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- **Allergies** can be exacerbated by air-conditioning, dust mites or materials to which sufferers are allergic in guest bedrooms.

c **Guest satisfaction** – often guests will not complain about a stuffy environment or a room that exacerbates any allergies they may have, but they are unlikely to return or recommend your hotel to others.

d **Staff productivity** – staff cannot work efficiently and effectively if they are uncomfortable. Poor IAQ will affect their concentration, productivity and how they relate to your clients. It can cause headaches, tiredness, dry or sore eyes or throat, skin irritation, dizziness and even nausea. So-called 'sick building syndrome' can have a detrimental effect on long-term health.

e You will be able to **reduce your operating** costs through investment in modern, energy-efficient **air-conditioning equipment** and proper **maintenance**. This will also reduce your CO_2 emissions.

5.2.2 Sources of indoor air pollution

Many factors affect IAQ in hotels and office buildings including:

a **The level of outdoor pollution** caused for example by smog, vehicle emissions and pesticides. SEE 5.3

b **Sources of indoor pollution** including the materials used in the fabric of building, carpets and soft furnishings, smoking, cleaning chemicals and the use of perfumes and salon products. SEE FIGURE 5.1

c The rate of **exchange between indoor and outdoor** air in the form of ventilation rates and distribution.

d The amount of **moisture** in the indoor environment (humidity), which is considerably increased in hot humid climates, near kitchen areas and if the hotel has a gym, spa or indoor swimming pool. In serious cases this can lead to the growth of mould and mildew which has health implications. Odours, sore throats and other respiratory irritation as well as discoloration and damage to furnishings are common problems caused by indoor humidity levels being too high.

5.2.3 Improving indoor air quality

The objective of the IAQ programme is to **safeguard the health and welfare** of your guests and staff while they are on the hotel premises. This is achieved by adopting air-quality objectives and standards, establishing procedures for dealing with specific IAQ problems and carrying out routine maintenance procedures. Monitoring IAQ is a technical matter, and if you do not have the necessary expertise and equipment in-house, an outside consultant/technician will be required. However, much of the programme can be set up by the hotel.

The best way to improve IAQ is by diluting airborne pollutants through increased ventilation and filtration. The distribution of outside air within the building, and even within individual rooms, is also a key determinant. Humidity levels are also important.

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Pollutant	Sources	Health effects
Ammonia	Cleaning products	Irritates eye and mucous membranes
Asbestos	Used as building and piping insulation in older buildings. Needs special attention where it is deteriorating	Asbestosis, Benign Pleural Disease, fibrosis, mesothelioma and lung cancer
Bacteria and other micro-organisms	*Legionella*, moulds and mildew	Can cause worsening of respiratory complaints
Carbon dioxide (CO_2)	Respiration, product of combustion	Feelings of stuffiness, drowsiness
Carbon monoxide (CO), nitrogen oxides, sulphur dioxide or hydrocarbons	Leaking combustion devices (boilers, cookers etc.)	Drowsiness and headache, worsening of respiratory complaints. Unconsciousness, respiratory failure and death in the case of carbon monoxide poisoning
Chemical vapours	Cleaning solvents, pesticides, paints and varnishes	Light-headedness, nausea, headache
Dust and particulate matter	Carpets, surfaces, smoking and other combustion	A range of allergic symptoms depending on size and nature of particles
Formaldehyde	Foam insulation, fabric finishes, fire retardants, furniture made with pressed wood, adhesives, carpet backing, cigarette smoke	Can irritate eyes, skin and mucous membranes and cause headaches and asthma
Methane gas	Formed by the decay of natural materials and is common in municipal landfills, marshes, septic systems and sewers. Enters buildings through cracks in foundations etc.	Highly flammable and potentially explosive. Reacts violently with oxidisers, halogens, and some halogen-containing compounds. Can cause asphyxiation
Odours	Cooking, smoking, perfume etc.	Annoyance, stress and even allergic reactions
Radon gas	Released by the soil on which the building is situated and enters through cracks in concrete walls and floors, floor drains, and sumps. High levels often contained in granite, cement or brick building materials	Increased likelihood of lung cancer due to inhalation of radon decay products
Viruses, infectious diseases	Humans and animals e.g. SARS and Bird flu	Wide-ranging
Volatile Organic Compounds (VOCs)	Solvents, aerosol sprays, cosmetics, dry cleaning, paints, pesticides, photocopiers, smoking	Wide-ranging – including eye, skin and mucous membrane irritation

FIGURE 5.1
Common indoor air pollutants

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5.2.4 Diagnosing problems

In order to assess your indoor atmosphere you should carry out an initial test of air quality by testing for routine air-quality indicators. Any observations made by staff or guests about internal air quality should be analysed to see whether there are any patterns of poor air quality. If such patterns exist, further thought should be given as to whether these indicate problems with the hotel operation or with the building conditions. SEE FIGURE 5.2

FIGURE 5.2
Levels of screening for assessing IAQ

INITIAL

Initial screening should identify the majority of air problems and should test for the following:

- **Carbon monoxide** (inefficient combustion)
- **Carbon dioxide** (human metabolism)
- **Particulates or dust** (various sources)
- **Ozone** (fluorescent lights/photocopiers)
- ***Legionella* bacteria** (cooling towers)

In making background measurements it is important to recognise that a single 'snapshot' measurement will not necessarily give you a valid picture of the IAQ level. For example, hotel areas affected by vehicle exhaust gas from the garage will have higher pollutant levels when garage traffic is greater. **You must therefore keep in mind the daily cycle of activities affecting IAQ when taking measurements.**

INTENSIVE

A more intensive sampling programme would extend the initial tests to include:

- **Nicotine** (indicator of environmental tobacco smoke)
- **Organics** (odours, specific toxic substances)
- **Formaldehyde** (irritation, toxicity)
- **Radon** (building situation/materials)

This second list is likely to require the assistance of an **external technical consultant** using appropriate instruments. This may also be your preferred route for the initial screening.

Further tests may be needed to identify sources and specify corrective measures, and this may require the technical assistance of a consultant. Major renovation or repair work on the building or its equipment may require a contractor, whose activity should be monitored. Further professional sampling should then be carried out to verify that air-quality goals have been met.

5.2.5 Action plan to improve IAQ

There are three basic approaches to improving IAQ:

Eliminating or reducing the pollutant at source

e.g. adjusting the time and duration of use when the pollutant is generated

Filtration or air purification

Ventilation or dilution of the pollutants

For detailed reference, the **American Society of Heating, Refrigerating & Air-Conditioning Engineers (ASHRAE)** produces guidelines on ventilation

The IAQ improvement programme should include routine review and correction of problems in the areas shown in FIGURE 5.3 over the following pages:

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FIGURE 5.3

INDOOR AIR QUALITY

ACTION PLAN TO IMPROVE IAQ

HEATING, AIR-CONDITIONING AND VENTILATION SYSTEMS (HVAC)

Ventilation rates

PARTICULARLY IN VARIABLE AIR VOLUME SYSTEMS

- Maintain the **required outside air supply and distribution**. Ensure that all systems are properly **balanced** and a surplus of approximately 10 per cent is maintained, to prevent negative pressure within the ventilated space, with the exception of the kitchen and laundry. Control any possible pollution from outside via fresh air intakes, such as traffic emissions, boiler flues, dry-cleaning ventilators, cooling towers.
- 'Tight' buildings where outdoor air is **controlled** mechanically and **well-filtered** before being distributed around the building can provide high quality indoor air, especially if high-efficiency filters are used.
- Minimum **fresh air flow rates** are defined by national building codes. A typical value is 8–12 litres of fresh air per second (l/s) per person.
- Fresh air quantities can be greatly increased when **energy recovery** from exhaust air is used to pre-heat or pre-cool fresh air. **Heat recovery** devices, such as air-to-air heat exchangers, can recover 75 per cent of the waste heat in exhaust air.
- **Carbon dioxide (CO_2)** levels are an indication of the number of people and the air quality in a room. Indoor levels should not exceed 1,000 ppm (parts per million). Automatic CO_2 control improves the ability of air-conditioning systems to adapt to variable indoor ambient parameters.
- Poor **extraction over cooking appliances** can lead to spillage into the kitchen and restaurant areas. Choose a supply and extract combination that directs contaminants towards the extract in the most efficient way.
- **Vapour and fine particulate grease** can be removed effectively from exhaust systems using ultra violet (UV) light treatment.
- Ensure that **vents are not blocked** by furniture or other obstructions.

Maintenance

- **Regular maintenance and cleaning** of your Heating, Ventilation and Air-Conditioning (HVAC) equipment is essential to ensure it is filtering and circulating air correctly, that the air-to-fuel ratio is correct in boilers and that there are no air leaks or blockages.
- It is important that proper **pressurisation** is maintained in order to avoid pollutants entering the hotel.
- **Cooling coils** must be steam-cleaned regularly to remove any build-up of deposits and bacteria, particularly in **humid climates**.
- **Clean and replace** high-efficiency filters regularly (twice a year at minimum). Vacuum clean heat exchangers and the front panels of chilled beam systems once a year.
- Make sure no rainwater is leaking into the building and into the AC system – this can lead to **microbial contamination** (including *Legionella*) and the dispersal of spores throughout the building.
- **Monitor water quality** in cooling towers and condensation drains regularly. Eliminate stagnant water accumulation and remove biological contaminants through a regular cleaning programme.
- If you operate a dry-cleaning operation in the hotel, ensure that the **extraction system** is sufficient to cope and that it is not allowing solvent spillage into the hotel air.

Refrigerants

- Purchase equipment using refrigerant that conforms with the requirements of the **Montreal Protocol**,[2] the international agreement covering the use and phasing out of **Ozone Depleting Substances (ODS)**. Currently, the most environmentally responsible choice is to select systems using natural refrigerants. As a very general guide:
  - **Chlorofluorocarbons (CFCs)** and **Hydrochlorofluorocarbons (HCFCs)** are ozone-depleting. The use of CFCs is no longer permitted. HCFCs are not permitted in new equipment and their use for equipment maintenance is being phased out.
  - **Hydrofluorocarbons (HFCs)** are non ozone-depleting (zero ODP), but have significant global warming potential (GWP)
  - **Natural refrigerants:** Ammonia has zero ODP and zero GWP and hydrocarbons (HCs) – i.e. R290 – have zero ODP and negligible GWP.
- Never substitute **alternatives** without first checking with your equipment supplier that they are **compatible** with your system. In some cases, modifications may be necessary before using replacements or it may be necessary to replace the equipment altogether. **SEE 5.3.8 AND FIGURE 5.5**

[2] See **www.unep.org/ozone/Treaties_and_Ratification/2B_montreal_protocol.asp**

CONTINUED OVER/...

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FIGURE 5.3

INDOOR AIR QUALITY

ACTION PLAN TO IMPROVE IAQ / CONTINUED

Extensions and refurbishment

- Take **radon** protection measures where it is known that soil radon concentrations are high. In the UK and elsewhere this is covered by building regulations.
- **A hot, humid climate** is more likely to cause indoor air quality problems than a hot dry one. Various design techniques can be employed in buildings to reduce or avoid the need for air-conditioning. These include the use of **natural cross-ventilation** whereby windows are located on both sides of the room, helping to create airflow across the space and provide a fresh and comfortable indoor climate with minimal energy consumption and at low cost.
- For buildings **without air-conditioning**, the use of **high ceilings, ceiling fans** and **louvred shutters** will all help the flow of air and keep the temperature comfortable for occupants.
- **Fresh air intakes** for ventilation systems should be located away from pollution sources such as main roads or cooling towers in order to avoid the danger of contamination by traffic fumes or *Legionella* respectively.
- In new or refurbished establishments, proper **commissioning** should be undertaken to balance all ventilation and AC systems before commencing operation.
- Do not dust, sweep, or vacuum debris that may contain **asbestos** and avoid sanding, drilling, or scraping such material. It is important to seek help from a qualified professional to handle and dispose of it. **SEE SECTION 8.7**
- Ensure adequate **ventilation in underground car parks**. Fans should be fitted with sensors so that they can regulate air quality automatically. This will result in considerable savings over having fans running on a 24-hour basis.
- Use **natural, sustainably-produced materials** such as wood wherever possible for interior fittings.
- Avoid the use of **plywood** and other materials that contain **formaldehyde**. In many countries its use is banned or restricted in the manufacture of wooden furniture items.
- Make sure all **paints, varnishes and adhesives** used are **free of solvents**, or contain negligible amounts. Manufacturers should be able to provide independent scientific information as to whether their products meet stringent criteria for emissions. You should consult these before purchasing.
- **New carpets** can contain chemicals that irritate skin and eyes. Ask your supplier for information on what the carpet contains and whether it will cause emissions before purchasing. If possible, unroll and air the carpet in a well-ventilated area before installation and leave rooms to air for at least 24 hours after fitting.

Cleaning and standards of hygiene

- In order to minimise the risks of **Legionnaire's disease (SEE ALSO SECTION 3.4.7)**:
  - **Hot water** should be stored above 60°C (thermostatic mixing valves should be installed on showers and taps to prevent scalding).
  - **Shower-heads** and **spa jets** should be regularly cleaned and flushed through. Ozone treatment and other purification technologies provide an environmentally preferable alternative to chlorine, but if this is not possible then use a 5–10mg/litre chlorine solution.
  - Care should be taken in the choice of **materials in contact with warm water** to ensure they do not serve as nutrients for the *Legionella* bacteria.
- **Dust and vacuum all soft furnishings** daily. In hotel bedrooms, this should be done as early as possible during the day so that any dust can settle before the room is occupied for the night.
- **Carpets** are often blamed for poor air quality, either for emissions or for harbouring dust mites and airborne debris. However, they do help to hold the allergens such as dust mites out of the air until they are vacuumed, so the key issue is to ensure regular maintenance and cleaning. Concentrate on the areas which get the most use – such as the hotel entrance, corridors, passageways into and out of rooms, stairways and elevators and eating areas. Deep clean carpets regularly to avoid the abrasion of embedded dirt.
- Purchase commercial **floor cleaning equipment** that has strong suction and enclosed bags with good filtration. This will ensure that the dust particles are not circulated back into the air into furnishings and beds.
- **Volatile Organic Compounds (VOCs)** can accumulate in the indoor environment and concentrations of as little as 0.2 milligrams per cubic metre of air can cause discomfort to allergy sufferers. Solvents used in inks, paints, glues, rubber, cement, felt pens and white-out fluids all contribute and can build up if there is insufficient fresh air in the room. Review your use of cleaning and office products and paints and avoid the use of solvents wherever possible. If solvent use is essential, ensure that lids are replaced on containers (even during use) as this will cut down on vapour loss. Follow manufacturers' guidelines and ensure adequate ventilation during use.
- Review your **cleaning** and **laundry** operations and identify where you can replace chemicals with environmentally preferable alternatives. Always follow manufacturers' guidelines and ensure adequate ventilation when using cleaning chemicals.

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Reduce humidity

- It is necessary to **control humidity** to prevent mould growth, particularly in humid climates. Humidity can lead to problems with condensation and provides an ideal environment in which moulds and dust mites can flourish. Levels should be kept at 60 per cent or below, for example through air-conditioning controls with a relative humidity reduction feature.
- **Kitchens and restaurants** create hot, moist conditions and odours. **Extraction hoods and fans** are particularly important in kitchens to ensure that the hot air and smells are not drawn into the ventilation or air-conditioning system. Ideally these should respond automatically to the prevailing conditions.
- Check for and remove **mould and mildew** on ceilings, walls, furnishings and all other surfaces. Non-breathable wall covering (such as vinyl) should never be used in climates with high humidity because moisture can be trapped behind it, providing ideal conditions for mould growth. Use breathable, organic paint, or paper and fabric wall coverings fixed with a mildew-resistant paste.
- Always ensure that rooms are **properly aired**, and in particularly humid or damp conditions use **dehumidifiers** to help reduce moisture levels. It is important to note that dehumidifiers can rapidly accumulate bacteria so they need to be cleaned regularly following the manufacturer's instructions.

Smoking

Implement a **no-smoking** policy throughout the hotel. This is becoming more and more common throughout the world as the health effects of passive smoking become recognised and laws are introduced banning smoking in public places. If you allow smoking, designate rooms for smokers and non-smokers and ensure you have no-smoking areas in the bar or restaurant. Seat smokers near the air exhausts and not the air supply ducts.

Use of plants

- Some **indoor plants** are widely believed to improve the quality of the internal environment by **absorbing pollutants**. In the late 1980s, a study by **NASA** and the **Associated Landscape Contractors of America (ALCA)** concluded that common houseplants such as bamboo palms and spider plants help to purify the air. Here are two examples of the use of plants to improve IAQ:
  - In 1999 the **Sheraton Rittenhouse Square Hotel**, in Philadelphia, USA planted a 40-foot high bamboo garden in the lobby to oxygenate the atrium area.
  - **The Orchid Hotel**, Mumbai, India, advocates the use of indoor plants rather than cut flowers as decoration to help counteract the effects of indoor pollutants. It recommends at least one 4–5 foot high plant for every 100 square feet of floor space in order to provide effective purification.
- **Do not use pesticides** on indoor (or outdoor) plants! Not only will it contribute to indoor pollution, but chemically-dependent plants will not be as effective at cleaning the air.

Air purifying plants

Latin name	Common name
Philodendron spp.	Heartleaf or Elephant Ear varieties
Dracaena spp.	Cornstalk, Janet Craig or Warneck varieties
Hedera helix	English ivy
Chlorophytum comosum	Spider plant
Ficus benjamina	Weeping fig
Epipremnum aureum	Golden Pothos
Spathiphyllum `Mauna Loa'	Peace lily
Chamaedorea sefritzii	Bamboo or Reed palm
Sansevieria trifasciata	Snake plant

SOURCE: Clean Air Gardening

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5.2.6 Costs of improving IAQ

Although it often requires only good maintenance to ensure that you are complying with your IAQ programme, some areas will require capital investment in equipment modification or replacement. For example, a specific ventilation problem may require one or more of the following, in increasing order of cost:

1. More frequent replacement of air filters
2. Use of a more efficient air-filtration method
3. Increasing the outside air ratio and implementing enthalpy control
4. Major redesign of the HVAC system, including:
   - supply
   - exhaust fans
   - control of the outside air ratio versus return air
   - heat recovery
   - automatic controls

Certain IAQ problems such as fumes from paint or welding activities and severe odours from kitchens or waste areas require more specific and immediate attention, and can sometimes be controlled by local ventilation, cleaning or better scheduling.

Looking at the financial benefits, an efficient IAQ programme will reduce the costs of cleaning air diffusers, improve the lifetime of materials within the hotel and reduce the risk of potential complaints and claims against the establishment. Guest comfort and satisfaction, as well as employee productivity, will also improve.

5.2.7 Applicable standards

Whilst there is no specific legislation governing indoor air quality, there are standards in many countries covering exposure to various pollutants and occupational safety and health. Your IAQ programme should maintain awareness of local and national standards and respond if and when they change. For example in the US, relevant guidelines would include the **Occupational Safety and Health Administration's (OSHA) Indoor Air Quality Standards**.

International guidelines on ambient air and IAQ have been developed by the **World Health Organization (WHO)** (see resources at the end of this section). The **American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) Standard 62.1-2007 – Ventilation for Acceptable Indoor Air Quality** is another useful source of information.

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5.2.8 Monitoring and evaluation

Evaluation of the IAQ improvement programme is necessary to ensure it is meeting its objectives. Evaluation procedures should be built into the programme from the outset:

- Monitor compliance with established operating and maintenance procedures.
- Review the frequency and type of complaints from guests and staff and how they are being handled.
- Monitor IAQ levels according to a schedule, depending on the severity of the problem.
- Monitor areas of new construction or renovation for compliance with IAQ procedures.
- Conduct a survey by questionnaire or interview among a sample of guests and staff to measure their opinions on the quality of IAQ and on the effectiveness of the IAQ programme.

5.3 EXTERNAL AIR QUALITY

5.3.1 Sources of air emissions

External air emissions are either created by natural means or are man-made. Natural sources include metabolic by-products, decomposition, fires, storms and volcanic activity – and there are limits to our ability to control them. Man-made sources, which we are able to manage, include fuel combustion in, for example, power stations, heating systems and vehicles, and emissions of organic and inorganic pollutants during industrial operations.

When a fuel is burnt, the main products given off to the atmosphere are carbon dioxide (CO_2), water and heat. Carbon dioxide is now known to be a key contributor to man-made global warming (SEE SECTION 2). The other principal products of combustion are sulphur dioxide (SO_2), oxides of nitrogen and particulate matter (from the entrainment of solid material from the fuel). Emissions of all these components vary greatly with the fuel type and the efficiency of the combustion process.

Emissions of volatile organic compounds (VOCs) to the atmosphere during manufacturing and in uses such as fire extinguishing, aerosol propellants and petrol distribution also contribute to global warming as well as local air pollution. Certain VOCs are potentially toxic and carcinogenic.

Chlorofluorocarbons (CFCs), along with other chlorine- and bromine-containing compounds used for refrigeration have been found to cause depletion of ozone in the Earth's stratosphere. Since 1987 they have been subject to the terms of an international agreement known as the **Montreal Protocol on Substances that Deplete the Ozone Layer** and their use has been phased out. SEE 5.2.5 AND 5.3.8

5.3.2 Effects of air emissions

a **HUMAN HEALTH:**

The effect of an air pollutant is largely proportional to its concentration, but this basic relationship is complicated by the fact that sensitivity to atmospheric pollution varies enormously from individual to individual. Concentrations causing no more than mild discomfort to one person could be a death sentence to someone with chronic bronchitis and a weak heart. People who smoke are often less able to cope with polluted air, and small children are particularly susceptible, as toxins are quickly absorbed into their bodies.

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Pollutants can also produce different, sometimes more severe, effects in combination with each other, or in particular environmental conditions such as extremes of temperature or humidity. For example, ozone (O_3) is not directly emitted from any man-made source in significant quantities but is formed in the lower atmosphere mainly by a series of chemical reactions initiated by sunlight. The sunlight causes oxidation of VOCs in the presence of nitrogen oxides (NO_x). Because the chemical reactions are not instantaneous and take hours or even days, the ozone level measured at a particular location may have been caused by VOC and NO_x emissions hundreds or even thousands of miles away. Ozone irritates the airways of the lungs, increasing the symptoms of those suffering from asthma and lung diseases.

Air-quality standards have been adopted within EU countries, the USA and elsewhere in order to protect public health. The US **Clean Air Act** requires the US **Environmental Protection Agency (EPA)** to set **National Ambient Air Quality Standards (NAAQS)** for pollutants considered harmful to public health and the environment. The Act established two types of national air quality standards: primary standards which set limits to protect public health, including that of sensitive populations such as asthmatics, children, and the elderly; and secondary standards which set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The World Health Organization (WHO) has also published air quality guidelines to help inform about the elimination or reduction of pollutants that are known or are likely to be hazardous to human health and wellbeing. They also provide a reference for setting national standards on air pollution by indicating pollutant levels below which lifetime exposure or exposure for a given averaging time does not constitute a health risk.

b **NATURAL AND BUILT ENVIRONMENT:**

Not only does the burning of fossil fuels release greenhouse gases which contribute to global warming and climate change, but it also contributes to acid precipitation (known commonly as acid rain). This phenomenon, and the resulting acidification of water catchments and the loss of resource and amenity through damage to tree and other life, indicates the scale of both the environmental damage and economic cost of air pollution. At a more local level, the discolouring and disfigurement of our buildings and monuments through air pollution represents a sizeable cost in terms of cleaning and reconstruction.

5.3.3 Hotels and external air pollution

Some of the ways in which the hotel industry contributes to environmental pollution are shown in FIGURE 5.4.

5.3.4 Air emissions management

The aim in managing and reducing your emissions to air is to:

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Pollutant	Sources
Emissions from burning fossil fuels/gas	• boilers for the generation of steam and hot water • use of vehicles • gas-fired equipment in kitchens and laundries • indirectly through consumption of energy delivered from power stations • generators for emergency power • bonfires or accidental fires
Emissions from the evaporation of hydrocarbons	• use or spillage of petrol or diesel oil • pesticides that contain chlorinated hydrocarbons
Ozone-depleting substances (ODS) including CFCs (chlorofluorocarbons) and HCFCs (hydrochlorofluorocarbons), halons, methyl bromide, carbon tetrachloride and methyl chloroform	• refrigerant loss from old refrigerators, freezers and chillers • use of aerosol spray cans for paint etc. • fire-extinguishers and halon computer room protection • foam insulation, styrofoam cups and packaging
Odours and vapours	• kitchen and laundry exhausts • toilet vents • volatile organic compounds (VOCs) such as spray paints and solvents
Bacteriological pollutants	• cooling towers (*Legionella*) • swimming pools • waste disposal • stores, kitchens, bathrooms
Miscellaneous gases	• formaldehyde (plywood, chipboard) • trihalogen-methane, chlorine (pools) • perchloroethylene (laundry) • carbon dioxide (fire-extinguishing equipment)
Particulates	• asbestos (SEE SECTION 8.7) • lint (laundry) • sawdust

FIGURE 5.4
Common sources of external air pollution from hotels

Most emissions that are harmful to the environment and which emanate from the hotel may be present indoors at much higher concentration levels and will eventually affect all the building's occupants, so their reduction or elimination is in everyone's interest.

Training and **positive actions** undertaken in the hotel will make employees more aware of air emissions in their personal environment and enable them to pass on information within the home and to friends, relatives and the wider community.

Your **action plan** for air emissions will require short, medium and long-term planning depending on your current operating situation, the ease of implementation and the availability of financial resources to make the necessary investment. Specific actions may include to:

a **Cut energy consumption** (and CO_2 emissions) by increasing efficiency and cutting waste.

b **Improve energy efficiency** through better insulation, heat recovery techniques, energy-efficient lights, computerised controls (such as a building management system), efficient equipment and other technology investments.

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c Install a **co-generation plant** which generates electricity and makes use of waste heat (or a **tri-generation** plant which will also produce cooling).

d **Use cleaner burning fuels** (such as gas instead of fuel oil, or fuel oil instead of coal).

e **Purchase electricity generated from renewable sources** (such as wind power) to cut emissions from power stations.

f **Invest in renewable energy systems** if they are suitable for your location, such as solar, water, wind, bio-conversion or the use of fuel cells. SEE SECTION 2 APPENDICES 8 AND 9

g **Modify operating practices** that are harmful to the environment, by avoiding all products manufactured from oil derivatives (plastic bags, etc.), using public transport whenever possible and improving communications to reduce travel.

h **Avoid** all products manufactured using or containing **ozone depleting substances (ODS)**.

i **Use new lighter, smaller cars,** which consume up to 20 per cent less fuel.

j Use district heat where possible, such as **waste heat from power plants**.

In addition to the above, there are **indirect aspects** to consider when formulating an emissions action plan. For example deforestation is having major impact on the world's atmosphere because forests are so important for the absorption of CO_2. Not only should you only purchase timber from sustainable sources which operate a replanting programme or consider avoiding products made with palm oil where indigenous forest has been cleared to plant palm trees, but you might wish to participate at corporate level in projects which encourage forest-friendly development and reforestation.

5.3.5 Actions for hotels

The management approach should be to reduce emissions at source, reduce consumption and to switch to less harmful products, systems, methods and technology. The key stages are:

a To identify equipment, materials, processes and operating procedures that cause or contribute to harmful emissions.

↓

b To assess the entire building and its contents with regard to emission hazards and concentration levels.

↓

c To develop a realistic action plan to manage each emission risk.

5.3.6 Emissions from burning fossil fuels/gas

SEE ALSO SECTION 2

a **BOILERS:**

- Use low sulphur and higher viscosity oil.
- Switch to gas-fired equipment instead of using electricity for kitchen and laundry equipment.
- Measure boiler combustion efficiency on all firing ranges regularly and record it. It should be in the region of 82–90 per cent. New boilers should have combustion efficiencies of more than 92 per cent.
- Oversized boilers contribute to excessive standby losses and pollution.
- Frequent firing-up and switching off results in high soot emission and poor combustion.

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- New burners are much more efficient, ideally you should see a blue flame.
- Install flue-gas heat recovery if the temperature exceeds 280°C at 8 bar steam pressure.
- Keep water and firesides clean.
- Investigate the possibility of using district heat instead of a boiler.
- Check if the boiler exhausts are able to re-enter the hotel, e.g. if fresh-air intakes are located nearby. If so, relocate them.

b VEHICLES:

- Train staff to modify their driving practices in order to reduce fuel consumption – for example using less frequent and hard acceleration.
- Switch to more efficient and smaller/lighter cars when purchasing for the vehicle fleet. Choose diesel or hybrid vehicles in preference to petrol-fuelled cars and consider bio-gas or bio-fuels in preference to diesel (where such vehicles are available).
- Use electric vehicles around the resort.
- Encourage staff and guests to use public transportation, car pooling, bicycles or video-conferencing.

c GENERATORS:

- Regular maintenance is the best way to ensure optimum combustion.
- Consider reducing the frequency of testing against the risk of a power failure.

5.3.7 Emissions from the evaporation of hydrocarbons

- Fuel spill control. SEE SECTION 8.2
- Pesticides containing chlorinated hydrocarbons. SEE SECTION 8.6

5.3.8 CFCs and refrigeration management

a BACKGROUND

CFCs (chlorofluorocarbons) and **HCFCs** (hydrochlorofluorocarbons) are a group of inert man-made gases of low toxicity, non-flammability and high stability. These properties made them excellent for use as refrigerants, however when CFCs are discharged to the atmosphere, they destroy the thin layer of ozone in the upper atmosphere which shields the earth from the sun's ultraviolet radiation. The extent to which they do so is known as their **Ozone Depletion Potential (ODP)**. They also have some **Global Warming Potential (GWP)**. The longevity of CFCs means that they take many decades to break down in the atmosphere.

In September 1987, responding to mounting global concerns about the increasing size in the hole in the stratospheric ozone layer above the Antarctic, the world's major producers and consumers of CFCs signed an international agreement – the **Montreal Protocol on Substances that Deplete the Ozone Layer**. Its aim was to eliminate the consumption and production of ozone depleting substances (ODS) and reverse the damage already done to the ozone layer. Under its terms, signatories agreed to cease production and consumption of CFCs with high ODP (known as Group 1 Annex A) completely from 1 January 1996. These substances were CFC-11, CFC-12, CFC-113, CFC-114 and CFC-115.

Subsequent international meetings in London (1990), Nairobi (1991), Copenhagen (1992), Bangkok (1993), Vienna (1995), Montreal (1997) and Beijing (1999) amended the details. In 1991 a system was introduced whereby financial support to help meet the Protocol was made available to developing countries (Annex 5 countries) through the **Multilateral Fund for the Implementation of the Montreal Protocol**.

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There is a slower phase-out (to zero by 2010) of other substances (including Halon 1211, 1301, 2402; CFCs 13, 111 and 112) and some chemicals (such as carbon tetrachloride and 1,1,1-trichloroethane) are treated separately. In 1996 the Protocol introduced the phase out of HCFCs and this will continue until a complete phase-out is achieved in 2030.

There are a few exceptions for 'essential uses', where no acceptable substitutes have been found (for example, in the metered-dose inhalers commonly used to treat asthma and other respiratory problems) or halon fire suppression systems used in submarines and aircraft.

Twenty years on, the Montreal Protocol is seen as a global success, with massive reductions in worldwide ODS use since it came into force. Just about every nation in the world (191) has signed it. Not only has it helped to protect the ozone layer, but recent research[3] also shows that the Protocol has helped to reduce global warming, and that without it, the amount of heat trapped due to ODS release would be double that of today.[4]

b ALTERNATIVE REFRIGERANTS

CFCs are referred to by numbers and, when used as refrigerants, the number is prefixed by the letter R. Thus the CFCs which were most commonly used in refrigeration – CFC-12 and CFC-502 are known as R-12 and R-502 respectively. These were replaced (as a transitional move) by HCFCs which have a lower ODP (calculated relative to CFC-11 and CFC-12, which are assigned an ODP of 1.0). There are now hydroflurocarbon (HFC) replacements for HCFCs which have a lower ODP but have a significant global warming potential (GWP). If released to atmosphere they could reduce the savings you make on CO_2 emissions through energy efficiency. However, it is important to remember that refrigerants only contribute to global warming when they leak. In most systems, 95 per cent of the greenhouse gas emissions will be created by the power station providing the electricity to run them.

Natural refrigerants, such as hydrocarbons (HCs) including propane, butane, propylene and ethane) and ammonia (NH_3), one of the oldest industrial chemicals, have made a comeback in recent years and are increasingly popular. HCs (which have a zero ODP and negligible GWP) are increasingly used in small refrigeration and air-conditioning appliances, and ammonia (zero ODP and zero GWP) for large scale commercial refrigeration applications, such as ice making and cold storage. Ammonia is toxic and flammable, so it is unlikely to be encountered in the hotel environment because of safety issues.

For the highest environmental standards, it is important to focus on the Life-Cycle Climate Performance (LCCP), not just the refrigerant. LCCP takes into account the emissions during the manufacturing of the refrigerant, transportation to the site, during charging of the chiller, lifetime leakage, and finally during recovery and disposal. This calculation must include emissions from the generation of electricity to power the chillers and account for any additional energy that may be necessary to assure safe operation.

Now that CFCs have been phased out, obsolete equipment that cannot be converted to use alternative refrigerants must be replaced immediately. The Protocol authorises production of new HCFC refrigerant for use in developed countries in new chillers until 2020 and for service until 2030. However, the total consumption of HCFCs must be reduced to zero by 2030 in developed countries and by 2040 in developing countries. After then, developed countries have a step-by-step commitment requiring, for example, that from 2010 the consumption must be reduced by 65 per cent compared with 1996. After production has been phased out, HCFCs can be supplied from reclaimed and recovered sources. For a full list of phase-out dates for Article 5 (developing) countries and non Article 5 (developed), refer to the **United Nations Environment Programme (UNEP) Ozone Secretariat**.[5]

You should never substitute alternatives without first checking the compatibility with your equipment supplier. In some cases, modifications may be necessary before using replacements or you may need to replace the equipment altogether.

[3] Led by the Netherlands Environmental Assessment Agency in March 2007

[4] **Source:** Phasing out ODS under the Montreal Protocol, **www.undp.org/chemicals/Montreal%20Protocol%20Section.pdf**

[5] See **http://ozone.unep.org**

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c STRATEGIC REFRIGERATION MANAGEMENT

The worst thing in refrigeration management is to do nothing. A strategic plan will ensure that you comply with environmental imperatives and legislation, while minimising your capital expenditure. You should:

Appoint team	Appoint a refrigeration manager or team
Prepare inventory	Prepare an inventory of all equipment and the quantity and type of refrigerant contained
Monitor use	Monitor usage of refrigerants
Test for leaks	Test equipment regularly for leaks
Maintain contact	Maintain contact with the original equipment manufacturers
Keep standards up-to-date	Gather the latest information on relevant national engineering standards and codes of practice
Monitor availabilty	Gather the latest information from manufacturers about availability of products and systems
Review & ensure compliance	Review containment equipment and procedures and ensure compliance with legislation
Consider all options	Consider options for containment, conversion or replacement – taking into account costs, safety and risks of alternative options
Implement decisions	Implement decisions, including maintenance and training routines
Monitor and review progress	Review progress periodically, keep abreast of legislation developments and monitor refrigerant supply

d REFRIGERATION INVENTORY

Prepare an inventory of the type, age, condition, expected operating life and energy consumption of all current refrigeration plant, prioritised by which contains the largest volume of refrigerant. The inventory should list chillers and commercial refrigeration equipment individually. You should also include any recovery and recycling equipment.

Small sealed appliances should be listed in groups. Old equipment should be disposed of responsibly to ensure that the gas is recovered and sent for recycling. The inventory of refrigerant stock should include the volume of each type contained in each piece of equipment and the amounts that are currently stored. The quantities purchased, consumed, disposed of or reclaimed should also be monitored.

e CHECK FOR LEAKS

There are various regulations, standards and directives that stipulate requirements for tightness testing for leakage of refrigeration systems. Under the **UK Environmental Protection Act 1990** the deliberate venting of refrigerant is an offence. Section 34 of the Act (Duty of Care) places a specific responsibility on personnel who have control over any refrigeration system to ensure that anyone undertaking tasks on their behalf does not allow these substances to escape. The **F-Gas Regulation (EC) 846/2006** requires operators of stationary refrigeration, air conditioning and heat pump equipment to prevent leakage of

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fluorinated greenhouse gases covered by the Kyoto Protocol, and to repair any detected leak as soon as possible. The regulation stipulates that:

- applications containing 3kg or more must be checked at least once every 12 months (apart from hermetically sealed systems containing <6kg)
- those containing 30kg or more must be checked at least once every six months
- those containing 300kg or more must be checked at least once every three months.

The regulations also require that operators maintain records and stipulates minimum training requirements for operators handling F-gas refrigerants.

Negative pressure chillers can lose up to 15 per cent of their refrigerant charge annually, while positive pressure chillers may lose eight per cent annually. Containment activities, such as leak detection, equipment repairs, pressure relief valves and the installation of high-efficiency purge equipment, can reduce this to five per cent and three per cent respectively.

f SWITCHING TO ENVIRONMENTALLY PREFERABLE REFRIGERANTS

Next you need to formulate a plan for making the transition to refrigerants with low ODPs. This should evaluate the potential for containment of existing refrigerants, converting to alternatives and/or replacing plant. SEE FIGURE 5.5

5.3.9 Odours and vapours

a KITCHENS, LAUNDRY AND TOILET EXHAUSTS:

- Use activated carbon filters to combat objectionable odours.
- Ensure that the required ventilation rates are being achieved. In kitchens, laundries and toilets, air pressures must be negative.

b PAINTS, SOLVENTS:

- Switch to using paints and solvents with low or no VOC emissions and try not to purchase any products containing substances that are hazardous to the environment.
- Put in place procedures for the safe handling, storage and use of essential substances that create emissions, such as ensuring adequate ventilation during use and drying.

5.3.10 Bacteriological pollutants

a COOLING TOWERS:

SEE 5.2 AND SECTION 3.4.7 for information about preventing the development of *Legionella pneumophila* and other bacteria.

b SWIMMING POOLS:

SEE SECTION 3.3.4 for more information about treatment methods for swimming pools.

c WASTE DISPOSAL:

SEE SECTION 6.3.2

d STORES, KITCHENS:

Follow procedures for the proper storage of hazardous substances as outlined in SECTION 8 and for food safety and hygiene in SECTION 6.

5.3.11 Miscellaneous gases

SEE 5.2.5 for information on furniture containing formaldehyde and emissions from the laundry. Carry out measurements of concentration levels to determine if maximum acceptable levels are exceeded.

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FIGURE 5.5 SWITCHING TO ENVIRONMENTALLY PREFERABLE REFRIGERANTS

Existing equipment

- Relying on the use of recycled or reclaimed refrigerants to maintain existing equipment is most viable where there is a large equipment inventory so that units can be gradually retired to keep others going. It may be worth acquiring recovery and recycling equipment in order to do this.
  - **Recovery** involves removing refrigerant in any condition from a system and storing it without testing or processing it.
  - **Recycling** implies cleaning the refrigerant for re-use by oil separation and single or multiple passes through devices such as replaceable core filter driers which reduce moisture, acidity and particulate matter.
  - **Reclaiming** refrigerant requires chemical analysis together with processing such as distillation so that it meets new product specifications – generally this is only possible at a reprocessing or manufacturing plant.
- The quantity of **virgin HCFCs** for sale is being increasingly restricted. For example, in the EU in 2008 the amount available for sale will only be 25 per cent of that available in 2001. The phase out date of recycled fluid is subject to a review to be completed in 2008 and could mean that HCFCs may be phased out earlier than the end of 2014.
- Operators of HCFC refrigeration systems must take all practicable precautionary measures to prevent leakages. Any system containing more than 3kg of HCFC refrigerant must be checked annually for leakage by suitably qualified personnel. Any HCFC refrigerant removed from a system during maintenance or at end of life must be properly recovered for re-use, recycling or destruction.

Retrofitting equipment with alternative refrigerants

- For equipment with a **long expected life**, the best solution will be to convert it for use with a substitute refrigerant which must share similar characteristics with the current refrigerant. Efficiency is also a major consideration as there can be a significant difference in the efficiency of a potential alternative with the refrigerants you are currently using. A decrease in efficiency may require increased heat rejection and necessitate modifications to chillers.
- **Scheduling retrofits** to coincide with major equipment overhauls will minimise costs. Most original equipment manufacturers can provide information on special design requirements (such as the compatibility of materials and lubrication) and may be able to analyse the energy and capacity trade-offs of retrofitting.
- The **condition** of your existing chillers is an important consideration if you are considering conversion. Non-destructive tests should be performed, such as eddy-current testing to check the integrity of the cooler and condenser tubes, vibration analysis to examine the condition of the compressor, and electrical tests of the motor. **SEE THE TABLE BELOW** for common substitute refrigerants used within the hotel industry.

Replacing old or inefficient equipment

- **Conversion** costs can be as much as 90 per cent of replacement costs, owing to the large number of replacement components. The net result of a conversion may be reduced capacity and lower efficiency. Replacing obsolete plant is the best way to reduce energy costs and improve performance while lessening impact on the ozone layer. It requires the greatest initial capital expenditure, but in the long run will yield savings in energy, maintenance and refrigerant costs.

Common refrigerants used within the hotel industry and their alternatives

CFC	HCFC	HFC	NATURAL REFRIGERANT
R11	R123		
R12	R401A R401B R409A R409B	R134a R413A	R290 R600a R717
R502	R402A R402B R403B R408A R411B	R404A R407A R407B R507	R290 R717
	R22	R404A R407C R401A R417A	R290 R717

NOTE: Never substitute alternatives without first checking compatibility with your equipment supplier. In some cases, modifications may be necessary before using replacements or it may be necessary to replace the equipment altogether.

See also **FIGURE 5.3** and for more information on chillers **SEE SECTION 2 APPENDIX 6**.

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5.4 NOISE

Noise can be as much an environmental issue as energy, water and waste. It is a consequence of the development of society and increased industrialisation, urbanisation, population, traffic and other human activities.

Noise constitutes any kind of sound that people consider undesirable, disturbing or annoying. Over time, background sound levels can rise to the point where they reach an unacceptable level of 'pollution'.

In many countries, noise that becomes a nuisance to others is covered by legislation, and offenders can be liable to prosecution. SEE APPENDIX 1

5.4.1 Sources of noise

Hotels can create various kinds of noise according to the time of day: see FIGURE 5.7, right.

5.4.2 The issues

Noise can have negative effects on human beings to the extent where it can actually damage health or cause other physiological effects. It can generally reduce the quality of our lives and affect other living species.

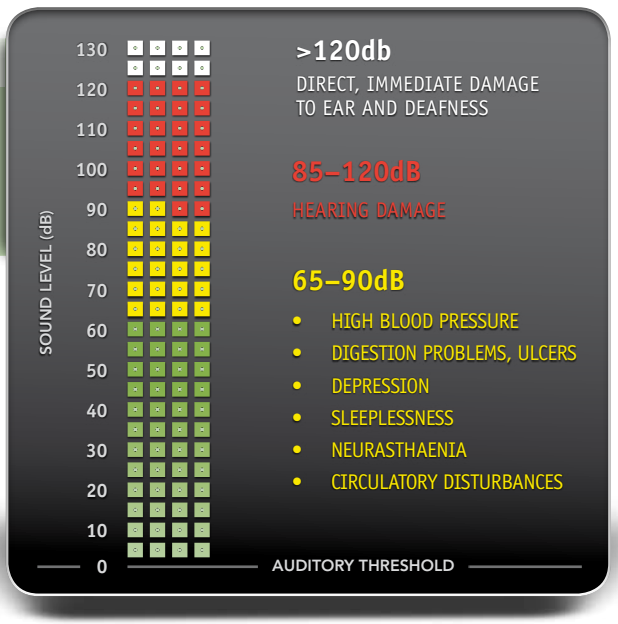
Our sensitivity to sound can depend on many factors including one's age and gender, current mood, activity or condition of health, stress levels, the time of day, acoustic factors, understanding the origin and necessity for the noise, one's ability to control it, and one's expectation of the quality of the environment.

Noise levels are measured in decibels (dB), and the possible effects of an increase in intensity are outlined below.

a EFFECTS ON HUMAN HEALTH:

FIGURE 5.6

Physical and physiological consequences of exposure to various decibel levels



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Noise source	Examples
Traffic	• Vehicles around the resort • Use of cars by staff • Deliveries and waste removal vehicles (engines, horns and reversing signals)
Construction	• Minor construction, renovation and maintenance work by engineering staff • Contractors • Major renovation or refurbishment projects, extensions or the building of new hotels and resorts
Entertainment and events	• Noise late at night from restaurants, discos nightclubs, casinos, musical entertainers and function rooms in the hotel • Large events such as weddings and celebrations, particularly if held in the hotel grounds
Equipment and systems	• Air-conditioning, ventilation and exhaust fans, chillers, boilers, pumps • Ice machines, compressors • Lifts • Laundry • Kitchens • Waste water treatment plant
Sport and leisure	• Swimming pool area (including pool bar and restaurants) • Water and other sports
Staff operations	• Engineering: hammering, drilling, sawing, etc. • Kitchen: dishwashing, cleaning, cooking, etc. • Laundry: washing, machine operation • Housekeeping: trolleys, vacuum cleaners, shampoo machines, etc. • General communication among staff • Music through public loudspeaker systems, paging and fire alarms • Gardening: lawnmowers, hedge trimming, watering systems
Guest rooms	• Communication: telephone, general conversation, TV, radio • Moving chairs, walking around, closing doors, using the minibar • Fan coils and other HVAC equipment
Bathrooms	• WC flushing • Filling and emptying baths • Hairdryers • Footsteps on hard floors

FIGURE 5.7
Common sources of noise in hotels

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b **PSYCHOLOGICAL EFFECTS:**

- Interruption of communication.
- Distraction from concentration.
- Interference with creative thinking or activities.
- Tiredness.
- Creation of (or addition to) stress.
- Sleep disturbance.
- Induces bad moods.
- Makes people aggressive.

c **REDUCTION IN QUALITY OF LIFE:**

- As a result of the above factors.
- Inadequate environment in which to recover from stress.
- Reduced level of enjoyment.

d **FINANCIAL CONSEQUENCES:**

- Reduces the value of buildings and sites (and increases the value of quiet places).
- Decreases employee productivity and efficiency.

5.4.3 A programme for tackling noise

Human beings generally feel well and can relax, recover, rest or concentrate better in conditions of quiet. Since the main objective of any hotel is to provide the best environment possible for its guests, a reasonably low sound level throughout the guest areas is extremely important. Equally important is the desired degree of privacy provided by a low level of sound transmission between adjoining rooms. Effective noise control will also improve the general well-being and productivity of employees.

5.4.4 The action plan

Your action plan should have the following objectives:

a To eliminate or minimise noise and maintain a suitable environment for guests, employees and neighbours.

b To prevent or minimise annoyance and adverse psychological, physiological or physical impacts on guests, employees, neighbours and other third parties such as tenants.

c To minimise possible revenue loss (e.g. guests who decide not to return because of noise issues.

d To communicate in advance with those who might be affected by specific operations such as building work or new installations.

e To address any complaints fully and promptly, and take the necessary action to prevent similar complaints in the future.

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5.4.5 The noise audit

The first step is to conduct a thorough tour of the building and grounds and identify all the possible sources of noise in the hotel, both interior and exterior, and prepare a summary of known problems and potential complaints. Noise can be tackled partly by changes in procedures, but investment in noise control may also be necessary.

5.4.6 Practical measures to avoid noise and its effects

a. Avoid or minimise noisy activities, particularly at night and at weekends. Determine the day of week and/or the time of day when noisy works can best be carried out. Try to accumulate jobs, so that noisy works are carried out at the same time, leaving more quiet time.

b. Determine the maximum sound levels within guest rooms for the telephone bell, TV and music sound levels, and set them accordingly.

c. Only use the public paging system as an absolute necessity and set restrictions for the time of day and location.

d. Set schedules and maximum sound levels for music entertainment in the hotel's function rooms and public areas and adhere to them.

e. Evaluate the effects of noisy functions on guest-room sound levels, especially when they take place late into the night.

f. Consider relocating or closing night clubs and discos that cause disturbance to neighbours. Put up signs reminding guests to leave quietly.

g. Investigate causes of false fire alarms and take remedial action. Ensure that your burglar alarm has a maintenance contract and call-out agreement.

h. Check if better maintenance can reduce the sound levels of lifts through, for example, smoother operation of roller guides, doors, acceleration and deceleration.

i. Check that appropriate doors are kept closed.

j. Wear ear protectors for noisy works.

k. Install a time clock for noisy ice machines on guest room floors so that they switch off at night.

l. Ensure that vehicle engines are turned off when not in use, that engines are not revved unnecessarily and that horns are only used in emergencies.

5.4.7 Investing in noise control

There are two basic approaches: active and passive. See FIGURE 5.8, overleaf.

5.4.8 Evaluation

As experience and knowledge grows, you will continuously improve your control of noise. Keep records of any complaints and the actions taken to rectify problems, and conduct regular measurements of noise levels in order to monitor improvements in performance.

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FIGURE 5.8

Active and passive measures for investing in noise control

ACTIVE MEASURES

Active measures target the reduction of noise at source. They may involve:

- Regular servicing to ensure equipment and vehicles are running quietly (e.g. replacing noisy exhaust systems).
- Actions for new plant installation, major renovation and equipment replacement such as:
  - installing quieter motors and transmissions
  - stiffening equipment structures
  - using dampers
  - using low-flow velocities
  - ensuring ducts are well-designed to prevent transmission from noisy to quiet areas
  - positioning noisy equipment away from site boundaries.
- Reducing the sound transmitted by structure/piping.
- Dealing with vibration:
  - isolating equipment in machines
  - compressors
  - rubber blocks
  - steel a/v springs
  - large heavy equipment on special foundation separate from building
  - vibration isolation panels
  - special damping material/elastic panel mounting.
- Fitting absorbent attenuators to reflecting walls and ceilings:
  - local absorption at working positions near noisy machines.
- Encapsulation at source:
  - enclose either the equipment or the room entrance with highly sound-absorbing materials
  - allow access to enclosures via easily-opened hatches
  - isolate noise emitting equipment in plant rooms through better construction
  - sealed materials, sound absorbent inner walls (mineral wool, fibreglass, rubber)
  - mount noise attenuators on cooling air openings.
- Replace diesel or petrol vehicles with electric, hybrid or LPG alternatives which are quieter.

PASSIVE MEASURES

Passive measures are aimed at protecting the recipient's ear – reducing transmission by erecting sound barriers. These measures need to be taken whenever the emission source cannot be controlled and is at a level which cannot be influenced, for example aircraft and traffic, and when noise within the hotel travels to undesirable areas.

The major decisions that determine the quality and quantity of noise in the hotel are made at the time of construction:

- The location and position of the hotel – which is influenced by the owner, planners and developer.
- The location of major noise sources in relation to other spaces requiring quiet – these are influenced by the architect.
- The quality and design of construction, for example the use of materials, the location and routing of pipes and the isolation techniques employed – influenced by architect and engineers.
- The quality of workmanship, i.e. attention to details such as the closing of all openings around ducts, pipes and cables – influenced by the building contractor.

However, considerable improvements can also be made through better soundproofing measures and techniques such as:

- Better windows (good sound insulation also provides good thermal insulation for better energy conservation).
- Sealing any unnecessary openings in walls, ceilings or floors.
- Installing gaskets, drop seals and automatic door closers to guestroom entrance doors.
- Using efficient, quiet fan coils.
- Purchasing minibars using absorbers rather than vapour compressor technology.
- Replacing WC flush valves with quiet flush mechanisms.
- Installing a sound-absorbing barrier underneath the bath.
- Offsetting sockets in adjoining rooms so that there is no hole through the entire wall.
- Providing quiet hairdryers.
- Using solid panelled fencing around equipment or the hotel perimeter to both screen the source and reduce noise leaving the site. Planting and landscaping will help to further absorb sound.

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5.5 MORE INFORMATION

5.5.1 Contacts

1. **American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)**
   www.ashrae.org
2. **Building Owners and Managers Association International**
   www.boma.org
3. **Building Research Establishment**
   www.bre.co.uk
4. **BSRIA**
   www.bsria.co.uk
5. **Chartered Institute of Environmental Health (CIEH)**
   www.cieh.org
6. **Institute of Refrigeration**
   www.ior.org.uk
7. **Multilateral Fund for the Implementation of the Montreal Protocol**
   www.unmfs.org
8. **National Institute for Occupational Safety and Health (NIOSH)**
   www.cdc.gov/niosh
9. **UK National Atmospheric Emissions Inventory**
   www.naei.org.uk
10. **UNEP Division of Technology, Industry and Economics (DTIE) Energy and OzonAction Unit**
    www.uneptie.org/ozonaction
11. **US Environmental Protection Agency (USEPA)**
    www.epa.gov/iaq
12. **World Green Building Council**
    www.worldgbc.org

5.5.2 Resources

1. **Achieving the desired indoor climate: Energy efficiency aspects of system design**
   ISBN 91 44 03235 8
   Published by The Commtech Group
   October 2003
2. **An Introduction to Indoor Air Quality (IAQ)**
   www.epa.gov/iaq/ia-intro.html
3. **ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality**
   https://www.ashrae.org/.../Public/20081030_62_1_supplement_final.pdf
4. **Building Air Quality: A Guide for Building Owners and Facility Managers**
   www.epa.gov/iaq/largebldgs/baqtoc.html
5. **Clean Air Gardening**
   www.cleanairgardening.com/houseplants.html
6. **Code of Practice for Refrigerant Leak Tightness in Compliance with the F-Gas Regulation**
   www.ior.org.uk
7. **Control of Noise at Work Regulations 2005**
   www.opsi.gov.uk/si/si2005/20051643.htm
8. **EC Directive 96/61/EC concerning integrated pollution prevention and control**
   http://europa.eu/legislation_summaries/environment/waste_management/l28045_en.htm
9. **F-Gas Regulation (EC) 846/2006**
   http://ec.europa.eu/clima/policies/f-gas/index_en.htm
10. **Good up high, bad nearby**
    www.epa.gov/airnow//gooduphigh/ozone.pdf
11. **Hydrocarbons in refrigeration – what caterers need to know**
    www.foster-uk.com/default.asp?p=74
12. **Indoor Air Quality**
    www.bre.co.uk/service.jsp?id=720
13. **Installation and commissioning of refrigeration systems**
    www.carbontrust.co.uk/Publications
14. **Netregs**
    www.netregs.gov.uk
15. **R22 Phase Out and F-Gas Regulations**
    www.johnsoncontrols.co.uk/content/dam/WWW/jci/be/eu_library/refrigeration/r22_ausstieg_00/Customer_Flyer_R22_phase-out_and_F-gas_3.pdf
16. **Refrigeration Fact Sheet**
    www.carbontrust.co.uk/Publications
17. **The Inside Story: A Guide to Indoor Air Quality**
    www.epa.gov/iaq/pubs/insidest.html
18. **US Clean Air Act**
    www.epa.gov/air/caa
19. **US National Ambient Air Quality Standards (NAAQS)**
    www.epa.gov/ttn/naaqs
20. **WHO air quality guidelines – global update 2005**
    www.who.int/phe/health_topics/outdoorair_aqg/en/index.html

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APPENDIX 1 Statutory noise, odour and other nuisances

Hotel owners and operators have a legal obligation not to cause a nuisance to, or a hazard to the health of, those in the surrounding area. The conditions that create a 'statutory' nuisance are set out by legislation. For action to be taken, the nuisance complained of must be (or be likely to be) prejudicial to people's health or interfere with a person's legitimate use and enjoyment of land.

Factors that can cause a statutory nuisance to others might include:

- if your premises are in a **poor state**
- **noise**
- artificial **lighting**
- **smoke, fumes or gases**
- **dust**
- **steam**
- **unpleasant smells or odours**
- **effluent**
- **animals** kept on the premises
- **insects** coming from your business premises
- deposits and accumulations of **waste** or other material
- other **discharges** from your premises.

You should be familiar with the national legislation and any other standards that apply to noise, odours and other nuisances for your country of operation. For example relevant legislation in England and Wales includes the **Anti-social Behaviour Act 2003**, the **Clean Neighbourhoods and Environment Act 2005**, the **Noise and Statutory Nuisance Act 1993** and the **Statutory Nuisance (Appeals) Regulations 1995 SI 2644** as well as the UK-wide **Control of Pollution Act 1974 (as amended)**, the **Environment Act 1995** and the **Environmental Protection Act 1990**.

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