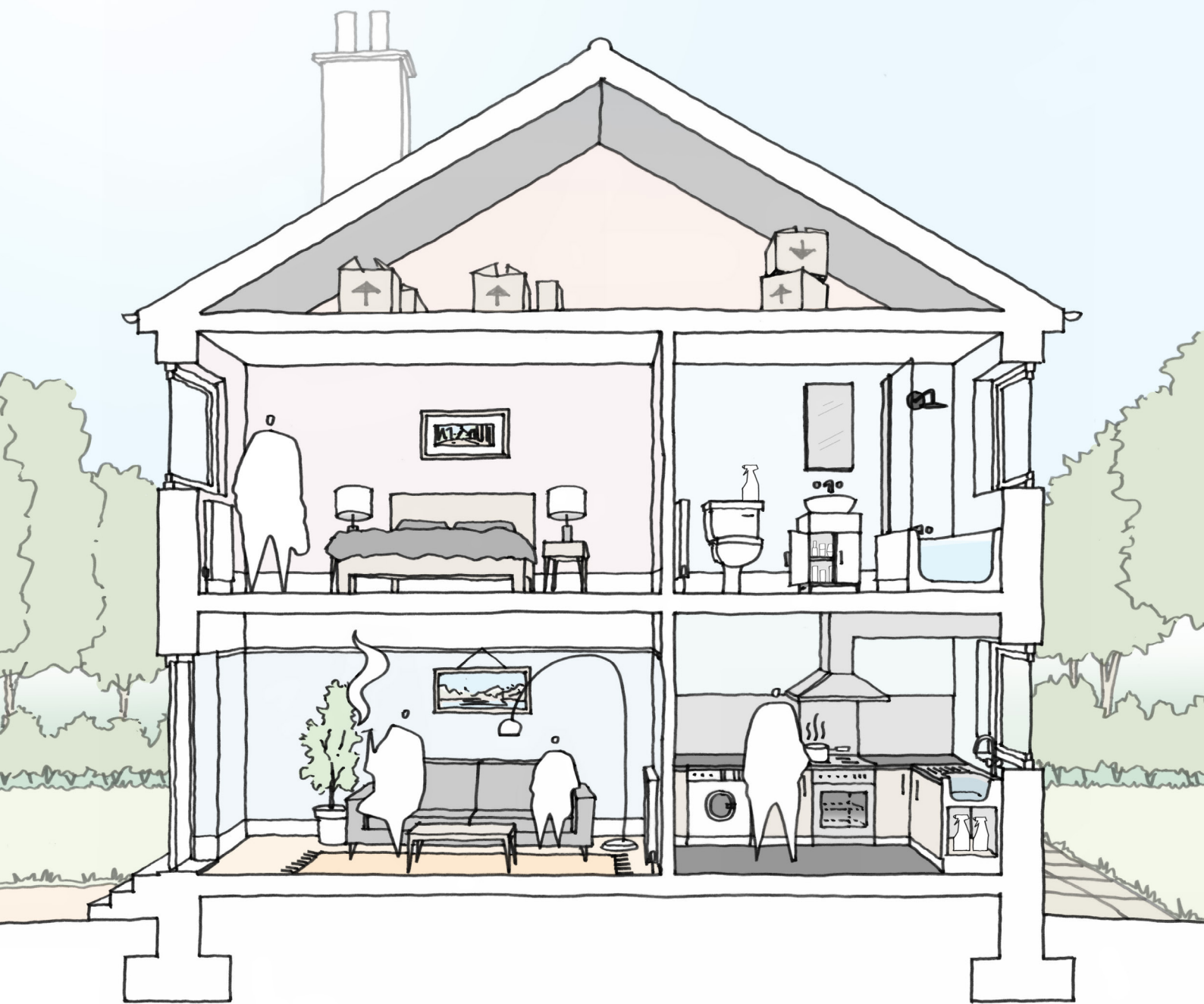


Indoor Air Quality

Home User Guide



Indoor Air Pollution

Indoor Air Pollution and Health

- We spend the majority of our time in buildings, particularly at home¹. In fact, over half of the body's lifetime intake of air is inhaled in the home¹, so the quality of air we breathe here is extremely important.

- Research has found that the air within our buildings can be up to 10 times more polluted than outdoor air², even in large industrialised cities.

- It is estimated that around 90% of people worldwide breathe polluted air³.

- Some people are particularly sensitive to the effects of air pollution, such as children, older people, pregnant women and those with existing heart and lung conditions. These groups often spend more time at home and therefore their risk of exposure to air pollutants can be much greater.

- Pollutants in the air can trigger or exacerbate existing heart and lung conditions. Other factors such as lifestyle, genetic makeup, exercise and nutrition can influence a person's susceptibility to air pollution⁴.

- The main sources of air pollutants in the home include household products, combustion appliances, excess moisture, building materials and furnishings.

- Health effects from exposure to air pollutants indoors can be immediate or may show up years later. The risk of adverse health effects from pollutants depend on individual susceptibility, pollutant concentration, the state of the individual's physical health and the frequency and duration of exposure.

Ventilation

- Inadequate ventilation can increase the concentration of pollutants indoors by preventing their escape. In order to reduce heat loss homes have become increasingly airtight. However, reduced air infiltration or 'leakage' can lead to higher pollutant concentrations if stale indoor air is not adequately replaced by fresh outdoor air.

- Airtight homes rely on properly working ventilation

1 Sundell, J., 2004, On the history of indoor air quality and health, Indoor Air journal, 14 (7): 51-58

2 Environmental Protection Agency. (2017) Volatile Organic Compounds' Impact on Indoor Air Quality [accessed 18/12/20] Available at: <https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality>

3 WHO, 2018, 9 out of 10 people worldwide breathe polluted air, but more countries are taking action [accessed 12/12/20] Available at: <https://www.who.int/news/item/02-05-2018-9-out-of-10-people-worldwide-breathe-polluted-air-but-more-countries-are-taking-action>

4 WHO, 2010, WHO guidelines for indoor air quality: selected pollutants, Copenhagen: World Regional Office for Europe

systems to remove moisture and pollutants released from building materials and household activities.

The following section provides information on indoor air pollutants commonly found in homes.

Volatile Organic Compounds (VOCs)

- Volatile Organic Compounds (VOCs) are chemicals that are readily emitted as gases at room temperature. Exposure to VOCs occurs mainly indoors, released from many items found in the home such as: paints, solvents, glues, indoor furnishings, air fresheners, hairsprays, cleaning products, pesticides and building materials.

- Scented products can emit a variety of VOCs and have been associated with health effects such as headaches, asthma exacerbation, runny nose and watery eyes. Some VOCs have been classified by authorities as substances that are capable of causing cancer in humans.

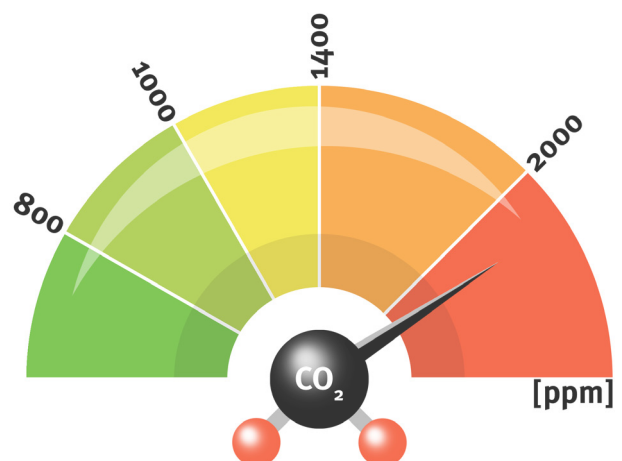
- Semi-Volatile Organic Compounds (SVOCs) found in vinyl flooring and furnishings containing flame-retardant chemicals can persist for a long time in the indoor environment.

Carbon Dioxide

- Carbon dioxide (CO₂) is a colourless gas that is emitted indoors in the air we exhale. Carbon dioxide is harmless at low concentrations however at higher concentrations it can cause symptoms such as rapid heart rate, rapid breathing, fatigue and nausea.

- There are other sources of carbon dioxide indoors other than people, such as emissions from pets, cigarette smoking and gas cookers.

- Inadequate ventilation can lead to a build-up of carbon dioxide inside your home. Carbon dioxide therefore is often used as an indicator for the quality of air indoors, with levels above 1,000ppm (or 700ppm above outdoor levels) suggesting poor ventilation.



- Carbon dioxide is odourless and therefore difficult to detect on your own. To detect on your own, however carbon dioxide meters can be installed to help recognize when levels are too high and ventilation may be needed.

Carbon Monoxide

- Carbon monoxide (CO) is a poisonous gas produced by the incomplete burning of fuel such as wood, coal, turf, natural gas and oil.

- Carbon monoxide can reach dangerous levels indoors due to poorly installed or maintained heating appliances, blocked chimneys and flues, or insufficient ventilation in rooms with fuel-burning appliances. Running a car engine in a closed garage or burning fuel in an enclosed space also increases the risk of carbon monoxide poisoning.

- Exposure to low levels of carbon monoxide can cause poor concentration, fatigue, nausea, vomiting, confusion and memory loss. At higher levels, it can cause seizures, loss of consciousness and death. It is not possible to detect carbon monoxide in the home without a carbon monoxide alarm.

Formaldehyde

- Formaldehyde is a strong-smelling gas that is flammable at room temperature. It is used in many building materials and household products and can be formed in the indoor environment during the burning of fuels for cooking or heating.

- Products that contain formaldehyde include paints, glues, pesticides, pressed fabrics, detergents and cosmetics.

- Smoking constitutes an important source of formaldehyde in homes due to the exceptionally high concentrations present in tobacco smoke.

- Exposure to formaldehyde can cause irritation of the eyes, nose throat or skin, breathing problems, coughing or wheezing. Formaldehyde has been classified as a human carcinogen in cases of unusually high or prolonged exposure⁵.

Particulate Matter

- Particulate matter (PM) is a term used to describe a mixture of solid and liquid particles suspended in the air. The particles can vary considerably in size, origin and composition, and include dust, pollen, soot, smoke, liquid droplets and soil particles. Some are large enough to see with the naked eye, others can only be seen with a microscope.

- Particles are produced indoors by activities including cooking, smoking, burning candles, and use of fireplaces or unvented space heaters. Particles of outdoor origin produced by traffic, forest fires, power plants or industrial facilities can also migrate indoors.

- Exposure to particles can affect the lungs and the heart. Exposure to fine particles pose the greatest risk to health as these can penetrate deep into the lungs.

Biological Pollutants

- Biological pollutants are substances that come from living organisms and many are small enough to be inhaled. They include things such as bacteria, viruses, house dust, mites, pollen and animal dander.

- Biological pollutants are typically found in areas that provide moisture and nutrients, such as damp areas in bathrooms, kitchens and around windows or in areas where dust collects, such as bedding, carpet and soft furnishings. They are often invisible but can trigger allergic reactions after single or repeated exposure.



- Children, older people and those with respiratory or breathing problems are particularly susceptible to biological pollutants.

Radon

- Radon is a naturally occurring gas formed by the decay of radium in soil and rocks, that can seep up through the ground and enter our buildings.

- Radon is more likely to accumulate in homes built in high radon areas. Moreover, energy efficiency measures have been found to increase radon concentrations indoors⁶.

- The decay of radon creates radioactive particles that can be inhaled and deposited in the lungs, causing damage to lung tissue. Long term exposure to radon can increase the risk of developing lung cancer.

5 5. National Toxicology Program, 2011, Report on Carcinogens, Twelfth Edition. Department of Health and Human Services, Public Health Service, National Toxicology Program, [accessed 01/12/20] Available at <http://ntp.niehs.nih.gov/go/roc12>

6 Meyer, W., 2019, Impact of constructional energy-saving measures on radon levels indoors, Indoor Air journal, 29(4): 860-685

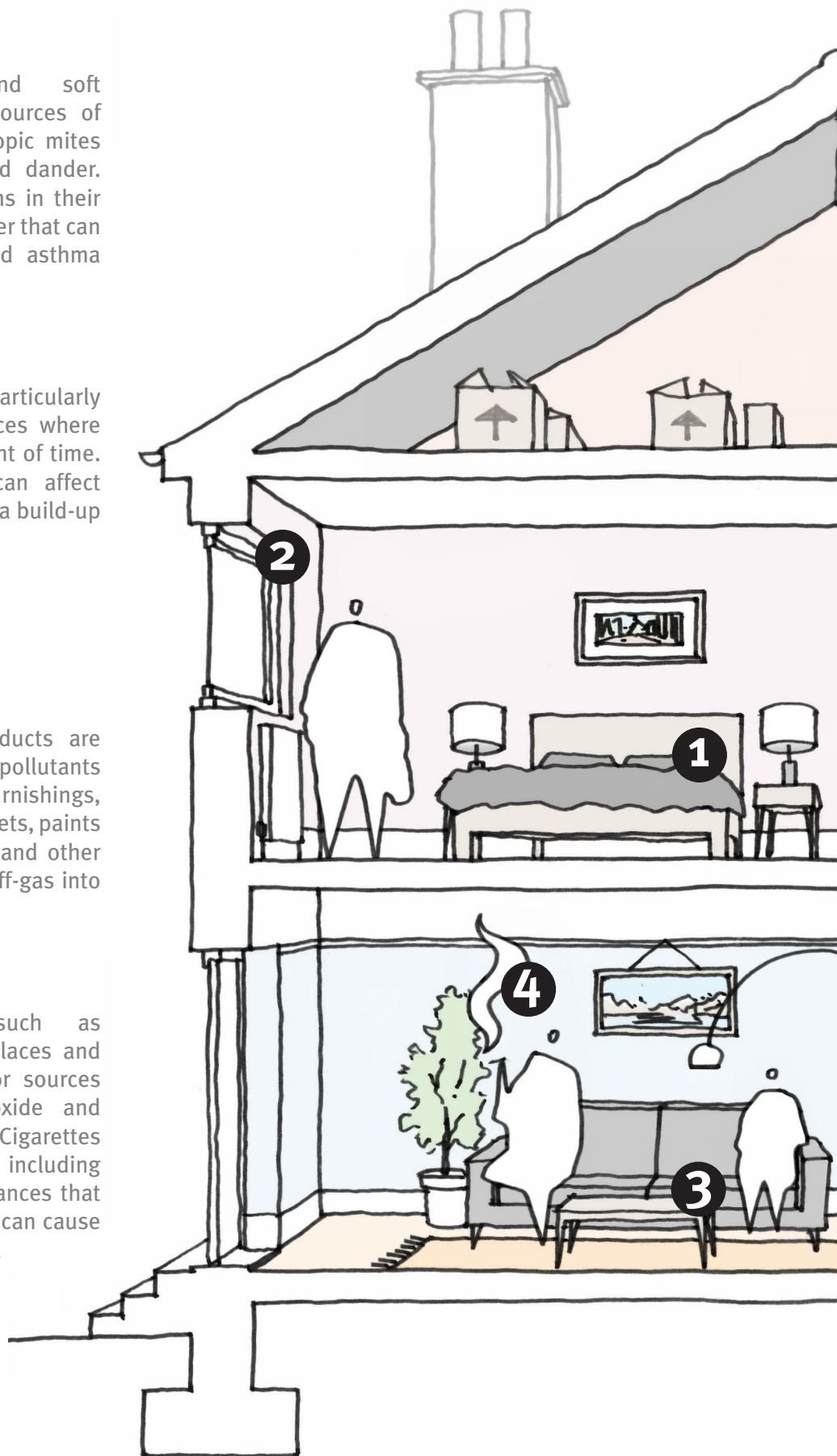
Pollutant sources in the home

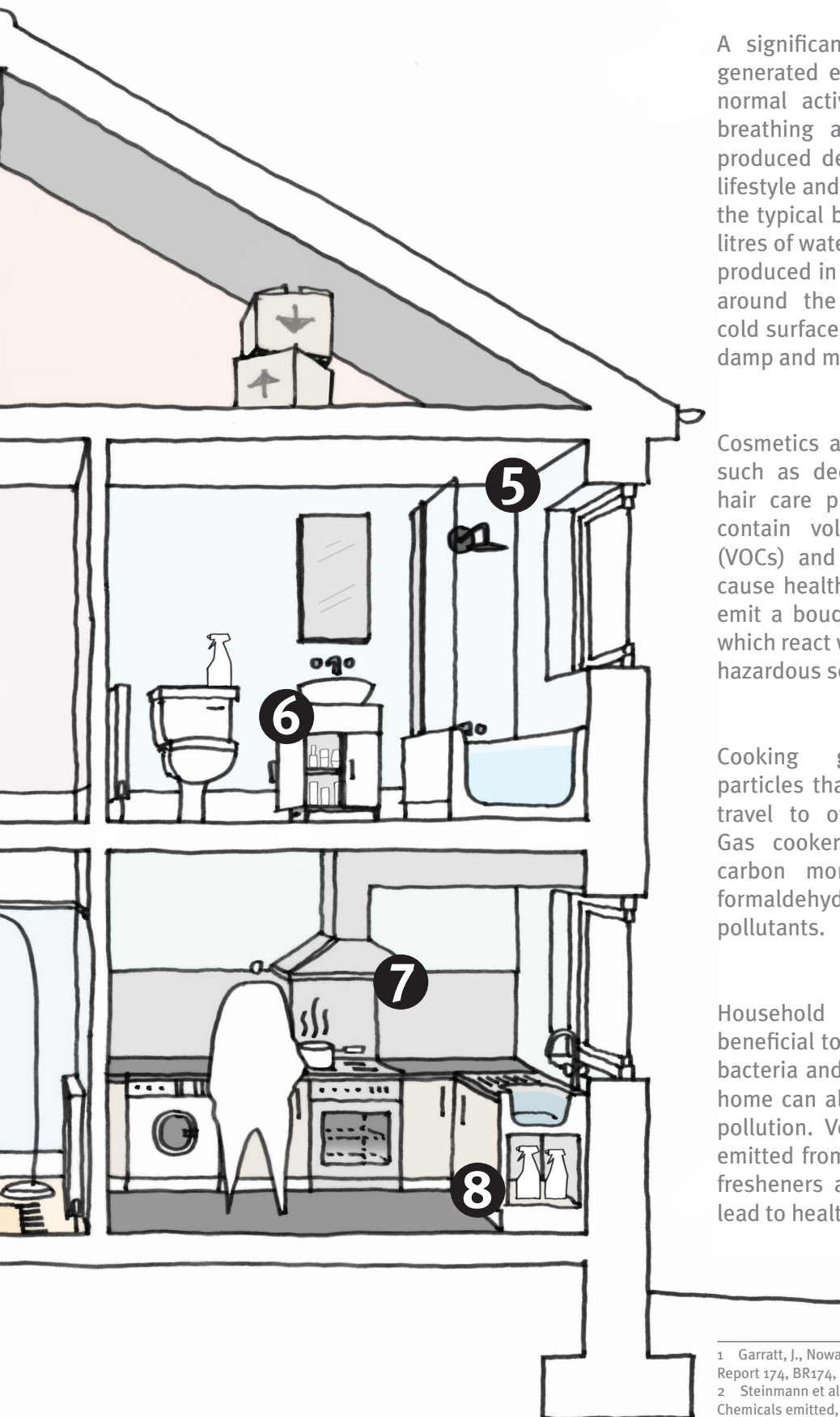
1 Mattresses, bedding and soft furnishings are important sources of house dust mites - microscopic mites that feed on dead skin and dander. Dust mites generate allergens in their fecal pellets and protein matter that can trigger allergic reactions and asthma symptoms in some people.

2 Bedroom ventilation is particularly important as these are spaces where we spend a significant amount of time. Poor bedroom ventilation can affect sleep quality and can lead to a build-up of stale air indoors.

3 Building materials and products are important sources of air pollutants indoors. New furniture, furnishings, laminated flooring, vinyl, carpets, paints and varnishes contain VOCs and other harmful chemicals that can off-gas into the air we breathe.

4 Combustion processes such as smoking, wood stoves, fireplaces and gas space heaters are major sources of particles, carbon monoxide and nitrogen dioxide indoors. Cigarettes emit thousands of chemicals including toxic and carcinogenic substances that can be harmful to health and can cause premature death and disease.





A significant amount of moisture is generated every day in our homes by normal activities such as showering, breathing and cooking. The amount produced depends on household size, lifestyle and appliances, but on average the typical burden is between 7 and 14 litres of water vapour per day.¹ Moisture produced in the bathroom can circulate around the home and condense on cold surfaces, leading to problems with damp and mould.

5

Cosmetics and personal care products such as deodorant, perfume, lotions, hair care products and nail polishes contain volatile organic compounds (VOCs) and other chemicals that can cause health effects. Scented products emit a bouquet of chemicals, some of which react with ozone in the air to form hazardous secondary pollutants².

6

Cooking generates high levels of particles that can linger in the air and travel to other areas of the home. Gas cookers or stoves can release carbon monoxide, nitrogen dioxide, formaldehyde and other harmful pollutants.

7

Household cleaning products while beneficial to help remove dust, viruses, bacteria and allergens from surfaces in home can also contribute to indoor air pollution. Volatile organic compounds emitted from cleaning products and air fresheners are easily inhaled and can lead to health risks.

8

¹ Garratt, J., Nowak, F., 1991, Tackling Condensation, BRE Report 174, BR174, Bracknell: BRE Press, ISBN 0851254446

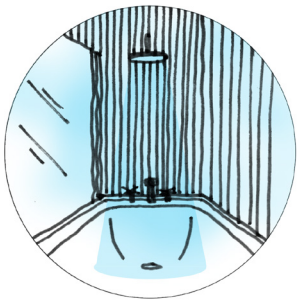
² Steinmann et al. 2010, Fragranced consumer products: Chemicals emitted, ingredients unlisted, Environmental Impact Assessment Review, 31 (3): 328-333

Ten practical ways to improve indoor air quality



1. Drying clothes

Dry clothes outside where possible, otherwise dry clothes in a well-ventilated space, for example, in the bathroom with the window open or extractor fan on. If using a clothes dryer, make sure it is vented outside. Never dry laundry on radiators indoors.



2. Bathroom moisture

Ventilate your bathroom to reduce moisture during and after showering or bathing by opening a window or using an extractor fan. Keep the bathroom door closed to prevent moisture from reaching other rooms, especially bedrooms which may be cooler and therefore more vulnerable to condensation.



3. Cooking

When cooking, try to avoid burning food and put lids on pans. Use a cooker hood or extractor fan vented to outdoors, where possible. Try to use the back rings of the cooker to reduce exposure. If replacing appliances, choose electric rather than gas cookers to reduce carbon monoxide and nitrogen dioxide exposure.



4. Cleaning

Vacuum and mop regularly to reduce dirt and make sure to clean and replace vacuum filters often. Avoid air fresheners and use non-toxic cream cleaning products rather than sprays, if possible. Reduce the amount of cleaning products used and never mix products unless instructed to do so.



5. Chemicals

Store paints, solvents, pesticides and other chemicals out of the occupiable space. Read and follow all label instructions carefully and seal products tightly when not in use. Use non-toxic low-VOC products when painting and decorating to help reduce exposure to indoor air pollutants.



6. Ventilation

If your home has trickle vents on the windows, make sure these are kept open. Check bathroom and kitchen extract fans regularly to make sure they are working OK and any filters are clean. Air out your home regularly to get rid of stale indoor air.



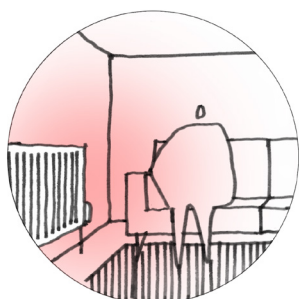
7. Allergens

The best way to avoid allergic reactions is to avoid exposure to substances you are allergic to. The most common allergens include pollen, house dust mites, pets, and mould spores. To reduce exposure to house dust mites, use allergen control mattress and pillow covers and wash bedding and soft toys regularly in hot water. If you cannot permanently remove a furry pet from the home, try to keep them out of the bedroom and away from soft furnishings.



8. Smoking

Smoking indoors can leave residues of chemicals on indoor surfaces such as walls, furniture and carpets that linger in an area long after a cigarette is extinguished. Do not let anyone smoke in the home. If this cannot be avoided, increase ventilation in the area where smoking occurs and do not smoke if children are present.



9. Heating your home

Heat your home adequately during cold weather to reduce the risk of damp and mould growth. If you have a fire or stove, only light this when you have to and try to burn only dry, well-seasoned hard wood or smokeless fuel. Ensure chimneys and flues are swept at least once a year and install a carbon monoxide alarm in every room with a fuel-burning appliance to help protect against carbon monoxide poisoning. Do not use unflued paraffin heaters in your home.



10. Personal care products

Choose personal care products that have lower VOC content, such as unperfumed shampoo, deodorant and soaps. Avoid using sprays, air fresheners or aerosols where possible, or use in a well-ventilated area.

Ventilating your home - natural ventilation - trickle vents with extract fans

Adequate ventilation is critical to help maintain a healthy, fresh and comfortable indoor environment. It can be difficult to detect air pollutants indoors, particularly those that are odourless and colourless.

Natural ventilation (trickle vents with extract fans)

Naturally ventilated homes rely on trickle vents to allow small amounts of air to enter and leave the home. Extract fans installed in bathrooms, kitchens and utility rooms provide rapid extraction of moisture and pollutants at specific times of need, for example when someone is cooking or taking a shower.

Trickle vents

A trickle vent (figure 1) is a small ventilation opening typically found on the head of a window frame that helps to provide background ventilation to a space. If the trickle vents in your home have controllable shutters, check that they are all open and ensure that they remain open at all times. Closing trickle vents restricts the amount of air entering and leaving your home, causing a build-up of moisture, odours and pollutants indoors. If trickle vents are closed for some time, condensation and mould may appear.

Extractor fans

Extractor fans (figure 2) should be used to provide additional ventilation for activities that produce pollutants or excess moisture, such as cooking, cleaning or taking a shower or bath. Intermittent extract fans are not intended to be used all the time. If you have a manually operated fan, these can be turned on and off as required by switches located in bathrooms, kitchens and utility rooms.

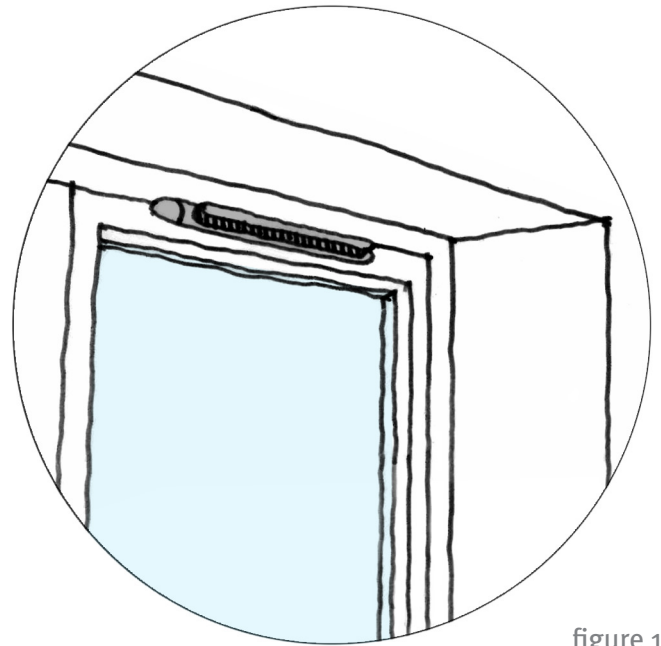


figure 1

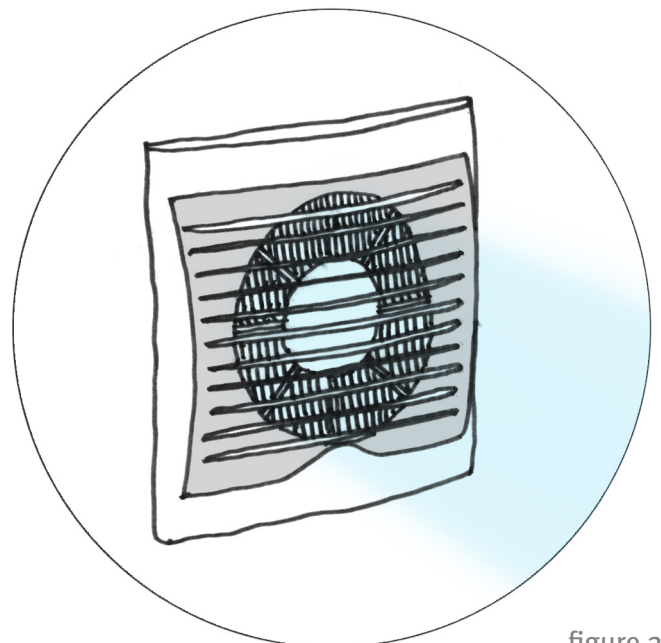


figure 2

How is the fan controlled?

Some fans operate automatically when you turn on a light switch; others are controlled by motion or humidity sensors. Some extract fans have a short delay before they turn on and/or continue running for 10-15 minutes after you turn them off. You can find out what type of extract fan is installed in your home by checking the user manual / home starter pack provided.

Checklist for maintaining your ventilation system

To make sure that your ventilation system continues to perform effectively, you should:

- Clean the grilles in trickle vents once a year with a vacuum, damp cloth or brush to remove dust and dirt.
- Clean extract fans and their grilles regularly to remove dust and dirt that can accumulate over time. Make sure the fan is switched off at the main isolator before cleaning.
- If your extract fan has a filter, this should be cleaned or replaced every six months, following the guidance provided in the user manual.
- Check to make sure nothing is restricting the movement of air through your trickle vents, particularly in rooms with curtains and blinds.
- If you are installing new doors, carpet or flooring, make sure there is at least 10mm air gap under the door to allow sufficient movement of air between rooms in your home.
- Get your extract fan serviced regularly by a qualified engineer, according to manufacturer's instructions / If you are concerned about the performance of your extract fan, arrange servicing through your landlord.

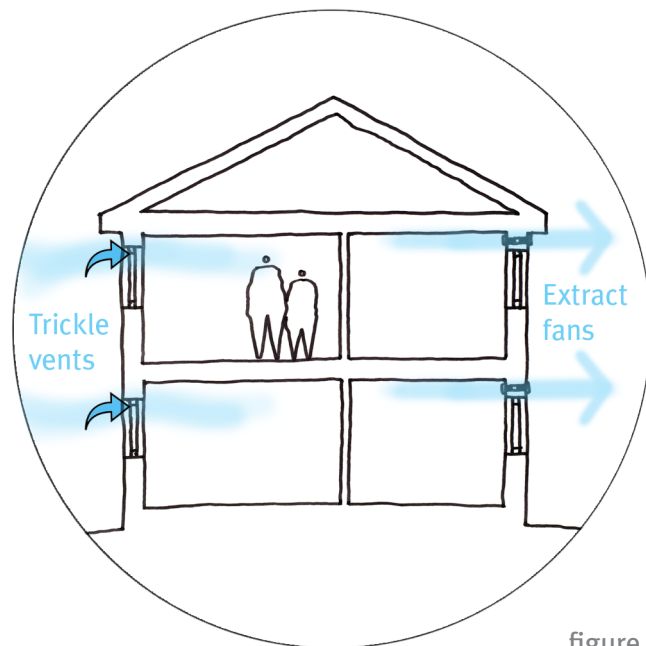


figure 3

Ventilating your home - mechanical extract ventilation

Adequate ventilation is critical to help maintain a healthy, fresh and comfortable indoor environment. It can be very difficult to detect air pollutants indoors, particularly those that are odourless and colourless.

Mechanical extract ventilation (MEV)

Mechanical Extract Ventilation is a ventilation system that continuously extracts air at a low rate from rooms where there is likely to be high levels of moisture, such as bathrooms, kitchens and utility rooms.

The systems operate with either a single centralized fan unit (figure 1) or with decentralized individual fans. The centralized fan unit (normally mounted in a roof space or hall cupboard) draws stale air out through a system of ductwork and grilles. In a decentralized system, individual room fans operate continuously to draw out moisture laden air. The mechanical extract ventilation system is designed to run all the time and replacement air is normally provided by trickle vents.

Trickle vents

A trickle vent (figure 2) is a small ventilation opening typically found on the head of a window frame that helps to provide background ventilation to a space. If the trickle vents in your home have controllable shutters, check that they are all open and ensure that they remain open at all times.

Should the ventilation system ever be turned off?

Your mechanical extract ventilation system is designed to run all the time and therefore should not be turned off. Turning the system off restricts the removal of stale air in your home, causing a build-up of moisture, odours and pollutants indoors. This could lead to condensation, dampness and mould growth. Manually operated fans can be turned on and off as required by switches located in bathrooms, kitchens and utility rooms.

Controlling your ventilation system

Your ventilation system is designed to allow you to adjust the airflow rate when required.

Boost switch

A boost function is available in your ventilation system to allow you to increase the ventilation rate. The boost switch (figure 3) is normally found adjacent to the light switch or extract grille in the bathroom and/or kitchen.

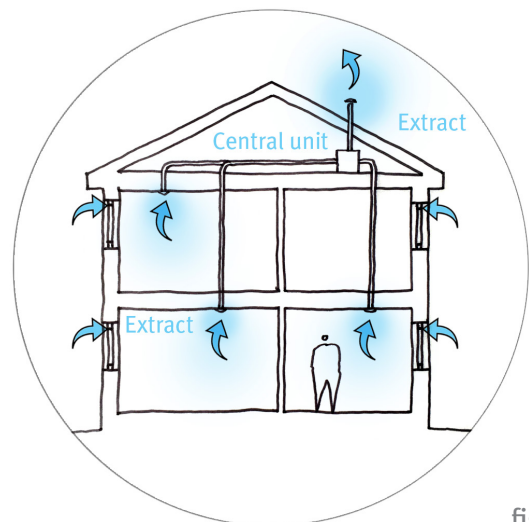


figure 1

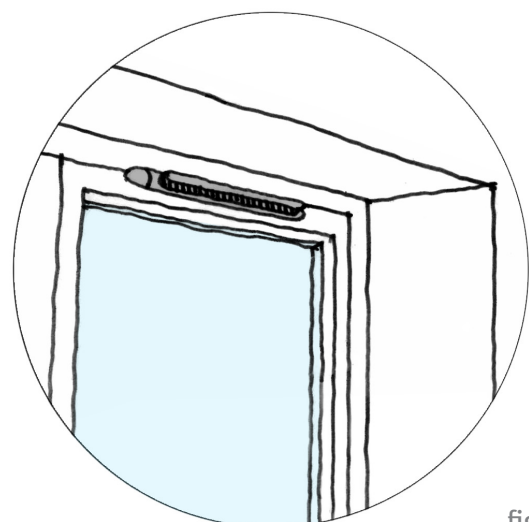


figure 2

Some boost functions operate automatically when you turn on a light switch; others are controlled by motion or humidity sensors. It is important to use the boost function to help remove moisture and pollutants when cooking and showering. The boost function however should be turned off when no longer needed as if it is left on all the time this will increase energy consumption and noise.

Other settings

A control panel (figure 4) may be available that allows you to change the ventilation setting to a higher fan speed, for example when your home is occupied by more people, or a lower setting when you are away on holidays. If you change the settings in your ventilation system, remember to switch back to the normal mode, particularly when returning from holidays. Setting the ventilation system at a lower ventilation rate when your home is occupied will lead to inadequate ventilation, potentially leading to problems with moisture and pollutants indoors.

Checklist for maintaining your ventilation system

To make sure that your ventilation system continues to perform effectively, you should:

- Clean the grilles in trickle vents once a year with a vacuum, damp cloth or brush to remove dust and dirt.
- Clean extract fans and their grilles regularly to remove dust and dirt that can accumulate over time. Make sure the fan is switched off at the main isolator before cleaning.
- If your extract fan has a filter, this should be cleaned or replaced every six months, following the guidance provided in the user manual.
- Check to make sure nothing is restricting the movement of air through your trickle vents, particularly in rooms with curtains and blinds.
- If you are installing new doors, carpet or flooring, make sure there is at least 10mm air gap under the door to allow sufficient movement of air between rooms in your home.
- Get your extract fan serviced regularly by a qualified engineer, according to manufacturer's instructions / If you are concerned about the performance of your extract fan, arrange servicing through your landlord.

Troubleshooting

Noise

If you find the ventilation system is too noisy, first check to make sure that the boost mode has been turned off if no longer required. Check filters are clean as a build-up of dust and dirt can affect the performance of the fan. If the problem persists, contact your landlord / service engineer.

Cold draughts

If you are having problems with cold draughts from your ventilation system, check that the boost mode has been turned off if no longer required. If you have a control panel, check that the setting is on 'normal' mode. If you are still having problems, contact your landlord / service engineer. Do not turn the ventilation system off as this will lead to problems with moisture and pollutants indoors.

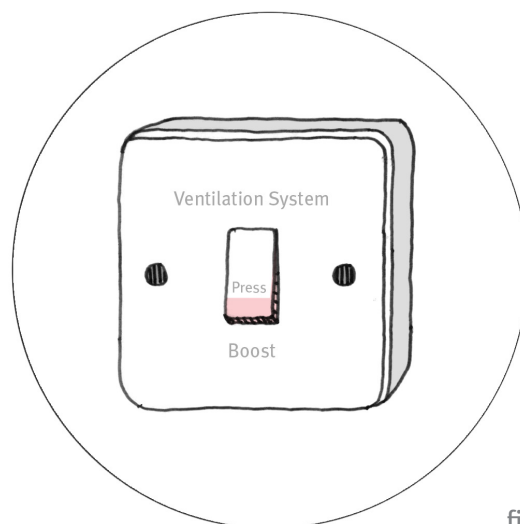


figure 3

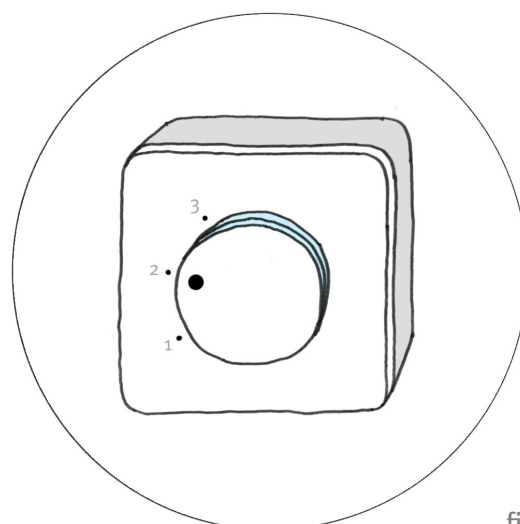


figure 4

Ventilating your home - mechanical extract ventilation with heat recovery

Adequate ventilation is critical to help maintain a healthy, fresh and comfortable indoor environment. It can be very difficult to detect air pollutants indoors, particularly those that are odourless and colourless.

Mechanical ventilation with heat recovery (MVHR)

Mechanical Ventilation with Heat Recovery is a whole house ventilation system that extracts stale warm air from kitchens, bathrooms and utility rooms and supplies an equal amount of fresh pre-heated outdoor air to bedrooms and living areas (figure 1). Fresh air from outside passes through filters and a heat exchanger unit, which warms the air, before it is then distributed around the home to bedrooms and living areas through a series of ducts.

The main benefit of a MVHR system is that you can recover heat from extracted air that would normally be lost to outside. The air that is supplied to your home is pre-heated, which helps to reduce your heating costs and the sensation of cold draughts. The warm extracted air and fresh supply air flow past each other without actually mixing, it is just the heat that is transferred. The air is normally filtered, which can help to remove pollen and other particles from the supply air.

Should the ventilation system ever be turned off?

An MVHR system is designed to run all the time to help remove excess moisture, smells and airborne pollutants from the home, exchanging stale air with fresh outdoor air. Turning the system off will reduce the quality of air in your home, leading to a build-up of moisture and pollutants indoors.

What controls are available?

Boost switch

A boost function is available in your ventilation system to allow you to increase the ventilation rate. The boost switch (figure 2) is normally found adjacent to the light switch in wet rooms, such as the kitchen and/or

bathroom. Some boost functions operate automatically when you turn on a light switch; others are controlled by motion or humidity sensors.

When should I use the boost function?

It is important to use the boost function to help remove moisture and pollutants when cooking and showering. The boost function however should be turned off when no longer needed. If it is left on all the time, this will increase energy consumption and noise.

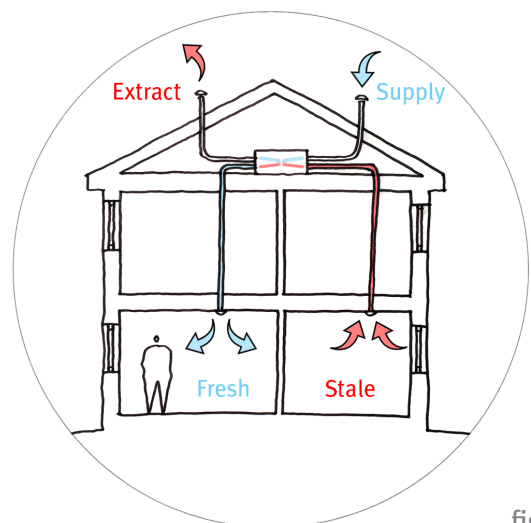


figure 1

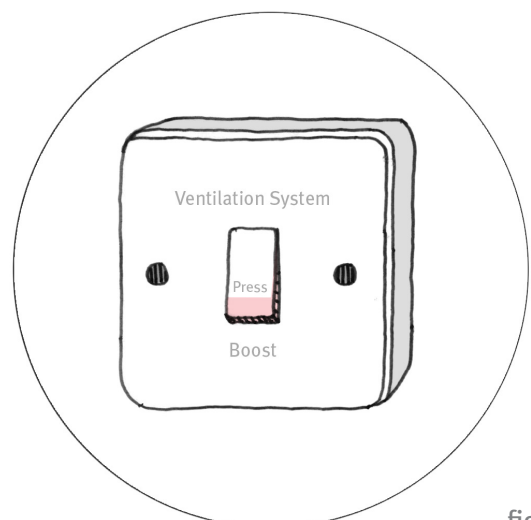


figure 2

Control panel

A control panel (figure 3) may be available that allows you to change the ventilation setting to a higher fan speed, for example when your home is occupied by more people, or a lower setting when you are away on holidays. If you change the settings in your ventilation system, remember to switch back to the normal mode, particularly when returning from holidays. Setting the ventilation system at a lower ventilation rate when your home is occupied will lead to inadequate ventilation, potentially leading to problems with moisture and pollutants indoors.

Summer by-pass function

A summer by-pass function works by stopping incoming supply air from being heated in the heat exchanger by warm outgoing air. This is usually activated automatically when outside temperatures reach a certain threshold.

An MVHR system however is not a cooling system; the summer by-pass function can stop heat from being recovered but does not guarantee that the temperature in the home will be reduced.

Checklist for maintaining your ventilation system

To make sure that your ventilation system continues to perform effectively, you should:

- Make sure the filters in the MVHR system are cleaned or replaced regularly, according to guidance provided in the user manual. This should typically be done every 6 months.
- If you have a control panel, check this regularly for filter or system error alerts. If there is an alert, check the user guide and follow the advice provided.
- Check to make sure nothing is restricting the movement of air through your supply or extract grilles.
- Clean extract and supply grilles regularly to remove dust and dirt that can accumulate over time. The extract grilles have been set to provide adequate airflow rates for the room, so it is important not to adjust the position of the grilles when cleaning.
- If you are installing new doors, carpet or flooring, make sure there is at least 10mm air gap under the door to allow sufficient movement of air between rooms in your home. These gaps are required to ensure that the MVHR system works effectively.

- Get your ventilation system serviced regularly by a qualified engineer, according to manufacturer's instructions / If you are concerned about the performance of your system, arrange servicing through your landlord.

Troubleshooting

Noise

If you find the ventilation system is too noisy, first check to make sure that the boost mode has been turned off if no longer required. Check filters are clean as a build-up of dust and dirt can affect the performance of the MVHR unit. If the problem persists, contact your landlord / service engineer.

Cold draughts

If you are having problems with cold draughts from your ventilation system, check that the boost mode has been turned off if no longer required. If you have a control panel, check that the setting is on 'normal' mode. If you are still having problems, contact your landlord / service engineer. Do not turn the ventilation system off as this will lead to problems with moisture and pollutants indoors.

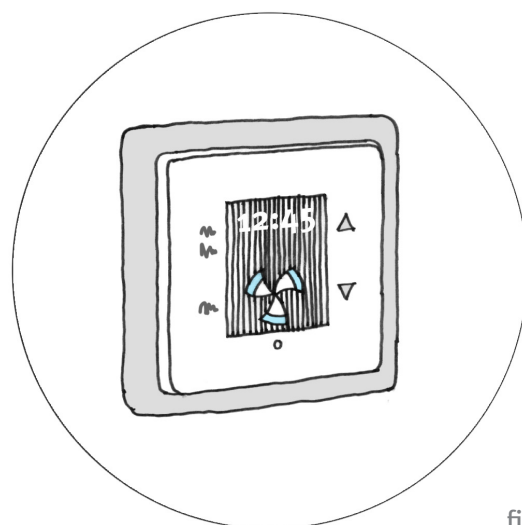
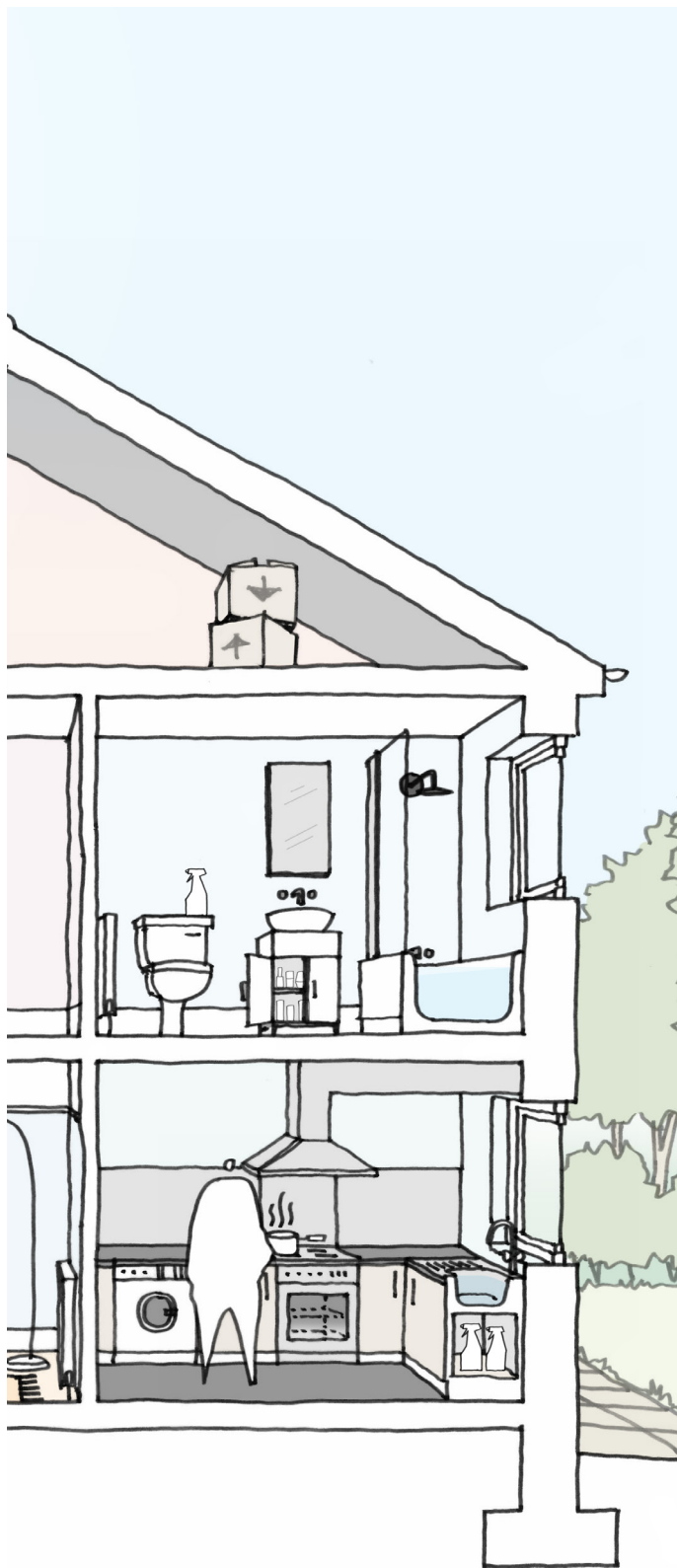


figure 3

Indoor Air Quality

Home User Guide



This guidance was prepared by Gráinne McGill, Tim Sharpe, Graham Devereux and Chris Morgan. Drew Carr prepared the drawings and typeset the document. All drawings copyright John Gilbert Architects.

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