

Energy Savings in Homes

About MNRE

*Akshay urja se desh vikas
Ghar ghar bijli, gaon gaon prakash*

In 1982, the Government of India set up the DNES (Department of Non-conventional Energy Sources). This was upgraded to the MNES (Ministry of Non-conventional Energy Sources) in 1992, and is now known as the MNRE (Ministry of New and Renewable Energy). The MNRE is the nodal ministry for all matters relating to the development and promotion of new and renewable energy in the country.

About TERI

TERI, established in 1974, is a not-for-profit, non-government research organization deeply committed to every aspect of sustainable development. Over the years, TERI has been working with governments, multilateral organizations, and corporate entities in providing comprehensive support on aspects such as policy issues, project evaluation, and technology.



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Ministry of New and Renewable Energy
Government of India



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ENERGY SAVINGS IN HOMES

Energy can be saved in homes by adopting the following measures.

- Using renewable energy devices/systems such as solar water heaters, solar cookers, solar lanterns, solar home systems, solar generators, and other devices
- Retrofitting some components of solar passive architecture, for example, sunshades, double glazed windows, smart glazing, window overhangs, roof treatments, ventilation, evaporative cooling, and day lighting, depending on the climatic zone where the house is constructed
- Adopting energy conservation devices, for example, LEDs (light-emitting diodes)/CFLs (compact fluorescent lights) instead of incandescent bulbs, electronics chokes and fan regulators, sensors for automatically switching lights on or off, automatic speed regulating fans/motors, energy-efficient electrical appliances such as fans, refrigerators, air conditioners, coolers, room heaters, and water pumps among others



RENEWABLE ENERGY DEVICES/SYSTEMS

Solar water heater

A solar water heater is a device that uses heat energy of the sun to provide hot water for various applications. In homes, it is useful for bathing, washing, cleaning, and other chores. A domestic solar water heater, with a capacity of 100 lpd (litres per day), is sufficient for a family of four or five members. It can easily replace a 2-kW electric geyser and can save up to 1500 units of electricity a year. It pays back the cost in three to five years depending on the electricity

tariff and hot water use in a year. After this, the hot water is available almost free of cost during the remaining lifespan of the system, which is about 15–20 years.

The system is generally installed on the terrace and requires minimum maintenance. It works automatically and one does not have to operate any part of the system. Typically, a surface area of 3 sq m is required to install it. The system can also be installed on a south-facing windowsill if space is not available on the terrace.

Two types of systems are being promoted—one based on FPC (flat plate collectors) and the other on ETC (evacuated tube collectors).



The life of FPC-based systems is generally 15–20 years, and they are costlier than ETC-based systems. There are 57 BIS (Bureau of Indian Standards)-approved manufacturers of these systems, and they have had a stable market in the country for the last many years.

ETC-based systems are relatively new and could be more reliable for colder regions and regions that have hard water. The life of these systems is, however, less since their collectors comprise glass tubes, which are fragile. There are 29 suppliers of these systems approved by the MNRE (Ministry of New and Renewable Energy). The list of manufacturers and suppliers is available at the Ministry's website (www.mnre.gov.in).

The cost of solar water heaters, with a capacity of 100 lpd, varies between Rs 18 000 and Rs 25 000. To offset the initial high price, loans at 2% are offered to users through banks/financial institutions. The list of such banks/financial institutions is available on the Ministry's website. In addition, some state governments also provide state subsidy. For example, Delhi Transco Ltd offers Rs 6000 as rebate on installation of the system. A few governments

also provide rebate in property tax and in electricity tariff if a solar water heater has been installed at home. Details are available on the Ministry's website.

These banks/financial institutions also provide an incentive to motivators who bring business to them. The incentive is of Rs 200 on each 100-lpd system that is installed. Motivators could be unemployed youth, who can take up work as solar entrepreneurs.

Solar cooker

A solar cooker is a device that uses heat energy from the sun to cook food. Two types of solar cookers are available in the market—box type and dish type. A box solar cooker, suitable for a family of four or five, can cook food in two to three hours. The cooker has to be kept outside in the sun and can cook up to four items at once. It is available with electrical backup, so it can be used even in non-sunshine hours. It costs Rs 1500–2500 depending on its features, and can save up to four LPG cylinders a year. Food cannot be fried in the box solar cooker.

A dish solar cooker can cook food in lesser time than a box solar cooker. It can even be used for preparing chapatias and frying. It can, however, be used to cook only one item at a time. It costs Rs 5000–6000. A subsidy of 30% is available on these cookers through State Nodal Agencies, whose list is available in annexure. There are about 35 manufacturers/ supplier of solar cookers. These cookers are available in Akshay Urja Shops, with dealers/ manufacturers of solar cookers, and districts/head offices of State Renewable Energy Development Agencies.

Solar lantern

It is a portable device for lighting. It is available with a 10 W SPV (solar photovoltaic) module, 7W CFL, maintenance-free lead acid



battery, and electronics. The lantern can provide light for a minimum of three hours daily and covers a range of 360°. Solar lanterns that follow MNRE specifications cost Rs 2500–3000. Imported models are also available at a lower price. Solar lanterns can be purchased from Akshay Urja Shops, dealers/manufacturers of solar cookers, and districts/head offices of State Renewable Energy Development Agencies.

Solar home system

It is a device to power lights, fans, and small TV sets in homes. Some models of solar home systems are listed below.

- 18 W module with one light (cost: Rs 5000 approximately)
- 37 W module with two lights or one light and one fan (cost: Rs 10 000 approximately)
- 74 W module with two lights and one fan or four lights (cost: Rs 10 000 approximately)

State Nodal Agencies offer a subsidy of up to 50% on these models for general areas and up to 90% for the North-East and special areas. The systems can be purchased from Akshay Urja Shops, dealers/ manufacturers of solar cookers, and districts/head offices of State Renewable Energy Development Agencies.

Solar inverter/power pack

Solar inverters can effectively replace small generators, which run on kerosene and petrol and cause pollution and noise. Installed in homes and small establishments, these inverters could power lights, fans, computers, and other electronic devices. The solar inverter comprises a solar photovoltaic panel, battery, and an inverter. It costs about Rs 2–3 lakh/kWp (kilowatt peak).



RETROFITTING SOLAR PASSIVE FEATURES

Passive architectural features are mostly integrated at the design stage of new homes. However, in case your home is still deficient on some concepts, you can retrofit certain features to achieve thermal and visual comfort and to reduce energy consumption.

Sunshades

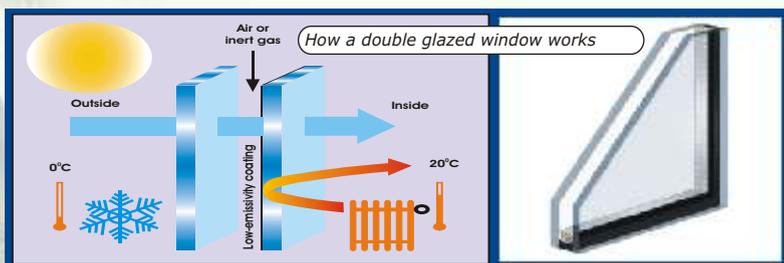
These are generally installed at the top of windows/doors to obstruct sunrays from entering the building during summers and



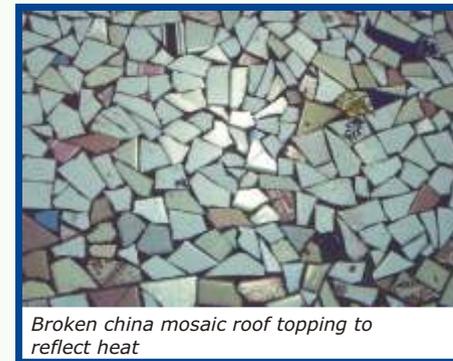
allowing them in during winters. This helps protect the building from over heating during summers, and keeps it warm during winters, thereby reducing the electricity consumed by room coolers/heaters. Windows on the east, west, and south of the house should be adequately protected by *chajjas* and sunshades. In case such features are absent, provide awnings or other shading devices to protect windows from direct sunlight.

Double glazed windows

Insulation that helps reduce heat gain into, and heat loss from, a building. Double glazed windows with air gaps can act as a good



insulation. The insulating air gap lowers the heat gain of the building. It should be used for air-conditioned spaces. BEE (Bureau of Energy Efficiency) has recommended specifications for glazing in air-conditioned spaces in the Energy Conservation Building Code 2007 (www.bee-nic.in). Most homes usually have single clear glass. Double glazed windows, with sun control (coatings, shading, and so on), should preferably replace single glazed windows to reduce energy used for air-conditioning.



Roof treatment

Roofs are exposed to maximum incident solar radiation. So it is important that the roof of your house should be protected to minimize solar gain. Some simple roof treatments that can be applied to existing homes to reduce summer heat gain are as follows:

- i) Whitewashing the roof before the onset of the summer.
- ii) Spraying water on the roof. Sprinkling water at regular intervals reduces heat gain through roof.
- iii) Using shining and reflecting material, for example, light-coloured broken china mosaic, heat reflecting paints, and other reflective material, on the rooftop.

Evaporative cooling

When water stored in a water body evaporates into the surrounding air, it lowers the ambient temperature. This phenomenon is known as evaporative cooling. The presence of a water body such as a pond, lake or sea near the building or even a fountain in the courtyard can provide the cooling effect. The most commonly used system is a desert cooler, which comprises water, evaporating pads, a fan, and a pump. External cooling through humidification can also be achieved by keeping surfaces of roofs moist using sprays or lawn sprinklers. Evaporative cooling is very effective in the hot and dry climatic zone, where humidity is low.



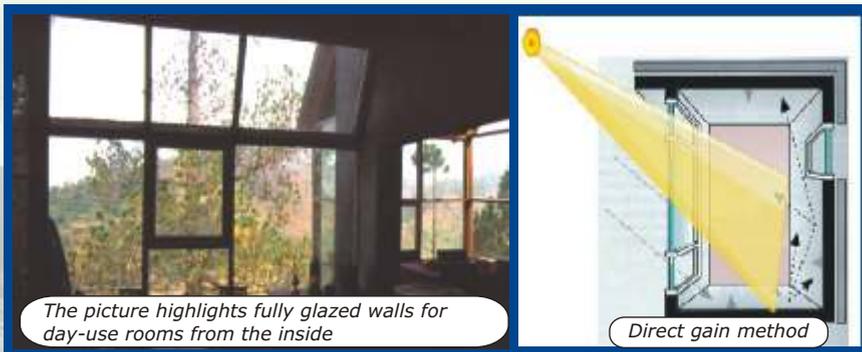
Landscaping

Landscaping provides a buffer against heat, sun, noise, traffic, and airflow. It is also effective in diverting airflow or exchanging heat in a solar-passive design. Deciduous trees, such as *amaltas*, *champa*, and similar varieties, provide shade in the

summer and sunlight in the winter when their leaves fall. So planting such trees to the west and south-west of a building is a natural solar passive strategy. Evergreen trees provide shade and wind control round the year. They are best placed to the north and north-west of a building. Natural cooling, without air-conditioning, can also be enhanced by planting trees to channel south-easterly summer breezes in tropical climates.

Passive heating

In places in cold climatic zones, for example Shimla, where temperatures outside are lower than they are inside, heat flows away from buildings through their external envelopes and due to air exchange. In such climates, passive heating measures are adopted to provide thermal comfort and also to reduce the demand for conventional heating. If your house faces south, construct sunspaces adjacent to south-facing walls. A sunspace can be constructed by using double glazing. The space between the glazing and the living space should have a thermal mass, which will capture solar heat during daytime and release it into the space during night time. The sunspace glazing should be protected by curtains and blinds so that heat does not escape out at night.



ENERGY CONSERVATION DEVICES/SYSTEMS

Efficient lighting

Lighting in a home is generally responsible for 20% of the monthly electricity bill.

Efficient lighting reduces energy consumption, thereby saving energy and money, without compromising on the quality of light. Lighting improvements are the surest way of cutting energy bills. Using new lighting technologies can reduce energy use in the house by 50% to 75%. Lighting controls offer further energy savings by reducing the amount of time that lights are on without being used.



Indoor lighting

Use fluorescent tubelights and energy-efficient CFLs in fixtures at home for high-quality and high-efficiency lighting.

Fluorescent lamps are much more efficient than incandescent (standard) bulbs and last up to six times longer. Although fluorescent and compact fluorescent lamps cost a bit more than incandescent bulbs, they pay for themselves by saving energy over their lifetime.

A 15 W CFL can replace a 60 W incandescent bulb and a 20 W CFL can replace 100 W bulb. The average cost of a CFL is Rs 100, and the excess investment is easily paid back in a year's time. A 36 W triphosphor tubelight, provides 32% more light than an ordinary tubelight and can be used in larger spaces. T5 tubelights are also good replacement for ordinary tubelights. They save about 40% energy and last twice as long as ordinary tubelights. The cost of a T5 tubelight varies between Rs 450 and Rs 500.

Outdoor lighting

Many homeowners use outdoor lighting for decoration or security. Outdoor lights can be powered by small PV (photovoltaic) modules that convert sunlight directly into electricity. Consider PV-powered lights for areas that are not close to an existing power supply line. Solar outdoor lights also come as stand alone fixtures. An 11 W CFL, with a 74 W photovoltaic module and a 12 V/75 AH

battery, costs Rs 22 000–24 000. When fully charged, the battery can power the light from dusk to dawn.

Efficient air conditioners

ACs (air conditioners) are used to cool or heat a room and usually consume the highest energy among all home appliances. Window ACs and split ACs are most commonly used. These are available in different sizes—0.75 tonne, 1 tonne, 1.5 tonne, and 2 tonne. Insulation of the walls, roof, and efficient windows in the room would allow you to pick an AC with lesser tonnage.



Selecting the right size

The energy consumption of an AC depends on its size. Therefore, select an AC that suits your requirements. A 1-tonne AC is appropriate for a 150 sq ft room, while a 2-tonne AC is sufficient for a room, which is 300 sq ft in area.

Selecting an efficient AC

The efficiency of an AC affects energy consumption as much as the size of the AC does. Select an efficient AC, preferably one that has a BEE Star label. The number of stars on the BEE (Bureau of Energy Efficiency) label indicates the efficiency of an AC; the higher the number of stars the more efficient the appliance. For instance, a BEE 4-star rated 1.5-tonne AC would consume 194 units of electricity in a month compared to an inefficient AC of the same size that would consume 278 units during the same period. An efficient 1.5-tonne AC would cost about Rs 16 500, whereas an ordinary AC would cost about Rs 15 000. The additional Rs 1500 invested on the efficient AC will be recovered in less than six months due to savings in the electricity bill. In case of the non-availability of the BEE star label, check the EER (energy efficiency ratio) mentioned on the AC. An EER of 8 is equivalent to a 1-star BEE label and an EER of 10.6 and above is equivalent to 5-star BEE label.

Installing an AC

While installing an AC, ensure that the exterior (or back) of the AC is not exposed to direct sunlight and is away from heat sources such as chimneys. Efficient airflow across the exterior would ensure efficient operation of the AC. Make sure that air does not escape through doors and windows by sealing them properly. This would help in reducing energy consumption. To optimize the efficiency of the AC ensure that equipments such as televisions, computers or lamps are placed away from it.

Operating an AC

The energy consumed by an AC is also affected by its operation. Set the temperature higher to reduce energy consumption. It is estimated that a temperature setting of 23 °C consumes 10% more energy than a temperature setting of 26 °C. A few ACs equipped with the 'sleep' mode enable savings during operation.

Maintaining an AC

Regular maintenance of ACs helps in improving their efficiency. Clean the filters of the AC at least once in 15 days to ensure efficient airflow and cooling. Also, to enable the AC to operate efficiently, the exterior part (or back) of the AC should be free from dust, preventing blockage.

Refrigerators

Refrigerators are one of the highest consumers of electricity in houses. However, they have become significantly efficient in the past few years, and are still improving. A typical refrigerator has a lifespan of 15–20 years. The cost of running it over that time period is several times the initial purchase price. So buy the most efficient model available; investing a little more in a refrigerator with higher efficiency offers solid payback. A BEE 5-star rated refrigerator that costs more initially will have lower operation costs because of better construction and insulation, and will pay for itself in less than four years compared to a 2-star refrigerator. A list of



energy-efficient appliances can be found at the BEE website (www.bee-nic.in) and (www.energymanagertraining.com). Models with top- or bottom-mounted freezers use 12% less energy than side-by-side designs.

TIPS FOR SAVING ENERGY

Passive design

- Use light colours to paint the interior of home for effective day lighting.
- Incorporate solar passive designs in buildings at the time of construction.
- In summers, draw curtains over windows facing south, west, and south-west or use sun films.
- Install double pane windows—heat escapes through a single glass pane almost 14 times faster than through a well-insulated wall.
- Control heat, air, and moisture leakage by sealing windows and doors with natural materials.
- Use reflective tiles or insulation on the roof to keep the interior cool.

Lighting

- Switch off lights and fans when there is nobody in the room.
- CFLs use 75% less electricity and offer similar amount of light as incandescent bulbs. If you replace 25% of the lights in high-use areas with CFLs, you can save up to 50% in lighting energy bills.
- Electronic ballasts can reduce power consumption by 20%. You can cut consumption by 10%–50% with slim tube lights that are star-rated by BEE.
- Use artificial lighting only when there is inadequate natural light in a space.
- Ensure that the type of lamp used in a space complements the tasks being performed in that space. This is commonly referred to as task lighting. For instance, do not use two wall-mounted bulbs where a single table lamp will suffice.

- Use dimmer switches. They allow lighting levels to be adjusted according to the occasion or task and reduce the energy consumption of the lamp.
- Use outdoor lights with timers or photocells so that they turn off automatically in daylight.
- Replace electromagnetic (copper) ballasts (chokes) with electronic ballasts.
- Don't replace tube lights with CFLs. A CFL is a point source, that is, it emits light from a single point, whereas a tube light is a line source and emits light over a larger linear spread.
- Don't use dark-coloured surfaces in workrooms. These reduce the reflected light levels and increase the number of lamps required to illuminate the space.
- Avoid switching lights on and off frequently. This affects the lifespan of the lamps.

Electronic devices and appliances

- Look for BEE-star labels on electrical appliances.
- Use electronic devices with occupancy sensors which switch on or off automatically by sensing if the room is occupied.
- Switch to evaporative coolers from air conditioners during hot/dry summer months.
- Buy split ACs instead of window ACs. They cost more, but they are more energy efficient and consume lesser electricity.
- Do not install AC units on walls that are exposed to direct sunlight through a major part of the day during summers. In other words, avoid installing the AC on the west and south walls.
- Do not apply dark colours on the external surfaces (roof and walls) of the house. Dark colours absorb more heat than light colours, leading to increased use of the AC.
- Do not expose the condenser (the part that faces outside) of split units on the terrace/roof to direct sunlight.

- Ensure that walls do not surround the AC unit on all sides. The condenser of the unit must have enough space around it for air to circulate and to help the refrigerant dissipate its heat easily.
- When using ACs avoid overcooling of the room to a degree where quilts need to be used.
- An easy way to cut down on the energy required by an AC is to set the thermostat at the highest possible point, and turn on the ceiling fan. This shall create air movement, circulate the cooled air more effectively, and help your sweat to evaporate easily without greatly increasing electricity use.
- With each degree that the temperature setting of an AC above 22 °C, 3% – 5% less energy is used. Set the temperature of the AC at 25 °C for the most comfort at the least cost.
- Clean an AC unit's filter periodically to enable efficient airflow and cooling.
- Do not use remote controls for switching off televisions and ACs. Switching them off from the mains saves electricity.
- Switch off electrical appliances when not in use. Low power gadgets such as chargers, adaptors, inverters, televisions, and so on consume substantial power even in the standby mode.
- If computers must be left on, turn off the monitors; monitors alone use more than half the system's energy. Setting computers, monitors, and copiers to 'sleep' mode when not in use helps cut energy costs by about 40%.
- Activate and standardize 'power down' on new and existing PCs.
- Purchase flat-screen LCD monitors.
- Do not use screensavers when computer monitors are not active. Let them switch to the sleep mode or turn them off instead.
- Allow enough space for air circulation around refrigerators.
- Avoid opening refrigerator doors frequently as it leads to energy loss.
- Allow hot food items to cool to room temperature before putting them in refrigerators.

Renewable energy devices

- Use solar water heaters instead of storage electric geysers. They require near-zero maintenance and save up to 1500 units of electricity a year.
- Clean the surface of solar collectors/solar photovoltaic panels at least once in 15 days, if installed on a terrace or in the open.

Following these power-saving tips can reduce electricity consumption by 30%–50% and can easily half your energy bill.

ANNEXURE

List of State Nodal Agencies for new and renewable energy

ANDHRA PRADESH

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The Chief Executive Officer, Jammu & Kashmir Energy Development Agency (JAKEDA)
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The Project Director, Ladakh Renewable Energy Development Agency
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List of manufacturers of renewable energy systems/devices

Available at MNRE website (www.mnre.gov.in).