Housing Energy Teaching Unit

Intro

Everyone lives in houses and they can make a large impact on the people living in them.

- What do we want our houses to be like? (brainstorm option)
    - Warm
    - Dry
    - Low cost to build
    - Low cost to run
    - Safe
    - Longevity

- Why?
    - Healthier
    - Less money
    - Less repairs/maintenance

Cold and damp homes are linked to poor health, especially for babies and small children, people who are ill, and older people[1].

New Zealand has government initiatives to try and encourage methods of building and improving homes so that they are warmer, drier and therefore healthier.

- Healthy Homes Standards
    - The Government has introduced new standards to make all rental homes warmer, drier and healthier. [2]
- Building Code
    - For safe, healthy and durable buildings, all building work in New Zealand must meet certain standards.[3]
    - These are set by the Government and cover aspects such as
        - structural stability
        - fire safety
        - access
        - moisture control
        - durability
        - services and facilities
        - energy efficiency

We will look at energy inputs/outputs for the buildings themselves and what goes on in them.

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[1] Keeping warm and healthy this winter, New Zealand Ministry of Social Development

[2] Healthy Homes Factsheet - Kainga Ora

[3] https://www.building.govt.nz/

Draw your own house like the one below (activity option)[4].

On the map, mark out the following:

- Heat sources e.g. heat pumps
- Windows and curtains
- Rooms that are usually warm
- Rooms that are usually cold
- Which side of the house the sun is shining on at 4pm

- Spend five minutes thinking about what they might be able to do to keep their homes warmer.

[4] Activity idea from https://sustaintrust.org.nz/school-activities/junior-assessor

Types of buildings - past to future

The following section compares building materials and the overall design of traditional buildings and modern New Zealand housing. The focus is on the differences in building materials in terms of thermal properties and energy efficiency.

Traditional Māori Whare and early European buildings (- 1840's)

Building Materials[5]

- Materials gathered from forests and swamps → materials were woven together (no nails or other metal fasteners used)
    - Timber was used for posts, ridge poles and outer walls
    - Mānuka was used for battens (holding down wall rushes)
    - Bark, rushes or toetoe used for thatching for the walls and roof
    - Slabs of tree ferns used for external walls
    - Reed used for interior walls
    - Raupo




[5] Te Ara - the Encyclopedia of New Zealand: [Building materials – Early houses.]

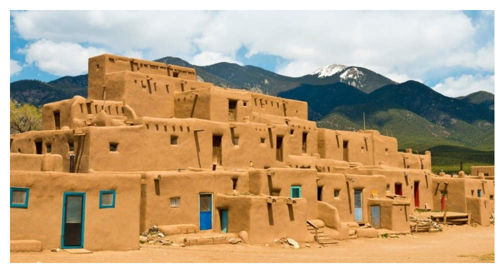
Creative Native – Indigenous Architecture and Design: [Whare Raupo.]

Museum of New Zealand Te Papa Tongarewa (2016): [Mana Whenua.]

Thermal Properties[6]

- Low door - smaller area for heat to escape
- Few or no window openings
- Inside fireplace
- Often built partly below ground level or earth heaped up against the outside walls for insulation/thermal mass
- Air inside the rushes/toetoe/reeds gives extra insulation
- Whare whakairo (carved meeting house) and Wharepuni (sleeping houses) were built with a roof extended past the front wall to form an open porch
- Raised buildings kept cooler (air circulation) and prevented pests

Other Traditional Buildings

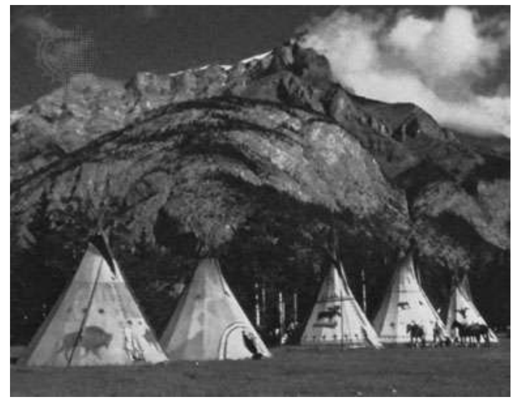
From	Description	Environment	Materials	Example
Australia - Aborigines[7]	Often nomadic people, so structures were often temporary and only built in certain seasons	Mild/hot climate. Often able to sleep outside with fires. Sometimes wet season and colder would mean a shelter was needed	Brushwood, bark, wooden frames	
South-Western USA - Pueblo Native Americans[8]	Very thick walls provide protection against the heat as well as structural support.	Hot for the majority of the year.	Sun-dried adobe bricks, timber framing	
Iceland - Vikings[9]	Turf walls and a central fireplace kept the single large room warm for the 30-50 people that often lived in there	Cold for most of the year. Vikings also lived in Greenland, Scandinavia and parts of modern Germany where they would adapt for temperature and resource differences	Wood, stone, turf (grass and soil)	

[6] Te Ara - the Encyclopedia of New Zealand: Māori architecture – whare Māori - First Māori buildings.

[7] http://aboriginalculture.com.au/housing.html

[8] https://travel.earth/delightful-traditional-houses-around-the-world/

[9] https://skjalden.com/viking-houses/

Parts of Canada and Greenland - Inuits[10] (igloo)	Temporary winter homes for hunting Inuits. The hard snow walls acted as insulation.	Very cold, inside the igloo the temperature would be between 0 and 15 degrees Celsius.	Packed snow, sometimes lined with animal skins.	
American Plains - Native Americans (tepee)[11]	These nomadic people had a structure that was easily transportable by horseback.	Variable but mainly temperate.	Animal skins, reed mats, canvas, bark for covering and wooden poles	
Russia - the “izba”, traditional peasant house[12]	Made from interlocking wooden beams due to the high cost of metal fasteners	Variable depending on part of Russia and time of year.	Wood	
Wales - Cottage[13]	Characteristically low walled with stone or earth walls and thatch roof. In other areas of the United Kingdom, slate roofs were common.	Often wet and cool.	Stone, clom (earth, straw and animal manure), timber, thatch (from local vegetation)	

[10] https://www.thecanadianencyclopedia.ca/en/article/igloo

[11] https://www.britannica.com/technology/tepee

[12] https://seeforestfortrees.com/wooden-architecture-russias-window-on-the-past-present-and-future

[13] https://www.tywicentre.org.uk/media/1050/tywileaflet1-eng-final.pdf

NZ - 1840's cob houses [14]	Built with cob, layers of mixed clay and straw/grass to make thick, warm walls.	Temperate but often damp (Otago, Nelson, Canterbury). Stone foundation and wide roofs kept moisture from the walls.	Clay, straw/grass, stone, lime plaster	

- What are some key similarities and differences of these traditional buildings? (brainstorm option)
    - All use locally sourced material
    - Nomadic people reconstruct their shelters where they go, or need to be able to carry them
    - Cold and hot areas both need thick walls for insulation

Common Modern New Zealand Buildings[15]

Houses are now built in a range of different styles.

Common Materials:

- Cladding: Weatherboard, brick veneer, cement, concrete, stucco etc.
- Roofing: metal, galvanised steel, aluminium, concrete tiles - tend to have low roof pitches (12-15°)
- In domestic buildings aluminium joinery almost completely replaced timber for doors and windows from the 1970s onwards

Houses built before 1978 had little or no insulation, although a range of insulation materials were available + benefits understood. Houses built after 1978 have some insulation as it became compulsory via the building codes.

The main changes between traditional and modern building is the much larger availability of building materials, including man-made and pre-fabricated. This means we are no longer restricted to local natural resources. Different living styles (e.g. having separate bedrooms) and heating and cooking methods other than a central open fire have also changed the layout of houses.

(questions to ponder)

Do you think that modern houses use more or less energy when making than traditional buildings?

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[14] https://teara.govt.nz/en/building-materials/page-1

[15] Te Ara - the Encyclopedia of New Zealand: Building materials – Steel, aluminium, plastics and insulation

Renovate. The technical resource for industry. BRANZ.

How do you think apartments differ from standalone houses?

Now that we can choose any way to build our house (building codes?) how should we build them?

- So they last
- So there is not much waste
- So they stay dry
- So they stay warm in winter/cool in summer (therefore saving money on heating/cooling)

Design a modern building based on the answers above (activity option)

Building materials

When choosing building materials there are different aspects to consider. It's a good option to have a look at the **life-cycle** of the different materials, starting by the raw material, the manufacture, the transport until their need of replacement and the waste management.

To **maintain resource availability** it is advisable to use renewable raw materials which are biodegradable. Furthermore it is good to use recycled materials or those with a reused component. **Energy efficiency** is another aspect to consider. Not exclusively the energy efficiency of the finished building itself but also energy consumption for the manufacture and the transportation of the materials. By choosing **locally sourced materials**, there'll be for example less energy consumption for transportation. For building in a sustainable way one may also consider the **recyclability** and **reusability** of the different materials. The options to recycle treated timber are for example limited because of the chemicals involved. Untreated timber can easily be composted or re-used for buildings. While brick and metals can be re-used easily as well, PVC recycling is for example rather limited. At last the **durability** of materials is essential because if the material lasts longer, less new material is needed for repairs and replacements.

In the following table there are different building materials and their various applications presented. [16]

Building material	Application
Timber	Framing, weatherboards, plywood, glue-laminated members, whole logs for walls, door and window frames
Concrete	Floor slabs, blocks, AAC (aerated autoclaved concrete), insulated concrete formwork, precast panels, piles, roofing tiles
Steel	Framing, beams, profiled sheets (roof and wall cladding), roof tiles
Aluminium	Weatherboards, profiled sheets, door and window frames
Zinc	Aluminium coated steel - profiled sheets, flashings, roof tiles
PVC	Weatherboards, window frames, guttering and spouting
Fibre cement	Weatherboards, sheets for monolithic claddings, and soffits
Earth	Bricks, rammed walls, living roofs
Straw bale	Walls
Fired brick and clay	Walls, wall veneers and roof tiles
Natural stone	Wall veneers

[16] https://www.smarterhomes.org.nz/smart-guides/construction-and-materials/exterior-building-materials/

Embodied energy and life cycle assessment

“Embodied energy is the total energy required for the extraction, processing, manufacture and delivery of building materials to the building site. Energy consumption produces CO2, which contributes to greenhouse gas emissions, so embodied energy is considered an indicator of the overall environmental impact of building materials and systems.

Unlike the life cycle assessment, which evaluates all of the impacts over the whole life of a material or element, embodied energy only considers the front-end aspect of the impact of a building material. It does not include the operation or disposal of materials.”[17]

A generic term of ‘environmental footprint’ can be used to describe all the embodied energy, end of life processes and impact the material will have environmentally.

Different materials will have a different amount of embodied energy, but some will also have longer longevity in the building or recyclability at the end of their use in the building. Finding environmentally responsible building materials; that also are safe, last a long time and are easy to build with; is a big balancing act.

Think about four building materials we have talked about and brainstorm what factors would contribute to their environmental footprint. (brainstorm option)

Four example materials: straw, brick, timber (treated or untreated), aluminium panels

Factors to think about/research

- Where does the source/raw material(s) come from, and how is it collected
- What are the process from it being a raw material to a useable building material
- How does it get from the source to the processing to the building site
- What can you do for leftovers/waste
- What happens when the building is knocked down
- How long will the material last

Which do you think will have the highest environmental footprint, and which will have the lowest?

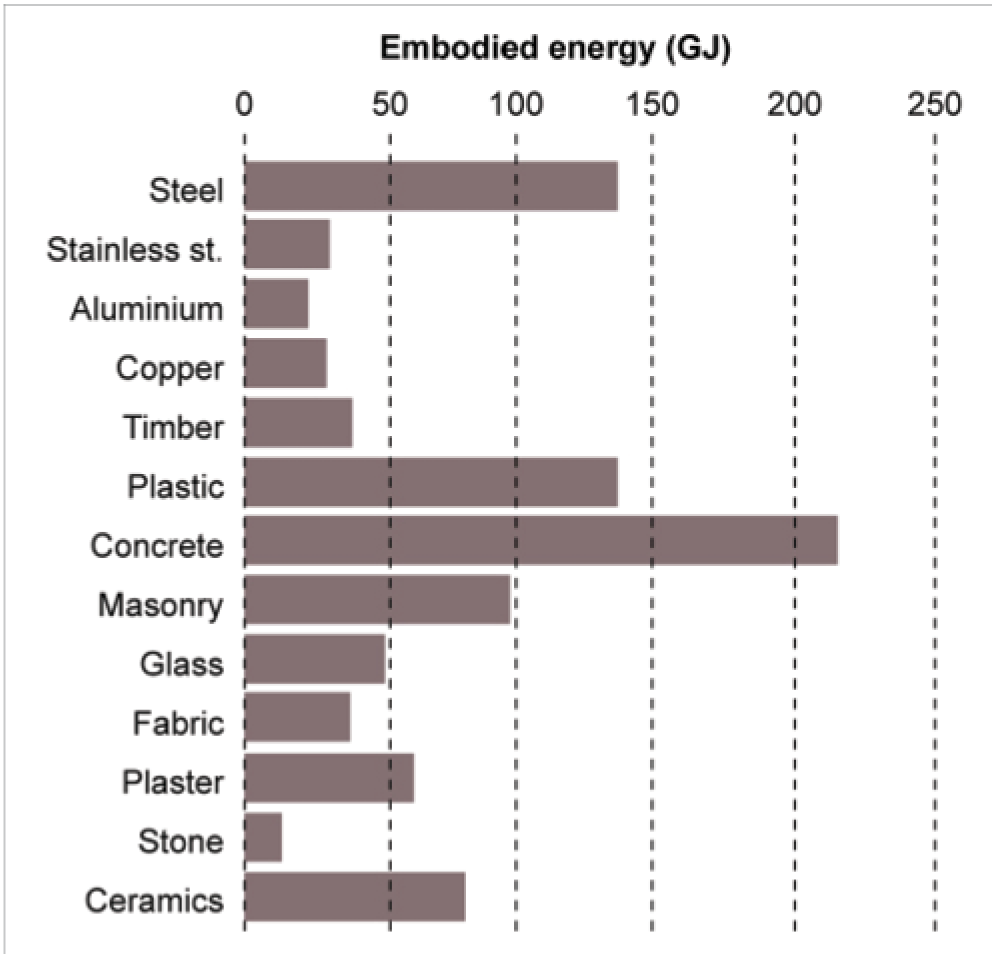
There are two New Zealand tools that can be downloaded for free (you do need to sign up) to calculate/show embodied energy and life cycle assessment for building materials. They can be quite hard to use but they can be found here:

- Embodied energy tool: BRANZ CO_2NSTRUCT
- Life Cycle assessment tool: LCAQuickV3.4.2 Data Entry | BRANZ

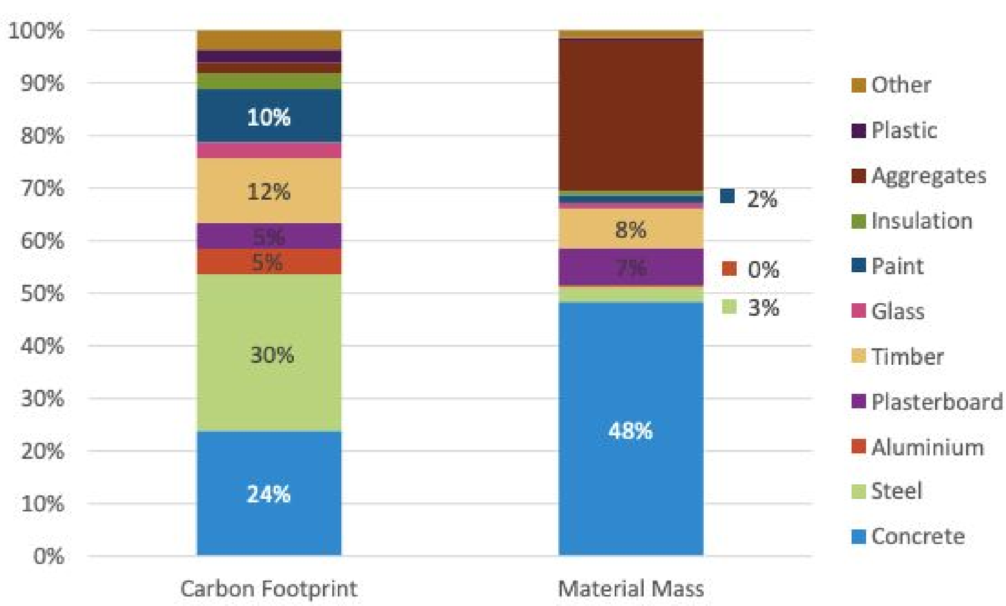
The below graph[18] shows some approximate embodied energy for common modern building materials. Please note that the energy will change depending on the country (this is an

[17] http://www.level.org.nz/material-use/embodied-energy/
[18] https://www.yourhome.gov.au/materials/embodied-energy

Australian graph), location within a country and what the material then becomes (eg sheet copper vs copper pipe will have different processing).

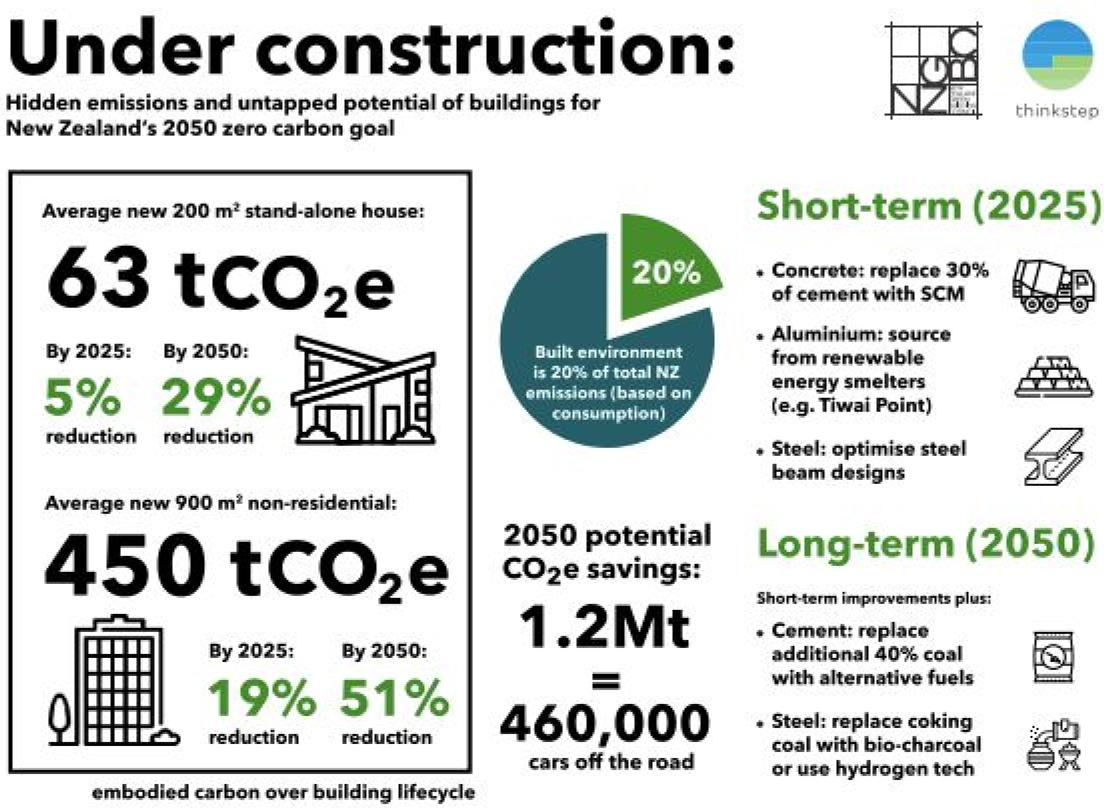


In New Zealand a big research project created for the New Zealand Green Building Association found that an average residential building has the following carbon footprint and material mass breakdown over the building's life.[19]



[19] Thinkstep on behalf of NZGBA; Under construction report, 2019

Their overall findings and recommendations are displayed in this infographic



Building Waste

"Construction and demolition waste makes up 40–50 percent of New Zealand's total waste going to landfill, according to government and council documents. Each home constructed generates an average of **four tonnes** of waste. An Auckland study found that construction waste by weight is made up of timber (20%), plasterboard (13%), packaging (5%), metal (5%) and other (45%).

Most of this dumping of construction waste is unnecessary – it has been demonstrated that simply by sorting waste, at least half of it could be diverted from landfills and cleanfills. Large volumes of waste also increase the costs of a project and its environmental impact."[20]

Thermal Properties

Keeping a house at a good temperature in an energy efficient way is key to keeping the house in good condition and the occupants healthy. The local climate and seasons make a big difference to how we want our houses to maintain or release heat during the day and night. In Ōtaki our average temperature in February is 18°C whilst our average temperature in July is 8.9°C[21]. This is not a huge variation, so we mainly need to keep our house warm in the winter and at night times, hopefully with little energy and cost input.The two big questions to do this are 'How do we stop heat escaping" and "What are efficient ways to warm the house".

[20] http://www.level.org.nz/material-use/minimising-waste/
[21] https://en.climate-data.org/oceania/new-zealand/wellington/otaki-19441/

Modes of Heat Transfer

Mode	Medium	Principle
Conduction	In solids	Heat is transferred from a hot area of a solid object to a cooler area by the collisions of particles.
Convection	In fluids and gases	Heat is transferred from one part of a fluid to another by the movement of the fluid itself. Hot fluid is less dense than cooler fluid, so it tends to rise. As the warmer fluid rises, it is replaced by cooler fluid. Convection currents occur. (same principle with gas)
Radiation	No need for any medium. Energy can even be transferred in a vacuum	Transfer of heat through electromagnetic waves.

The following website has animations of each mode of heat transfer as well as an activity for heat loss in buildings through the different modes (activity option)

https://www.e-education.psu.edu/egee102/node/2053

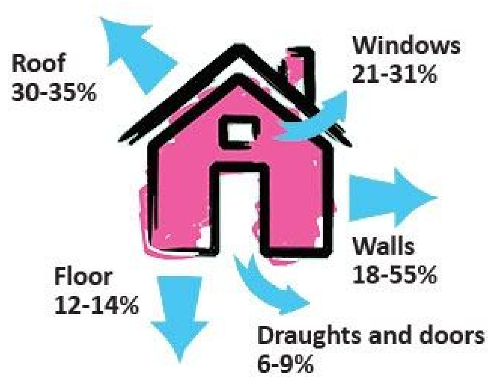
All heat is created or lost in a building via those three methods. If a heater or fire is being used in the house, it is most energy efficient to make sure that heat doesn't escape the house, which would normally occur via convection or conduction.

"There are two ways in which we can reduce energy consumption.

- The most cost-effective way is to improve the home's "envelope"—the walls, windows, doors, roof, and floors that enclose the home—by improving the insulation (conduction losses) and sealing the air leaks (convection losses).
- The second way to reduce the energy consumption is by improving the efficiency of the furnace that provides the heat."[22]

Where do you think most of the heat loss occurs? And what can be done to prevent it? (brainstorm option)

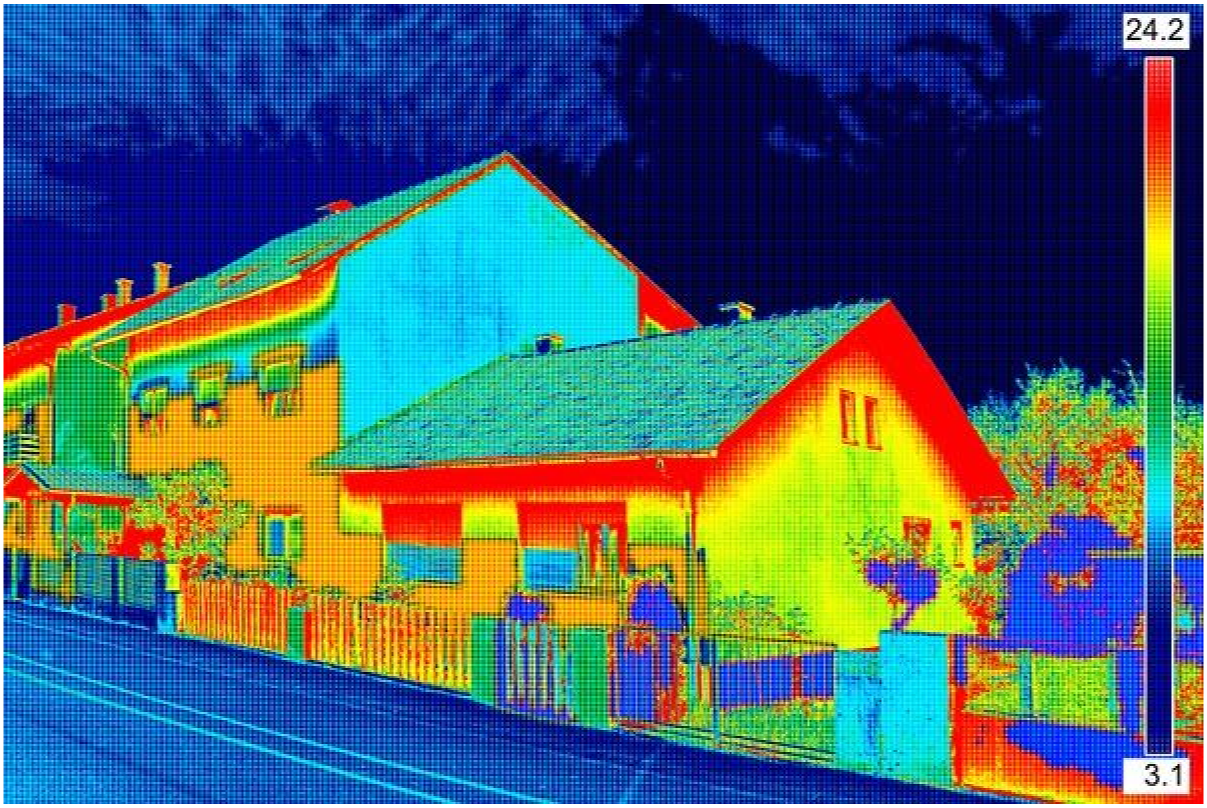
From an average, New Zealand, uninsulated home[23]:



Heat loss can be measured using infrared cameras, thermometers or temperature guns. It is also possible to measure air leakage using a device called a 'blower door'.

Infrared image source[24]

[22] https://www.e-education.psu.edu/egee102/node/2053
[23] https://www.mitre10.co.nz/Image/warmhomes/WHSH-heat-loss-new.jpg
[24] https://homeinspectionform.com/wp-content/uploads/2018/01/home-inspection-checklist.jpg



Insulation

The insulative property of a material describes how much heat transfers (via conduction) through a material. Insulation refers to materials that have a high insulative value - heat does not transfer easily. If your building walls have insulation applied, less heat loss will occur. Insulation is measured in R-value - R-values are a measure of resistance to heat flow. The higher the R-value, the better the insulation.[25] Be aware, R-value reduces with humidity.

Building components (e.g. walls, ceilings, floors, windows) need to have a minimum R-value in New Zealand for new builds, renovations and rental properties.[26]

	Climate Zones 1 and 2	Climate Zones 3
Roof	R 2.9	R 3.3
Walls	R 1.9	R 2.0
Floor	R 1.3	R 1.3
Heated floors	R 1.9	R 1.9
Windows	R 0.26	R 0.26

[25] https://www.tenancy.govt.nz/maintenance-and-inspections/insulation/compulsory-insulation/
[26] https://www.pinkbatts.co.nz/insulate-your-home/building-code-requirements/

In climates that get a lot colder, often building regulations specify a higher R-value for building components. In Ontario, Canada, the wall insulation requirements are R 24 and attic insulation requirements R 60. Their average winter temperature can be between 0°C and -30°C.

Create 'Energy Cubes' of plywood (or cardboard boxes) to test different insulative materials (by placing different materials on the walls/roofs of different boxes (activity option). Measure the temperature difference between the internal air and the external air.

Small air gaps (so there is no air movement causing heat transfer via convection) are really good insulators, so a lot of insulation is designed to trap lots of little air pockets. This is why materials such as fiberglass batting is effective as an insulative material, but rammed earth is not.

R-values of common insulation or building materials[27]:

Material	Thickness (mm)	R-Value (m²°C/W)
Earthwool glasswool ceiling batt (made from recycled glass)	105	3.2
Greenstuf Insulation ceiling batt (made from polyester)	175	2.9
Pink Batts ceiling batt (made from fiberglass)	115	2.2
Polystyrene	20	0.48
Macerated Paper (little pieces of paper blown into wall cavity)	95	1.7
Mud brick/Rammed Earth	200	0.16/0.15
Straw bale[28] (compressed)	500	9
Aluminium framed single pane window [29]		0.15
Wood framed single pane window		0.19
Aluminium framed double glazed window		0.26
Well-fitting heavy or thermal drapes added to a window		0.26

Insulation, good windows and curtains can make a big difference to keeping a comfortable and healthy temperature in your home, without needing to use lots of energy all the time (e.g. running a heater). New Zealand has subsidies in place to help gethomes get insulated and curtained.

[27] https://www.designnavigator.solutions/CRC.php
[28] http://strawmark.co.nz/benefits/
[29] https://www.consumer.org.nz/articles/double-glazing

Thermal Bridges

“Thermal bridges are regions of relatively high conducted heat flow in a building envelope. An example of a thermal bridge is the wood stud in an exterior frame wall or ceiling joist. Where insulation is installed between studs or joist, the stud or joist has a greater conductivity to heat flow than the insulation and therefore provides an easy path for heat to escape. The result is a cold spot at the interior face of the wall lining or ceiling lining where it is in contact with the wood. Another example of a thermal bridge is a gap that occurs in insulation due to poor installation practices. Therefore thermal insulation in wall and ceiling cavities increases interior surface temperatures, reducing the likelihood of interior surface mold, mildew, and condensation. Typically a 1 cm hole in 1 Sqm of insulation can reduce the R-value by as much as 25%"[30]

Thermal Mass

Another thermal property of a building is the thermal mass of it’s materials.

“Thermal mass describes the ability of a material to absorb and store thermal energy. Some materials have what is described as a high thermal mass, others have a thermal mass that is lower. In climates where there are cool winters and a reasonable variance between temperatures during the day and night, a wall built with materials that have a high thermal mass can be used to keep the temperature inside your home fairly static. Stone, concrete, earth and brick are all wall-building materials which have a high thermal mass.

However, thermal mass must be harnessed properly, or you risk constructing walls that draw heat indoors during warm days and then absorb it from your heating devices in cooler weather. Thermal mass often needs to be used in conjunction with insulation and passive heating and cooling for it to work well.”[31]

You can think of it like a battery, the material charges up with warmth during the day and releases it at night, making the internal temperature more consistent. This can reduce the need for heating during cold nights. However it can also lead to overheating if badly designed.

“Thermal mass stores and re-releases heat; insulation stops heat flowing into or out of the building. A high thermal mass material is not generally a good thermal insulator. Thermal mass is particularly beneficial where there is a big difference between day and night outdoor temperatures.”[32]

[30] http://www.nrl.co.nz/understanding-moisture/
[31] https://build.com.au/thermal-mass-and-wall-insulation
[32] https://www.yourhome.gov.au/passive-design/thermal-mass

Humidity (Dampness)

Relative humidity (RH)

“Air usually contains water vapour, the amount depending primarily on the temperature of the air. Warm air can hold more moisture than cold air, so as the air temperature falls, the maximum amount of water the air can hold also falls.

The ratio of water vapour in the air to the maximum amount of water vapour the air can hold at a particular temperature is expressed as relative humidity (RH). For example, a RH of 30% means that the air contains 30% of the moisture it can possibly hold at that particular temperature.

When air can hold no more moisture at a given temperature (i.e. the RH is 100%), the air is said to be saturated. As air temperature increases, its capacity to hold moisture also increases, so if air temperature rises and its moisture content remains the same, the RH decreases.

Humidity in a building affects both thermal comfort and indoor air quality. For example:

- high RH (very moist air) will make people feel chilled in cold weather and hot and sticky in warm weather
- low RH (very dry air) can cause dryness and discomfort in the nose and make skin feel dry and itchy.

In addition to the direct effect on comfort, damp air:

- facilitates the growth of fungi (mould) and bacteria that can cause respiratory problems and/or allergic reactions
- provides the conditions for dust mite populations to grow, which can affect asthma sufferers
- results in odours in poorly ventilated spaces because of fungal growth
- will result in condensation forming on windows, walls and ceilings that are colder than the air temperature and potentially damaging building materials.”[33]

Where does moisture in a building come from:

Sources Of Moisture	Litres
Cooking (non extracted)	3.0 / day
Clothes Washing	0.5 / day
Baths / Showers	1.5/day (per person)
Dishwashing	1.0 / day
Clothes drying (unvented)	5.0 / load
Portable gas heater	1.0 / up to per hour
Breathing (per hour) (average)	0.2 / per person
Breathing asleep (per hour) (average)	0.02 / per person
Perspiration per hour	0.03 / per person

[33] http://www.level.org.nz/passive-design/controlling-indoor-air-quality/humidity-and-condensation/

Moisture Removal[34]

Moisture can be removed in three basic ways:

- By diffusion through the building envelope. This occurs as the moisture migrates through the wall linings in the direction of lower water vapour pressure towards the exterior.
  This happens all the time, with no human input.
- By mechanical dehumidification which remove moisture from room air by blowing it through a series of cooling coils. Water is condensed on the coils where it is collected and removed.
  This happens by use of machines such as dehumidifiers or some heat pumps.
- By the replacement of interior air with exterior air. When cold outside air is introduced into a house and heated, its relative humidity is reduced, and it can absorb additional moisture. While this may seem like it would lower the temperature, this is only temporary as the colder outside air ability to hold moisture is lower so it is easier to heat. Colder, drier air is more efficient to heat than warmer, moist air.
  This happens when windows and doors are opened, or with fans and extractors.

So the easiest ways to remove moisture in your house are:

- Open a window or have a fan on when showering or cooking - any time steam is being produced
- Try to dry clothes outside if possible
- BRANZ testing has found that opening windows wide for just 10–15 minutes each day can lower moisture levels inside a house. If they are opened on opposite sides of the room they create a cross air flow which moves air faster.[35]

Condensation

"Condensation occurs when warm, moisture-laden air comes into contact with a colder surface such as glass. The air temperature in contact with the colder surface suddenly drops, reducing the amount of moisture it can hold. This results in moisture formation, or condensation, occurring on the cold surface."[34]

This looks like water droplets on windows, and sometimes on walls. It can be reduced by reducing humidity (as above) so that air is less likely to become saturated; and by reducing the likelihood of warm air coming into contact with cold surfaces (through insulation).

Condensation should be wiped up so that the moisture isn't reabsorbed back into the air, raising the humidity and heating costs.

Issues with humidity[36]

Low humidity (under 30%) can lead to dryness and discomfort in the nose and make skin feel dry and itchy.

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[34] http://www.nrl.co.nz/understanding-moisture/
[35] http://www.level.org.nz/passive-design/controlling-indoor-air-quality/humidity-and-condensation/
[36] https://greenhomesnz.co.nz/hows-your-humidity/

High humidity (over 60%) can

- lead to people feeling chilled in cold weather and hot and sticky in warm weather which is not comfortable.
- facilitate the growth of fungi (mould) and bacteria that can cause respiratory problems and/or allergic reactions
- provides the conditions for dust mite populations to grow, which can affect asthma sufferers
- results in odours in poorly ventilated spaces because of fungal growth
- will result in condensation forming on windows, walls and ceilings that are colder than the air temperature and potentially damaging building materials.
- mold growth on interior walls, ceiling stains, paint peeling and growth on shower curtain which can lead to decay of the building structure

Around 45% humidity is considered ideal.

Investigate the growth of mould on bread slices - use dry, damp and cold, damp and warm (experiment option)

What other energy use is a big factor in a house setting? Electricity use.

Electricity is brought into houses via the national electric grid or sometimes for "off-grid" houses it is brought directly from the source (e.g. solar panels on the roof). When coming the national grid, 82.4%[37] of our electricity generation nationally is renewable sources (eg. solar, geothermal, wind, hydro). House owners pay for the electricity and the money pays for the creation/upkeep of the infrastructure creating the energy and delivering the energy. If off-grid they pay for the equipment installation and maintenance.

As a very rough estimate a typical NZ home with 2 adults and 2 children would consume between 15 and 28 kWh per day.[38]

In order to reduce how much electricity a household needs (and therefore needs to pay for) we can

- Insulate and keep the house dry (reduces heating/cooling energy use)
- Use efficient light bulbs (lighting accounts for around 10% of household electricity use)

Research found incandescent lamps generate 3.3 times more CO_2 emissions than CFLs (compact fluorescent lamps) and LEDs (light emitting diode) in NZ. LEDs with high efficacy are the best choice for NZ homes as they have the least environmental impacts and the lowest energy consumption over a complete life cycle.[39]

LED type light bulbs use up to 80 percent less energy than incandescent bulbs, while producing the same amount of light. Most LEDs should last at least 15,000 hours which is 15x longer than standard incandescent bulbs.[40]

- Turn appliances/lights off

Appliances differ in how much energy they use, and some (like fridges) need to run all the time. See https://www.powershop.co.nz/assets/Resource-Hub/Saving-Electricity/Main-Hub/63c48ace03/Appliances-and-their-power-usage.pdf for typical power usage of appliances.

Some appliances (such as TVs, microwaves, gaming consoles, Sky decoders) have a 'standby' mode. Most still use some power, though it can be very little. You can find out more here https://www.consumer.org.nz/articles/appliance-running-costs

Appliances can't use electricity when not in use if they are turned off at the wall.

For appliances that need to be on all the time, or used regularly energy ratings describe how energy efficient an appliance is.

Use energy monitors to test different appliances (and LEDs vs incandescents) and see how much electricity they use (activity option). Monitors can be purchased at hardware stores.

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[37] https://www.mbie.govt.nz/dmsdocument/11679-energy-in-new-zealand-2020
[38] Q. What is the consumption in kWh for a typical NZ home?
[39] Life Cycle Assessment of Indoor Residential Lighting
[40] https://www.consumer.org.nz/articles/led-bulb-buying-guide