Auroville Consulting

ENERGY CONSERVATION & EFFICIENCY

A GUIDEBOOK FOR RESPONSIBLE ENERGY MANAGEMENT

AUROVILLE
INDIA
2016

ACKNOWLEDGEMENT

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The following team members from Auroville Consulting were involved in its preparation: Martin Scherfler, Nitin Cherian, Osheen Siva and Vikram Devatha.

DISCLAIMER

This publication will help residents understand various technologies available in the market, and to make informed choices in selecting the more energy efficient appliances for their homes, as compared to their less efficient predecessors. This publication also depicts in an informative way, the benefits of implementing or switching to energy efficient fixtures in an environmental perspective. Every unit of electricity saved impacts the ecosystem in a positive way. A more cohesive approach is recommended between building planners and residential/commercial building users in relevance to choice of electrical appliances in order to increase the efficiency of future planning exercises.

EXECUTIVE SUMMARY

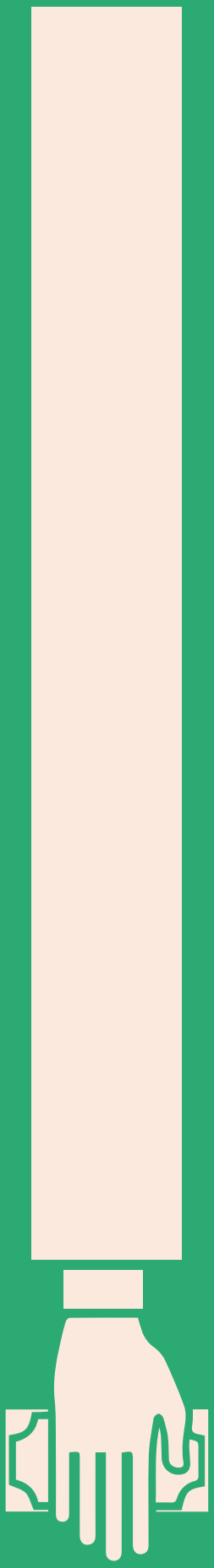
The publication attempts to inform community members about energy saving opportunities for the residential and commercial sector by serving as a simple sourcebook that may help building stewards take environmentally sound and responsible decisions to optimise the energy consumption in their buildings.

This publication provides tips to achieve energy savings for common electrical appliances used in households: fans, lights, AC, refrigerators, washing machines and hot water heaters. It elaborates on electricity savings achievable by employing highly efficient appliances available in the market today.

The points covered are:

- Best practices for energy saving related to usage habits.
- Best practices related to choice of appliances: AC, water heaters/geysers, fridges, lights, fans, washing machines.
- Best practices for energy saving related to inverter and battery usage and maintenance.

Results presented in this publication show that there are substantial energy savings and CO2 emissions reduction by energy conservation and efficiency initiatives. Research shows that an electricity savings potential of 23% can be achieved on the whole of India's economy if financially viable energy efficiency interventions are made.



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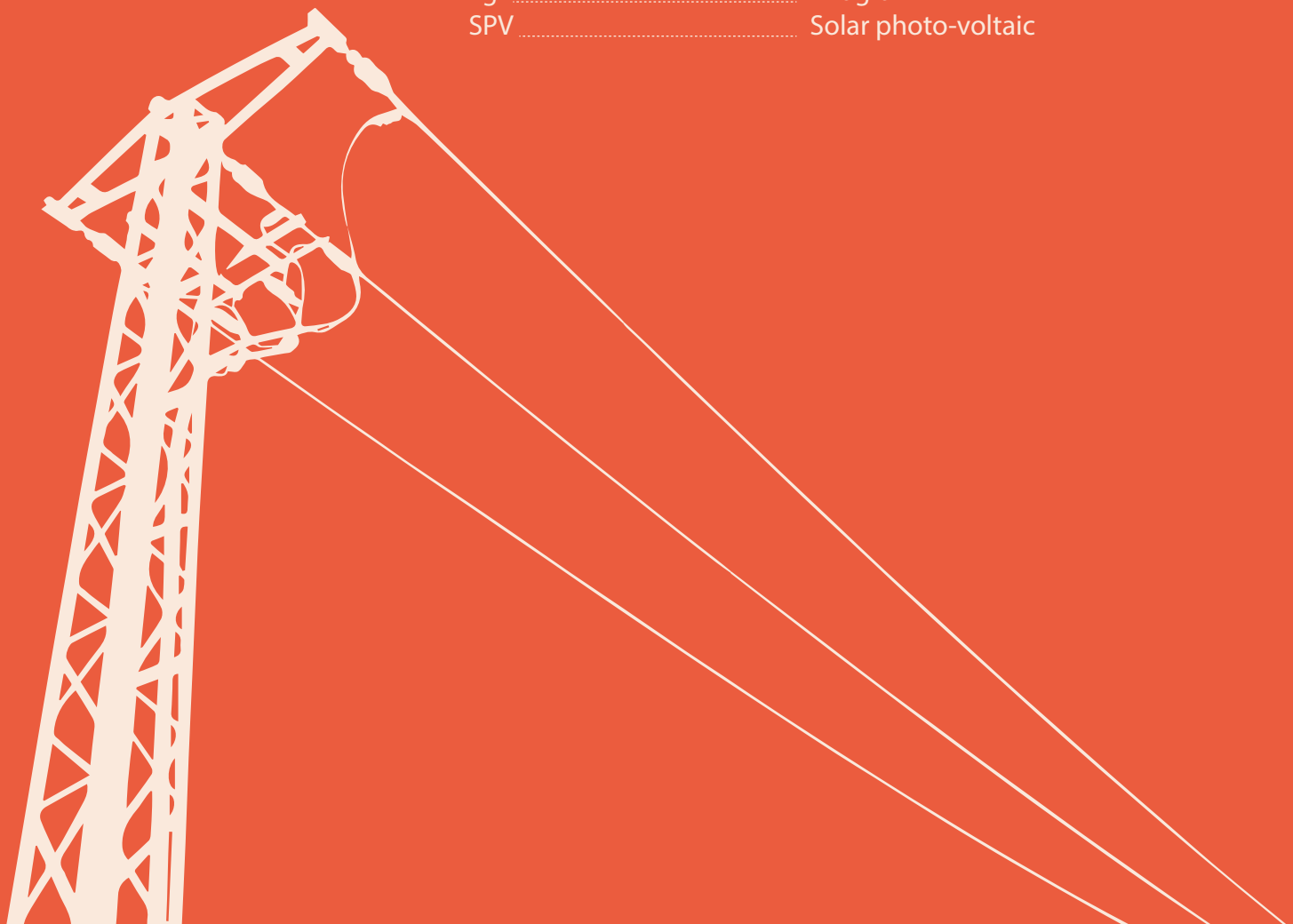
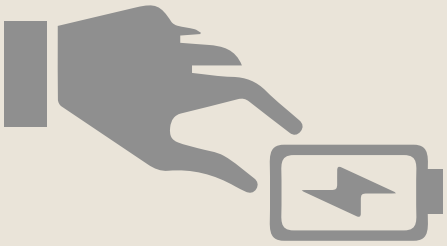
ABBREVIATIONS

kWh	Kilowatt hour (or) unit of electricity
kW	Kilowatt
GW	Gigawatts
MW	Megawatts
W	Watts (or) unit of power
$kgCO_2E$	Kilograms of carbon-di-oxide emitted
BEE	Bureau of Energy Efficiency
AC	Air conditioner
H	Height
Lpd	Liters per day
m^3	Cubic meters
min	Minute
sq.m or m^2	Square meters
Lumens	It is measure of the brightness output
LED	Light emitting diode
NSSO	National Sample Survey Organization
cm	Centimeter
VFD	Variable frequency drive
kg	Kilogram
SPV	Solar photo-voltaic



INTRODUCTION



Define the Need (vs. Greed)

Do we need it? → For example: light during the day

Energy Conservation

What is the most energy efficient design? → Using natural light instead of artificial light

Energy Efficiency

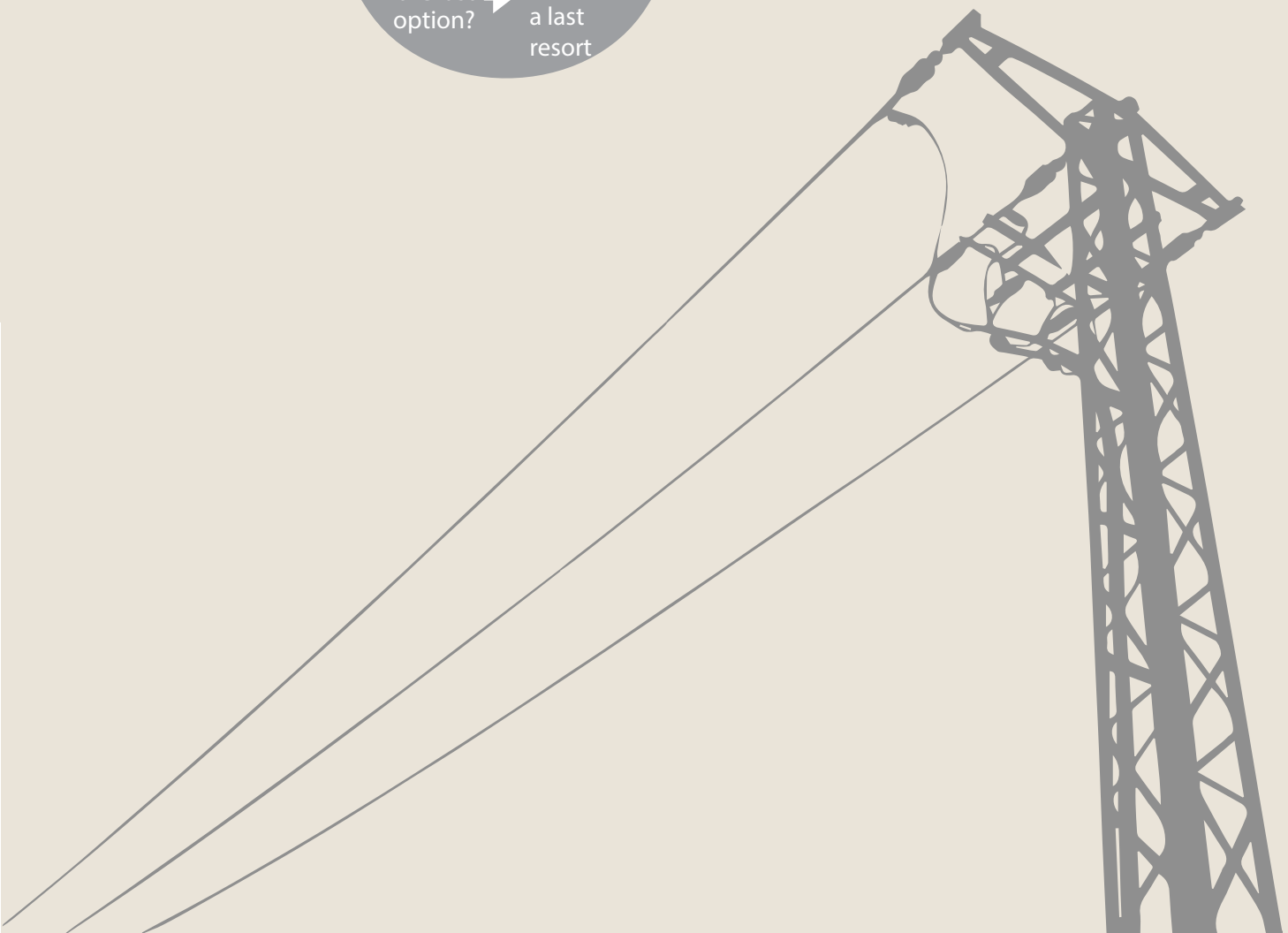
What is the most efficient technology for it? → Using CFLs or LEDs instead of incandescent light

Renewable Energy

What is the most sustainable production? → Using renewable energy

Fossil Fuel

What is the last option? → Use fossil fuels as a last resort



“ENERGY EFFICIENCY IS THE FASTEST, CLEANEST AND CHEAPEST WAY TO MEET RISING ENERGY DEMAND”

During the 20th century our energy consumption habits were shaped by the seemingly unending reserves of fossil fuels. The availability of cheap fossil fuel created wasteful behavior patterns. As we are now facing a national and global energy crisis and the need for a more efficient use of our energy resources, we are asked to examine behavior in regard to resource management at our workplaces as well as at our homes. The unsustainable use of energy constitutes a huge potential for energy savings.

Today the building sector accounts for more than 40 percent of India’s electricity consumption. With the projected population growth, economic growth and increased urbanization energy consumption is expected to rise steeply in the coming years. In order to achieve long-term energy security and sufficiency that enables sustainable and equitable economic growth, India will have to find smart and effective strategies for introducing energy conservation and energy efficiency programs at a large scale while simultaneously increasing its share of renewable energy sources.

Reducing a building’s electricity consumption without compromising on the desired performance of the building is usually achieved through technological solutions including the use of highly efficient electric appliances. Another equally important method is awareness creation and behavior change towards a more efficient use of resources. Changing our habits is a daunting task that calls for much perseverance, but the impact of behavior change can be tremendous and it requires very little (and often no) modern technology or financial resources to be implemented.

To emphasize yet again, the intent of this publication is to be a “buying guide” for common residential electrical appliances like fans, lights, refrigerators, air conditioners, washing machines and geysers to help you understand various technologies available in market, and understand which is the most energy efficient.

To ‘define the need’ one must actively and consciously think about requirements to create a comfortable working/living environment. Decide on your needs without considering the available options that technology has to offer (e.g. the maximum setting on your AC, fan or lights).

These are subjective choices, but we are all similar human beings and you will likely find that we all have similar needs. For example: most people agree that a quiet, bright room at 26˚C with an adjustable office chair and desk make a comfortable office environment. For lighting, AC and ventilation there are many guidelines and even regulations that help to translate needs into objective data and figures.

To conserve energy is to reduce the consumption of artificially generated energy, be it thermal, electrical or any other. Use natural flows and systems (i.e. natural light, shading and natural ventilation) to meet your earlier defined needs as much as possible.

This is where habits play an important role. Many habitual changes, small and large, that can significantly reduce our consumption are known and available. Energy Conservation a is reducing energy consumption without a service/technical interventions (minimum cost or low cost). Energy efficiency is using less energy to provide the same service or output by the deployment of highly efficient appliances. For lighting, air conditioning, ventilation and other services energy conservation and efficiency tips will be introduced in the following chapters.

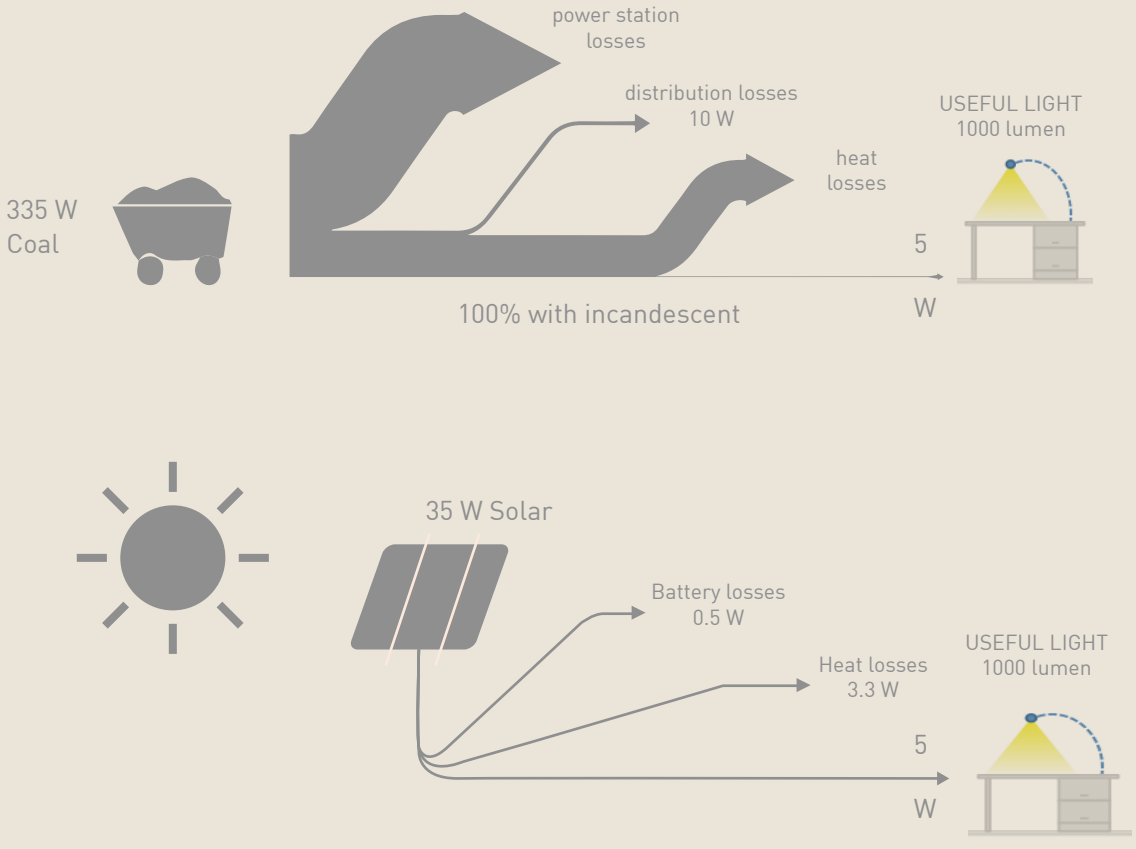
DEFINE THE NEED AND CONSERVE ENERGY

AVOIDED ENERGY – A SYSTEM APPROACH

Typically, centralized energy systems waste more than two-thirds of their energy in the process of generation, transmission and consumption. These are huge losses. It also means that every kWh saved at the consumer side equates to at least 3 kWh worth of energy that does not need to be produced in the first place. Energy conservation interventions at the end-user level translate into substantial savings at the production, transmission and distribution side. Can we imagine reducing energy consumption by 90 percent or more, through energy conservation and energy efficient technologies? What would be the equivalent power plant capacity that can be avoided and the resulting savings?

We want to have a light service of about 1000 lumen. Let us consider a fossil fuel based energy plant with an initial energy input of 335 units, of which 225 units get wasted at the source due to generation inefficiency and heat wastage. Another 10 units get wasted in the transmission and distribution process via the high voltage power grid. Hence, from the initial 335 energy units, only 100 units are available for the end-user; however, 95 units go to waste because of an inefficient light bulb (incandescent lamp). As a result, an input of 335 units of primary energy on the supply side will result in an equivalent of only 5 units of energy service rendered at end-use; the remaining 330 units go to waste.

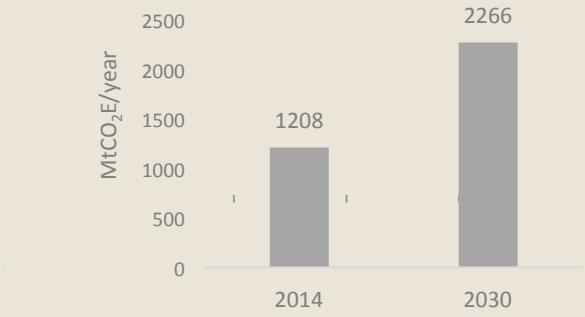
Instead of using an incandescent light bulb to get our 1000 lumen light services we may install an LED lamp which is 9 to 10 times more efficient. By switching from an incandescent light to the LED, we can reduce the energy consumption by a factor of 10. This results in financial savings for the end-user, but more importantly, by replacing an incandescent lamp with a LED, the 335 units of primary energy needed to supply the incandescent lamb will be reduced to only 35 primary units. This represents a saving of 300 units (90%) of primary energy by simply adopting a more efficient appliance. Promoting energy efficient appliances instead of scaling-up the production capacity is one of the most cost-effective interventions, resulting in financial savings, in lowering of CO2 emissions and ensuring that more people have access to energy services.



Energy flow chart from production to distribution

ENERGY CONSUMPTION TRENDS

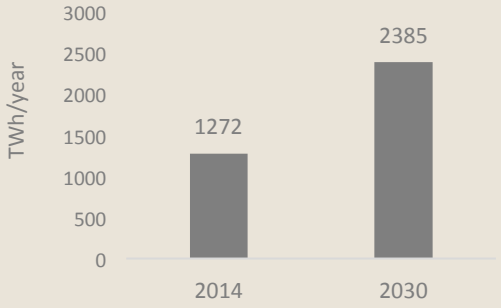
The building sector in India is already consuming close to 35% of the total electricity consumption in India. This is expected to increase further by 700% by 2050, as compared to the year 2005 levels. A large quantity of incremental electricity demand will come from the residential sector. The figures below indicate the electricity consumption and its relative CO2 emissions in India for the baseline year 2014 and its projected forecast in the year 2030.



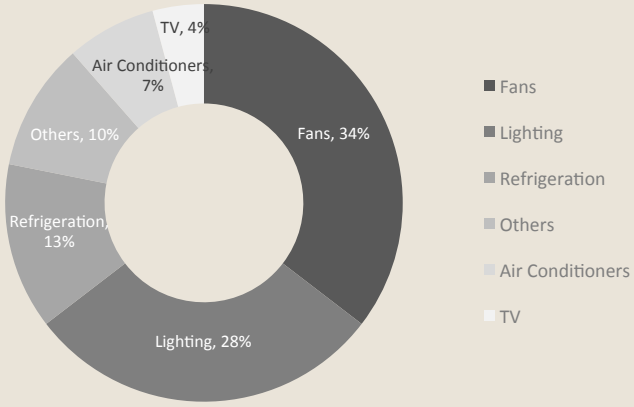
Current electricity consumption of India and its projected forecast

ENERGY SAVINGS POTENTIAL

- Energy efficiency is the fastest, cleanest and cheapest way to meet energy needs (India's projected annual savings is $42 billion).
- 42,370 MW of power plant output can be avoided by 2021 through building energy efficiency.
- Energy savings potential for the economy as a whole is about 23%.
- Potential energy savings of up to 30 - 40% in commercial sector.



Current CO2 emissions of India and its projected forecast

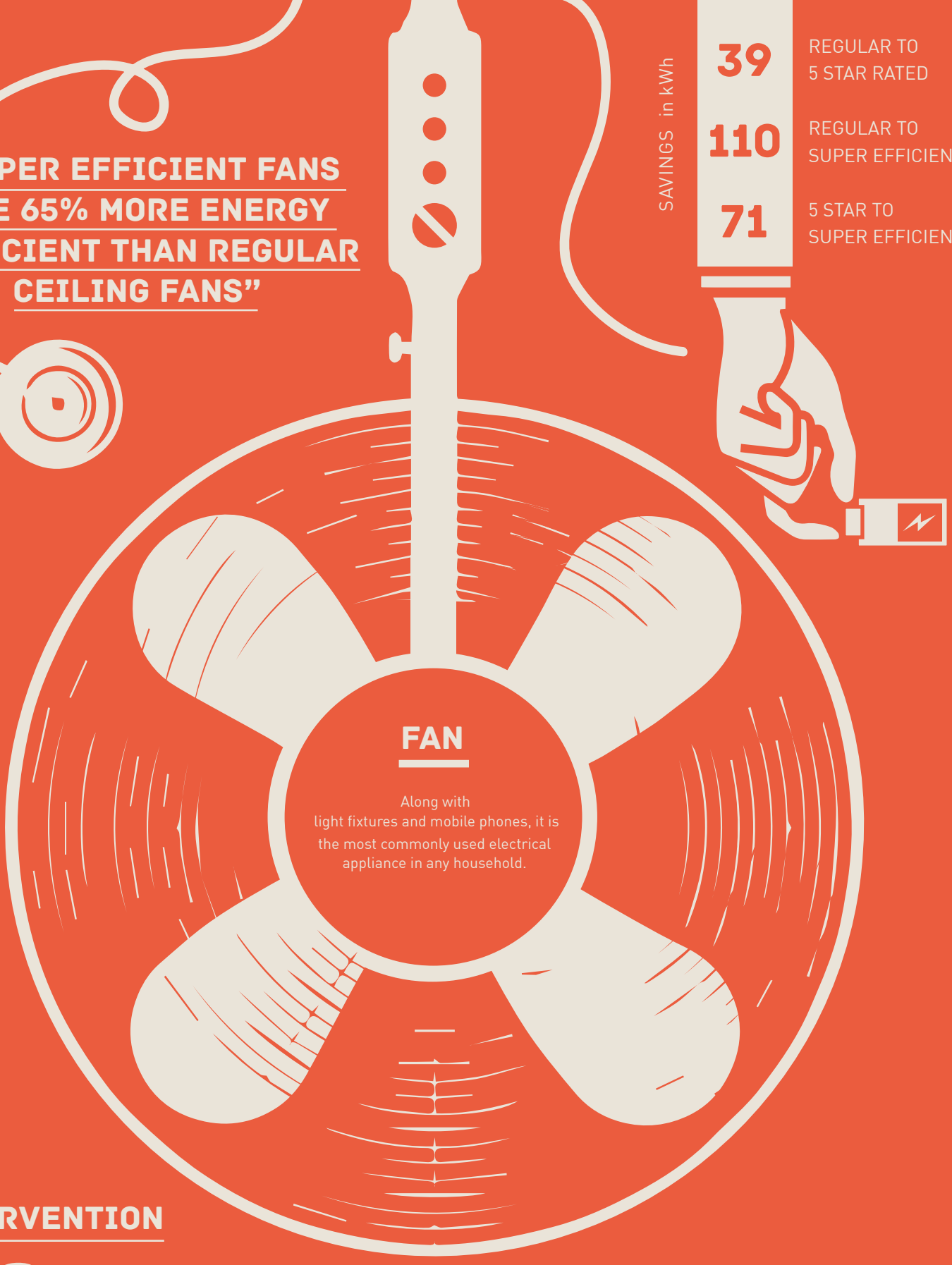


Percentage of average electricity consumption by appliance in India

“SUPER EFFICIENT FANS ARE 65% MORE ENERGY EFFICIENT THAN REGULAR CEILING FANS”

SAVINGS in kWh

39	REGULAR TO 5 STAR RATED
110	REGULAR TO SUPER EFFICIENT
71	5 STAR TO SUPER EFFICIENT



FAN

Along with light fixtures and mobile phones, it is the most commonly used electrical appliance in any household.

INTERVENTION

	REGULAR TO 5 STAR RATED	REGULAR TO SUPER EFFICIENT	5 STAR TO SUPER EFFICIENT
% OF SAVINGS POTENTIAL	23	65	54
LITERS OF PETROL (L/YR)	2	5	3

*kWh = Kilowatt per hour

kWh calculated for the medium running speed of the fan

Auroville Consulting

A fan does not reduce the room temperature. It creates a wind chill effect. By blowing air around, the fan makes it easier to evaporate sweat from your skin, eliminating body heat and thus making you feel 2 to 4 degrees cooler. The more evaporation, the cooler you feel. With much lower electricity consumption in comparison to air conditioning, a ceiling fan can give good comfort in warm and humid climates.

Fans constitute 34% of the annual electricity consumption in a typical residential household in India. This leaves room for a great potential of energy conservation by introducing an energy efficiency intervention.

CONSERVATION

- Maintain at least 0.3m between the fan blade and the ceiling
- The distance of the fan blades from the floor should be (3xH + W)/4, where H is the floor-to-ceiling height of the room, and W is the height of the work plane.
- Install only the number of fans you need; install them at the right height and right place.
- Only run it on step five (full speed) when actually needed.
- Switch off the fan when leaving the room.

MAINTENANCE TIPS

- Dust the blades of the fans on a regular basis.
- Dust the motor casing in the body of the fan.
- Fans that use solid materials for housing, such as metals, tend to vibrate less and last longer.
- The blades should be protected / treated against corrosion.
- Ensure that the blades are balanced in terms of weight and aerodynamics; for this reason the blades of one fan should not be interchanged.

Energy efficiency is all about achieving the same results while using less electricity. The older ceiling fans typically consume about 70-80 Watts of electricity. The air delivery of these fan ranges between 230 and 250 m3/min. In the current scenario, with improved manufacturing technology and a stronger emphasis on energy efficient fans, 5-star-rated fans consume about 45-50 Watts of electricity, which constitutes a reduction in energy consumption of about 35%.

EFFICIENCY

The most energy efficient fans on the market are the so called super-efficient fans, which consume about 30-35 Watts of electricity, with air delivery capability of 250 m^3/min and a reduction in energy consumption ranges from 47% to 65% at lower speeds.

If the replacement of existing fans with super-efficient fans or five-star rated fans is not a realistic option, we recommend changing the regulators from resistor type to electronic type. This contributes towards energy conservation

Changing the resistor-regulator to electronic step regulator can reduce power consumption by:	
61%	at the minimum speed when using an electronic regulator against a conventional regulator.
27%	on average under reduced speed, if the fan is used along with an electronic regulator against a conventional regulator.

WATTS	Savings kWh/year	Savings potential	Liters of petrol/ year
40	77	88%	8
60	110	83%	12
100	175	80%	19

The traditional incandescent light bulbs, which were available in various variants: 40W, 60W and 100W, are the most inefficient in terms of energy consumption. 90% of the energy they consume is lost as heat and only 10% is converted into useful light. They have a lifespan of 1200 hours. These bulbs are energy guzzlers. It makes a lot of sense to replace them with energy efficient options just from a cost-saving perspective.

SWITCH FROM INCANDESCENT TO LED BULBS

Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources like lamps and light fixtures, as well as natural illumination by capturing daylight during the hours between sunrise to sunset.

Lighting constitutes about 30% of the annual consumption of a typical residential household in India and about 24% in Auroville. Thus, it is a major contributor in the electricity bill, and the energy efficient options are fairly simple to implement and provide a higher rate of returns.

3 common variants of lighting:

Incandescent bulbs I LED bulbs I Tubelights

LIGHT

"LIGHTING CONSTITUTES ABOUT 30% OF THE ANNUAL ELECTRICITY CONSUMPTION IN A RESIDENTIAL HOUSEHOLD"

When buying a lighting appliance, look for the:

Wattage: It is a measure of electricity consumption. Lower the watts, lesser the electricity consumption.

Lumens: It is a measure of the brightness (or) light output. More the lumens per watt, better the energy efficiency.

*kWh - Kilowatt Hour

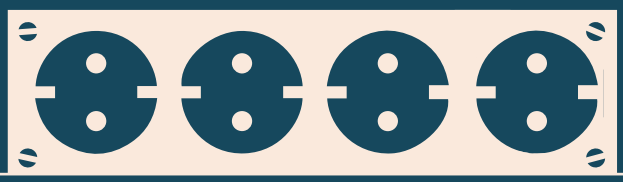
MAINTENANCE & OPERATION TIPS

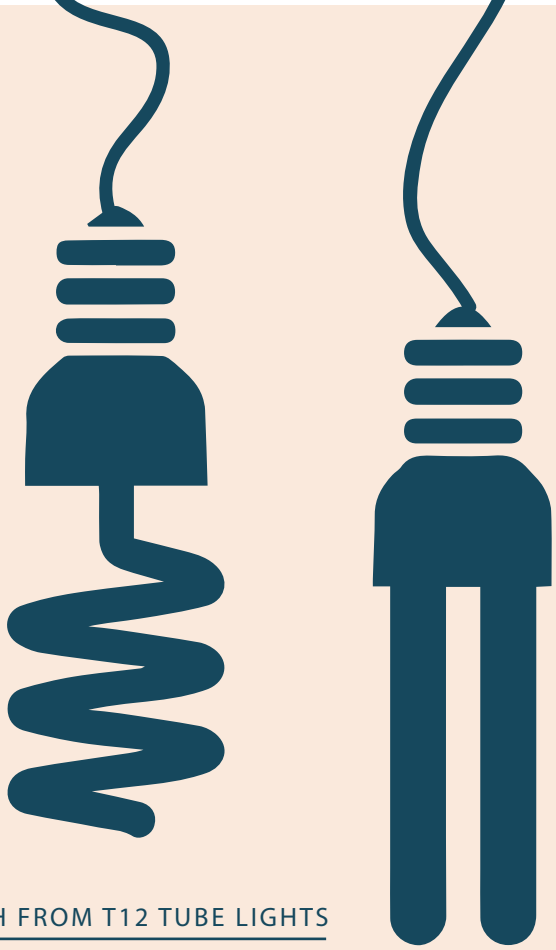
A thick layer of dust on the bulbs and tube lights can reduce luminance by 25%. Dust the lighting appliances on a regular basis.

Controls such as timers and occupancy sensors save electricity by turning lights off when not in use and provide optimum lighting in a room.

Outdoor lights are usually left on for a long time for security or decoration purposes. Using LEDs in these fixtures will save a lot of energy.

Choice of lighting has a direct impact on the air conditioning of the room. Higher number and inefficient working of lighting appliances overworks the compressor of the air-conditioner.





SWITCH FROM T12 TUBE LIGHTS TO T5 TUBE LIGHTS

A typical tube light has a ballast (to stabilize the current through the lamp) and a tube. The tube comes in three standard sizes: T12, T8 and T5 (these numbers represent the thickness of the tube light). The smaller the number, the higher the efficiency.

In the past, tube lights used to come with electromagnetic ballast which caused the lights to flicker on start.

Nowadays we use the electronic ballast which prevents tube lights from flickering. The electromagnetic ballast consumes far more electricity than the electronic ballast. Most tube lights today use the electronic ballast.

T5 tube lights with electronic ballast are the best available tube light options in the market. A T12 tube light with an electromagnetic ballast typically consumes 55W of electricity but a T5 with electronic ballast will consume only 28W.

CONSERVATION

Keep your curtains or shades open during the day to use natural daylight instead of turning on lights.

Turn off the lights in rooms that are not in use.

Decorate your interiors & paint your walls with lighter colors that would reflect the daylight

LEDs are the latest and most efficient lighting option, available in the market. Their electricity consumption is 50% less than that of CFLs and 80% less than incandescent bulbs for the same amount of light.

LEDs are long lasting with a lifespan of about 50,000 hours; performance remains the same throughout their lifespan and they have lower operating temperatures. than incandescent bulbs.

ENERGY EFFICIENCY INTERVENTION FOR TUBE LIGHTS

Switch from	Savings kWh/year	% Savings potential	Liters of petrol/year
Regular T-12 to T-5	59	49	6
Rated T-12 to T-5	26	30	3
Rated T-8 to T-5	18	22	2

ENERGY EFFICIENCY INTERVENTION

DIRECT COOL REFRIGERATORS

Old refrigerators consume significantly higher units as compared to new ones. With improvement in technology refrigerators have become increasingly efficient. Buying a new 5 – Star rated refrigerator will not only save electricity but also provide you with better cooling and latest features in the same sized refrigerator. By replacing your old and inefficient refrigerators, you can achieve an energy saving potential of 50% - 75%.

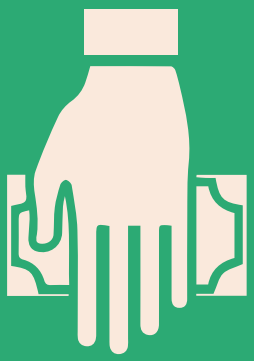
SWITCH FROM REGULAR TO INVERTER

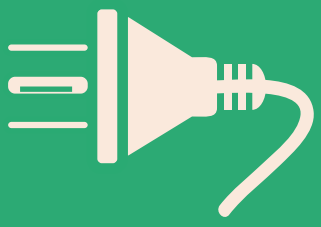
Storage volume 300 to 400 liters

Annual savings kWh/year **1125**

Savings potential **90%**

Liters of petrol/year **124**





"INVERTER TECHNOLOGY REFRIGERATORS SAVES ABOUT 30% TO 50% ELECTRICITY WHEN COMPARED TO A CONVENTIONAL REFRIGERATOR"

Refrigerators are major consumers of electricity in any home after air conditioners. Refrigerators are one of the few appliances, apart from televisions that are common to residences. Nearly 39% of the population in urban households of India possess a refrigerator, based on a NSSO survey in 2012. Refrigerators constitute 13% of the annual electricity bill in a typical residential household.

REFRIGERATOR

Refrigerators have a device called thermocouple which senses the temperature inside the refrigerator and makes the compressor go "on" or "off". Every time the refrigerator door is opened, heat enters the refrigerator and the compressor has to take care of this load as well. So most regular compressors are built to take care of peak load plus the "door open shut" load which during most of the year is much more than the actual requirement. The compressor uses electricity to do its job and is the most electricity consuming part of a refrigerator.

FROST FREE: SWITCH FROM REGULAR TO 5-STAR

Annual savings in kWh **699**

% of savings potential **77**

Litres of petrol/ year **77**

Storage volume 200 to 300 litres

*kWh - Kilowatt Hour

MAINTENANCE TIPS

1. Overfilling of the storage capacity of the refrigerator with food items should be avoided, to ensure adequate air circulation inside.
2. Refrigerator motors and compressor generate heat, so maintain a 10 - 15 cm. gap between the wall and the refrigerator unit on all sides to allow adequate space for continuous airflow.
3. Allow hot and warm foods to sufficiently cool down to room temperature before putting them in refrigerator.

4. Make sure that refrigerator's rubber door seals are clean and tight. If light around the door is seen, the seals need to be replaced

5. Make sure that refrigerator is kept away from all sources of heat, including direct sunlight, and appliances that tend to heat up.

6. When dust builds up on refrigerator's condenser coils, the compressor works harder & uses more electricity. Therefore clean the coils regularly.

7. In manual defrost refrigerator, accumulation of ice reduces the cooling power by acting as unwanted insulation. Therefore, defrost freezer compartment regularly in a manual defrost refrigerator.

8. It is important to pick refrigerator of right size while buying. Also, refrigerators are most efficient when they are full, but not overloaded. With empty refrigerators you pay more for what you use.

9. If refrigerator is older and needs major repairs, it is likely to become inefficient after repairs. It may be advisable to replace old refrigerator with a new and energy-efficient one.

Minimize the amount of time the refrigerator door is open. The longer the door stays open, the more hot air gets inside – making the refrigerator spend energy cooling it down.

Avoid putting hot food items into the refrigerator.

CONSERVATION

EFFICIENCY

Bureau of Energy Efficiency rates various brands and models of refrigerators on their efficient use of electricity. So always look for star rating. Currently, BEE star rating is available only for Single Door (Direct Cool) and Double Door (Frost Free) type of models. For the purposes of this study, we have compared the least energy efficient refrigerator (one that is not BEE rated) with the most energy-efficient model available in the market today.

Inverter refrigerators are currently the most energy efficient refrigerators available in the market.

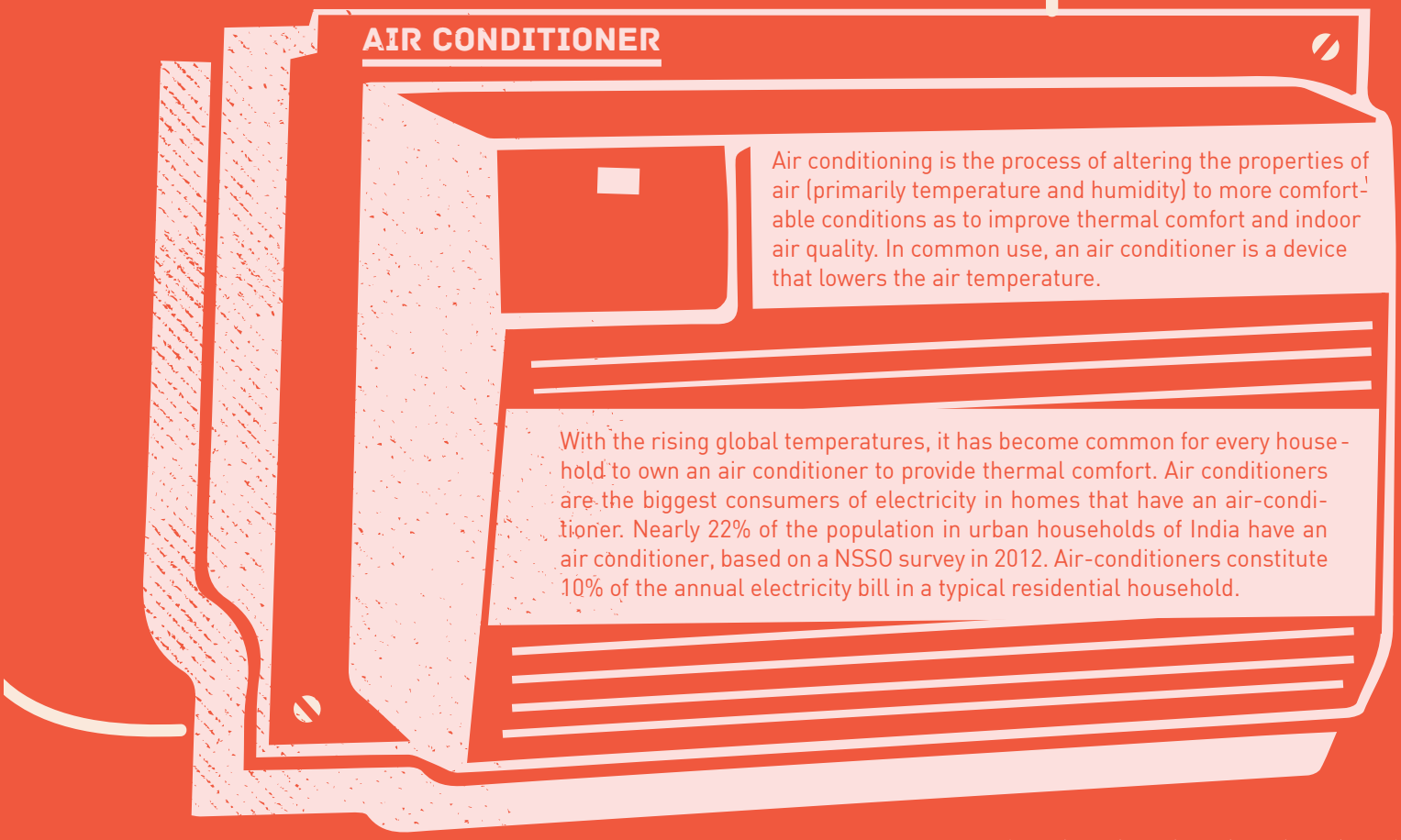
SWITCH FROM REGULAR TO INVERTER

It is an all season refrigerator. It has variable-speed motors that change their speed as per the need. It saves about 30% - 50% electricity when compared to a conventional refrigerator. Although prices of inverter technology refrigerators are on a higher side, they can save a good amount of electricity, thereby helping you recover the money in your electricity bills.

Like refrigerators, the air conditioner attains the desired temperature according to the temperature set by its thermostat. The compressor in the air conditioner is turned on and remains on until the room temperature decreases to be the same as the temperature of the thermostat. Once the desired temperature is reached, the compressor turns off until the room temperature increases again. This turning on and turning off, of the compressor determines a cycle of the air conditioner and its power consumption.

"SWITCH FROM A REGULAR AIR CONDITIONER TO AN INVERTER TECHNOLOGY AIR-CONDITIONER AND ACHIEVE 50% OF ANNUAL ENERGY SAVINGS"

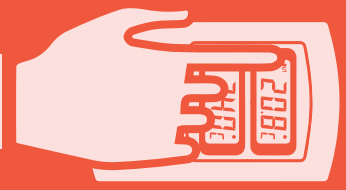
AIR CONDITIONER



Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more comfortable conditions as to improve thermal comfort and indoor air quality. In common use, an air conditioner is a device that lowers the air temperature.

With the rising global temperatures, it has become common for every household to own an air conditioner to provide thermal comfort. Air conditioners are the biggest consumers of electricity in homes that have an air-conditioner. Nearly 22% of the population in urban households of India have an air conditioner, based on a NSSO survey in 2012. Air-conditioners constitute 10% of the annual electricity bill in a typical residential household.

1116	53	123
Annual savings kWh/year	% of Saving potential	Liters of petrol/year



SWITCH FROM REGULAR SPLIT TO INVERTER TECH AC

INTERVENTION

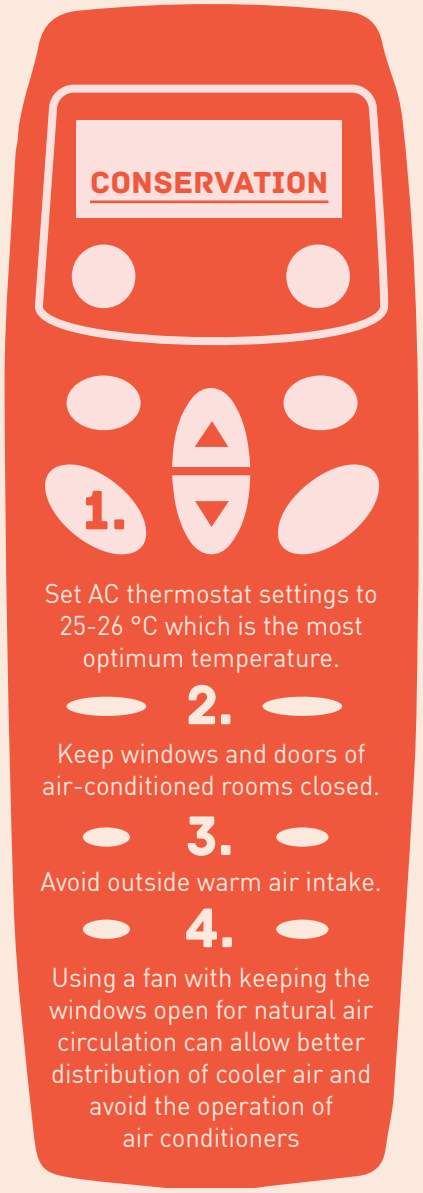
SWITCH FROM REGULAR WINDOW TO 5-STAR WINDOW AC

392	24	43
Annual savings kWh/year	% of Savings potential	Liters of petrol/year

Bureau of Energy Efficiency rates various brands and models of air conditioners on their efficient use of electricity. So always look for star rating. Currently BEE star rating is available for both models: window AC's and Split AC's. For the purposes of this study, we have compared the least energy efficient AC (one that is not BEE rated) with the most energy efficient model available in the market today.

* BEE star rating is upgraded every 2 years, with new technologies coming in. Be sure to make an informed decision, before buying.

*kWh - Kilowatt Hour



1.

Set AC thermostat settings to 25-26 °C which is the most optimum temperature.

2.

Keep windows and doors of air-conditioned rooms closed.

3.

Avoid outside warm air intake.

4.

Using a fan with keeping the windows open for natural air circulation can allow better distribution of cooler air and avoid the operation of air conditioners

5.

Avoid placing appliances (lamps, televisions, etc.) that heat up, near the thermostat control of AC.

6.

Plant a tree or a creeper near windows where air conditioners are installed to prevent direct sunlight from entering the room.

7.

Insulation pipes exposed to weather should be protected by aluminium sheet metal, painted canvas or plastic cover

Adjust the diffuser fins to achieve even cooling of the room.

Use a light colours for interior walls, curtains & interior furnishing. Dark colors absorb more heat.

Ensure to size the tonnage of the AC based on the room size and occupancy. An AC with inverter technology mitigates this problem.

EFFICIENCY

Clean outdoor coils when they become dusty. Efficiency of AC degrades in dusty conditions.

The unit should be installed in a shaded spot on the north or east side which results in a 10% energy savings potential.

Do not place lamps, televisions or other electric appliances near, these appliances generate heat.

Clean the air-conditioner filter regularly:
A dirty air filter reduces airflow and may damage the unit.

Consider light colored paints for interior walls, curtains and interior furnishing. Dark colors absorb heat and will take more time to cool.

Hand over the annual maintenance contract of AC directly to the manufacturer or its authorized service technicians.

If room air conditioner is older and needs major repairs, it is likely to become inefficient after repairing. It may be advisable to replace old AC with a new and energy-efficient one.

Consider providing shading to the outdoor metal cabinet (or) compressor unit of a split AC and window AC, because if it is exposed directly to the sun, the AC tends to overwork.

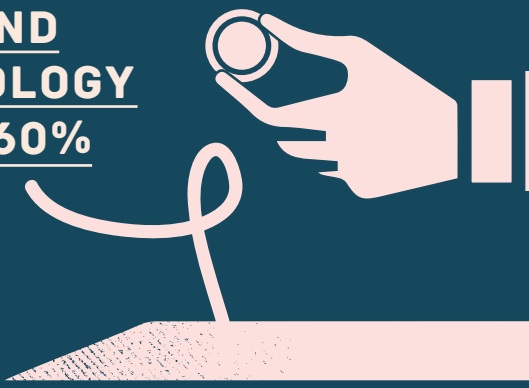
Provide insulation to all the cooling pipes and conduits, which may deteriorate over a period of time.

INTERVENTION

SWITCH FROM REGULAR TO INVERTER TECH. + DIRECT DRIVE TECHNOLOGY WASHING MACHINE

Washing machines are the third highest consumers of electricity, after AC and refrigerators, in a residential setting.'Over the years, many Indian households have switched from conventional hand washing to regular washing machines with the launch of cheap models of washing machines. Nearly 20% of the population in an urban setting have access to a washing machine in their households. This leaves room for a great saving potential, in terms of energy and water, if an efficient washing machine is used. Hence in both cases, buying a BEE 5 star rated washing machine is always recommended.

"WASHING MACHINES WITH DIRECT-DRIVE TECHNOLOGY AND INVERTER TECHNOLOGY CAN HELP SAVE 60% OF ENERGY"



168	62	18
Annual savings kWh/year	% of Savings potential	Liters of petrol/year

FULLY AUTOMATIC VS SEMI AUTOMATIC MACHINES

Whenever "Automatic" is associated with a washing machine, it means that the machine not only washes the clothes but also extracts after washing. The main difference between a Fully Automatic and Semi-Automatic washing machine is that in fully automatic washing. entire process from washing to spinning happens through an automated program, whereas in semi-automatic, you will have to move clothes from one operation to another manually. Since both machines operate similarly, from a conservation point of view, neither option offers great benefit over the other.

For the purposes of this study, we have considered a fully automatic front-loader washing machine with a 7 kg rated capacity (typical in all residential households).

Electricity consumption of washing machine depends on how you use the washing machine. Front loaders use less water but have longer wash cycles. Top loaders use more water but have smaller wash cycles. If you use hot water, then top loaders will consume more energy since the amount of electricity needed for heating up the water is far higher than the amount needed by the motor of the washing machine. If you use cold water, a front-loader washing machine will consume more energy since they have longer wash cycles.

*kWh - Kilowatt Hour

Never leave a washing machine in standby mode.

1.

2.

Whenever possible, use cold water, it can drastically cut down on the electricity used.

CONSERVATION

3.

Hang your clothes outside to dry. Not running the dryer not only saves energy, but also helps them last longer.

Choose a high spin speed or the extended spin option to reduce the amount of remaining moisture in your clothes after washing.This decreases the amount of time it takes to dry your clothes.

4.

EFFICIENCY

A washing machine with the inverter technology has sensors that detect the load of the washing machine. Based on the load, the electronic circuit determines the optimum speed at which the motor should be run to optimize the electricity use. These models have a VFD or Brushless DC motor that allow optimum use of electricity at variable speeds.

A washing machine with the direct-drive technology possesses less moving parts; the gears and belts that are present in the conventional motor are absent here. This ensures that the energy lost in friction or in running a gearbox is reduced. Therby saving electricity.

Rinse the washer once a month by running an empty cycle with a cup of bleach and water to help reduce the risk of mold or mildew buildup.

Washing machines use about the same amount of energy regardless of the size of the load, so run full loads whenever possible, but do not overload them.

MAINTENANCE

Leave the machine door open after each wash; washing machines use airtight seals to prevent water from leaking while the machine is in use. When the machine is not in use, this seal can trap moisture in the machine and lead to mold.

Use the right detergent or else it may need multiple cycles to wash the clothes properly leading to water and energy wastage.

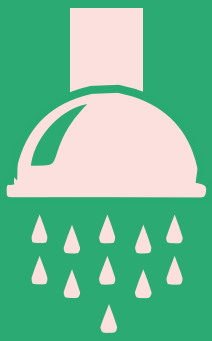
While buying a water heater one has to make sure that not only does it cover the needs of the family, but it also does not leave a significant dent on electricity bills. People often look at the wattage, however wattage does not affect the electricity/energy consumption of water heaters. The energy consumption of a water heater depends on the following factors: Volume of hot water used, temperature of the tap water, temperature of water used for bathing, Thermostat temperature (by default, this is set to 60°C by all manufacturers) and standing losses (heat lost through the surface of the water heater, when no water is drawn).

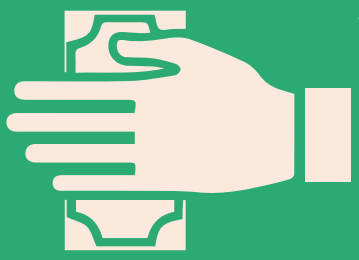
"THE IDEAL SIZE OF WATER HEATER SHOULD BE CLOSE TO THE VOLUME OF HOT WATER REQUIRED AT ONE GO"

Solar and renewable energy are quite popular these days. Solar water heater is a system that utilizes solar energy (or the energy from sunlight) to heat water. It has a system that is installed on a terrace or open space where it can recieve sunlight and the energy from the sun is then used to heat water and store it in an insulated tank. The system is not connected to electricity supply and thus does not have an on-off switch, but it uses the sunlight throughout the day to heat the water and store it in the storage tank. Water from the storage tank can then be used for any application as desired.

For the purposes of this study, we have considered a 25 liter capacity electric water heater, which is typically used in a common household setting. We have not considered instant water heater and gas water, though it proves beneficial in energy costs because they are not very prevalent. We have drawn comparisons between the least efficient and the most efficient electric water heater available in the market today, of similar capacities (or) storage volume.

"Standing loss" or heat/energy loss of a water heater to the surrounding in 24 hours is an important factor used by BEE to decide on the star rating of a water heater. Using hot water optimally and choosing the right sized heater can minimize "Standing Loss", but the most efficient water heater for a given size can assist in minimizing losses. The water heater with the least value of standing loss units is ranked as the most efficient. BEE star rating is optional for water heaters, hence not all water heaters available in the market are rated. It is always better to buy a branded water heater because brands comply with BIS standards and are safe to use.





INTERVENTION

209	32	23
Savings kWh/year	% of Savings Potential	Liters of petrol/ year

SWITCH FROM REGULAR TO 5-STAR RATED WATER HEATER

*kWh - Kilowatt Hour

CONSERVATION

1. Switch on the geyser before use & switch it off immediately after you bathe.

2. Use less hot water, as water will help save electricity.

3. The geyser consumes electricity when unused hot water is left in the geyser.

EFFICIENCY

Sizes of solar water heaters in the market start from 100 to 200, 250, 300 and 500 liters per day. The maximum area required for the similar capacities are: 2 sq.m, 4 sq.m, 5 sq.m, 6 sq.m, 10 sq.m respectively. An ideal step to attain energy efficiency is to replace the inefficient electric geysers with a solar water heater. From an electric geyser of 25 lpd capacity in a household of 4 members, a switch to a solar water heater of a 100lpd capacity is recommended.

SWITCH FROM REGULAR TO SOLAR POWERED WATER HEATER

658	100	72
Annual savings kWh/year	% of Savings potential	Liters of petrol/year

Scaling happens on solar water heaters regularly especially if the water is hard. So the collectors need regular cleaning using acid. Ensure you have an annual service contract with the installers.

Occasional leakages could happen in the system, but local plumbers are sure to repair such problems.

MAINTENANCE & OPERATIONAL TIPS

Use smaller sized geysers, because the electricity consumed is dependent on the amount of water heated.

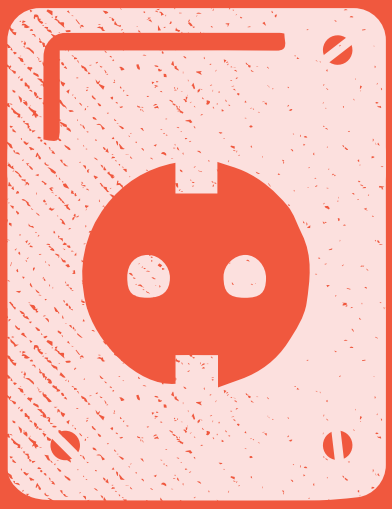
Periodic maintenance of your electric water heaters /solar water heaters can minimize the efficiency losses.

"ONE WEAK CELL IN THE BATTERY INCREASES THE INTERNAL RESISTANCE AND REDUCES THE PERFORMANCE OF BATTERY"

Inverters cannot save electricity. When the electricity passes through the inverter, there are some losses in the electricity, which cannot be entirely eliminated. However, the overall efficiency of an inverter A of a particular manufacturer can definitely be better than another inverter B of a different manufacturer, which means that the energy losses in one inverter can be lower than energy losses in another. But energy loss in an inverter will always be there.

INVERTER AS POWER BACKUP

In this case there is no power supply from the mains, so power is taken from the battery and supplied to the setup where it is used. Efficiency here will be effectiveness with which inverter draws and uses 1 unit (or kWh) of power. If all of it is effectively used then the process is 100% efficient. But if only 0.85 units are supplied to the system then the efficiency will be 85% with 0.15 units lost.



Efficiency of a system in simple terms can be defined as the ratio of power it gives as output to power it takes in as input. If the batteries are charged using regular power supply then there are 2 operations for which efficiency can be identified: power backup and charging of batteries

CHARGING OF BATTERIES

Here the inverter takes power from the power supply and charges the batteries. Power input is power taken from mains and power output is the energy saved in the battery.

Efficiency here will be effectiveness with which inverter saves 1 unit (or kWh) of power. If all of it is stored in the battery it will be 100%. If only 0.85 units are saved then the efficiency will be 85% with 0.15 units of energy lost.

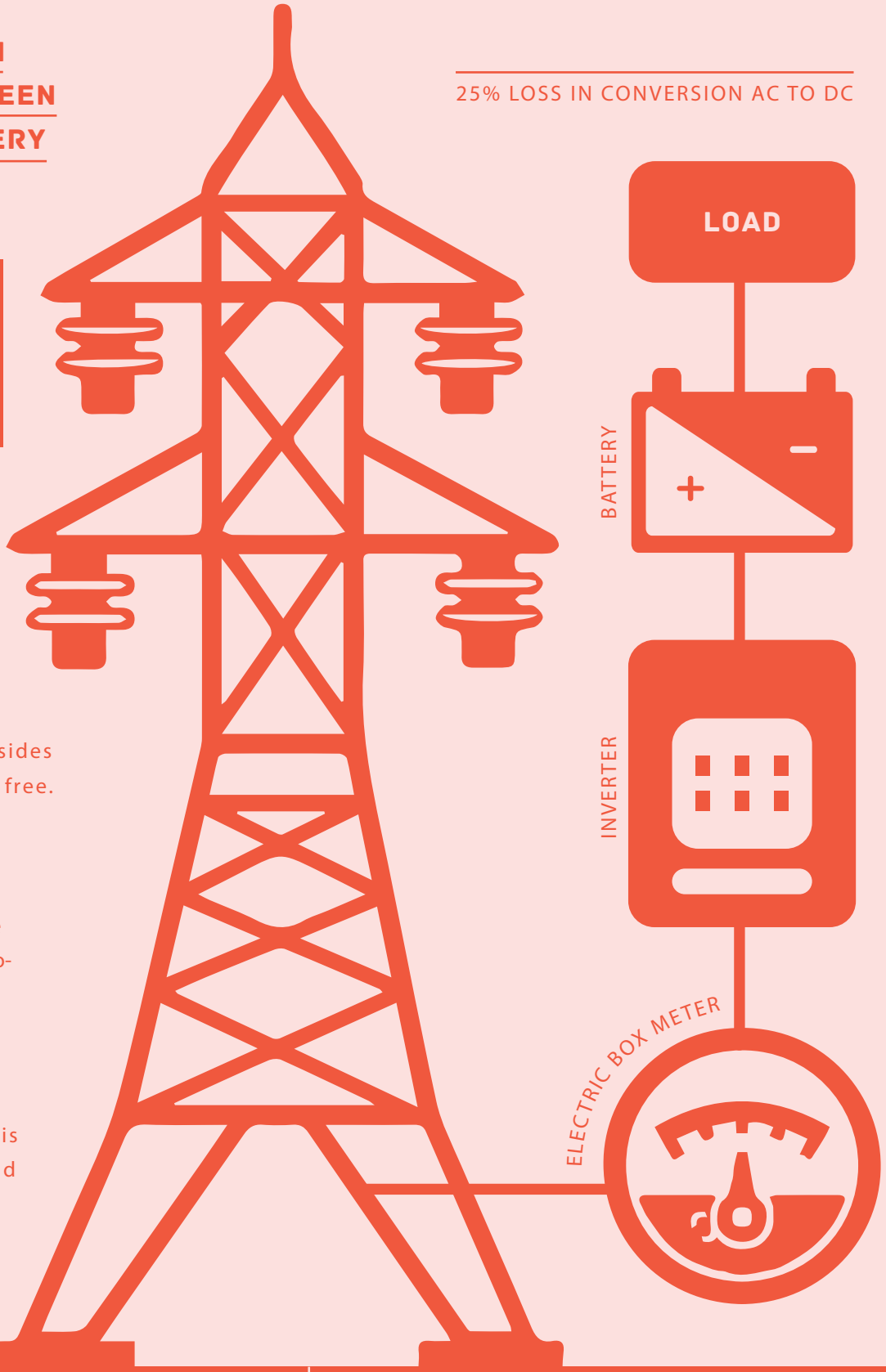
Inverters are not 100% efficient. Inverters use certain energy to drive their electronics and cooling fan. It is 8% during no load and goes up to 20% during full load. This inefficiency is generally taken care of by the manufacturer and the kVA rating mentioned is what is at the output terminal

INVERTER & BATTERY

*kWh - Kilowatt Hour

ENERGY LOSS IN CONVERSION BETWEEN INVERTER & BATTERY

25% LOSS IN CONVERSION AC TO DC



MAINTENANCE & OPERATIONAL TIPS

If your battery faces issues like heating and low backup time, it needs attention.

Always keep the top and sides of battery clean and dust free. Use cotton cloth to clean these surfaces.

Rusting and corrosion are very bad for battery perfo-rmance. Keep the battery terminals corrosion free and rust free.

Replace your battery if it is dead or damaged. One bad cell can reduce the efficiency and life of the battery.

Chart out an annual maintenance contract with battery installers for regular and timely maint-enance related checks to improve the life of the batteries.

Store the batteries in an adequately ventilated place; battery life decreases with every 10% upsurge in air temperature.

Always top up the battery with distilled water.

After installation, use the battery on a regular basis. If there are no frequent power cuts, discharge the battery completely once every month and then recharge it.

If you use tubular lead acid batteries, check their water level every two months. Ensure that the water level is maintained between the maximum and minimum water limit.

“THE AMOUNT OF SOLAR ENERGY THAT IS ASORBED BY THE EARTH’S ATMOSPHERE IS EQUIVALENT TO 8000 TIMES THE TOTAL ELECTRICITY CONSUMPTION IN THE WHOLE WORLD”

Solar PV panels come in two variants: Mono is for mono-crystalline PV cell and multi is for multi-crystalline (or polycrystalline) PV cell. The difference between the two is that mono-crystalline is made of single silicon crystals whereas multi-crystalline PV is made up of multiple crystals. A mono-crystalline is more efficient in converting solar energy into electricity per square meter area than a multi-crystalline PV. Thus the space required for the same amount of wattage is less in mono-crystalline PV panel.

However, a mono-crystalline PV is costlier than a multi-crystalline PV. The choice between the two depends depends on the area that you have for PV installation.

SOLAR PV

INVERTER & BATTERY

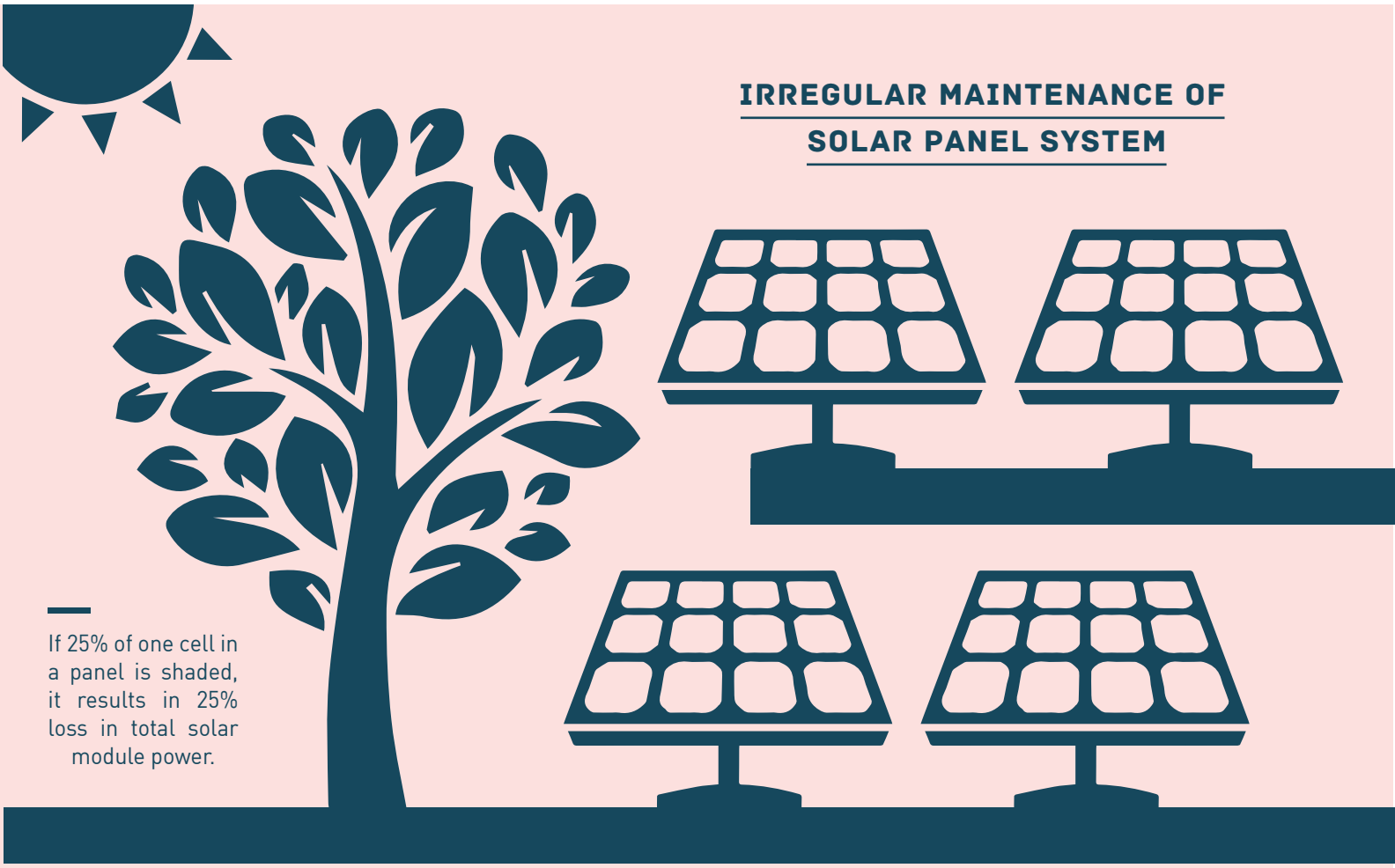
With increasing power tariffs, power cuts and decreasing solar panel prices, there is an upsurge in interest in people to adopt solar technologies.

Electricity cost rises every day, causing more people to show interest in using solar energy to meet their electricity needs. Power cuts and dependence on diesel generator sets is making people look for more and better sources. Solar PV panels provide a good alternative

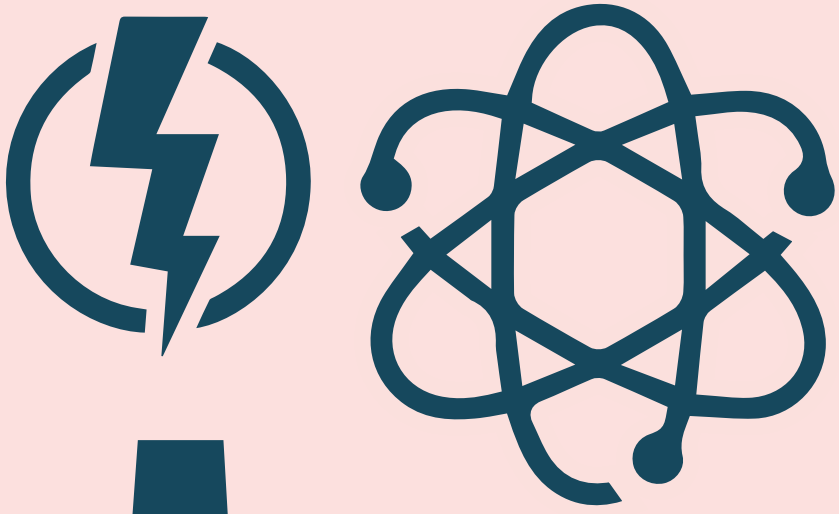
Solar panels are an investment that requires maintenance, in order to run efficiently. Here are a few operational and maintenance tips to help you get the most from your solar panels.

*kWh - Kilowatt Hour

IRREGULAR MAINTENANCE OF SOLAR PANEL SYSTEM



If 25% of one cell in a panel is shaded, it results in 25% loss in total solar module power.

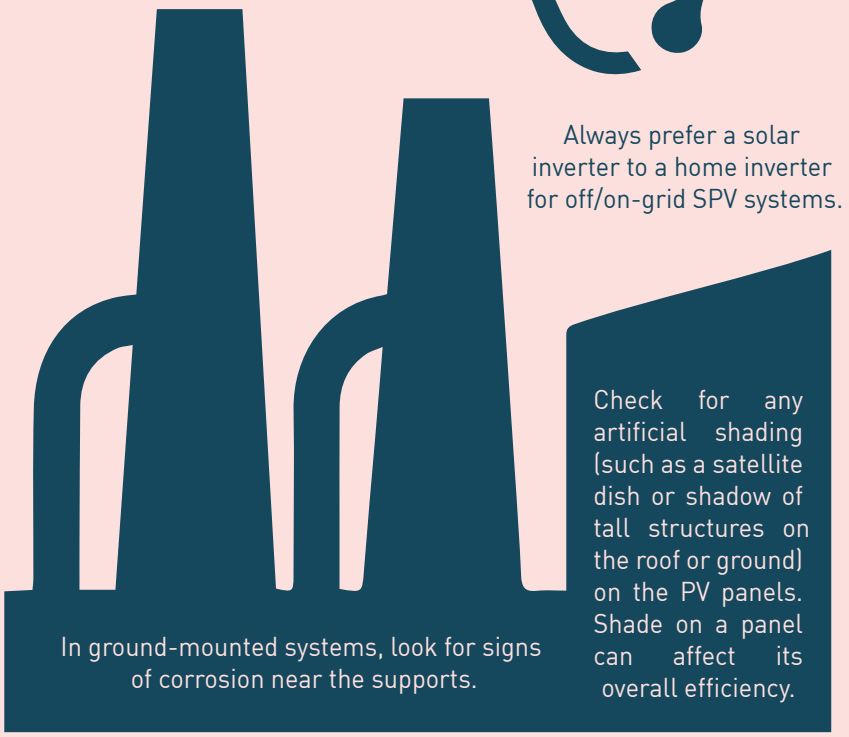


Preventive, predictive, and corrective maintenance of SPV systems can improve the overall efficiency of the system.

At least once a year, ensure that O&M personnel conduct a general inspection of the PV installation site.

Panels may tend to get shadowed by trees. Every six months trim any overhanging branches back to ensure maximum light hits each panel.

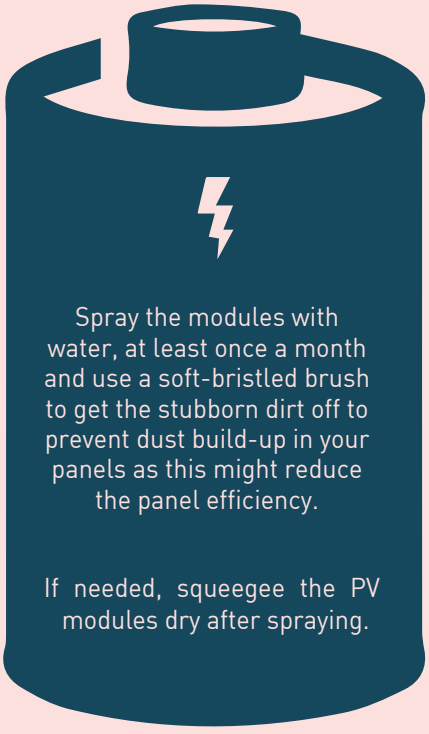
Check for signs of animal infestation under the PV arrays.



Always prefer a solar inverter to a home inverter for off/on-grid SPV systems.

In ground-mounted systems, look for signs of corrosion near the supports.

Check for any artificial shading (such as a satellite dish or shadow of tall structures on the roof or ground) on the PV panels. Shade on a panel can affect its overall efficiency.



Spray the modules with water, at least once a month and use a soft-bristled brush to get the stubborn dirt off to prevent dust build-up in your panels as this might reduce the panel efficiency.

If needed, squeegee the PV modules dry after spraying.

Inspect PV modules for defects that can appear in the form of burn marks, discoloration, delamination, or broken glass.

Check modules for excessive soiling from dirt buildup or animal droppings.

In roof-mounted SPV systems, check the integrity of the penetrations.

Auroville Consulting

ENERGY CONSERVATION & EFFICIENCY

A GUIDEBOOK FOR RESPONSIBLE ENERGY MANAGEMENT

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2016