YOUR GUIDE TO

BUILDING AN ENERGY EFFICIENT HOME

SEI SUSTAINABLE ENERGY IRELAND

The energy for life…

Energy is essential to our daily lives. It heats our homes, fuels our transport and supplies our electricity. At the moment, most of the energy we use comes from fossil fuels such as oil, gas, coal and peat. Unfortunately there is a limited supply of fossil fuels in the world and we are using them up at a very fast rate. The other downside to fossil fuels is that burning them for energy also produces CO_2, a greenhouse gas, which causes climate change. That's where sustainable energy comes in.

So what is sustainable energy?

Sustainable energy refers to a way we can use and generate energy that is more efficient and less harmful to the environment. Another way of explaining sustainable energy is that it will allow us to meet our present energy needs without compromising the ability of future generations to meet their own needs. We can do this by being more efficient in how we use energy in our daily lives and also by increasing the amount of energy that comes from renewable sources such as the wind, the sun, rivers and oceans.

What are the benefits of sustainable energy?

The good news is that being sustainable in how you use energy has immediate benefits:

- It will save you money on your electricity and heating bills
- Your home will be more comfortable and convenient
- And you will also be making a vital contribution to reducing climate change

Believe it or not, the small actions you take to be more energy efficient in your home can have a very significant impact on improving the environment. The collective efforts of individuals can often be the most powerful of all.

Who is Sustainable Energy Ireland?

Sustainable Energy Ireland (SEI) was set up by the government in 2002 as Ireland's national energy agency with a mission to promote and assist the development of sustainable energy. SEI's activities can be divided into two main areas:

- ***Energy Use -*** Energy is vital to how we live our daily lives but most of us don't use energy as efficiently as we could. By assisting those who use energy (mainly industry, businesses and householders), to be more energy efficient, SEI can help to reduce the amount of energy we use overall.

- ***Renewable Energy -*** Energy that is generated from renewable sources such as wind and solar power is clean and doesn't produce harmful greenhouse gases. By promoting the development and wider use of renewable energy in Ireland SEI can help to further benefit the environment, in particular reducing the threat of climate change.

SEI is also involved in other activities such as stimulating research and development, advising on energy policy and producing energy statistics.

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

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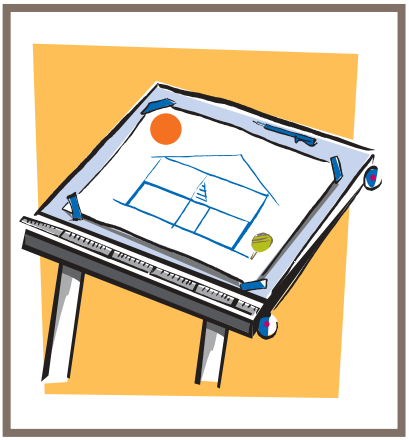
Did you know…

- **Energy use is responsible for two-thirds of Ireland's greenhouse gas emissions.**
- **Irish homes use around a quarter of all energy used in the country– that's even more than industry.**
- **The average home consumes almost 40% more electricity than it did in 1990.**
- **Renewable energy currently accounts for just 2% of Ireland's energy supply.**

Planning & Building an Energy Efficient Home

While the Building Regulations require that new buildings achieve minimum standards of energy efficiency, higher levels are in many cases worthwhile. Since a house being built today can be expected to be occupied for 60 years or more, an energy-efficient design can yield considerable savings over its lifetime.



Although some energy-saving measures can be implemented at a later stage, retrofitting is often more expensive and less effective than incorporation when the house is being built.

Apart from reducing fuel and electricity bills, an energy-efficient home design can provide improved comfort for occupants while helping to protect the environment. It can also provide insurance against future increases in fuel costs.

This leaflet aims to provide tips on energy efficiency to those planning to build (or buy) a new home. It is not comprehensive – the range of details for energy-efficient house design is too wide for that.

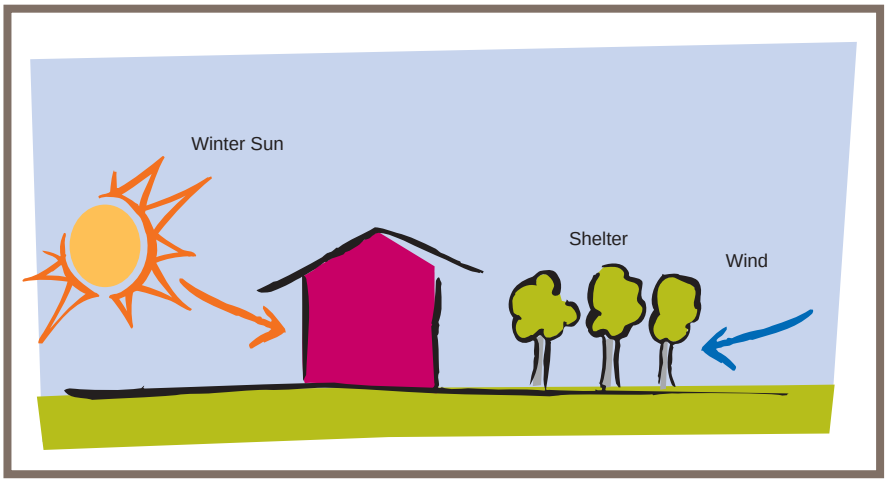
1 Fundamental Planning Decisions

Site selection

Energy used in driving from place to place can amount to a significant proportion of a household's total energy consumption. By locating new houses near to work-places, schools, public transport routes, etc., transport energy consumption can be reduced.

Transmission of sunshine through windows (passive solar heating) can reduce heating costs. The selection of a site which is exposed to the low-altitude winter sun can allow for passive solar heating.

By selecting a location sheltered from the wind, heat loss from the building can be reduced. Shelter can be provided by nearby trees, adjacent buildings or surrounding hills. If no such shelter exists, it can be provided in time through planting trees or shrubs.



In some, mainly rural, locations there may be potential for renewable energy sources other than solar, for example hydropower, wind power, wood, biogas, or heat which can be extracted from the ground or sea. The possibility of obtaining heat from a combined heat and power plant or group heating scheme may also influence the selection of a site.

Building form and orientation

A compact building form of minimum surface-to-volume ratio is best for reducing heat loss. However, a rectangular building with one of the longer facades facing south can allow for increased passive solar heating, day-lighting and natural ventilation. As well as reducing energy costs, sunny south-facing rooms also have high amenity value.

Projections such as bay and dormer windows should be kept to a minimum, since by increasing the surface-to-volume ratio of the building, they will increase heat loss. They also tend to be more difficult to insulate effectively.

Pitched roofs should have one slope oriented south to allow for optimum performance of a roof-mounted or roof-integrated active solar heating system. Even if such a system is not planned during construction, it may be installed at some stage during the life of the building.

Energy assessment

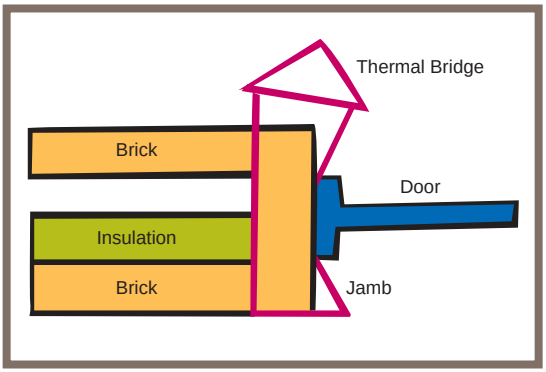
Many decisions affecting the energy performance of a house are taken early in the design process. A method of calculating annual heating energy consumption should be used to compare alternatives at the preliminary design stage.

2 Building Fabric and Structure

Insulation

Levels of insulation higher than those required in the Building Regulations are in many cases economically justified. Insulation should be well distributed around the building shell. It is better to have a good overall level of insulation than, for example, a highly insulated floor with no roof insulation.

Attention should be given to the avoidance of thermal bridges. These are "short circuits" across insulation, which are commonly found at lintels, jambs and sills of doors and windows, and at junctions where floors and ceilings meet external walls. They give rise to increased heat loss and possible condensation problems.



There are many examples of buildings performing more poorly than expected in energy terms due to poor quality workmanship in installing insulation. To achieve the level of energy efficiency predicted by the design, it is very important to ensure good quality workmanship and supervision during construction.

Ventilation

Adequate ventilation is essential to provide fresh air and to remove moisture, odours and pollutants. However, excessive ventilation during the heating season results in energy wastage and can also cause discomfort due to draughts.

Controlled vents should be installed in every room; trickle or slot vents incorporated in window frames can ensure a reasonable amount of continuous fresh air and can be opened up or closed down to a minimum as required.

Cooker hoods and small fan exhausts allow for controlled removal of moist air from kitchens and bathrooms, and prevent this air being drawn into living or bedrooms.

Attention should be given, during both design and construction, to ensuring that the building is well sealed. Services should be designed with minimum penetration of pipework and cabling through the building's insulated shell. Doors and windows should come with factory-applied draught seals. Porches and draught lobbies can reduce draughts at external doors.

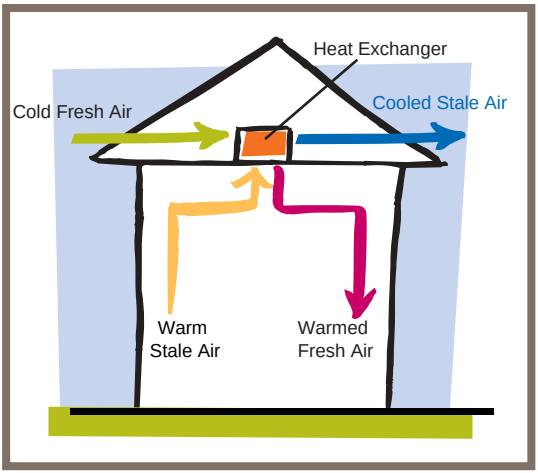
Never seal up a house completely, as a minimum of fresh air is required for health and safety reasons.

If an open fire or other fuel-burning fireplace appliances are to be installed, they should have an independent air supply. This can be achieved by means of an underfloor draught or by using a room sealed appliance such as a balanced flue heater.

A balanced ventilation system involving fans, ductwork and a heat exchanger can transfer heat from warm stale outgoing air to incoming fresh air (this is called "mechanical ventilation with heat recovery"). Stale air is usually extracted from rooms such as kitchens and bathrooms, and warmed fresh air supplied to living rooms and bedrooms.

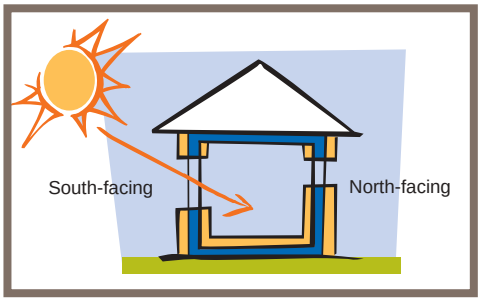
For such systems to work well, the house must be well sealed. Correctly sized systems can reduce ventilation heat loss considerably.

If the house is to be built in an area where leakage of radon gas from the ground gives rise to concern, appropriate steps should be taken to prevent its entry into the house. The Radiological Protection Institute of Ireland can advise on this.



Passive solar features

If the house is exposed to the low-altitude winter sun, glazing should be concentrated on the south facade. Window area on the north facade should be minimised to limit heat loss. Thermal mass within south-facing rooms, e.g. masonry walls or concrete floors, can absorb and store solar energy during the day and release it gradually during the evening. The heating system should have a fast response time and good controls to maximise the usefulness of solar gains. Overheating protection in south-facing rooms in summer can be provided by overhanging eaves, blinds, natural ventilation, thermal mass or other means.

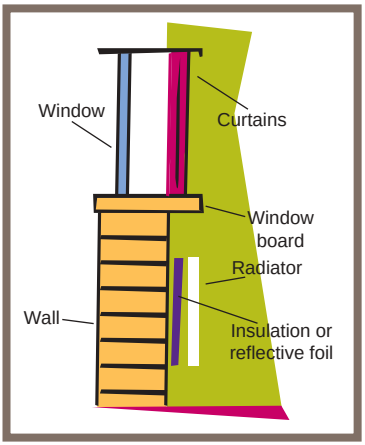


In general, it is not wise to increase south-facing glazed areas too dramatically. Otherwise additional measures will be required to avoid overheating in summer and excessive heat loss at night and on overcast days in winter.

Windows should have a high resistance to heat loss. 'Low-emissivity' double glazing, which has a special coating to reduce heat loss, is required.

Well-fitting curtains can help to retain heat at night. If a radiator is mounted below the window, the curtains should not cover it when closed, but should rest lightly on a window-board or shelf above the radiator. This arrangement will direct warm air from the radiator into the room rather than up behind the curtain.

A well-designed sunspace or conservatory on the south side of a building can reduce the heating needs of a house by acting as a buffer against heat loss and collecting solar energy on fine days. However, there are many examples of sunspaces, poorly designed from an energy point of view, which increase heating requirements. Sunspaces should not be heated, and should be separated from the heated space by walls and / or closable doors / windows. They should not be regarded as being habitable all year round. The energy losses from one heated sunspace can negate the savings of ten unheated ones!



Building materials

The embodied energy of a product is the energy used to produce it, and includes energy used in extracting raw materials, processing and transport, e.g. Irish-grown timber will incur lower transport energy use than timber imported from overseas. The embodied energy of a house is typically over five times its annual energy consumption and therefore equates to approximately 5-10% of the total energy consumption during the life of the house.

The building materials selected should have minimum environmental impact during their entire life cycle, including manufacture, use and disposal. Building components should be designed for long life and durability, and ideally should be recyclable at the end of their operating lives.

3 Heating systems

Energy efficient houses need smaller heating systems than conventional houses. The resulting savings will help to pay for the cost of additional insulation.

Boilers

The heating system should be efficient, not only at full load, but also at lower loads. If looking at oil or gas boilers, you should ensure that the boiler complies with the EU boiler efficiency directive. In the case of gas boilers, you should consider condensing boilers, which cost a bit more but are highly energy-efficient.

If selecting individual room heaters, consider room sealed, balanced flue units. Room heaters should be correctly sized for the room they are to heat and should be thermostatically controlled.

Hot water systems

It is generally more energy-efficient to heat water using an efficient boiler or other fuel-burning appliance than with an electric immersion heater. The hot water cylinder should be well-insulated; factory applied insulation is generally more effective and durable than a lagging jacket. As well as providing space heating, combination 'combi' boilers supply hot water directly to the taps, thus avoiding the losses associated with storage in a hot water cylinder.

Location/Configuration

By locating the heating and hot water systems, including pipework, entirely within the insulated building shell, heat losses can become heat gains. Ensure good ventilation to the boiler and take account of fire regulations. Attention should be given to minimising the lengths of pipe runs and associated heat losses.

Automatic controls

Heating system controls should be installed to ensure that heat is provided only when and where it is needed. The Building Regulations require thermostatic radiator valves that allow control of temperatures in individual rooms. Separate time and temperature control in two or more zones is necessary where floor area is greater than 100m^2.

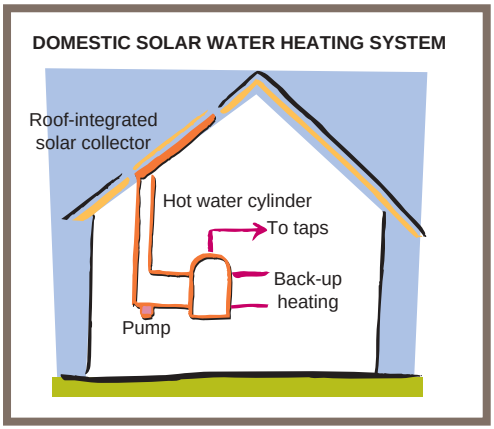
Open fires

Open fires, whether of the solid fuel or gas type, are wasteful of energy, and even when they are not in use, the chimney gives rise to uncontrolled ventilation heat loss. If a fireplace must be installed, an 'underfloor draught' air supply (a small duct or pipe installed within the floor and connecting the outside air directly to the fireplace) can help to reduce the amount of warm internal air escaping through the chimney. A closed stove is preferable to an open fire in terms of controlled efficient heat.

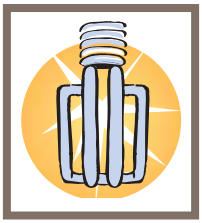
Solar

Active solar heating systems, including a solar collector on a south-facing roof, can contribute to heating needs.

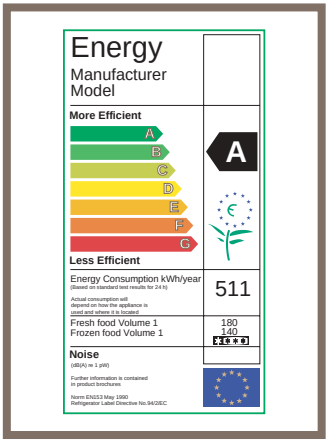
A solar water heating system can provide about 60% of a family's annual hot water requirement, with back-up heating coming from the conventional system. A solar space heating system can contribute to heating needs, particularly in spring and autumn. Though the economics of such systems may be marginal at present low fuel prices, they use a clean, sustainable energy source.



4 Lighting and Appliances



Energy-efficient lamps and fittings should be chosen for all rooms where lights are likely to be switched on for long periods - living rooms, kitchens, halls, security lighting etc. While a compact fluorescent lamp (CFL) costs more to buy than an ordinary tungsten bulb, the energy savings it will yield will more than recoup the investment over its long operating life.



All fridges, freezers, washing machines and tumble dryers on display in shops are now required by law to display Energy Labels indicating their energy efficiency. These labels can assist the purchaser in selecting an energy-efficient model.

5 Complete package

The heating energy performance of a new building design can be predicted using a standardised energy rating method. The result is usually expressed in kilowatt-hours per square metre of floor area per year (kWh/m^{2}y). According to the HER method, a typical house just satisfying the 2002 Building Regulations will have a rating of about 90 kWh/m^{2}y. However, it is possible to achieve a fuel consumption less than this value through measures referred to in this leaflet.

From early 1997, the Technical Guidance Document L to the Building Regulations will incorporate a provision whereby an energy rating procedure can be used to demonstrate compliance.

Householder manual

The energy consumption of a house depends nearly as much on the behaviour of occupants as on the building design. While the former is beyond the control of the designer, he/she can provide guidance to occupants on energy-efficient operation of the house through a user's manual, personal instruction, or both. This guidance could include topics such as the use of timers, control of ventilation, servicing of heating system, energy-efficient cooking tips, etc.

Demonstration

High standards of energy-efficient building design have been demonstrated in many recently-constructed housing projects in Ireland, including 400 low-energy houses built around Ireland with co-funding under the EU THERMIE programme. Some of these have active solar heating systems.

Relevant Standards

Building Regulations, 2002
Part L: Conservation of Fuel and Energy
Part F: Ventilation / Part J: Heat Producing Appliances.

ISEN 832 - Thermal performance of buildings - calculation of energy use for building - residential buildings CEN 1998.

Useful contacts for further information

For information on energy efficiency measures
SEI, Glasnevin, Dublin 9.

For information on solar heating systems
Energy Research Group, School of Architecture, U.C.D., Richview, Clonskeagh, Dublin 14.

SEI, Renewable Energy Information Office, Shinagh House, Bandon, Co. Cork.

For information on radon gas
Radiological Protection Institute of Ireland, 3 Clonskeagh Square, 119 Clonskeagh Road, Dublin 14.

Useful publication

Green Design: Sustainable Building for Ireland; Ann McNicholl and J. Owen Lewis (eds), Energy Research Group, University College Dublin; Office of Public Works, 1996.

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NDP NATIONAL DEVELOPMENT PLAN

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