SUSTAINABILITY

PURSUING BETTER BUILDINGS

nrg systems
Building Designers

SUSTAINABILITY

PURSUING BETTER BUILDINGS

Development of sustainability goals are essential for us occupying the planet to ensure a healthy future for generations to come.

We; as consumers of our earth's resources will have to embrace the logic that many of our current consumer practices can not be maintained.

We all now recognize that we have dwindling fossil fuel energy reserves, they are finite. I believe most of us also recognize that we are seriously damaging the planet, which is our only environment.

If we as a civilization continue to ignore this we can expect major impacts.
There are many practices that we all take for granted as the norm that will have to change to ensure a sustainable future.

The sun and the energies created from it burning away is enough, when harnessed, to be an infinite resource of renewable energy.

The future is literally in our hands and we have the abilities and technologies to adapt and modify these practices to re-align from a consumerist approach to a long term sustainable future.

We have a duty of care, it is our responsibility to our future generations and to our planet to preserve as much biodiversity as currently exists.

From a financial standpoint we all recognize energy costs will increase dramatically as the resource "dries up"
Utilizing the sun's energies offers all of us methods to minimize these costs substantially or in full.

"We live in exciting times"

SUSTAINABILITY

The good news is we do have a future and we can continue to pursue sustainability goals.

Here are some of them. The highlighted sustainability goals in red are specifically relevant to this discussion to pursue better buildings

1. Poverty – End poverty in all its forms everywhere
2. Food – End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Health – Ensure healthy lives and promote well-being for all at all ages
4. Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Women – Achieve gender equality and empower all women and girls
6. Water – Ensure availability and sustainable management of water and sanitation for all
7. Energy – Ensure access to affordable, reliable, sustainable and modern energy for all
8. Economy – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9. Infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10. Inequality – Reduce inequality within and among countries
11. Habitation – Make cities and human settlements inclusive, safe, resilient and sustainable
12. Consumption – Ensure sustainable consumption and production patterns
13. Climate – Take urgent action to combat climate change and its impacts
14. Marine-ecosystems – Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Ecosystems – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Institutions – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Sustainability – Strengthen the means of implementation and revitalize the global partnership for sustainable development

(From Wikipedia) The Sustainable Development Goals (SDGs) are the current harmonized set of seventeen future international development targets. The Official Agenda for Sustainable Development adopted on 25 September 2015 has 92 paragraphs outlining the 17 Sustainable Development Goals and targets.

SUSTAINABILITY

PURSUING BETTER BUILDINGS

“Solar energy” is recognizing the harnessing of the sun’s impact on our environment and our climate .
Past and present civilizations have recognized and recorded their knowledge and relationship with the sun.
White rammed earth buildings of the Mediterranean reflect and insulate the sun’s heat, natural evaporative cooling and ventilation achieved through building design in the middle east, earth & cave buildings sought as refuge to temper the extremes of climate. In the arctic and sub-arctic regions wood is the material of choice for its insulating value and ease of construction.

And its not just our human ideas but also plants, insects and animals have demonstrated strategies which can be readily adopted. The most commonly cited is the Australian termite nests that demonstrate architectural and construction processes to control the internal temperature of the nest in direct response to the climate.

Known as the natural EARTH SCIENCES .
We must understand and observe them so that we can readily and effectively enhance our natural and our built environment .

All the methods and technologies of harvesting natural energies are sustainable indefinitely!

Design Fundamentals

GOOD DESIGN MUST CONSIDER THE FOLLOWING

- **Physical Size**
- **Thermal Transfer Basics**
- **Orientation & Environment**
- **Glazing**
- **Thermal Mass**
- **Insulation**
- **Ventilation**
- **Materials & Properties**
- **Other Considerations**

(carbon footprint, effective efficient construction techniques, resource management, life cycle, recycleability etc)

Design Fundamentals

Physical Size

- The most fundamental energy saving method
- Bigger is not better.
- The bigger the building the bigger the demand on our planet's shared resources.
- Social Impact – loss of social interaction ie; public swimming pools, theatre
- Adopt appropriate design for real spatial requirements not imaginary. Example -a grandiose entry that costs a fortune that no one useful uses. While you need to consider re-sale options in the future don't let public opinion dictate spatial requirements.

Thermal Transfer Basics

Understanding the basic principles of heat or thermal transfer provides our principal opportunity to capitalize on the phenomenon. Recognizing thermal transfer assists in building design through material selection, ventilation, thermal mass, glazing locations…….every aspect really

Radiation	The transfer of energy by the emission of electromagnetic radiation. (example - Climate models)
Convection	Heat transfer within a solid or between solid objects (example – density equalization)
Phase Transition	Effects of heat transport on evaporation and condensation. (example – Water to steam)
Conduction	The transfer of energy between objects that are in physical contact (example – stove top cooking from pot material to water)

Design Fundamentals

Orientation & environment

The Solar chart is an essential tool in appropriate design.
This area in the NE has a latitude of approximately 37degrees

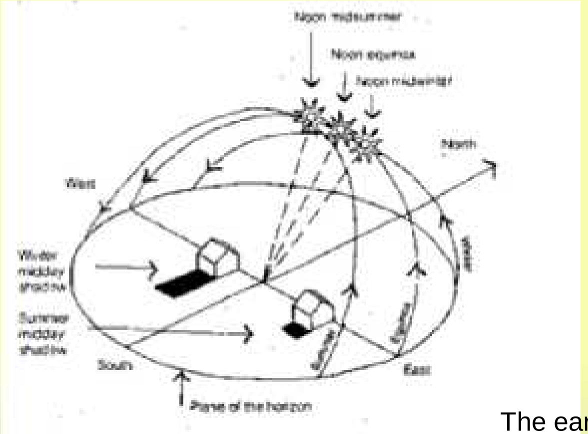
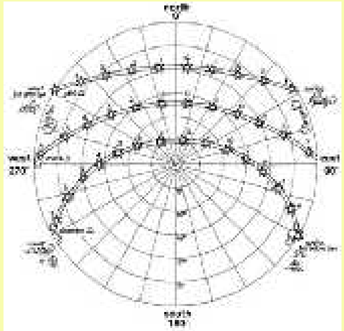


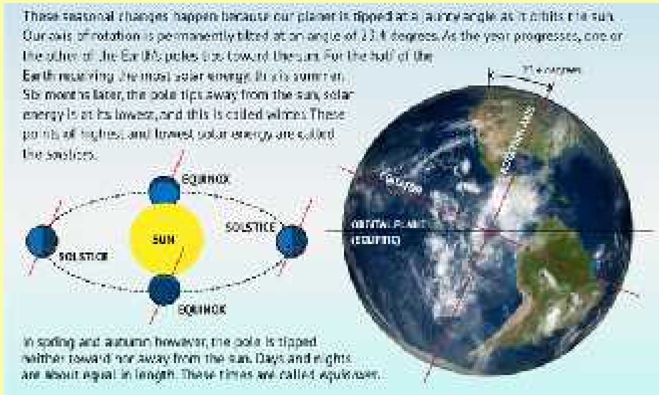
Figure 3.1: Apparent movement of the sun with summer and winter shadows



The Solar Chart

The earth's irregular orbit around the sun gives us seasonal variations influenced by the amount of solar radiation. Solar charts, available for each latitude demonstrate the time of day, the time of year and the relative location of the sun.
We can use this information to provide winter sun into our buildings and screen from summer sun.

Diagrams courtesy of the Sustainable Energy Council



Sun path for four important dates:
The *Autumn Equinox*, March 21, is when we have approximately equal day and night.
The *Winter Solstice*, usually on June 22, is when the Sun is furthest north and we have our shortest day; and longest night.
The *Spring Equinox*, usually on September 23, is identical to that of March 21, except that the Sun rises 16 minutes earlier on September 23.
The *Summer Solstice*, usually on December 22, is when the Sun is furthest south and we have our longest day and shortest night.

Design Considerations

Favour living areas of the building to face north to maximize solar access through glazing. (fenestration)

Minimize glazed areas to west, east and south. *See also cross ventilation*

Provide eaves to maximize winter sunlight penetration and minimize summer penetration.

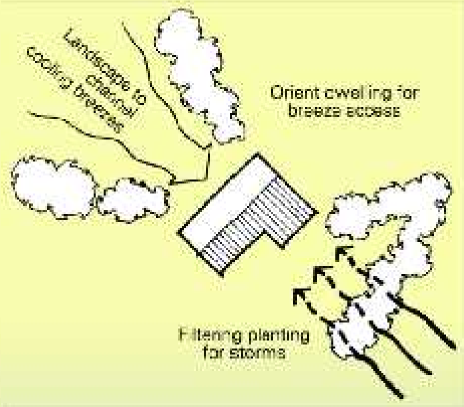
A year of photos of the path of the sun in Budapest

Design Fundamentals

Climate & Micro-climate Considerations

Orientation & environment

ASSESSING A SITE

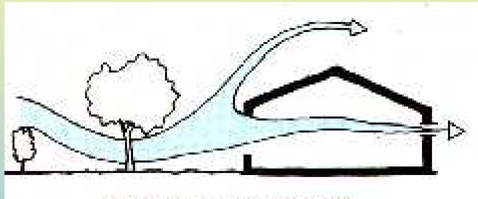


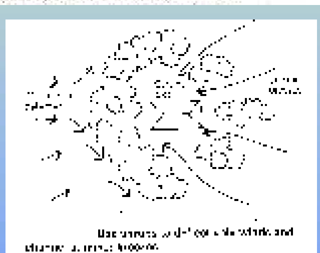
KNOW YOUR CLIMATE

The design and comfort required depend upon the prevailing weather conditions.

In the North East area of Victoria the weather conditions are described as between Cool Temperate to Dry Temperate.

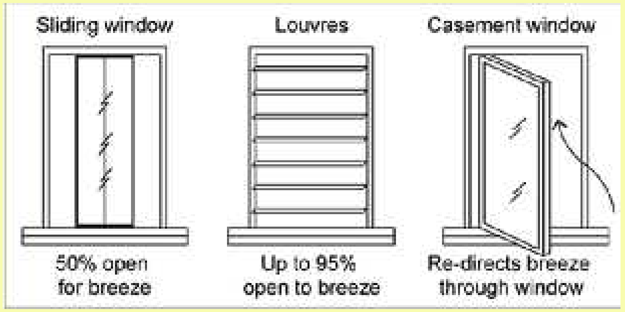
- Observe the environment behaviour of the site.
- What are the salient features that will / may impact on the design.
- Every site is different. Wherever you live, your environment will have its' own unique constant interaction with the general atmospheric weather patterns. Macro and micro catabatic & anabatic wind patterns
- Topography effects solar exposure, wind patterns, air flow, temperature and humidity. Understanding these effects and harnessing them through passive and active means can dramatically reduce the buildings demand for other sources of energy and improve the comfort within the built environment.
- Heat is generated by solar exposure, shaded areas remain cooler. Temperature is transferred by convection, conduction and radiation.


Planting to promote ventilation



Good building design utilizes all these aspects.

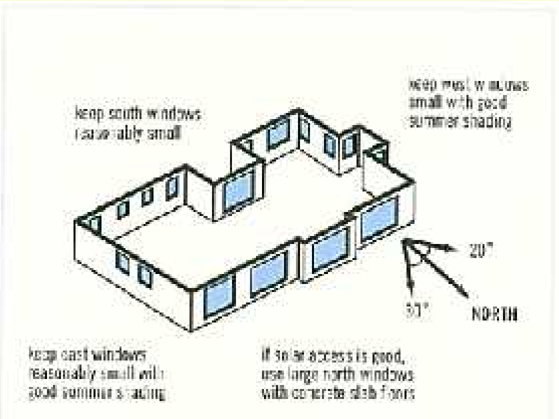
Design Fundamentals

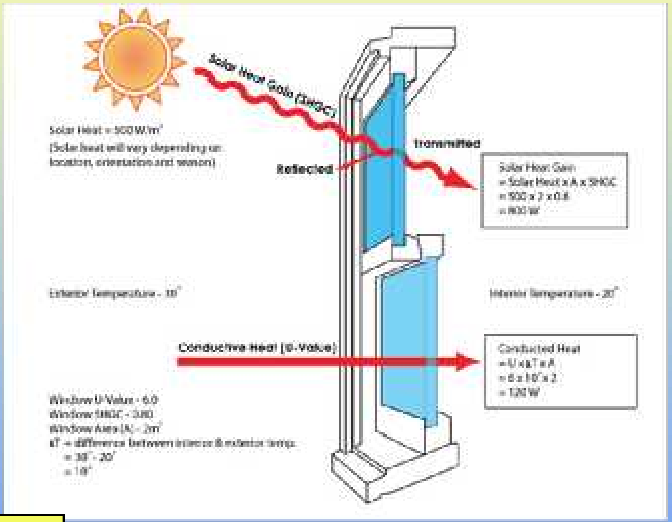


GLAZING

Glazing provides heat and light to the building interior

Maximize natural daylighting to all spaces within the building





The impact of glazing on the thermal performance of a building is complex.

Consider:

- **climatic conditions in your location — temperature, humidity, sunshine and wind**
- **building design — the orientation, form and layout of the building**
- **building materials — the amount of mass and insulation**
- **the size and location of windows and shading** -Carefully assess the best glazing solutions for each sector orientation. Double or triple glazed, low E etc.
- **thermal properties of glazing systems including operation and framing systems.**

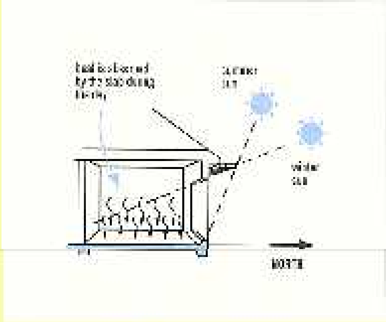
At the design stage, some simple principles can be followed to optimise the thermal performance of your home.

- **Locate and size windows and shading to let sunshine in when the temperature is cold and exclude it when it's hot.**
- **Use thermal mass to store the sun's heat and provide night-time warmth in cold conditions.**
- **Locate window and door openings to allow natural cooling by cross-ventilation.**
- **Provide seals to openings to minimise unwanted draughts**.

"Maximizing solar energy in buildings is only as good as the weakest measure."

Design Fundamentals

Thermal Mass



SUMMER

WINTER

Diagrams courtesy of the Sustainable Energy Council

Thermal mass can be any material that stores or holds heat.

The advantage of internal mass within the building is that it slows the heat loss and gain within the building.

Thermal mass to the external skin can be problematic through applying heating and cooling loads within the building.

Maximize the internal mass and minimize mass to the external walls.

Thermal mass is the ability of a material to absorb and store heat energy.

A lot of heat energy is required to change the temperature of high density materials like concrete, bricks and tiles. They are therefore said to have high thermal mass.

Lightweight materials such as timber have low thermal mass.

Appropriate use of thermal mass throughout your home can make a big difference to comfort and heating and cooling bills.

The rate at which heat is absorbed and re-released by uninsulated material is referred to as thermal lag.

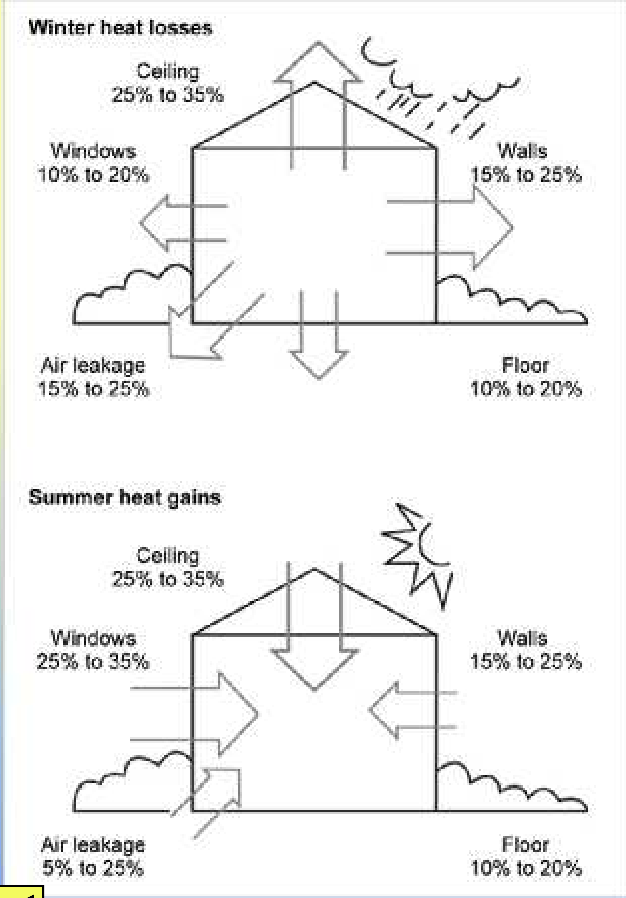
Lag is dependent on conductivity, thickness, insulation levels and temperature differences either side of the wall.

Consideration of lag times is important when designing thermal mass, especially with thick uninsulated external wall systems like rammed earth, mud brick or rock.

Design Fundamentals

Insulation & Sealing

We have captured either heat or cool now we have to maintain for as long as possible

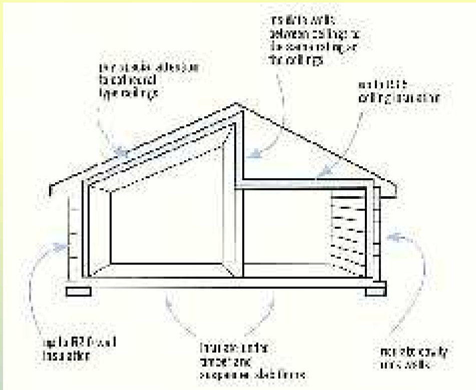


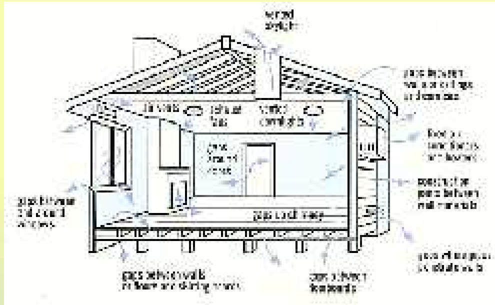
Insulation is material that has a low temperature conductivity.

Typically insulation material is placed between inside and outside wall fabric.

Walls, roof and floors should all be insulated.

Floor, wall and roof materials can also have insulation properties. Pelmets over curtains prevent heat loss and heat gain.





Recognize all areas of air leakage and address with appropriate detailing.

Use Weather seals

Material Choice

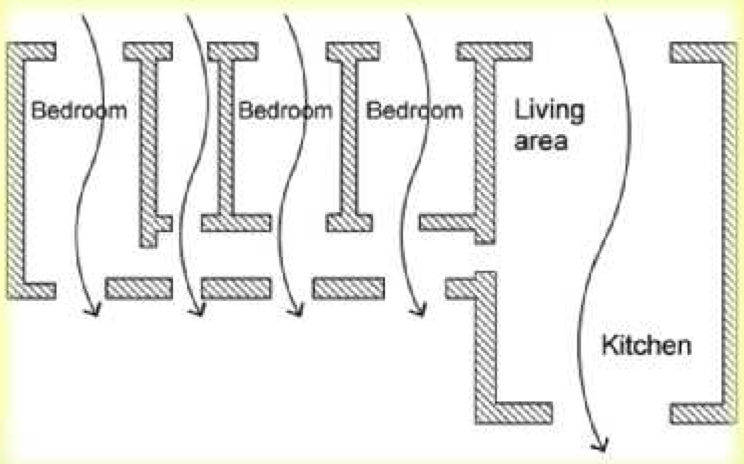
Provide airlocks at all external openings.
Design door swings so that they blow closed — not open.
Airlocks can be double purpose rooms (e.g. laundries and mud rooms). Seal wood storage areas if wood heating is used**.**

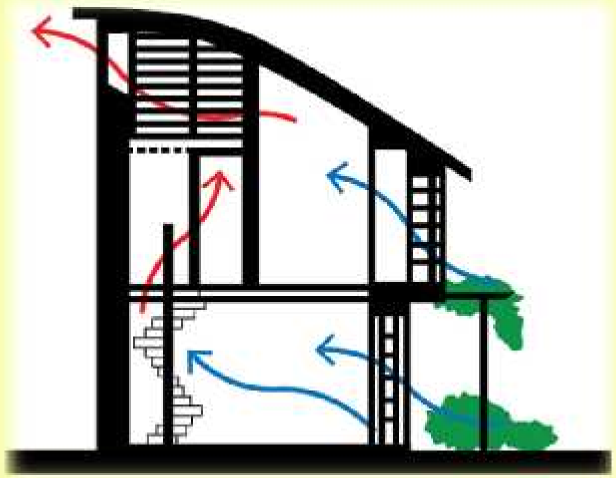
Diagrams courtesy of the
Sustainable Energy Council

Minimize Losses

Design Fundamentals

Ventilation



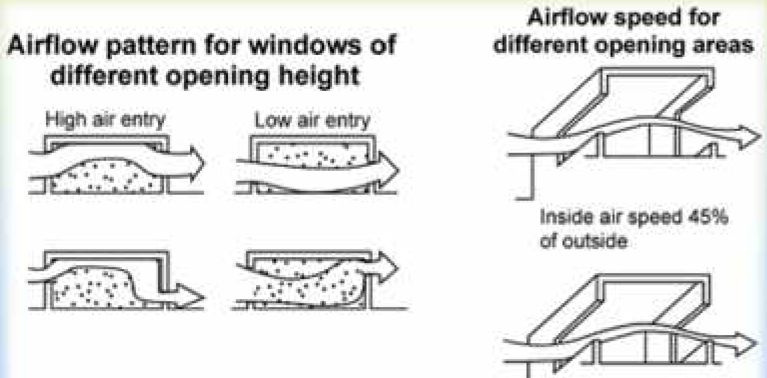


Window operation can enhance the movement of air within the building

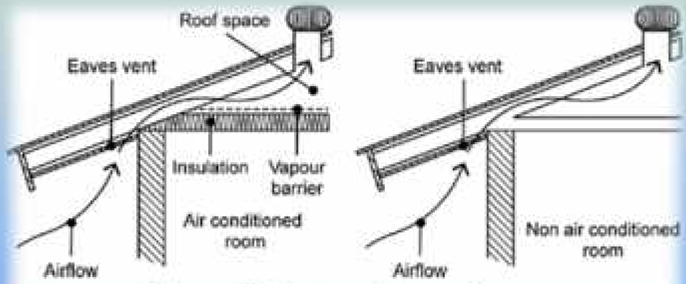
Cross ventilation is also important.

Note

It is very important to seal the building from air leaks to minimize energy losses and gains.



Louvre windows offer variable ventilation path and speed options



Using ventilation to cool the roof space

DESIGN FUNDAMENTALS

Materials

During the design process care is given to the choice of materials to enhance human comfort within the building environment in addition to other requirements of the building.

<u>REQUIRED PROPERTIES</u>

INSULATIVE Examples - Wool, spun fibre, reflective foil, wood and wood products, straw bale, aerated concrete, polystyrene, cork, aerated concrete block or panels, Double glazing.

THERMAL MASS Examples -Concrete, steel and most metals, brick, stone, water, tiles, etc.

AESTHETIC CONSIDERATIONS – Reflect or contrast local landscape

DURABILITY / Maintenance considerations / Lifespan / Lifecycle / ability to be recycled

SUSTAINABILITY – Sustainably managed natural resources, Re-Use, Re-cycle

AVAILABILITY – Local sourced preferred, Avoid

TOXICITY - Avoid or minimize the use of toxic materials . For example materials that contain High levels of VOCs, (volatile organic compounds) such as most PVC & PAINTS

COLOUR – The role of colour. example; The impact of Light & Dark colours of materials.

$ COST – Initial cost against factors such energy savings, ethically sourcing, etc.

Design Fundamentals –Other Considerations

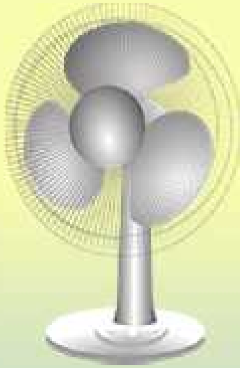
Appropriate design MUST minimize our use and dependency on fossil fuels

ACTIVE SYSTEMS

HEATING AND COOLING REQUIREMENTS

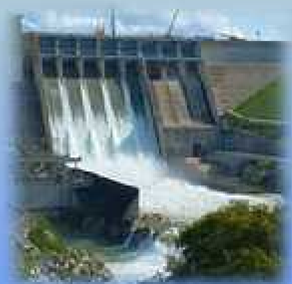
•Increasing humidity through mist or water vapor.

•Increasing air flow to decrease humidity

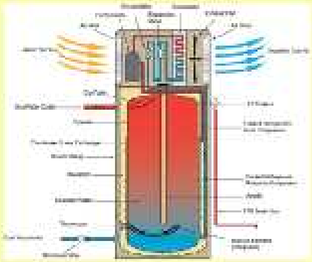


SOLAR POWER OPTIONS

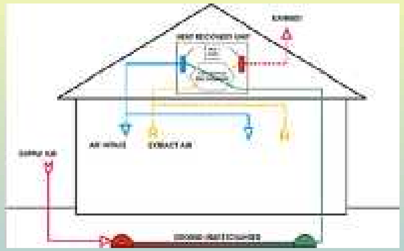
Natural earth energies are harnessed to produce electrical energy by wind, Photovoltaic cells (sunlight) Hydro (rivers & weirs), tidal, bio-gas and geothermal.

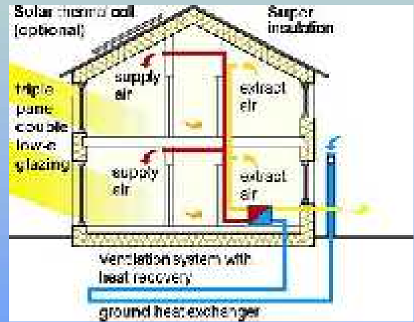


WATER HEATING OPTIONS



HEAT RECOVERY SYSTEMS





Design Fundamentals
–Other Considerations

- carbon footprint,
- effective efficient construction techniques,
- resource management,
- life cycle,
- recyclability .

Please recognize that my presentation has just scratched the surface of this important, immense and rewarding subject .

There is no shortage of sustainability resource information available and acknowledge and encourage accessing these resources:

My thanks to the resources of

Sustainability Victoria & Sustainability Council, yourhome.gov.au/passive-design
Warm House / Cool House

THINK SMALL

Smaller footprint means less cost, less drain on our resources.