GUIDE TO

CENTRAL HEATING

OPTUM

OPTUM

BETTER LIVING BY DESIGN

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1. ABOUT THE AUTHOR

Kevin Henderson is the founder and MD of Optum Energy Solutions, an award-winning plumbing and heating firm located in Wanaka and Queenstown, New Zealand. Kevin is responsible for running all facets of the business, including procurement, operations, estimating and commercial management. Kevin has a proven management track record and over 40 years of experience in the industry.

Kevin is a certifying Plumber, Gas Fitter and Drainlayer in NZ and has a City & Guilds Advanced Craft qualification gained in Scotland. In his younger years Kevin was named as 'Apprentice of the Year' two years in a row. Kevin feels he has been very lucky to have had great mentors in business and has been a New Zealand Master Plumber for 30 years.

'We are always looking for better and more cost efficient ways to provide a healthy living environment for our clients, in fact, it is our mission. Our goal is to create a safe, healthy and comfortable living space for your home. We care about the environment, but we also care about our customers, partners and employees."

2. INTRODUCTION

WHAT IS CENTRAL HEATING AND WHY DO WE NEED IT?

Central heating, as the name implies, involves heating your home from a single source and distributing the warmth to various rooms, ensuring comfort throughout the entire house. Traditionally in New Zealand, heating has focused on the living room with a wood or gas fire, and occasionally a panel heater in the hallway to take the 'chill off' the rest of the home. However, with innovation, technological advancements, increased awareness of health concerns, and a growing demand for consistent comfort, central heating in New Zealand has undergone significant changes.

Central heating offers numerous benefits, primarily enhancing the health, comfort, and well-being of all household members. It helps eliminate mould, keeps the home dry, and ensures that all rooms are warm and comfortable, not just the living room. Additionally, central heating can be automated with a timer to suit your lifestyle.

In Winter, central heating makes getting out of bed much easier, with bedroom temperatures at a comfortable 16 or 18 degrees instead of a chilly 5 or 6 degrees, sparing you the ordeal of leaving your warm bed and rushing to the shower. The living room will already be cozy and warm, eliminating the need to turn on the gas fire or stoke the wood fire, only to feel the warmth just as you are about to leave for work. With central heating, your home will be warm before you return, allowing you to step inside and relax immediately.

WHAT ARE THE Options?

3. RADIATORS

Radiator central heating is the best way to heat both new and existing homes to provide heating quickly and efficiently to individual rooms.

Radiators are generally wall hung and have warm water pumped through them to heat the metal surface and radiate heat into the room. A room can be heated quickly (if the radiator is sized correctly) with each radiator and room being controlled individually by a manual thermostatic valve attached to the radiator. The control valve (TRV) sets the temperature for the radiator to operate in the room, so when the room achieves the temperature required, the radiator will turn off until the room drops in temperature and the valve automatically opens to maintain the required temperature.

Radiators are very responsive to changes in the weather and how that can affect the internal temperature of the home. Due to the speed of the heating process the heating system can be on a timer programme and set to come on and go off when required. An example would be for the heating to come on at 6am, so the home is warm when getting out of bed, and off at 8.30am when everyone is at school or work. Then it can be set to come on at 3pm when the kids return from school and off at 10pm in the evening when everyone is in bed.

The convenience and comfort of pre-programmed automation for warming the home coupled with individual room control is a cost-effective way to heat your home when compared with typical methods that are used in New Zealand. The radiator heating system is heating all of the home and not just a living room. The rooms can all be at different temperatures such as the living room at 22 degrees, bathrooms at 20 degrees and bedrooms from 16 to 18 degrees so all very flexible.

TYPES OF RADIATORS

There are various models of radiators to suit your home, including towel rails for the bathrooms and fan coil radiators. There are also many designer radiator options available which combine thermal efficiency and aesthetics to complement the interior design or act as a focal point.

Fan coil radiators use an inbuilt electric fan to assist natural heat convection. As a result, they emit large amounts of heat for a relatively small unit. Fan coil units are suited to air to water heat pump systems and can be used to both heat and cool rooms. Fan coils can be:

- Mounted on a wall as a freestanding unit
- Recessed into a wall
- Completely concealed so that only the grills show

HOW TO CHOOSE THE RIGHT RADIATORS

Design is critical to maximise efficiency. Undersized radiators will never achieve the temperature in the room that you will need. This will impact the heat source (boiler/heat pump) which will continually run trying to deliver the heat needed for the room creating higher running costs.

Be particularly aware of the wall space needed for radiators, especially when there is a lot of glass in the home.

BENEFITS OF RADIATORS

HEALTHY	Reduces damp and cold spots by providing even heating throughout a house. No blown air movement which is ideal for asthma sufferers and those with allergies.
RESPONSIVE	Radiators heat up and cool down quickly and are very adaptable to changing weather.
SAFE	Radiators are great for children, the elderly, and pets.
SILENT	Radiators are totally quiet, unlike air conditioning units.
CONTROLLABLE	All radiators are controlled individually or as a system.

4. UNDERFLOOR HEATING

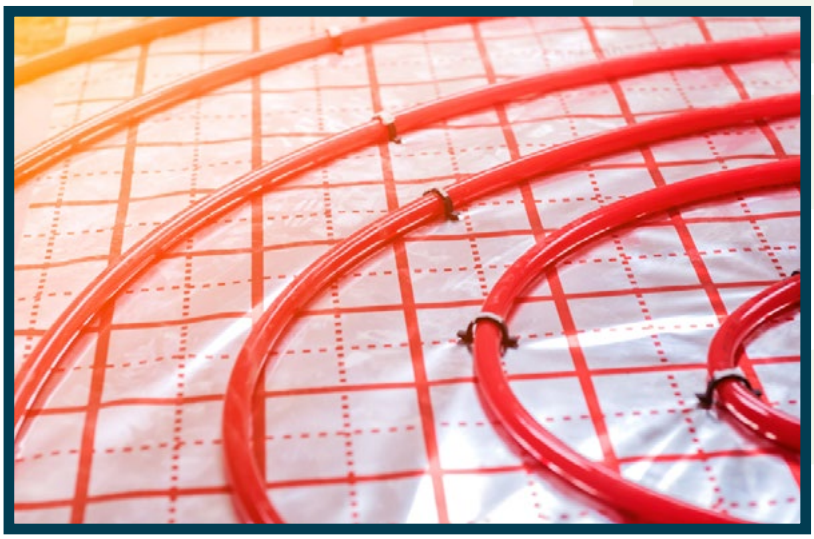
Underfloor heating is the most luxurious form of central heating as its radiant heat is evenly distributed throughout your home and because the heat source is at your feet, the perceived comfort level is greater. Hard floor surfaces are warm to the touch, there is no air being blown around it is totally silent. The system is totally hidden from view and, unlike radiators or surface mounted heat pumps, takes up no wall space. This makes it ideal for large open-plan homes or those with lots of glazing.

The heat from the underfloor system can be produced by air-to-water and geothermal heat pumps or by boilers fuelled by gas, diesel, or wood. This flexibility means that warm-water underfloor heating is becoming highly desired by Kiwi homeowners.

Underfloor heating is particularly well suited to buildings with high ceilings. The radiant effect of heat from the floor is effective up to a height of about two metres, so the problem of heat gathering at the top of the room is less than with other systems.

Underfloor heating is generally run in concrete floors creating radiant heat from the thermal mass of the concrete slab. There are other systems available that sit on top of the concrete slab and have a thin screed poured over which can have floor covering laid on top of the screed cover.

The underfloor heating in the concrete floor is slightly harder to control due to the thermal mass of the concrete and the lag time needed to heat up and cool down, but there are smart solutions to help control this to maintain the comfort level within the home. The screed type heating is an easier system to control as there is no thermal mass and the floor will respond quickly.



4. UNDERFLOOR HEATING

Underfloor heating runs at low temperatures and would run for approximately 10 hours per day in winter. The thermostats in the rooms will control and allow for solar gain during the day to lower the floor heating temperature and prevent overheating in the room. Similarly, the thermostat can "ramp up' the heating to adjust for cold snaps to maintain room comfort.

TYPES OF UNDERFLOOR HEATING

ELECTRIC

This type of heating has electric cables run in the floor and is powered using electricity. Electric underfloor heating is used mainly in bathrooms but can be used on other floors. This type of system has a lower capital cost to install but generally costs more to run, depending on the network and supplier costs and fees.

Photovoltaic solar can be integrated to offset some costs, however, there is a lot less sun in the winter when needed to provide the energy required to operate the heating.

HYDRONIC

This type of heating system has water pipework run in the floor in a series of zones or circuits. Warm water is pumped through the pipework at a lower temperature of 35-45 degrees and the pipework will heat the floor surface. For the system to be maximised each room should have it's own zone with the pipework running to a central collection point called a manifold. Each room can have a separate thermostat to control the room temperature to maintain the required comfort level for the room.

BENEFITS OF UNDERFLOOR HEATING

HEALTHY	Reduces damp and cold spots by providing even heating throughout a house. No blown air movement which is ideal for asthma sufferers and those with allergies.
RESPONSIVE	In bathroom situations the reaction time is quite quick as the electric matting is laid on top of the concrete slab and directly under the tile flooring.
SAFE	Underfloor heating is great for children, the elderly, and pets.
SILENT	Totally quiet, unlike air conditioning units.
CONTROLLABLE	Controlled from a room thermostat and can have a timer to programme the on/off times for individual rooms.

WHAT TO BE AWARE OF WHEN FITTING UNDERFLOOR HEATING

FLOOR COVERINGS

Floor coverings are not an issue for radiators or the active ceiling panels, however, the floor coverings do need to be considered when designing and installing underfloor heating in a home.

The main difference between flooring types and their suitability for use with underfloor heating is the material thermal conductivity – meaning how quickly and efficiently heat generated can transfer to the floor surface.

TIMBER FLOORS

Different types of wood flooring have different thermal properties, as such there are differences in their suitability for use with an underfloor heating system. The more dense and thinner the floorboards are, the better they conduct heat and typically more suitable they are for underfloor heating.

Laminated wood flooring is more suitable but needs to be kept to a thinner profile. Natural wood floors are okay to be used although not as thermally efficient and need to be handled carefully to prevent splitting, bowing and cupping.

CONCRETE

Polished concrete is an ideal finish for underfloor heating. The concrete is the direct conductor of the heat energy that is transferring into the room, combined with high thermal mass allows for full benefit of the underfloor heating system.

TILE OR STONE

Similar to concrete, tile and stone flooring are one of the most suitable finishes as they have high thermal mass and good conductivity. Heat from the pipes can quickly transfer to the surface and increasing the thickness will not affect the output. Tiles can be heated to 29°C or more, meaning that you can also achieve one of the highest heat outputs.

CARPET

Carpet is suitable for use, provided carpet or underlay does not act as an insulator blocking the heat. Most carpets can be used, however wool or high pile is a thermal insulator and will slow the transfer of heat from floor to the air above, the thicker the carpet the greater the thermal resistance.

4. UNDERFLOOR HEATING

Choosing the right carpet is very important when installed over an underfloor heating system. Carpet with high insulating properties will restrict the heat from rising up through the carpet. This will result in reduced efficiency of underfloor heating and increased energy costs by having to run at a higher temperature.

The thermal insulation property – Thermal Resistance – is referred to as an R-value. The R-value is used to measure a material's resistance to heat transfer or thermal resistance – the higher the R-value the greater the insulating effect.

R-VALUE AND TOG

Similar to R-value, TOG stands for 'Thermal Overall Grade' and is a measure of thermal resistance of a unit area, also known as "thermal insulance." It is commonly used in the textile industry and often seen quoted on fibre-filled bedding such as quilts and duvets, **and carpet underlay**. While engineers use R-values for their heating and cooling energy calculations, TOG is often used when referring to carpet and carpet underlay. TOG is the R-value x 10.

For example: TOG 1.5 = R 0.15 x 10

Modern heating systems can cope with carpeting of almost any thickness or density provided the (approximate) thermal resistance value is known in advance by the heating system installer. Even with older, already established systems a wide choice of carpeting is possible. In all cases, the main requirements are that the carpet assembly's durability and appearance retention is not significantly affected and, the assembly has no odour when heated.

While the carpet and underlay to be used with a combined value up to a maximum of TOG 2.5 is considered acceptable, a much higher TOG value will affect the efficiency of the heating.

For example: Combined TOG value: A carpet of TOG 1.60 and underlay of TOG 0.75, has a 2.35 TOG value and would be okay to use in this situation.

CHOOSING UNDERLAY FOR UHF SYSTEMS

There is a balance needed when making the underlay selection. The underlay used should allow adequate heat to pass through the floor covering into the room area above as well as giving the carpet structure adequate support during its performance lifetime. The thermal resistance of underlay is dependent on a number of factors, the most important being, what it is made of and its thickness. Rubber underlays are preferred by underfloor heating system suppliers as they generally have lower Tog values than foam or felt underlays.

COMBINATION OF UNDERFLOOR AND RADIATOR HEATING

A combination of underfloor heating and radiators is a good option for homeowners to consider. When deciding whether to combine these to have a multi heating system within the home considerations need to be made about whether it will suit the layout of the home and how the rooms will be used. Living areas are typically heated with underfloor heating as these areas are used and "lived" in the most. Bedrooms could have radiators to be programmed to operate when needed. Bathrooms with tiled floors are often a high priority for underfloor heating in colder parts of New Zealand.

Combination heating could be heated by a boiler or a heat pump with some additional design required for radiators being heated by a heat pump.

5. CEILING HEATING AND COOLING PANELS

Heated ceiling panels have been around for a long time in Europe, Asian and American markets and have evolved into a very efficient and controllable heating system. With the benefit of the modern air to water or geothermal heat pumps the panels can be used for cooling too.

“Active ceilings” heat or cool much faster than a radiant floor system since it does not have to heat or cool as much mass as in an underfloor slab, nor does it need to overcome overlay flooring or rugs. “Active ceilings” are excellent for changeable weather which is becoming typical in the shoulder seasons.

There is a gentle, even temperature throughout the room and home. Even the surface of the floor warms or cools in unison with the ceiling.

A question that usually gets asked is “how can the panels heat the room when heat rises,” so to address this point heat doesn’t rise...hot air rises.

Radiant heating is a technology for heating indoor and outdoor areas. Heating by radiant energy is observed every day, the warmth of the sunshine being the most commonly observed example, where the heat of the sun will heat any surface it comes in contact with. This is what the Active ceiling panels do when producing the heat from the ceiling using the same principle.

The Active panels can be installed in walls to act as a radiator, but without being seen or taking up valuable wall space. There are some rules to follow to ensure that the panels are protected from wall penetrations.

Silent, and healthy. With no air blowers there is no air movement, the room is silent, and there is no recirculation or collection of dust particles resulting in healthier air. This is particularly a great benefit for a bedroom to get a good night’s sleep at the optimal temperature with no noise.

WOOD FIRE FOR CENTRAL HEATING

This type of boiler is a wood fire with a large water jacket around the fire box. When the wood fire is operating, the heat from the fire produces a large amount of hot water that can be used to heat radiators, underfloor and domestic hot water.

There are various sizes of fire that can produce different amounts of heated water and sized for the heating system in the home. A buffer tank or thermal store can be used to store the heated water and dispersed to the heating system using a circulating pump. This is an uncontrolled heat source, so requires an open vent for safety.

This type of fire is subject to the air pollution zone rules specific to the region and not usually allowed to be installed in an urban area. Check with the local authority before starting any work. This is a great way to heat your home if you have access to lots of firewood.

GAS BOILERS

Gas boilers have been around for a very long time and with the latest condensing models are very efficient. The efficiency comes from the boiler recycling the heat from the burner so effectively heating twice within the boiler. This has made a huge difference to the efficiency of a gas boiler and running costs.

The boiler provides high heating output for radiators and hot water for quick heating of rooms and hot water supply. Most domestic boilers are wall hung to provide some space saving and are quiet when operating. The boilers come set up for either natural gas or LPG

There is also a combination boiler which can provide instant hot water and heating from the same source.

The boiler can also be set up to run underfloor heating at a low temperature to keep the boiler efficient when heating the floor. If it is a combination boiler it can do both low temperatures for the underfloor and high temperatures for the hot water.

DIESEL BOILERS

The installation of a diesel boiler is typically more involved and costly than gas boilers but offer slightly better running cost savings over LPG options. A diesel boiler requires a fuel storage tank located outside.

Condensing boilers use advanced combustion technology which scavenges energy found in the flue gas temperature that would otherwise be lost to the atmosphere resulting in running efficiencies up to 97%.

The modern diesel boilers are much more advanced than the older models, much quieter, flexibility with the flues which can be located directly through the wall, at a higher level or through the roof.

There is an annual service required for diesel boilers and the fuel tank. There can sometimes be issues with a diesel bug in the fuel if not checked which causes a fungus to grow and clog the fuel filter, the outcome is the boiler not running efficiently and needs to be cleaned out and re-serviced.

Similar to gas boilers, diesel boiler can be used for radiators, underfloor and domestic hot water offering high temperature heating to heat quickly and efficiently.

HEAT PUMPS

There are several options for heat pumps for heating and cooling and should not be confused with ducted air heat pumps. The ones we will talk about specifically are for hydronic installations, meaning, using water to provide the heating and cooling.

AIR TO WATER HEAT PUMPS

An air to water heat pump extracts latent heat from the outside air and transfers that at a higher temperature to heat water. An air to water heat pump has been traditionally used to heat underfloor pipework in a concrete slab with low temperature water between 35 and 45 degrees creating a comfortable heat in the home. With recent advances in technology, the heat pumps can deliver up to 65 degrees which allows to heat radiators, pools, spas and hot water.

With the right model, the heat pump can "reverse" the process to provide cooling in the floor for the summer and warmer months. Unlike an "air to air" heat pump system there is no air blowing or noise, this is a completely silent way to heat and cool the entire home or specific rooms.

The heat pumps are highly efficient and environmentally have a very low impact. The heat pump is classified as a renewable energy as it uses free air to provide an energy source. A quality heat pump has a low noise level (35 decibels @4meters) to ensure quiet operation for the comfort of homeowners and neighbours. Heat pumps are measured by using COP (coefficient of performance) showing how the heat pump will operate in certain conditions. A heat pump at 300% would mean that for every 1 kilowatt of power used, the heat pump will produce 3 kilowatts of energy, so a ratio of 3:1. There are a number of quality heat pumps that will produce better efficiency and will still operate "efficiently" to low temperatures of around -10. Some manufacturers will say that their heat pumps can operate to -20, which may be true, however the heat pump is not running efficiently, at this temperature range the heat pump will be running at 1:1.

If you want to reduce your carbon footprint and increase your central heating energy efficiency, an air-to-water heat pump will provide for that. It's a simple and eco-friendly choice for your home. Air-to-water heat pumps are electrical appliances that get the most value from a unit of electricity.

There are many brands and models of heat pumps on the market, however it is worth paying a bit more for a heat pump with low noise when operating, quality components and a good warranty.

GROUND SOURCE HEAT PUMPS / GEOTHERMAL HEAT PUMPS

The latest and most efficient heat pump technology, geothermal or ground source heat pumps offer exceptional energy efficiency, they extract heat from the ground temperatures to generate heat through compression within

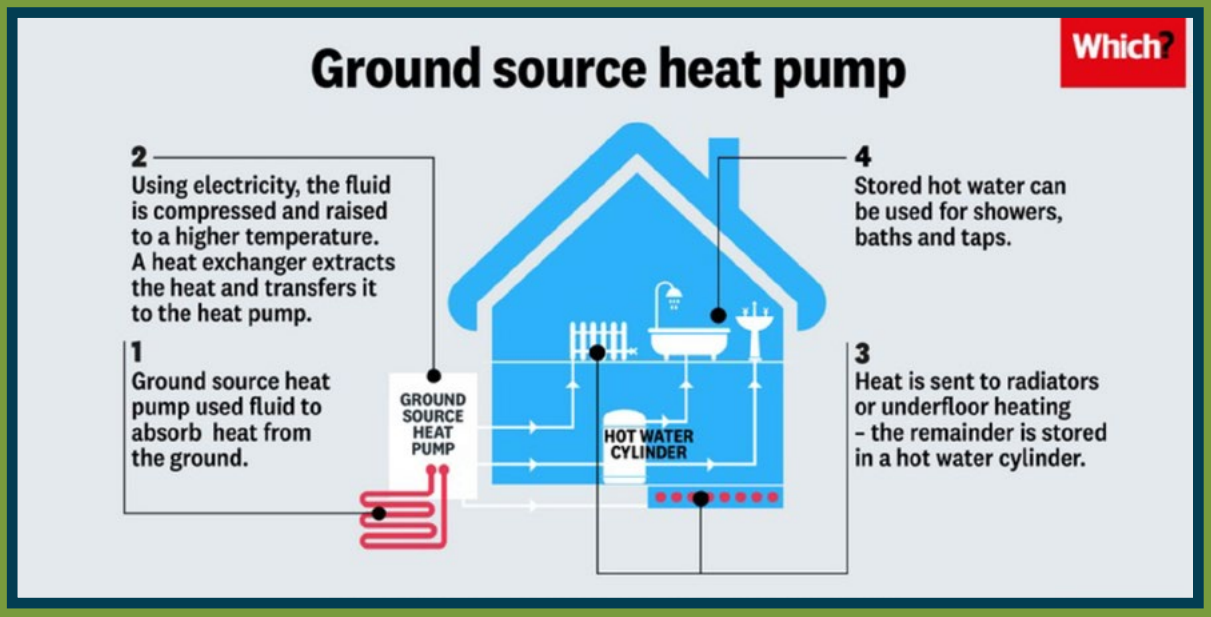
the heat pump. Ground Source Heat Pumps are more efficient than the more common air to water heat pumps due to extracting heat from the ground which is a much more stable source of heat than an air to water heat pump which are heavily influenced by fluctuating air temperature. The air is of course much colder when you need it the most for the heating. A ground source unit will give constant heating performance, often in excess of 4:1 (400% efficiency) because the in-ground temperature is stable all year round with no fluctuation.

Heat is extracted from the ground in two ways.

1. By a coil of pipework which is laid in a trench or a field layout, typically at 1200mm -1500mm deep. This is known as a closed loop collector or a slinky.
2. From a bore hole being drilled into the ground (normally to 100mtrs depth).

The amount of collector (or pipework) required is dependent on the size of the heating system load and is also influenced by the ground type, the best ground being wet and sandy - the worst being rocky ground, which will require the pipe to be laid in a layer of introduced sand. Typically, the collectors will be somewhere from 500m to 1500m in total length, which is charged with a water/glycol mix.

There is a lot of capital cost in running the collectors or bores with excavation and drilling, so a specific design is required to ensure there is enough heat being extracted from the ground to provide the correct heating output in the home. If the collector field is undersized there is the potential for the ground to freeze creating a very inefficient system.



The GSHP can be used to deliver heating for underfloor heating, domestic hot water and a pool. To keep the system efficient, it is best to keep the delivery temperature at a low level. While a GSHP can deliver high temperatures, the efficiency is lost with higher temperatures.

7. HEATING CONTROLS

Control of a heating system has come a very long way with advances in technology and access via the internet.

Within the home there are various brands and models of programmers and thermostats that can control when the heating will be on or off at different times during the day, the temperature the room or home will be pre-set to achieve the best comfort for you.

Having a thermostat in a room can help with efficiency of the heating system, for instance if you do have a wood or gas fire operating, the thermostat would turn off the heating system for that room to save overheating and system inefficiency.

There are also several control systems that can operate via the internet router, so you can use a smartphone or a tablet to turn on or alter the heating remotely or even by an individual room. This is a great tool if you are away on holiday and want to have the home warm on your return, or you have guests that may be turning up unexpectedly, you're not at home and you want to have the home or room warm for their arrival. It is all operated very easily from your phone, setting the times and temperature.

8. RUNNING COSTS

Heat Source	Type	Cost of Fuel	Cost of Heat	Monthly Cost*
Natural Gas	Radiators	$0.086 / kWh	11.2 c / kWh	$275
	Underfloor	$0.086 / kWh	10.6 c / kWh	$285
LPG	Radiator	$125.00 45kg	23.0 c / kWh	$575
	Underfloor	$125.00 45kg	20.0 c / kWh	$604
Diesel	Radiators	$1.08 / litre	20.0 c / kWh	$425
	Underfloor	$1.08 / litre	18.6 c / kWh	$450
Firewood	Radiators	$85.00 / m^3	10.6 c / kWh	$270
	Underfloor	$85.00 / m^3	10.0 c / kWh	$250
Heat Pumps				
Air to Water	Radiators	0.23 / kWh	10.6 c / kWh	$265
	Underfloor	0.23 / kWh	9.4 c / kWh	$285
Ground Source	Radiators	0.23 / kWh	8.3 c / kWh	$210
	Underfloor	0.23 / kWh	7.5 c / kWh	$225

*All costs include GST. All running costs are approximate and depend on the thermal efficiency of the home and design.

Underfloor heating tends to use more energy than radiators due to longer running periods. The approximate cost is based on heating a single storey home with a garage at 240m2, 4-bedrooms, two living areas heated to 21°C and two bedrooms heated to 18°C for 6-8 hours per day for a radiator system and 10 hours on low for underfloor heating.

Installation costs vary depending on the style of home and thermal efficiency, so it is always best to have a design and heat loss calculation carried out prior to getting any work done. A proper design is critical to make sure that the heating system is capable of heating the home to the comfort you desire or expect.

8.

A heat loss calculation will determine how thermally insulated and efficient the home is by taking into account the level of glazing, (single, double or triple) the insulation values for the walls and ceiling and then working out what you need the heating system to produce to make sure you have the heating system to deliver the warmth and comfort you need.

Room data

Building	001	
Storey	0	Ground floor
Room	3	ENTRY/HALL

Room data

Width	b_R	8.35 m	Room ground area	A_r	27.6 m²
Length	l_R	3.31 m	Standard inner temperature	Θ_i	20 °C

Output (power) data

Standard heat load	Q_N	1245 Watt	QnUfhCalculation		**1144 Watt**
Specific heating load per m²	q_{HL}	45.14 W/m²	Open output	Q_{out}	**0 Watt**
Standard transmission heat downward	Q_{P-A}	101 Watt	Achieved output		**100 %**
Design thermal output	Q_H	1144 Watt	Heat output by underfloor heating	$\Phi_{UFH,R}$	1144 Watt
Margin	x	%			
Flow temperature		45 °C			

Catalogue data

Manufacturer	<Generic>
System element	Trägerelement
Pipe description	Kunststoffrohr PE-X 16 x 2,0

Top floor covering

Tag	timber 16mm
Thermal resistance of cover	0.110 (m²*K)/W

Load screed layers

Screed layers-designation	concrete
Screed layers-thermal conductivity	2.300 W/(m*K)
Screed layers-thickness	50 mm

Thermal insulation

Insulation layer structure	Under concrete slab
Thermal resistance	(m²*K)/W
Insulation layer structure application case	Heated room below
Neighbouring temperature	20 °C

Ceiling (lower)

Thermal resistance	2.307 (m²*K)/W

UFH - Heating

No.	D	A_{gross} m²	A_{net} m²	L_{Conn} m	L_{Loop} m	$Q_{Loop\ actual}$ Watt	V_H l	m_H kg/h	$\dot{V}_H$ l/h	Δp_{Loop} mbar	σ K	$\Theta_{s,m}$	Manifold	Profile
1	OA 20 cm	10.4	10.4	7.6	66.9	444	7.6	27.6	27.8	6.7	19.0	25.6 °C	OA 20 cm	3054/2
2	OA 20 cm	17.2	16.4	0.8	78.1	699	8.8	32.4	32.6	10.4	19.0	25.6 °C	OA 20 cm	3054/2

Example of a heating design with relevant calculations

9. DESIGN CONSIDERATIONS

You can have the best and most expensive system installed, but if it is not designed with the proper calculations, then the system will not provide the comfort required or effective operational costs desired.

There are a number of software options to calculate a heating/cooling system available. It is now much easier to calculate how much heating or cooling your home will need to be comfortable and healthy. Using a reputable heating engineer, you should know how much heat a room will lose through walls, ceilings, floors and glazing, this is critical! When this type of modelling is carried out a proper system is much easier to design so you know that the system will work BEFORE the install begins.

Just because a room is small, it does not mean that a small radiator will provide the heat or comfort required in the room. There are many factors to consider, for example, there may be a lot of glass or poor insulation. Having the facts and data saves a lot of **problems and stress** when the room is finished, only to find it is cold and the small radiator never turns off because it cannot generate enough warmth for the room. Not only is the room not comfortable, it is costing a lot of money and using a lot of energy to never actually achieve the purpose of heating the room. If calculations had been done at the beginning, then it would have highlighted this issue and that some other forms of heating/cooling were needed and built into the room accordingly.

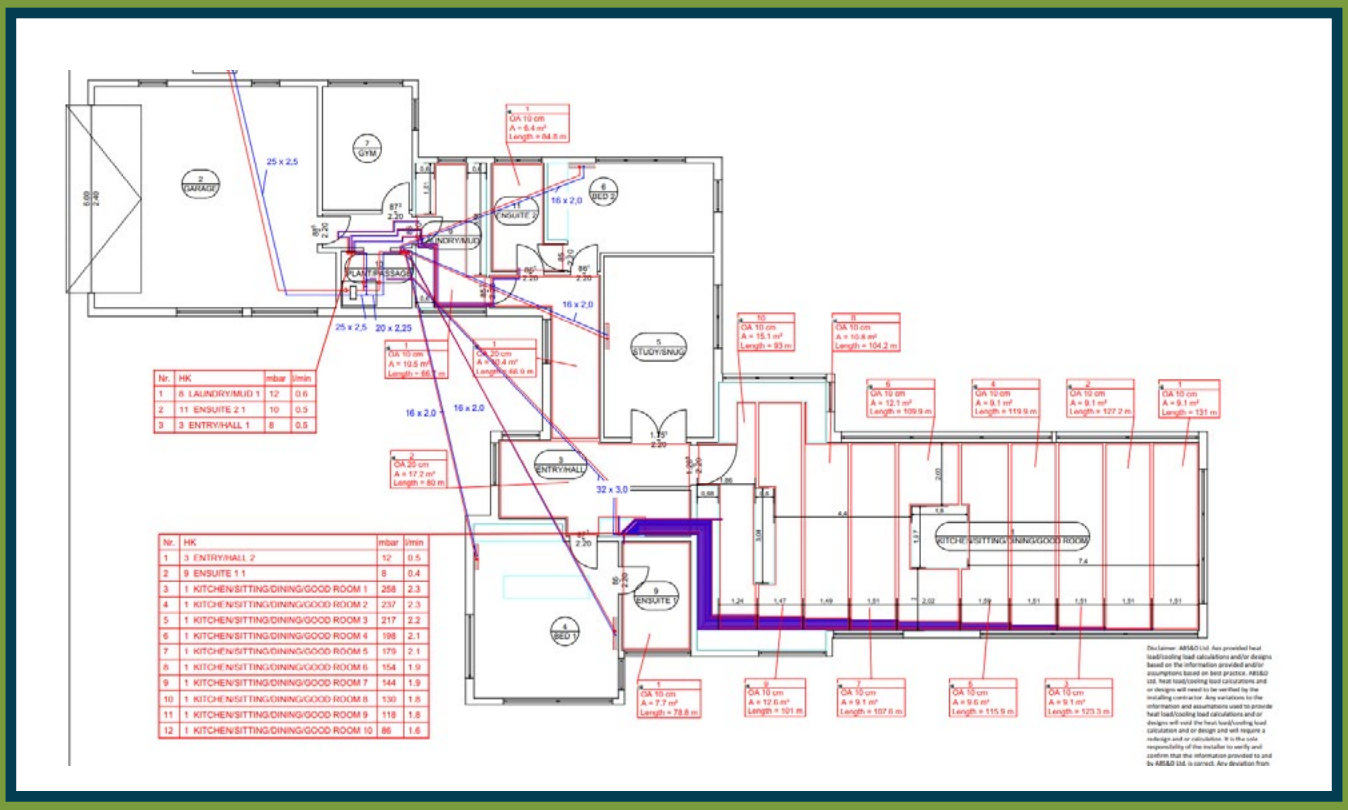
If a design is being supplied, make sure that **ALL** calculations are covered such as:

- Heat losses from glazing
- Insulation values in the walls for each room
- Insulation values in the ceiling for each room
- Insulation values in the floors for each room
- Insulation values in the entire building structure

The more detail the better the design will be, the better the comfort and the better the running costs.

9.

Example of a heating layout in a house from a designed system



This eBook aims to provide a thorough understanding of New Zealand central heating systems, their benefits, and considerations, helping readers make informed decisions about their heating needs and investments.

If you would like further information and advice contact us at Optum Plumbing and Heating, the central heating specialists in Queenstown and Wanaka.

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