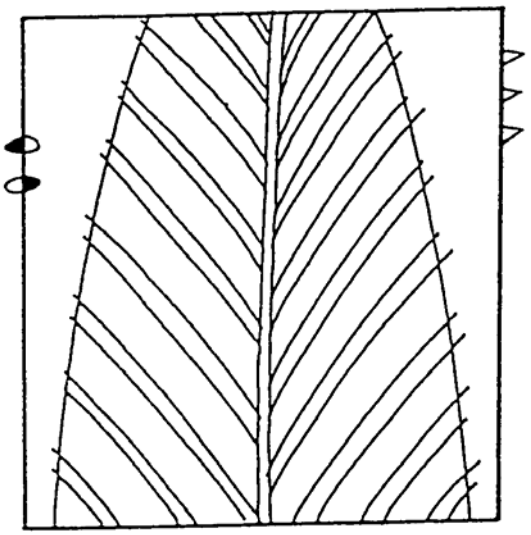
# HEATING YOUR HOME



Waitakere City Council
Te Taiao o Waitakere

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*This chapter is part of the Waitakere City Council's Sustainable Home Guidelines. The complete set can be obtained through most libraries or from the Waitakere City Council, Private Bag 93109, Henderson, Waitakere City 0650, New Zealand, phone 09-839 0400, email: info@waitakere.govt.nz.*

*The guidelines are also available on the council's web site: http://www.waitakere.govt.nz*

## Why worry about home heating?

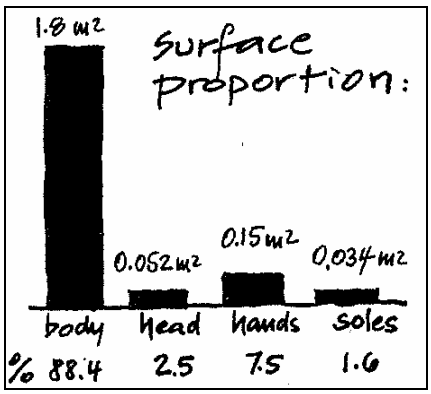
Home heating undoubtedly offers great potential for energy saving in the home. The way most of us use electricity to heat our homes is wasteful. Moreover, home heating causes the highest peaks in electricity demand. It is these winter night peaks, rather than total energy consumption, that drive the construction of new dams and power stations.

## Feeling comfortable

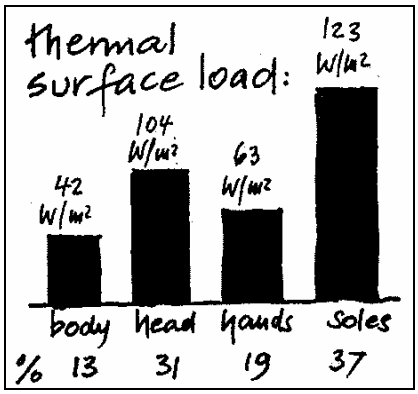
What temperature feels comfortable?

There is no simple answer to that question. For a start it depends on the person you're asking. Do they have a high metabolic rate, good circulation? Are they elderly or an infant? What are they doing – working, thinking, sleeping? What are they wearing? The thermal effect of all these things may be measurable, but individuals also have different mental sensitivities to heat and cold and what is "comfortable" for them.

And even the different parts of our body have varying heat-emitting surface areas but require quite contrary thermal surface loading in order to feel comfortable. This is why we get cold feet easily, and why a warm floor is likely to give us better comfort than warm air around the head.



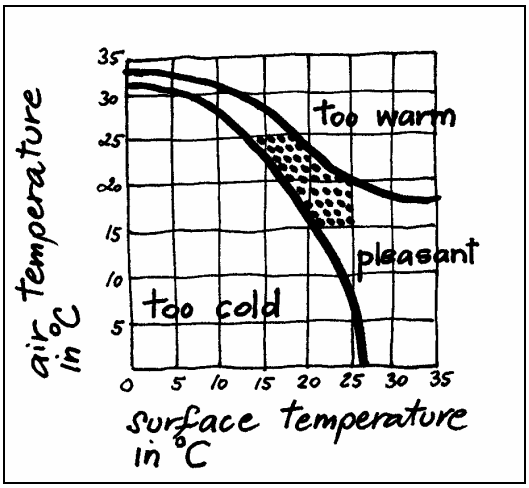
*Body surface in square metres*



*Required heat in watts per square metre*

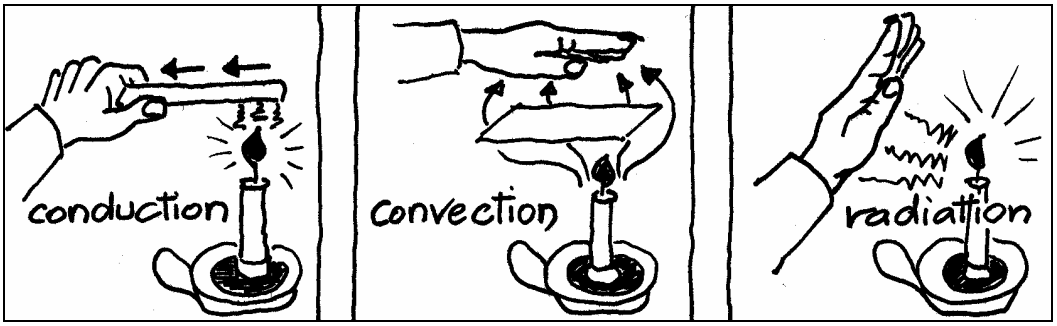
Then there's the question of what temperature we are measuring. At what height above the floor (it's likely to vary considerably)? And how do the surface temperatures of walls and floor compare with air temperatures?

If you're next to a surface with a temperature of 15 degrees, you need 24 degrees of air temperature to feel comfortable. If the air temperature is 15 degrees you need only 21 degrees of surface temperature to achieve a similar comfort level. The latter combination – warm surfaces with cooler air – is preferable; it means no condensation, healthier air, and less energy to maintain the comfort balance.




*Comfort zone*

## Principles of heating

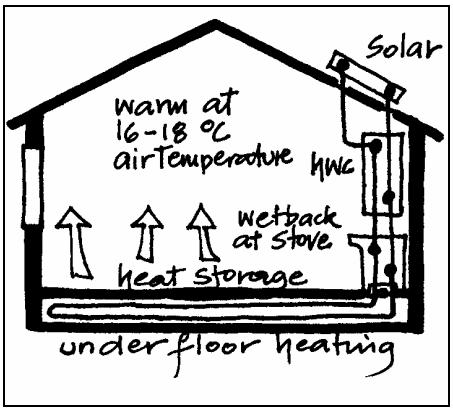



Heat can get to you from a heater in one of three ways:

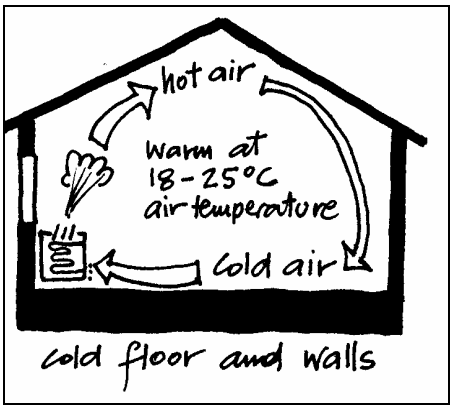
- **Conduction**: vibrational energy being passed from molecule to molecule – such as a hot water bottle, a cup of coffee, or putting your feet up on a heater

- **Convection**: warm air blowing or wafting past you – such as a fan heater. Denser cool air will generally fall to displace warmer air.

- **Radiation**: heat from a warm surface transferring directly to you by infra-red waves – such as from an oil-filled radiator.




*Radiation (warm surfaces)*




*Convection (warm air)*

Each form of heating has its place (and no heater produces only one form of heat) but radiation is likely to offer the most efficient, practical and comfortable solution for most heating needs. All materials are constantly radiating thermal energy in all directions. Such radiation can keep you comfortably warm even when the air temperature is low. A gently warm floor or wall will give you better comfort than a red-hot bar element.

Other considerations to ensure a healthy indoor climate include:

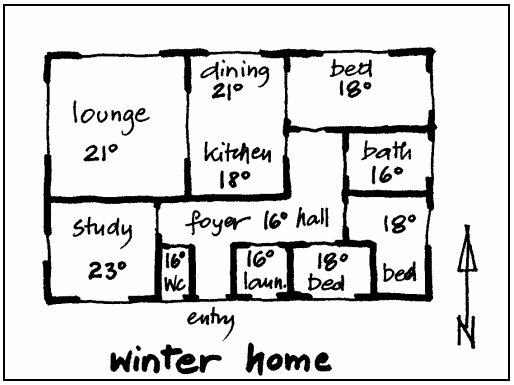
- Heating elements should be easy to clean.
- Surface temperatures should be higher than air temperatures, especially at night to avoid condensation.
- Make sure there is some air movement to avoid layers of very different air temperature.
- Avoid electrostatic charges and the outgassing of volatile organic compounds – keep a room well vented when first using a painted radiator.
- The surface temperature of a heating element is best below 70 degrees for metal and 100 degrees for terracotta tiles – otherwise dust is scorched, resulting in higher pH, ammonia and organic acids.
- Make sure gas heaters are vented to the outside with a flue, to avoid the build-up of water vapour and potentially dangerous gases.
- Ensure good ventilation in rooms like kitchens and bathrooms where moisture is produced.
- Maintain a relative humidity between 55-65% – more humid air will promote the growth of bacteria and dust mites, while drier air hampers the self-cleaning mechanism of our respiratory passages.

## A heating plan for your home

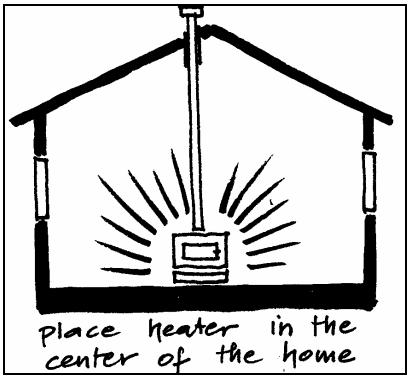
The most energy-efficient heating is by passive solar design (see the chapter *Design for the Sun*) and the most energy-efficient cooling is by designing for natural ventilation. In the Auckland climate it is possible to design a home that can achieve comfort with little or no need for supplementary heating. The NOW Home in New Lynn, a conventional-looking 3-bedroom home designed to be energy-efficient, needed heating on only a few days in the cold winter of 2006 (see Reference section at end of this chapter).

Nevertheless most of our homes are not designed for this sort of efficiency, so we need backup heating at times during the winter. In our variable winter climate a full central-heating system is likely to be wasteful of energy unless it is carefully controlled with temperature sensors and timer controls. You are better to think about a range of heating options suited to the different parts of the house.

Flexibility is the key to efficient home heating. Aim for different temperature zones in your home. It would be absurd to heat the laundry, which you visit for short periods of physical work, to the same level as a study, where you need to sit and concentrate in comfort for a long period of time. You will probably want a higher temperature in the lounge than the kitchen. If you use a bedroom mainly for sleeping you may choose to heat just the bed itself, creating a comfortable cocoon with a duvet and hot water bottle. An exception to this may be for an asthma sufferer where a higher bedroom temperature will reduce the relative humidity and the incidence of the dust mites that aggravate asthma.



*Comfortable temperature zoning*



*Heat source*

As a general principle you should avoid placing your main heating source against an outside wall where heat is likely to leak straight out. A more central position will reduce heat loss, store heat in the floor and walls, and circulate warmth more effectively throughout the rest of the house.

In Waitakere, however, much of the cold weather comes with the south-westerly wind. It creates high pressure on that side of your house, forcing itself in through the cracks of door and window frames, and then flows through the house until it is sucked out by the low pressure area on the leeward side. It makes sense therefore to think of putting heaters towards the upstream end of this flow.

The north-easterly – our other prevailing wind – is seldom cold enough to require heating. It is usually warm and humid, so it may influence the placement of a de-humidifier or air-conditioning unit.

As well as the plan layout of the house you need to think of the way heat rises. You should feed heat in low down, ideally at floor level, so it will start off warming your feet. Heat will move naturally from a lower room in the house to a higher room, but not the other way round. If you have a high ceiling you can use a reversible ceiling fan to push the warm layer of air back down to you (and in summer of course it can help keep you cool).

## Making the most of your home heating

The most effective way of reducing the energy we consume for home heating is to pay attention to the many ways it can leak straight out of the house once we turn it on.

### *Draught-stopping*

Most of our houses leak air at a surprising rate. There are often big gaps around doors and window frames, which can be reduced with foam strips or other draught-stopping devices available at hardware stores. Timber frame construction can result in other less obvious cracks where the wind can force its way in. The joint between wall and floor, for instance, comprises timber plates and skirting, nailed but not sealed. As the timber warps or the footings subside with age, substantial gaps can open up. They are not always apparent to the eye, but you can test for them with a feather or small piece of paper.

An old chimney is another heat drain. Chimneys after all are designed to create a draught up the flue. If you no longer use the fire make sure the flue is sealed off.

### *Windows*

Most heat loss occurs through windows. A house without windows would be much easier to keep warm! But of course we need them to let in the free energy of the sun, and a large part of smart design is balancing the energy gains and losses through windows. Double glazing reduces condensation, mould growth and noise, as well as heat loss. (See *Insulation* for more on double glazing.)

The simplest way to achieve a degree of insulation with windows is to use curtains or blinds. It is very important though to seal off the blanket of air between the drapes and the window. The drapes should be continuous from jamb to jamb. At the top they should seal against a pelmet; at the bottom against a window sill or the floor. Otherwise the cold surface of the window will trigger a continuous sheet of cold air sliding down and out across the floor. Of course the drapes will be of benefit only if they're closed when the sun goes down.

There is little insulation benefit from so-called "thermal" drapes. The insulation improvement comes more from the still-air gap than from the material. So a drape or blind with two or more layers separated by an air gap will lose less heat. You can buy blinds with a honeycomb structure which have reasonable insulation properties.

## *Insulation*

The hottest air gathers in a layer just beneath the ceiling. Up to 40% of your heating can escape through the ceiling, but fortunately this is the easiest place to add insulation in most existing houses - so long as there is an attic space between the ceiling and the roof. Heat loss can be cut dramatically by insulation.

Even if your ceiling is already insulated you could consider adding an extra layer. Old insulation may have settled, may have been poorly installed, or may not be as thick as current recommendations. Use a blanket type material over the ceiling joists — you don't need to remove the old material.

There is a wide range of suitable insulation products and the payback period can be as short as four years. For more detail on insulation as a material and its correct installation see the sections on *Design for the Sun* and *Insulation.*

## *Doors*

Doors on the south side of the building have the potential to lose a considerable amount of heat – almost as much as similarly sized windows. Insulating doors and ensuring that they are well sealed on each edge will minimise heat loss.

## *Common sense*

Above all, you can increase heating efficiency just by exercising common sense. Close curtains as soon as the sun goes down. Keep doors closed – heat only the rooms that you are using. Wear warm clothing.

## Choosing heaters and heating systems

The following examines the main heater types available for the home.

**Convection** heaters are inherently inefficient because they focus on warming the air. They are best for quick-response short-term heating in a small area, such as a kitchen first thing in the morning.

Low temperature electric **radiators,** usually oil-filled, offer an efficient, comfortable and healthy heat source with a reasonable response time. They can be free-standing and mobile, or mounted on a wall. The latter type can be connected to the hotwater supply instead of using oil as their thermal mass. Unlike the higher temperature bar-type radiators they do not scorch dust particles in the air. Models with thermostats and timers are easier to manage efficiently.

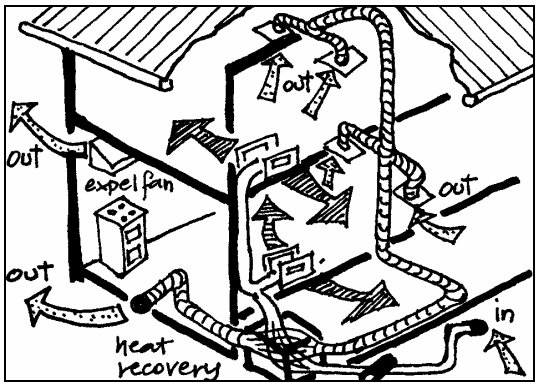
Theoretically, the ideal source of radiant heat would be the floor. **Radiant floor heating** based on warm water pipes set in a concrete floor slab runs at low temperatures of 40 - 50 degrees. It creates very comfortable warmth, especially round your feet, which need warmth most. However, the response times are so long that underfloor heating is better for areas with a more consistently cold winter climate than Auckland has.

Ceiling mounted heaters do not make much sense because the heat tends to stay up there in the ceiling, unless you blow it down with a ceiling-mounted fan. However, i**nfra-red globes** have an application for cheap, quick-response heating of a confined area such as a bathroom

**Nightstore heating** uses cheaper electricity late at night to store heat for slow release during the day. As it warms up the house for the morning, it works well for retired people or a young family at home, but is wasteful if the whole family is away at work and school during the day. Of course, you also have to make sure that you are set up for the power company's night rates, and that you set the controls for the timing and level of heating you need.

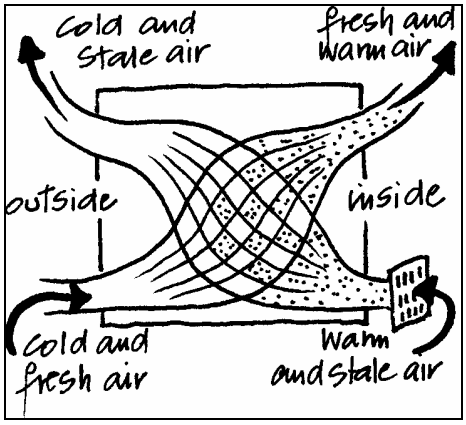
A **heat pump** operates on the same principle as your fridge – only in reverse. Refrigerant circulates through an evaporator panel in an outside unit, extracting molecular energy from the surrounding air. A compressor condenses it back to a liquid, which releases the heat into the house. Electricity – about a third to a quarter of what an equivalent heater would use – is needed only for the compressor. The payback period can be as little as four years, depending on the initial cost of your system. It can be reversed to provide cooling in summer. Look for its Energy Star Rating label. It features an arc of 1 to 6 stars: the more stars it displays, the more energy efficient it is relative to conventional heaters of the same type.

Traditional **HVAC (heating, ventilation and air conditioning) systems** consume large amounts of energy. They are used mainly for commercial and public buildings, but residential use may be appropriate in some circumstances for health reasons. The system aims to control indoor climate, regulating air humidity, air temperature and indoor air quality. The system must be designed, operated and maintained to required standards (ASHRAE) as it can otherwise create unbalanced and polluted indoor air.

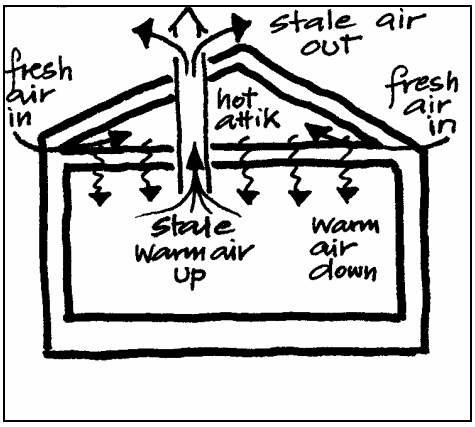


*HVAC – heating, ventilation and air conditioning*

Simpler **heat-exchange systems**, such as heat recovery ventilation, work on the principle of extracting heat from stale air that is being vented to the outside and using it to warm up fresh air that is being brought in. Again, the process can be reversed for cooling in summer (so long as the outside air temperature is lower). There are various systems available, and they can be very efficient, especially if they draw warmth down from spaces where it is usually wasted, like an attic. They do need to be designed to fit appropriately into the particular house.



*Heat exchanger recovery ventilator*



*Pore ventilation dynamic exhange*

A bonus in the Auckland climate – with its remarkably high level of asthma – is that the natural dehumidification inherent in the heat recovery ventilation process improves indoor air quality: moisture, mould, dust mites and other asthma-aggravating allergens are reduced.

Although an **open fireplace** makes a lovely feature in a room it wastes most of its heat straight up the chimney. Its efficiency can be increased somewhat by increasing the thermal mass of the fireplace. Brickwork to the sides and behind will absorb heat and then radiate it back into the room. A smoky fire is inefficient as well as polluting, and may indicate poor design and proportioning of the firebox and flue.

Modern **woodburning stoves** use natural heating principles together with modern technology to create an energy-efficient, double-combustion heat source. They are particularly relevant where there is freely available firewood, and they can offer the opportunity of combining space heating with water heating, cooking and baking. They can heat space directly by radiation or indirectly by running water through wall radiators or underfloor pipes. They can be used in conjunction with solar panels to provide a year-round hotwater supply. They must be operated in accordance with instructions, using clean dry untreated firewood.

**Pellet burners** have the highest efficiency of any type of solid-fuel burner. The pellets are made from sawdust and other wood wastes. The burner is designed to be highly controllable and to start and run automatically if required. However, they need about 250 watts of electricity to run the fan and the auger, and you will be dependent on the manufacturer of the pellets.

All wood stoves release lung-harming microscopic particles in their smoke, and these contribute significantly to air pollution and premature deaths. So for properties smaller than two hectares, only burners verified as low in emissions may be installed. There is a list of approved burners on the Ministry for the Environment website.

The exhaust gases of **gas and oil-fired heaters** must be vented to the outside to avoid condensation and pollution of the indoor air by oxides of carbon, nitrogen and sulphur.

## Advice at the Waitakere City Council:

Phone the call centre (09) 839 0400
Ask for: Eco Design Advisor
Building Consents

### In print

*Your Home Technical Manual,* Australian Government. Comprehensive printed resource, much of it relevant to New Zealand, particularly the 'temperate' and 'cool temperate' sections.

### On the web

http://www.smarterhomes.org.nz is a mine of up-to-date and independent information. Designed for the general public, it's easy to use, has case studies, and includes features such as Homesmarts, a calculator you can use to find information relevant to your needs or simply to run a home-health check.

If there are questions you can't find answers to on Smarterhomes, www.level.org.nz goes into more depth and is aimed at the design and building industries, with drawings and links to Building Code compliance documents.

Information on the NOW home is available on http://www.nowhome.co.nz/home.aspx

*Energy Efficiency and Conservation Authority,* www.energywise.org.nz. The brochure "Getting warmer by degrees" is available on this site, or from the council.

Ministry for the Environment, search keyword "woodburners", www.mfe.govt.nz

*Eco-building Products and Services Directory,* Building Biology and Ecology Institute, phone Auckland (09) 376 6767, Wellington 0800 223 272. This is updated regularly and can be obtained from the website www.ecoprojects.co.nz.

This chapter was last reviewed in September 2008.

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