Advance Physics Letter

Estimation of CO_2 Saving From Household (Residential) Appliances Assisted With "Solar Technology"

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Abstract-The present study is done to report the possible optimization of CO_2 emission, other greenhouse gases and possible reduction of coal consumption at thermal power stations which is to generate the electricity for home appliances. The analysis is done to optimize the electricity usage with certain considerations regarding the domestic equipment so that we can save electricity. It is found that we are currently consuming power 784.49 million Unit per day in India as estimated in table 3. Coal consumption for producing this much power is estimated around 588.368 million kg. The CO_2 emission estimated around 2.898 lakh tone. One of possible methods to save the energy is to use the solar options. Thus assistance of solar technology for energy i.e. power generation is presented.

Index Terms- Energy, CO_2 Emissions, Solar Option

I. INTRODUCTION:-

Day by day the coal consumption in power plants is increasing due to need of energy in various forms. The living standard of mankind are changing continuously and thus the rate of energy consumption also increasing.As coal is slowly depleted in around 25-30 years [1]. If we are not finding the better alternative of coal then this coal is depleted as soon as.We can reduce the coal consumption by changing our life style and also introducing some assistance with renewable energy sources to the electrical and electronic equipment's.

The first question comes in our mind how it possible? Our electric & electronic equipment's how it will work?

What is the capacity of that product?How much power consume by the product?How can reduce the power consumption by this product?How much coal consume by the power plant to produce this amount of electric power?What is the benefit & what are their effects in our environment? These are some of basic questions and solution to these questions are analysed in the paper.

Energy is one of the major inputs for the economic development of any country. For developing countries, the energy sector has a critical importancein view of the ever-increasing energy needs requiring huge investments to meetthem. Energy intensity (energy consumption per unit of GDP) indicates thedevelopment stage of the country. India's energy intensity is 3.7, 1.55, 1.47 times of Japan, USA, Asia and 1.5 times of World average respectively.

The major commercial energy consuming sectors in the country are classified in the figure, industry remains thebiggest consumer of commercial energy and its share in the

Over-all consumption is 49%.The usage of energy resources in industry leads to environmental damages by polluting the atmosphere. Few of examples of airpollution are sulphur dioxide (SO_2), nitrous oxide (NO_X) and carbon monoxide (CO) emissions from boilers and furnaces, chloro-fluro carbons (CFC) emissions fromuse of refrigerants, etc.

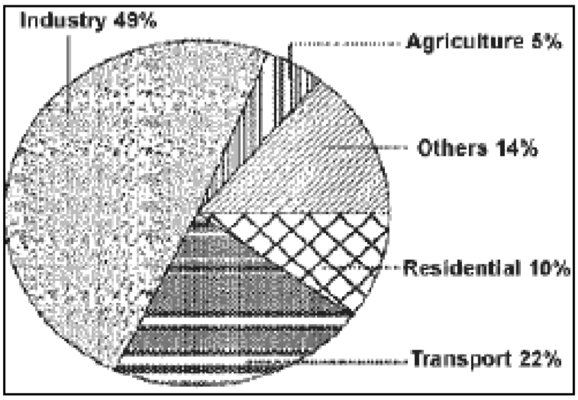

Fig 1- Energy Consumption in Various Sectors

II. ELECTRICITY DEMAND & PRODUCTION:-

Electricity demand, growing at 8.7% annually during the present decade, has outstripped theEconomic growth rate of 6.2% and electricity consumption per person has increased to355 kWh (2001–2002) from 90 kWh in 1972 [2] Coal demand in the country was been projected to be 460 and 620 Mt for the years 2006–2007 and 2011–2012, while the total commercial energy demand was 411.91 and 553.68 M tone for the same years.Consumption scenario has been determined to be 5584 MU equivalent of electricity.

The future projections for the year 2013-14 to be 6831 million equivalent units of electricity. As such the target set for the year 2013-14 is 10% of the forecasted energy consumption scenario by MNRE which comes out to be 683 million equivalent units of electricity.

Year	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**	**2019-2020**
Electricity (MU)	**1620**	1695	1774	1856	1942	2033	2127	2226
Petrol (MU)	**685**	717	750	785	822	860	900	942
Diesel (MU)	**2933**	3130	3341	3567	3807	4064	4338	4631
Kerosene (MU)	**909**	876	844	814	784	756	728	701
LPG (MU)	**399**	412	426	441	456	471	487	504
TOTAL	**6545**	6831	7136	7462	7811	8183	8580	9004

Table 1- Energy Consumption (Source: MNRE)

III. SPECIFIC COAL CONSUMPTION:-

The coal consumption depends on ash contain, volatile matter contain etc. For Indian coal with 42% ash & 12% volatile matter the rate is 350MT/hr of coal for a 500MW (G.D. Rai). The All India specific coal consumption in thermal power stations during 2006-07 was 0.70 kW/kWh [3]. Region wise Coal consumptions are given below:

Table No. 2

Region	**Sp. Coal Consumption (Kg/Kwh)**	
	2005-06	**2006-07**
Northern Region	0.691	0.688
Western Region	0.724	0.752
Southern Region	0.654	0.680
Eastern Region	0.719	0.733
All India	**0.70**	**0.715**

ELECTRICITY CONSUMPTION SCENARIO-

Raipur comes under the area of Chhattisgarh State Power Distribution Company Limited which is formed in the unbundling of Chhattisgarh State Electricity Board into five companies in accordance with the provisions contained in the Electricity Act 2003 by the Govt. of Chhattisgarh, Notification on dated 19.12.2008. The electricity generation in Chhattisgarh is around 1924.7 MW which is being met from different generating stations. Raipur has 255 MW average annual demands for electricity. At present, city is getting its power through Chhattisgarh State Power Distribution Company limited. As shown in figure below the annual electricity consumption of the city is growing [14].The power consumption ofelectricity in Raipur has increased from 1402.15 MU in year 2006-07 to 1941.925MU in the year 2008-09. The daily average power requirement was reported to be around 5.32 MU. The major energy consumingcategories are residential, commercial/institutional (offices and shops),municipal services, industrial and transport.

IV. POWER COSUMPTION BY DOMESTIC APPLIANCES:-

In our daily life we are using many kinds of domestic products like tube lights, T.V., Computers, Laptop, Refrigerator, A.C. etc.These products are operated by electricity & they are consuming some power by their designed parameter or capacity.The power consumed by each appliance depends on many factors:

a. The average watts per hour consumed by the appliance when in active use. For many appliances, this is not the same as the rated power consumption of the appliance since most do not normally operate continuously at their rated energy consumption.

b. The number of hours in active use of each appliance per year.

c. The power consumed by the appliance (standby power) when it is not in active use.

By the help of this method (which are given below) we know how much power consume & how much our electricity bill is by this equipment.

V. ENERGY CONSUMPTION ANALYSIS:-

A sample analysis is presented and in similar manner the analysis has done for all appliances mentioned in table 3.

Ex: - If we have 30W of CFL bulb then

Power consume by CFL- 30W

Average hours using in a day – 8hr

Electricity cost per unit – 3.5 Rs

Total power consume by product in a day (kWh)-

30×8×1 = 0.240 kWh

Cost per hours –0.03×3.5×1 = 0.105 Rs

Cost per day – 0.105×8 = 0.84 Rs

Cost per month –0.84×30 = 25.2 Rs

Cost per year – 0.84×365 = 306.6 Rs

Domestic Equipment:-

Assuming that for domestic purpose above mentioned appliances required in a single home. According to 2011 survey of India the annual household appliances sells is given [4] in Table No.3.

Table No - 3

Appliances for a single home (Assumed)	Power Consume In A Day (KWh) By One Appliance	Total Appliances Sold in a year (Millions)	Total Power Consume in a day (Millions Kwh)
Lightning	0.24	522.9	125.496
Cooler	0.8	38.5	30.8
Fan	0.84	353.9	297.276
Television	1.5	139.6	209.4
Refrigerator	4.8	33.3	159.84
Washing Machine	0.3	16.5	4.95
A.C.	9.6	4.7	45.12
Microwave	4.2	12.5	52.5
Water Heater	2.0	38.9	77.8
Computer	0.5	3.3	1.65
Radio	1.2	74.4	104.16
CD Player	0.16	64.2	10.272
Toaster	0.4	3.6	1.44
Total	**26.18**	**1306.3**	**1120.703**

VI. ANALYSIS OF COAL CONSUMPTION & POWER CONSUMTION:-

Residential electricity consumption is still gradually rising, year by year. Although many appliances are getting more efficient and more powerful in terms of energy consumption, appliances are used more often and for longer periods of time, and many appliances are having more functions or special features that require more energy.To produce 1unit electricity 0.75kg of coal is required [5].In our analysis we are considering only those appliances which are given below-

Table No - 4

Appliances	Total No. of Appliance	Power use by sigle appliance (kWh)	Total Power uses (kWh)	Total Cost per day
CFL Bulb	4	0.24	0.96	3.36
Computer	1	0.5	0.5	1.75
LED T.V.	1	0.4	0.4	1.4
Refrigerator	1	4.8	4.8	16.8
Elec. Iron	1	1	1	3.5
Celling Fan	2	0.34	0.68	5.88
Cooler	1	0.8	0.8	2.8
Washing Machine	1	0.3	0.3	1.05
Total	**12**	**8.38**	**9.44**	**39.62**

For domestic purpose we need approximately 10 kWh or 10 unit and to produce this much power we require in the power plant 7.5 kg of coal in a day for a single household. In 2011 survey, household appliance sold volume around 1306.30 million (from table 3). From analysis it is fond that these appliances consumes more than 1120.70 million unit of electricity in a single day (assuming all devices running through the day).

To produce this much of electricity we require- 1120.70×0.75 = 840.525 million kg of coal

So our household appliances consume 840.525 million kg of coal and 1120.7 million kWh electricity in a single day.

VII. GREEN HOUSE GAS EMMISSIONs:-

Raipur falls under the area of Chhattisgarh State Electricity Board (CSEB). In Raipur City power is beingdrawn from the new integrated Northern, Eastern, Western and Northeastern regional Grid. The average specific emission factor for grid has been reported as 0.85t CO_2/MWh as per Central Electricity Authority. The emission factor as 0.85tCO_2/ MWh for electricity generation.

Emission of CO_2can be calculated as[5]-

$q_{CO2} = c_f / h_f \times C_{CO2}/C_m$

Where:-

q_{CO2} = specific CO_2 emission (CO_2/kWh)

c_f = specific carbon content in the fuel (kg_C/kg_{fuel})

h_f = specific energy content (kWh/kg_{fuel})

C_m = specific mass Carbon (kg/mol Carbon)

C_{CO2} = specific mass Carbon Dioxide (kg/mol CO_2)

Emission of Carbon Dioxide, when combusted, some common fuels are indicated in the table below.

Table No. 5

Fuel	Specific Carbon Content *(kg_C/ kg_{fuel})*	Specific Energy Content *(kWh/ kg_{fuel})*	Specific CO_2 Emission *(kg_{CO2}/ kg_{fuel})*	Specific CO_2 Emission *(kg_{CO2}/ kWh)*
Coal (bituminous/anthracite)	0.75	7.5	2.3	0.37
Gasoline	0.9	12.5	3.3	0.27
Light Oil	0.7	11.7	2.6	0.26
Diesel	0.86	11.8	3.2	0.24
L.P.G.	0.82	12.3	3.0	0.24
Natural Gas, Methane	0.75	12	2.8	0.23

Here the heat loss 55%-75% - in power generation is not included in the numbers. So the approximated household appliances required minimum power about 10 units (kWh) & 7.5 kg of coal in a single day in single house and it will emit 3.7 kg of CO_2 approximately.India is liberating more than 4.146 Lakh Tone of CO_2 in a day by household appliances. This is only single day of liberation of CO_2 that is very-very dangerous for our health, wealth & environment.

VIII. EFFECT ON ENVIRONMENT:-

Coal is the major fossil fuel used in industrial units and power plants for generation of power in India. The CO_2 emitted as a product of combustion of coal (fossil fuels) is currently responsible for over 60% of the enhanced greenhouse effect. Through combustion process coal is convertedinto useful heat energy, but it is also produces the harmful gases and products for health and environments. Coal Combustion at thermal power plants emits mainly carbon dioxide (CO_2), sulphur oxides (SO_x), nitrogen oxides (NO_x), CFCs [6], other trace gases and air born inorganic particulates. CO_2, NO_x and CFC_s are greenhouse gases (GHGs). CO_2 produced in combustion is perhaps not strictly a pollutant (being a natural product of all combustion); nonetheless it is of great concern in view of its impact on global warming. Carbon dioxide molecule is a stable molecule with less than 10 years average residence time, i.e. 3 years in the troposphere [6], though its residence time is over 100 years in the atmosphere, and its concentration rate in the atmosphere is increasing by 0.4% per year.

The Intergovernmental Panel on Climate Change (IPCC) suggests that the global mean surface temperature of the earth has increased by between 0.3° and 0.6°C since the late 19th century. Giorgi and Hewitson[6] concluded that a doubling of CO_2 would increase the temperature by 2–4°C and decrease rainfall by 10–20%.The global atmosphere traps an increasing amount of heat due to the increased concentration of CO_2, and thus, results in higher temperatures. This atmospheric temperature change is of concern since even an increase of a few degrees would lead to severe regional effects, such as prolonged droughts, crop failure, cropping pattern change, vegetative production with increased desertification, polar ice partially melting, resulting in ocean flooding and submergence of major portions of low lying islands and coastal areas.

Problems like global warming, climate change, natural hazards like flooding and change in sea levels are on their headway. The increasing concentration of carbon dioxide is held responsible for all these. For all these changes, human activities are held responsible, which mainly includes the emission of GHGs by fossil fuel combustion [6]. CO_2 is a universal production of the cycle of life. It is absorbed by plants and generated and released by oxygen utilizing processes such as animal respiration, natural decay processes and anthropogenic combustion of fossil fuels. The level of CO_2 in the world depends on the balance between these processes. CO_2 is a product of the combustion of the hydrocarbons in coal, oil and gas.

IX. NEED FOR RENEWABLE ENERGY-

India has been dependent on fossil fuels such as coal, oil and gas for its energyrequirements. Today, more than 65% of its capacity is fossil fuel dependent. Despitethe recent discoveries of gas as well as initiatives to develop coal reserves, it is likelyto have dependency on fossil fuels in coming future. However, in the last couple of years, the price of fossil fuels has shown a consistent upward trend.India currently imports about 72% of its total oil consumption and this share ofimported oil is expected to reach 90% by 2031-32. The story of coal imports is notexpected to be significantly different. It is envisaged that India will be importing 50-60 million tons of coal every year by the end of the eleventh five year plan.

According to the scenarios developed as apart of the Integrated Energy Policy report(IEPR) by the planning commission, imports could increase to as high as 45% of thetotal coal requirement. This will make the country vulnerable to price shocks as well as increase the risk of political maneuvering by supplying countries.Given this scenario, it is of paramount importance that the country develops allpossible domestic energy sources. India cannot afford to ignore any source of energy just because those sources are currently expensive, since the economic loss due tonon – supply of electricity will be greater than the cost of selected sources of energy.Minimizing dependence on import of conventional fuel and provision of energy to allat affordable prices should be the main concerns for energy policy of India. Therefore, India must make every effort to harness indigenous renewable resources.

X. ROLE OF SOLAR ENERGY IN ENERGY SAVING-

While wind has been a success story in India and has great potential, however, windis extremely site specific and therefore, not suitable for large scale distributedgeneration. Further, the total wind potential (around 50000 MW) in the country ismuch less as compared to the total solar energy potential (around 600GW). If technology is improved, solar energy potential could be increased further,significantly.Solar energy systems do not require any fuel and therefore, operating costs arenegligible. Over a life time cycle, the costs of the solar energy applications like largesolar farms, roof top installations, telecom towers etc. can be lower than that of conventional energy products and especially compared to the expensive and highly polluting diesel generators.

The other advantages of solar energy systems are thatthey are modular in nature, have long life, are reliable, and require low maintenanceeffort. Hence, this distributed source of energy is uniquely suitable for India.We can reduce coal consumption & also minimize the emission of CO_2 by using solar option.

Saving approximately 30% electricity [7] can be done by adopting mentioned techniques, Coal & as well as CO_2emission. So that

1. **In a single home** - Power uses are-

10×30% = 3 Unit

10 Units – 3 Units = 7 Unit

Thus 7 unit of power to run our household appliances in a day only-

Coal- Based on above calculation reduce 30% of coal so that we need only 5.25 kg of coal in a day

CO_2-Reduction of 30% of CO_2 emission,based on above calculation so only 2.59 kg of CO_2emission will be in a day.

2. Total consumption in our India in a day

Power - 784.49million Unit

Coal - 588.368 million kg of coal

CO_2 - 2.898lakh Tone of CO_2

XI. SOLAR TECHNOLOGY:-

Solar power i.e. Photovoltaic (PV) power systems convert sunlight directly into electricity. Using residential PV power system some or all daily electrical energy demand can be fulfilled. This system can be mounted on roof or at any place where sun light is available, exchanging daytime excess power for night-time usage. The house remains connected to the electric utility at all times. The system includes battery backup or uninterruptible power supply capability to operate selected circuits in the residence for hours or days during a utility outage [12].

A. PV Electrical System Types

There are two general types of electrical designs for PV power systems for homes; systems that interact with the utility power grid and have no battery backup capability; and systems that interact and include battery backup as well.

1. Grid-Interactive Only (No Battery Backup)

This type of system only operates when the utility is available. Since utility outages are rare, this system will normally provide the greatest amount of bill savings to the customer per dollar of investment.

However, in the event of an outage, the system is designed to shut down until utility power is restored.

Typical System Components:

PV Array: A PV Array is made up of PV modules, which are environmentally-sealed collections of PV Cells— the devices that convert sunlight to electricity. The most common PV module that is 5-to-25 square feet in size and weighs about 3-4 lbs. /ft^2Often sets of four or more smaller modules are framed or attached together by struts in what is called a panel. This panel is typically around 20-35 square feet in area for ease of handling on a roof. This allows some assembly and wiring functions to be done on the ground if called for by the installation instructions.

Balance of system equipment (BOS): BOS includes mounting systems and wiring systems used to integrate the solar modules into the structural and electrical systems of the home. The wiring systems include disconnects for the dc and ac sides of the inverter, ground-fault protection, and overcurrent protection for the solar modules. Most systems include a combiner board of some kind since most modules require fusing for each module source circuit. Some inverters include this fusing and combining function within the inverter enclosure.

DC-AC inverter: This is the device that takes the dc power from the PV array and converts it into standard ac power used by the house appliances.

Metering: This includes meters to provide indication of system performance. Some meters can indicate home energy usage.

2. Grid-Interactive With Battery Backup

This type of system incorporates energy storage in the form of a battery to keep "critical load" circuits in the house operating during a utility outage. When an outage occurs the unit disconnects from the utility and powers specific circuits in the home. These critical load circuits are wired from a subpanel that is separate from the rest of the electrical circuits. If the outage occurs during daylight hours, the PV array is able to assist the battery in supplying the house loads. If the outage occurs at night, the battery supplies the load. The amount of time critical loads can operate depends on the amount of power they consume and the energy stored in the battery system. A typical backup battery system may provide about 8kWh of energy storage at an 8-hour discharge rate, which means that the battery will operate a 1-kW load for 8 hours. A 1-kW load is the average usage for a home when not running an air conditioner.

Typical Component:-

1. Batteries and battery enclosures
2. Battery charge controller
3. Separate subpanel(s) for critical load circuits

B. Estimating System Output

PV systems produce power in proportion to the intensity of sunlight striking the solar array surface. The intensity of light on a surface varies throughout a day, as well as day to day, so the actual output of a solar power system can vary substantial. There are other factors that affect the output of a solar power system.

These factors need to be understood so that the customer has realistic expectations of overall system output and economic benefits under variable weather conditions over time.

C. Factors Affecting Output

1. Temperature

Module output power reduces as module temperature increases. When operating on a roof, a solar module will heat up substantially, reaching inner temperatures of 50-

75°C. For crystalline modules, a typical temperature reduction factor recommended by the CEC is 89% or 0.89. So the "100-watt" module will typically operate at about 85 Watts (95 Watts x 0.89 = 85 Watts) in the middle of a spring or fall day, under full sunlight conditions.

2. Dirt and dust

Dirt and dust can accumulate on the solar module surface, blocking some of the sunlight and reducing output. Much of California has a rainy season and a dry season. Although typical dirt and dust is cleaned off during every rainy season, it is more realistic to estimate system output taking into account the reduction due to dust build up in the dry season. A typical annual dust reduction factor to use is 93% or 0.93. So the "100- watt module," operating with some accumulated dust may operate on average at about 79 Watts (85 Watts x0.93 = 79 Watts).

3. Mismatch and wiring losses

The maximum power output of the total PV array is always less than the sum of the maximum output of the individual modules. This difference is a result of slight inconsistencies in performance from one module to the next and is called module mismatch and amounts to at least a 2% loss in system power. Power is also lost to resistance in the system wiring. These losses should be kept to a minimum but it is difficult to keep these losses below 3% for the system. A reasonable reduction factor for these losses is 95% or 0.95.

4. Dc to ac conversion losses

The dc power generated by the solar module must be converted into common household ac power using an inverter. Some power is lost in the conversion process, and there are additional losses in the wires from the rooftop array down to the inverter and out to the house panel. Modern inverters commonly used in residential PV power systems have peak efficiencies of 92-94% indicated by their manufacturers, but these again are measured under well-controlled factory conditions. Actual field conditions usually result in overall dc-to-ac conversion efficiencies of about 88-92%, with 90% or 0.90 a reasonable compromise.So the "100-watt module" output, reduced by production tolerance, heat, dust, wiring, ac conversion, and other losses will translate into about 68 Watts of AC power delivered to the house panel during the middle of a clear day (100 Watts x 0.95 x 0.89 x 0.93 x 0.95 x 0.90 = 67 Watts).

Critical factors need to be considered for Solar systems-

- Water Efficiency,
- Energy & Atmosphere,
- Environmental Quality,

D. Cost Analysis:-

According to the Chhattisgarh Government if we installing PV solar system for our household appliances or in our requirement of electricity CG government provided 60% subsidy of the total installation cost.

On the basis Table No 3 for a single home requirement of electricity is 7 unit (7kWh) in a day & installation of PV solar technology for this much power according to the CREDA Raipur.

Area – 36 square meter

Installation Cost without subsidy = 672000 Rs

Installation cost with subsidy = 268800 Rs

Life of Solar Panels = 25 Years Minimum

Power generation = 7 to 10 unit a day

Maintenance cost = 500 Rs per year

Total installation cost = ((500×25) + 268800) = 281300 Rs

According to the Chhattisgarh State Electrical Board (C.S.E.B.)

For 7 unit = 40 Rs per day

Yearly payment = 40×365 = 14600 Rs

In 25 Years = 25×14600 = 365000 Rs

On the basis of this analysis we can save our money approx. 83700 Rs without affecting our environment.

XII. RESULT-

The present study & the analysis done for carbon emission power optimization & reducing the coal consumption to generate electricity. The estimation of carbon emission reduction found 3.7 kg of CO_2 by single home in a day and it can be made using solar assisted devices. On the basis of home appliances sold out from the period 2010-2012 which consume electricity, 4.16 lakh tone CO_2 emission estimated in a day. This huge amount of CO_2 can be minimised using energy efficient devices and renewable energy conversion systems.

Electricity Saving

10 units by single home & 1120.70 million units in our India saved in a single day.

Coal Saving

7.5 kg by single home & 8.4 lakh tone coal is save by all over countryin a day.

The Domestic Sector accounts for 30% of total energy consumption in the country. There is a tremendous scope to conserve energy by adopting simple measures. This information is a guide, which offers easy, practical solutions for saving energy in home appliances. Please, take a few moments to read the valuable tips that will save energy & money and ultimately help conserve our coal which is used thermal power plant.

Suggestions To Save Energy:-

Lighting:-

1. Turn off the lights when not in use
2. Take advantage of daylight by using light-coloured, loose-weave curtains on your windows to allow daylight to penetrate the room also, decorate with lighter colours that reflect daylight
3. De-dust lighting fixtures to maintain illumination
4. Use task lighting; instead of brightly lighting an entire room, focus the light where you need it

XIII. COMPACT FLUORESCENT BULBS ARE FOUR TIMES MORE ENERGY EFFICIENT THAN INCANDESCENT BULBS AND PROVIDE THE SAME LIGHTING

Fans:-

1. Use electronic chokes in place of conventional copper chokes Fans
2. Replace conventional regulators with electronic regulators for ceiling fans
3. Install exhaust fans at a higher elevation than ceiling fans

Electric iron:-

1. Select iron boxes with automatic temperature cut off
2. Use appropriate regulator position for ironing
3. Do not put more water on clothes while ironing
4. Do not iron wet clothes

Mixers

1. Avoid dry grinding in your food processors (mixers and grinders) as it takes longer time than liquid grinding

Microwaves ovens

1. Consumes 50 % less energy than conventional electric / gas **Stoves**
2. Do not bake large food items
3. Unless you're baking breads or pastries, you may not even need to preheat
4. Don't open the oven door too often to check food condition as each opening leads to a temperature drop of 25°C

Electric stove

1. Turn off electric stoves several minutes before the specified cooking time
2. Use flat-bottomed pans that make full contact with the cooking coil
3. Bring items taken out of refrigerators (like vegetables, milk etc.) to room temperature before placing on the gas stove for heating
4. Use Solar Water Heater – a good replacement for an electric water heater

Electronic Devices

Do not switch on the power when TV and Audio Systems are not in use i.e. idle operation leads to an energy loss of 10 watts/device

Computers

1. Turn off your home office equipment when not in use. A computer that runs 24 hours a day, for instance, uses - more power than an energy-efficient refrigerator.
2. If your computer must be left on, turn off the monitor; this device alone uses more than half the system's energy.
3. Setting computers, monitors, and copiers to use sleep-mode when not in use helps cut energy costs by approximately 40%
4. Battery chargers, such as those for laptops, cell phones and digital cameras, draw power whenever they are plugged in and are very inefficient. Pull the plug and save.
5. Screen savers save computer screens, not energy. Start-ups and shutdowns do not use any extra energy, nor are they hard on your computer components. In fact, shutting computers down when you are finished using them actually reduces system wear – and saves energy

Refrigerator

1. Regularly defrost manual-defrost refrigerators and freezers; frost build up increases the amount of energy needed to keep the motor running.
2. Leave enough space between your refrigerator and the walls so that air can easily circulate around the refrigerator
3. Don't keep your refrigerator or freezer too cold.
4. Make sure your refrigerator door seals are airtight
5. Cover liquids and wrap foods stored in the refrigerator. Uncovered foods release moisture and make the compressor work harder.
6. Do not opens the doors of the refrigerators frequently
7. Don't leave the fridge door open for longer than necessary, as cold air will escape.
8. Use smaller cabinets for storing frequently used items
9. Avoid putting hot or warm food straight into the fridge

Washing machines

1. Always wash only with full loads

2. Use optimal quantity of water
3. Use timer facility to save energy
4. Use the correct amount of detergent
5. Use hot water only for very dirty clothes
6. Always use cold water in the rinse cycle
7. Prefer natural drying over electric dryers

Air Conditioners

1. Prefer air conditioners having automatic temperature cut off
2. Keep regulators at “low cool” position
3. Operate the ceiling fan in conjunction with your window air conditioner to spread the cooled air more effectively throughout the room and operate the air conditioner at higher temperature
4. Seal the doors and windows properly
5. Leave enough space between your air conditioner and the walls to allow better air circulation
6. A roof garden can reduce the load on Air Conditioner
7. Use windows with sun films/curtains
8. Set your thermostat as high as comfortably possible in the summer. The less difference between the indoor and outdoor temperatures, the lower will be energy consumption.
9. Don't set your thermostat at a colder setting than normal when you turn on your air conditioner. It will not cool your home any faster and could result in excessive cooling.
10. Don't place lamps or TV sets near your air-conditioning thermostat? The thermostat senses heat from these appliances, which can cause the air conditioner to run longer than necessary.
11. Plant trees or shrubs to shade air-conditioning units but not to block the airflow. A unit operating in the shade uses as much as 10% less electricity than the same one operating in the sun.

XIV. CONCLUSION:-

To prevent the environmental damage caused by faster exploration rate of fossils fuel and emitting greenhouse gases in huge amount must be reduced. The analysis presented gives single household consumption of electricity & CO_2 emission also at approximate value for India thus the use of energy efficient devices like solar thermal collector for water heating & solar panels for electricity generation is suggested.

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