PASSIVE Solar Design

SUSTAINABLE ENERGY IRELAND

Renewable Energy Information Office

Solar Homes Catch the Sun

Are you planning a new house?

Discover how you can apply solar architecture principles to:

- ***keep your heating bills to a minimum***
- ***enjoy the comfort of a warm and cosy house***
- ***create a healthy and ecological living environment for you and your family***

RENEWABLE ENERGY FOR EUROPE

Campaign for take-off

Revolutionary Standards in Comfort and Energy Efficiency

Solar architecture relies on simple and sensible principles to:

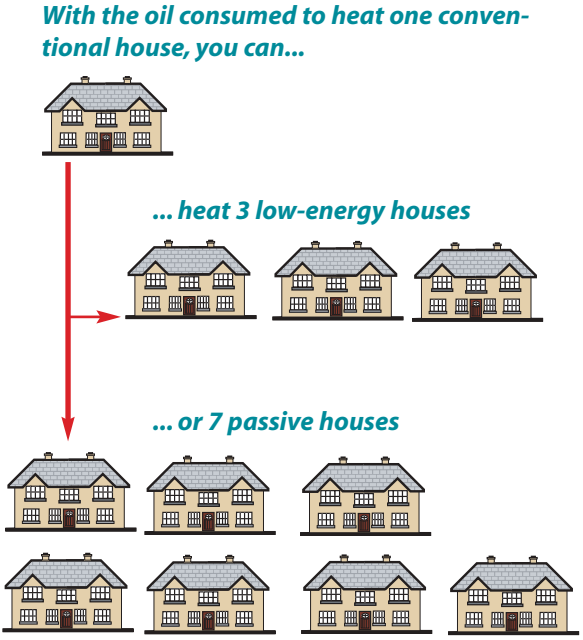
- minimise heat losses from your house
- maximise free solar energy input during the winter
- provide adequate ventilation and daylighting
- use renewable energy to heat your house cost-effectively

These principles, which will be detailed in the following sections, can be applied to various degrees of effectiveness to reduce the heating demand of your house.

GOOD Insulate your house according to current BUILDING REGULATIONS and use solar energy gains to cover at least 20% of your heating requirement.

VERY GOOD Adopt a LOW-ENERGY HOUSE strategy and reduce your heating requirement by 60% compared to a conventional new house.

EXCELLENT Go a step further with the PASSIVE-HOUSE standards and reduce your heating requirement to the point where no central heating is required.



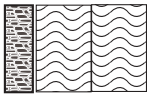
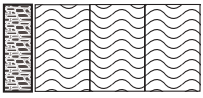
The benefits of living in a "low-energy" house or a "passive" house in terms of energy efficiency and heating bills are obvious. But it goes a lot further:

THERMAL COMFORT	Highly insulated external envelope means no more cold surface walls, windows and ceilings
HEALTH AND HYGIENE	Controlled ventilation means good air quality and no condensation and dampness problems
HIGHER PROPERTY VALUE	High quality construction and the promise of low running costs mean better sale or renting value

Step One: Keep the Heat In

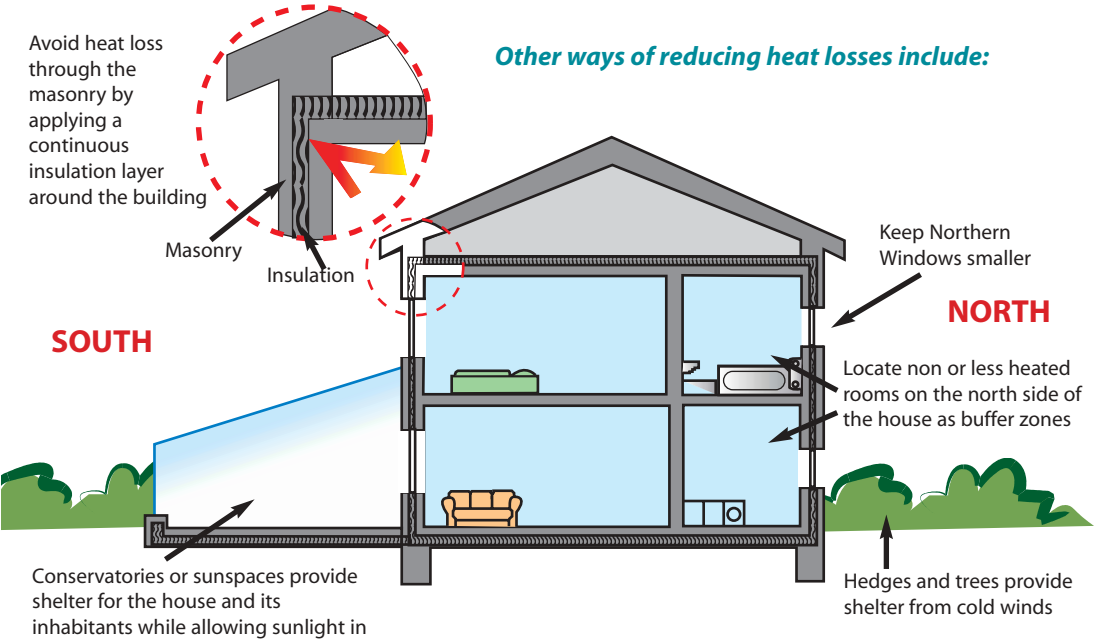
The first objective of an energy efficient home is to reduce heat losses. Like a polar bear, protect your house with a thick layer of insulation in the roof, walls and floor, as well as highly insulating windows. This is your best guarantee against expensive heating bills and a cold house.

These graphics compare the insulation thickness required for a wall to achieve:

CURRENT BUILDING REGULATIONS	LOW-ENERGY STANDARD	PASSIVE-HOUSE STANDARD
		
10 cm U value = 0.27	15-20 cm U value = 0.20-0.15	25-30 cm U value = 0.10-0.13

The U value of a fabric is a measure of its insulating property and is expressed in W/m^2,K.

It is also important to seal your house in order to avoid nasty draughts and unwanted air leaks. Windows and doors should close tightly, there should be no cracks in the walls and ceilings, tubing for electrical wires and water pipes should be sealed, etc.

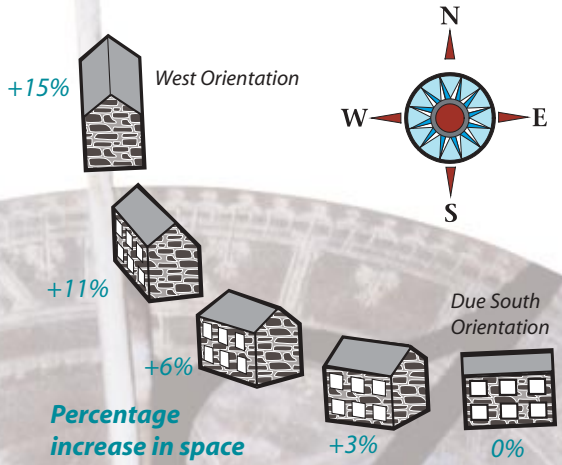


Step 2: Let the Sun Shine In

The second objective of solar architecture is to let the sun shine into your house to bring in natural light and free heat. This is best achieved by giving your house a southerly orientation and locating larger windows on the south façade.

Daylighting is another important principle of solar architecture. Windows open your house to natural light, brightening your interior and providing good visual comfort. They also bring a connection with your environment and let you enjoy the view when inside.

Good windows have a high insulating value to minimise heat losses (U value <2.0 W/m^{2}K) and a high degree of transparency (≥65%) to maximise solar gains.



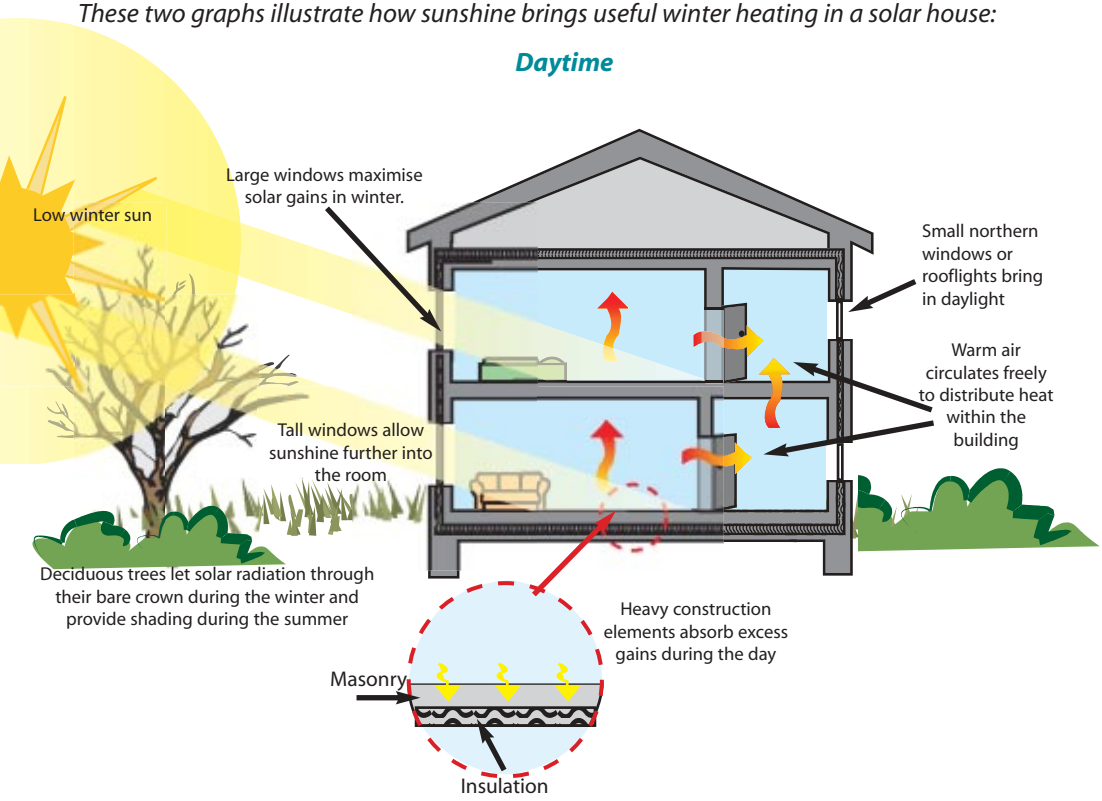
Percentage increase in space heating demand with deviations from a mainly due south window orientation.

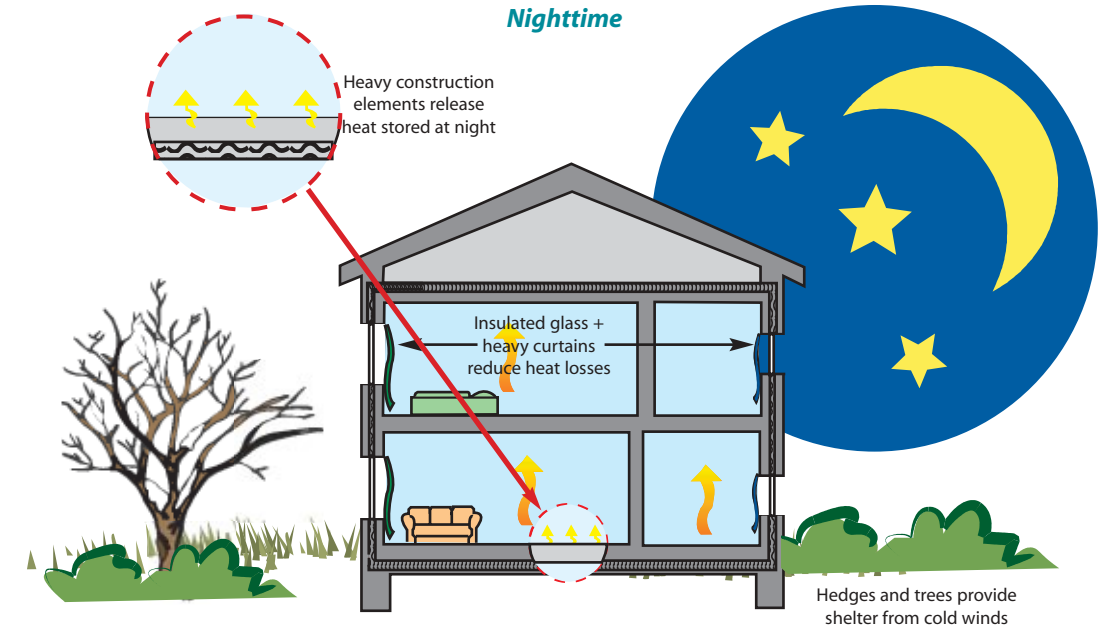
During the summer, two simple rules can be applied to avoid overheating:

- generally, opening windows should be sufficient to dissipate excess heat in the house. Ventilation at night will be particularly effective at cooling down the house's masonry
- avoid excess heat gains from the sun by shading windows with blinds (external preferably), eves, roof projection or overhangs, and deciduous trees

South façade of a house in Doolin, Co. Clare

These two graphs illustrate how sunshine brings useful winter heating in a solar house:





Step 3: Give Yourself a Breath of Fresh Air

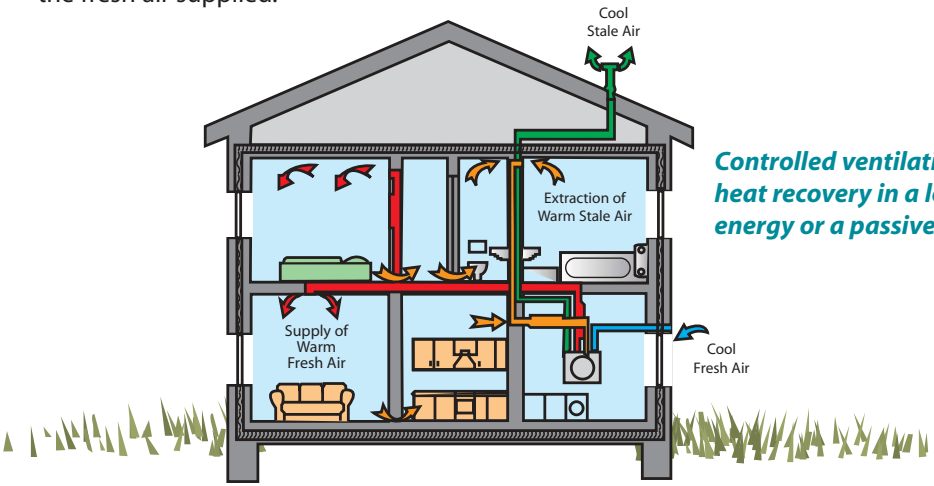
Adequate ventilation is important to ensure a constant supply of clean and fresh air in your house, as well as removing moist air to prevent condensation and the proliferation of mould and dust mites. In a highly sealed and insulated house, it is particularly important to ensure that the indoor air is replaced regularly without leading to excessive heat losses (i.e. without opening windows).

In a low-energy or a passive house, a controlled ventilation system with heat recovery is recommended. In such a system, fresh outside air is supplied through ducts to living rooms while exhaust air is extracted from wet rooms and ducted outside. The heat content of the exhaust air (warmer) is recovered to pre-heat the incoming fresh air.

The advantages of a heat recovery ventilation system are:

- automatically controlled supply of fresh air
- 80% of the heat content of the exhaust air is recovered and supplied with the fresh air
- can be fitted with filters to remove dusts and pollen inducing allergies and asthma
- windows can be kept safely closed to avoid noise disturbance and risks of intrusion

A heat pump system can also be fitted on the heat recovery system to extract heat from the exhaust air, which can then be used to produce hot water and/or pre-heat the fresh air supplied.



Controlled ventilation with heat recovery in a low-energy or a passive house

Step 4: The 100% Solar House

In a solar house, the heating requirement is reduced so much that it is very easy to provide the remaining heat demand from a renewable energy source. A heat pump or wood heating system would provide your space heating without any difficulty, and a solar water heater your hot water. As heating equipment can be downsized considerably (by at least twice compared to a conventional house), the initial investment will be much lower as well. All in all, you will have the benefit of a very economical heating system totally pollution free (and carbon tax free!). For further information on renewable heating systems, please read our additional leaflets on heat pumps, solar heating and wood heating.

A Profitable and Sustainable Investment

Market research in Europe has demonstrated that, on average, low-energy and passive houses cost only 6 to 8% more to build than conventional houses. But that is not the whole picture! What future house owners should be looking at is the actual yearly running costs of their house (mortgage and heating). In low-energy and passive houses, the much lower heating bill more than compensates for the slight increase in mortgage repayment. Plus houses of such a high specification have a much better resale value than standard houses.

From the building developer's point of view, adopting a low energy strategy will pay for itself. House buyers or tenants are more and more aware of the importance of energy efficiency and are willing to pay extra for a guarantee of comfort and low running cost. In a rented low-energy or passive house, the high comfort and low heating bill mean that tenants will want to stay longer. This reduces maintenance costs of the house, administrative hassle and expenses for the owner.

SUSTAINABLE ENERGY IRELAND

Renewable Energy Information Office

Sustainable Energy Ireland's Renewable Energy Information Office, one of Europe's leading renewable energy agencies, provides expert, independent information and advice on the development of all renewable energy technologies, including solar energy.

For further information on passive solar design and other solar technologies:

- download REIO's factsheets on www.sei.ie/reio.htm

- order REIO's Solar CD-ROM by email, fax or phone

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NDP NATIONAL DEVELOPMENT PLAN

EUROPEAN UNION STRUCTURAL FUNDS

Sustainable Energy Ireland is funded by the Irish Government under the National Development Plan 2000-2006 with programmes part financed by the European Union