



MARRAKECH 2016  
COP22|CMP12|CMA1  
UN CLIMATE CHANGE CONFERENCE

LIFESTYLE for minimum carbon footprint



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# SPEECH OF THE PRIME MINISTER SHRI NARENDRA MODI AT PARIS COP 21

President Hollande, Excellencies,

The pain of Paris is yet to heal. So, I speak in admiration for your resilience and resolve. And, I salute the world for standing, in full strength, with France and Paris.

Over the next few days, we will decide the fate of this planet. We do so when the consequences of the industrial age powered by fossil fuel are evident, especially on the lives of the poor.

The prosperous still have a strong carbon footprint. And, the world's billions at the bottom of the development ladder are seeking space to grow. So, the choices are not easy. But, we have awareness and technology. We need now national will and a genuine global partnership.

Democratic India must grow rapidly to meet the aspirations of 1.25 billion people, 300 million of whom are without access to energy. We are determined to do so, guided by our ancient belief that people and planet are inseparable; that human well being and nature are indivisible.

So, we have set ambitious targets. By 2030, we will reduce emissions by 33 to 35 per cent per cent of 2005 levels, and 40 per cent of our installed capacity will be from our non- fossil fuels. We will achieve it by expanding renewable energy - for, example, by adding 175 Gigawatts of renewable generation by 2022. We will enlarge our forest cover to absorb at least 2.5 billion tonnes worth of carbon dioxide. We are reducing dependence on fossil fuel through levies and reduction in subsidies; switching sources of fuel where possible; and, transforming cities and public transportation.



We hope advanced nations will assume ambitious targets and pursue them sincerely. It is not just a question of historical responsibility. They also have the most room to make the cuts and make the strongest impact.

And, climate justice demands that, with the little carbon space we still have, developing countries should have enough room to grow. -This also means aggressive mitigation action by developed countries before 2020, including ratification of 2nd Commitment period of Kyoto Protocol, removing conditions and revisiting targets.

The principles of equity and common but differentiated responsibilities must remain the bedrock of our collective enterprise across all areas - mitigation, adaptation and means for implementation. Anything else would be morally wrong; and disparities. Equity means that national commitments must be consistent with the carbon space nations occupy.

We also need a strong Agreement on Adaptation and Loss and Damage.

Developed countries must fulfill their responsibility to make clean energy available, affordable and accessible to all in the developing world. This is in our collective interest. So, we look to the developed countries to mobilize 100 billion US Dollars annually by 2020 for mitigation and adaptation in the developing countries. They must fulfill their commitment in a credible, transparent and meaningful manner.

Energy is a basic human need. So, we need an ambitious technology initiative, driven by a public purpose, not just market incentives. This includes intellectual property. For this, we need to scale up Green Climate Fund that will improve access to technology and intellectual property. We still need conventional energy. We should make it clean, not impose an end to its use. And, there should be no place for unilateral steps that become economic barriers for others.

We welcome stocktaking that is transparent, covers both support and commitments, and based on differentiation.

*Ultimately, for success, moderating our lifestyle is necessary, and possible, for a low carbon future.*

Excellencies, The presence of 196 countries tells us that we have a chance to unite behind a common purpose.

We will succeed if we have the wisdom and courage to craft a genuinely collective partnership that balances responsibilities and capabilities with aspirations and needs.

I am confident that we will.

Thank You.

# ABBREVIATIONS

<b>AEPC</b>	Alternative Energy Promotion Centre
<b>ASRTS</b>	Active and Safe Routes to School
<b>BEP</b>	Best Efficiency Point
<b>BIS</b>	Bureau of Indian Standards
<b>BRT</b>	Bus Rapid Transit
<b>CAGR</b>	Compound Annual Growth Rate
<b>CFL</b>	Compact Fluorescent Light
<b>CMA</b>	Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement
<b>CMP</b>	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
<b>CO<sub>2</sub>e</b>	Carbon Dioxide Equivalent
<b>COP</b>	Conference of the Parties
<b>CSP</b>	Concentrated Solar Power
<b>DoE</b>	Department of Energy
<b>DEWA</b>	Dubai Electricity and Water Authority
<b>EPA</b>	Environment Protection Agency
<b>FAO</b>	Food and Agriculture Organization
<b>GHG</b>	Greenhouse Gases
<b>GGEL</b>	Godawari Green Energy Limited
<b>ICAR</b>	Indian Council of Agricultural Research
<b>ICT</b>	Information and Communication Technology
<b>IDCOL</b>	Infrastructure Development Company Limited
<b>IEA</b>	International Energy Agency
<b>IIEC</b>	International Institute of Energy Conservation
<b>IRCTC</b>	Indian Railway Catering and Tourism Corporation
<b>JNNSM</b>	Jawaharlal Nehru National Solar Mission
<b>LED</b>	Light Emitting Diode

<b>MW</b>	Megawatts
<b>MWRA</b>	Massachusetts Water Resource Authority
<b>NDCs</b>	Nationally Determined Contributions
<b>OBHS</b>	On-board Housekeeping Service
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>REDP</b>	Renewable Energy Development Program
<b>RMB</b>	Renminbi (the official currency of the People's Republic of China)
<b>SIDS</b>	Small Island Developing States
<b>SWH</b>	Solar Water Heaters
<b>SHS</b>	Solar Home System
<b>UHI</b>	Urban Heat Island
<b>UJALA</b>	Unnat Jyoti by Affordable LEDs for All
<b>UNEP</b>	United Nation Environment Programme
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>WVMs</b>	Water Vending Machines
<b>WWF</b>	World Wide Fund

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*We need to make minimum  
carbon footprint lifestyle  
a global mass movement as  
Gandhi did with non-violence.*



# FOREWORD

## **Anil Madhav Dave**

Minister (IC), Environment, Forest and Climate Change  
Government of India



Climate change is a global crisis and requires global solutions. Last year and this year several landmarks have been achieved in ensuring global cooperation. Paris Agreement comes into force dramatically in less than a year after it was signed. In October this year 197 countries also resolved to phase out super pollutant HFCs in shortest possible time under an amendment in the Montreal Protocol. In 2015 global emissions stalled amid growth signifying that decoupling of growth and emission has already started.<sup>1</sup> The challenge is to apportion the available atmospheric space equitably to the developing countries, least developed countries and highly vulnerable Small Island Developing States (SIDS) in accordance with their development needs and climate justice.

Global per capita carbon emission stands today at approximately 5 tonnes per year, which has to be brought down to 2 tonnes per year by 2050, if we have to have a reasonable chance of staying below 2 degrees Celsius rise in temperature by the end of the century.<sup>2</sup> We are fortunate that it is still possible. We can face our next generation with head held high, if we can do it in our lifetime. But it's only possible when each one of us contributes to it. It requires a fundamental change in how we relate to nature and other living and non living things, and consume. A change in the lifestyle is only possible way out of this crisis.

Mr. Narendra Modi, our Prime Minister, has been a champion of the cause of climate change and change in the lifestyle. In his leadership, the country has taken many decisions which have social, financial and political implications, but in his leadership we stand as a proud and responsible member of the global community, which puts interest of humanity above all. In his address at Paris last year he said “moderating our lifestyle is necessary and possible for a low carbon future.” We are taking this wisdom to move from an exemplary past to an ambitious future and yet without having a bigger footprint. And we are confident that we will achieve this.

This booklet contains examples, which show that a little more discipline and small efforts by individuals, without reducing their comfort or lowering their living standard, can have huge contribution in making this planet durable. Only right way of living, is the low carbon living.

We hope that this booklet will help you to reduce your footprint significantly and will work as a guide towards low consuming and low carbon lifestyle. Each one of us needs to be the change that we are asking for, as Mahatma Gandhi has said.

# INTRODUCTION

## WHAT IS THE CRISIS

Greenhouse gases emissions reached 52.7 Gigatonnes (billion tonnes) CO<sub>2</sub>e in 2014. A large contribution to this is the emissions from fossil fuel and industries, which stood at 35.5 GtCO<sub>2</sub> for 2014 (IEA, 2016). Since 2012 the CO<sub>2</sub> emissions have stalled. That is a very good news but International Energy Agency warns that the emissions will increase through 2050. There is a direct relation between carbon (and Greenhouse Gases) emission and rise in temperature. A 2 degrees Celsius rise in temperature (as compared to preindustrial times) is considered manageable. To hold the rise below 2 degrees Celsius, the carbon concentration in the atmosphere has to be limited at 450 ppm (parts per million) and hence reduction in carbon emission is required. However, even a 2 degrees Celsius rise in can be very harmful for the island states due to resulting sea level rise. It might also translate to more than 2 degrees Celsius for various regions in the world. Rise beyond 2 degrees Celsius can be catastrophic. 5th Assessment Report of the IPCC estimated that to hold the temperature rise below 2 degrees Celsius we must not put more than 1000 Gigatonnes (billion tonnes) of carbon dioxide and other gases by 2100. It implies that global carbon emissions have to be reduced to net zero (all global emissions neutralized by forests, land and water, which work as sinks for emissions) between 2060 and 2075 and the emissions will have to be reduced to 42 GtCO<sub>2</sub>e by 2030. To be able to hold temperature rise at 1.5 degrees Celsius net zero emissions will have to be achieved earlier, say by 2050 and emissions will have to be reduced to 39 GtCO<sub>2</sub>e by 2030 (UNEP, 2016). It will obviously require earlier and steep reduction through more stringent actions.

## WHAT ARE WE DOING AND WHETHER IT'S SUFFICIENT?

The Paris Agreement adopted last year and coming into force this year determined to make efforts to hold the rise in temperature well below 2 degrees Celsius and pursue ambitious efforts to hold it at 1.5 degrees Celsius. All the countries have given pledges to reduce their emissions post 2020 known as Nationally Determined Contributions (NDCs) towards this end. These pledges provide both unconditional actions (which the countries will do on their own) and conditional actions, which they will undertake on the condition of finance, technology and capacity building made available by the developed countries. An analysis by UNEP (based on the 119 pledges covering 146 countries and 85-88 per cent of the global GHG emissions in 2012) shows that though NDCs collectively show an increase in ambition

level as compared to business as usual; but they are insufficient to hold the rise in temperature below 2 degrees Celsius. The full implementation of the unconditional pledges will take the emissions levels to 56 GtCO<sub>2</sub>e in 20230, which still leads to a 3.5 degrees Celsius rise in temperature by the end of the century. The emission gap with full implementation of the conditional pledges is 14 GtCO<sub>2</sub>e in 2030 and 7 GtCO<sub>2</sub>e in 2025. Even after including the implementation of the unconditional pledges, the emission gap in 2030 remains at 12 GtCO<sub>2</sub>e and 5 GtCO<sub>2</sub>e in 2025 (UNEP 2015). This clearly calls for more ambitious efforts on the part of all countries led by developed and industrialized countries.

Other parallel efforts also being made to reduce emissions. The International Civil Aviation Organization, a UN agency (based in Montreal, Canada) looking into aviation safety and emissions agreed to take up a programme to reduce aviation emission from 2021 onwards. Initially, countries will join this programme voluntarily in two phases (2021-2023 and 2024-2026); however, beginning 2027 all countries will be on board to reduce their aviation emissions. Aviation emissions are not covered under the Paris Agreement. It contributes less than 3 per cent of total global emissions, however, it's projected to rise sharply in the coming decades as flying becomes more affordable.

It is still possible to achieve 2 degrees Celsius target even if no additional efforts are made till 2020, however, in that case, besides reducing emissions, huge forest sinks have to be created. It will also increase significantly the reliance on nuclear energy, carbon capture and storage and bio-energy combined with carbon capture and storage. Large-scale deployment of these technologies is still far from feasible. Expedited and enhanced efforts in ensuring emission reduction before 2020, will increase the possibility of achieving 2 degrees Celsius target. No additional efforts till 2020 will make it almost impossible to achieve 1.5 degrees Celsius target.

## WHAT WE ARE NOT DOING

International negotiations, national actions and other cooperative efforts are indispensable in solving this crisis. However, climate stabilization efforts have been more rooted in technology and economics. These two are of course, enabler in moving towards a durable planet. However, the crisis is beyond technology and finances. The world needs a transformation towards sustainable lifestyles through cultural, spiritual and behavioral changes. We cannot fight this crisis without involving each and every person of this world. 1.2 billion people do not have access to commercial energy and many more do not have access to the basic services like health, education and food; their contribution to this crisis is negligible. Therefore, people in affluent societies will have to take leadership role in reducing their own footprint and educating and inspiring others. Despite the fact that carbon emissions are highly concentrated and top 10 per cent emitters contribute to 45 per cent of global emissions, we believe that sustainable lifestyle need to become a global

movement,<sup>3</sup> and its only when each one of us participates in this movement. We cannot wait for others to start and then follow.

There are many estimates to GHG emissions and sustainable level emissions as they are dependent upon a number of variables. However, it is almost certain that current per capita emissions have to be reduced by more than half by 2050 to stay below 2 degrees Celsius. This is impossible without a change in the lifestyle. Minimum carbon footprint needs to become a global movement. This is the only solution.



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1

FOOD & AGRICULTURE

Agriculture contributes to 13 per cent of global emissions (mainly in the form of Methane and Nitrous Oxide) and it's the second largest sector after energy in terms of emissions. While an individual (not being farmer) has almost no control on emissions in agriculture but food and dietary practices can reduce or increase personal footprint significantly. Reviewing the way we eat and what we eat can have strong positive correlation with carbon dioxide emissions. We can always make a choice of food which has less embedded emissions. This can be done in various ways from eating vegetarian or vegan food, eating locally produced seasonal food with less packaging, controlling food waste, and using energy efficient cooking and kitchen appliances. Current food production, though adequate for the global population, has left more than 800 million people in the world without access to food due to variety of reasons including poverty, distribution problems, price volatility etc. This is another important consideration, beyond environmental concerns, not to waste food. Food contributes to about 17 per cent of the total emissions of a household. Changing the foods can have a big impact on our carbon footprint.







*The carbon footprint of a vegetarian diet is about half that of a meat-lover's diet*



# EATING MEAT, BET YOU CAN'T BEAT THE HEAT

Meat production is a major contributor to climate change. It is estimated that livestock production accounts for 70 per cent of all agricultural land use and occupies 30 per cent of the land surface of the planet. Livestock produce a considerable volume of greenhouse gases that contribute to climate change. The United Nations Food and Agriculture Organization (FAO) estimates that livestock production is responsible for 18 per cent of greenhouse gases.



The growing of livestock and other animals for food consumes lot of resources and energy. It takes several kilograms of grain to produce one kilogram of lamb or beef. Lamb's emission is six times more than the chicken.<sup>4</sup> Eating one kg of lamb is equal to emission from driving 91 miles. if quitting meat is difficult, one can always reduce the frequency. Avoiding three meat-based meals in a week is equal to planting one tree every year. The carbon footprint of a vegetarian diet is about half that of a meat-lover's diet.<sup>5</sup>

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**Turin an Italian city has been turned in to a "Vegan City".<sup>6</sup> This program promotes vegetarian diets to safeguard our environment and health of citizens.<sup>7</sup>**

**Table 1: Food, CO<sub>2</sub> emission and car miles equivalent**

Rank	Food	kg CO <sub>2</sub> Eq	Car Miles Eq
1	Lamb	39.2	91
2	Beef	27.0	63
3	Cheese	13.5	31
4	Pork	12.1	28
5	Turkey	10.9	25
6	Chicken	6.9	16
7	Tuna	6.1	14
8	Eggs	4.8	11
9	Potatoes	2.9	7
10	Rice	2.7	6
11	Nuts	2.3	5
12	Beans/tofu	2.0	4.5
13	Vegetables	2.0	4.5
14	Milk	1.9	4
15	Fruit	1.1	2.5
16	Lentils	0.9	2

Source: <http://www.greeneatz.com>



*The global carbon footprint of food waste (excluding land use change) has been estimated at 3.3 Gt of CO<sub>2</sub> equivalent*

# FOOD WASTE; THINK OVER IT SERIOUSLY IF YOU ARE NOT IN A HASTE

The 2011 FAO assessment of global food losses and waste estimated that more than a third of all of the food that's produced on our planet never reaches a table. It's either spoiled in transit or thrown out by consumers in wealthier countries, who buy too much and throw what they cannot eat. This works out to roughly 1.3 billion tonnes of food, worth nearly USD 1 trillion at retail prices. Besides, social, economic, and moral implications of that waste, its environmental costs are huge. This not only means a missed opportunity for the economy and food security, but also a waste of all the natural resources used for growing, processing, packaging, transporting and marketing food. On a global average, per capita food wastage footprint on climate in high income countries is more than double that of low income countries, due to wasteful food distribution and consumption patterns in high income countries. Food losses and waste amounts to roughly USD 680 billion in industrialized countries and USD 310 billion in developing countries. The global carbon footprint of food wastage - excluding land use change - has been estimated at 3.3 Gt of CO<sub>2</sub> equivalent. If the food which is produced annually, but not eaten, were a country, it would rank number three in the world for greenhouse gas emissions, behind the USA and China. This is more than double the total GHG emissions of all road transportation in the USA in 2010 (1.5 Gt of CO<sub>2</sub> equivalent) and triple the EU (0.9 Gt of CO<sub>2</sub> eq).



In India and many other countries biogas produced from food and kitchen waste is used as alternative gas for cooking fuel. It is composed of methane and little amount of carbon dioxide.<sup>8</sup> Methan village in Sidhpur Tehsil of Patan district is the home of India's largest biogas plants.<sup>9</sup>





*Eat locally grown and fresh food*



## FOOD EMISSIONS; DON'T PANIC, EAT LOCAL, FRESH AND ORGANIC

Huge emissions are involved in production, transportation and processing of food. Transporting food requires petroleum-based fuels, and many fertilizers are also fossil fuel-based. Among imported foods frozen food has the highest carbon footprint, followed by canned, and then food packages in plastic, glass, cardboards. Out of season produce requires continuous refrigeration and hence have higher emissions and costs too. Fresh foods produced locally generally require less packaging, or no packaging at all and don't have huge food miles attached. They also reduce the need for raw materials and reduce the burden on landfills. Furthermore, they support local farmers and create employments.



USA in 2010 laid out 5 year strategic plan for the development of local and regional food system under the name Know Your Farmer (KYF).<sup>10 & 11</sup>

In India ICAR has established various research centers to promote the development of local and organically grown food.<sup>12</sup> ITC has financed investment plan of nearly 1000 crore in local and seasonal market of fruits and vegetables to power its agricultural marketing business.<sup>13</sup>





*Plastic water bottle can take approximately 1,000 years to biodegrade*



## DRINKING BOTTLED WATER, NOT THE WAY TO BE SMARTER

Bottled water are generally packaged and flown away from long distances requiring huge emissions in the transport and packaging. The greenhouse gas produced for each bottle of water is equivalent to driving a car for two kilometres.<sup>14</sup> Billions of barrels of oil are used just to create plastic water bottles. Less than half of the plastic water bottles used each year are recycled even in developed countries. Thrown-away water bottles clog landfills and produce harmful gases that destroy the ozone layer, they increase the need for raw materials which increases the need for fuel to mine the raw materials. Plastic water bottle can take approximately 1,000 years to biodegrade.<sup>15</sup>

Most tap water (in developed countries) is safe to drink. Instead of buying bottled water filtering tap water is smarter idea. Drinking 3 litres of water from reusable water daily can save emissions of 270 kg CO<sub>2</sub> per year.



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Indian Railways plan to provide clean drinking water at stations in low cost.<sup>16</sup> To begin with, the IRCTC plans to install 4,615 water vending machines (WVMs)<sup>17</sup> in the first phase at various stations in the National Capital Region including Agra and Jhansi divisions besides the divisions of Lucknow and Varanasi among others.<sup>18</sup> Passengers can avail the water at affordable rates which will be Rs. 1 per glass, Rs. 3 for half a Liters, Rs. 5 for one liters and Rs. 20 for a can from these vending machines.<sup>19</sup>

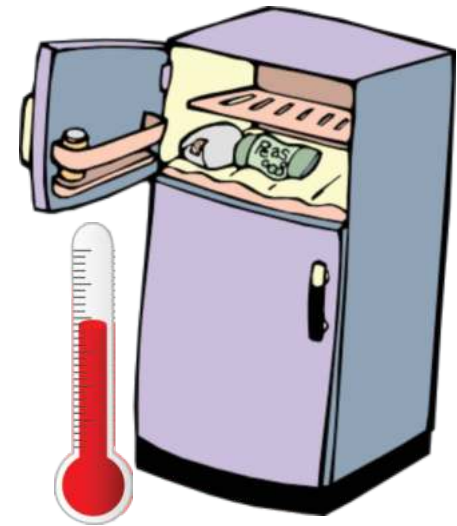


*Refrigerators account for about 20 per cent of household electricity use*



## REFRIGERATORS; USE ENERGY SAVER MODE, UP THE THERMOSTATE FOR BETTER

Refrigerators account for about 20 per cent of household electricity use. Use a thermometer to set your refrigerator temperature as close to 35 to 38 degrees Fahrenheit and your freezer as close to 0 degree Fahrenheit as possible. Make sure that its energy saver switch is turned on. Also, check the gaskets around refrigerator/freezer doors to make sure they are clean and sealed tightly. Placing refrigerators out of direct sunlight and away from the stove and other heat-producing appliances can also help reduce consumption. Through-the-door features like cold water or automatic ice dispensers can increase electricity usage by as much as 20 per cent compared to similar models without these features.



## WASHING MACHINES, DRYERS AND DISHWASHER; FULL LOADS SAVE LOT OF WATER AND POWER



We should always run washing machine and dishwasher only with a full load. Most of the energy used by these appliances is spent in heating water, and every cycle uses the same amount of water irrespective of the load. Using the air-dry option instead of the heat-dry, rinse-hold and pre-rinse features, also reduces electricity consumption. If the dishwasher doesn't have this option, open the door after the final rinse cycle to dry the dishes. Running cold cycles in dishwashers and washing machine can help save electricity and emissions. For drying clothes use sun drying than tumble driers.





*Campaign to provide milk to school children in Rwanda*



## Hunger and Malnutrition Facts

- The United Nations Food and Agriculture Organization estimates that about 795 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic undernourishment in 2014-2016. Almost all the hungry people, 780 million, live in developing countries, representing 12.9 percent, or one in eight, of the population of developing countries.
- The vast majority of hungry people live in developing regions, which saw a 42 percent reduction in the prevalence of undernourished people between 1990–92 and 2012–14. Despite this progress, about one in eight people, or 13.5 percent of the overall population, remain chronically undernourished in these regions, down from 23.4 percent in 1990–92. As the most populous region in the world, Asia is home to two out of three of the world's undernourished people.
- There has been the least progress in the Sub-Saharan region, where more than one in four people remain undernourished – the highest prevalence of any region in the world. Nevertheless, the prevalence of undernourishment in Sub-Saharan Africa has declined from 33.2 percent in 1990–92 to 23.2 percent in 2014–16, although the number of undernourished people has actually increased
- Hunger continues to take its largest toll in Southern Asia, which includes the countries of India, Pakistan and Bangladesh.
- Latin America has the most successful developing region record in increasing food security.

Source: FAO, 2015



*Eating together enhances bonding and joy and reduces carbon emission*

# COOKING SMART AND EATING TOGETHER, HAVE LOTS OF MONEY AND CARBON TO SPARE

Cooking accounts for substantial electricity or energy consumption (12 per cent in Australia, 4 per cent of the average gas and electricity bill in the UK) Changing the way one cooks as well as using energy-efficient cooking appliances can reduce the amount of energy use and cut energy bills in the process. If all members of the family eat together, which signifies togetherness and increases joy, frequent reheating of food before serving can be avoided. If eating together is not possible, store cooked hot food in insulated containers to serve it hot later. Following some efficient cooking practices given below can reduce our expenses and emissions.



Table 2: Tips for energy efficient cooking

Tips for energy-efficient cooking in the oven	Tips for energy-efficient cooking on the hob
Cook as much food/ containers with food, in the oven in one go to make sure all the space and heat is being used.	Always use the right size of pan for the amount of food you are cooking.
Keeping the oven door clean can help you see how your food is doing. When cooking, each time you open the door the oven loses heat and requires more energy to get back up to temperature.	Certain pan types are better at conducting and retaining heat. Copper-bottomed pans heat up quicker than stainless steel and cast-iron pans retain heat more efficiently, so you won't need the heat to be turned up so high.
Defrosting frozen food in advance typically halves the cooking time.	Turn down the ring or burner once the cooking temperature or state is reached; simmer food rather than boiling it.





*System of rice intensification reduces water demand for rice crop*

<p><b>Pre-boiling potatoes before reduces the amount of time they take to cook in the oven</b></p>	<p><b>Use a pressure cooker for cooking pulses, and even joints of meat, whole meals, or stews. It speeds up the cooking process. Use separators in the pressure cooker to cook different items at the same time.</b></p>
<p><b>Glass and ceramic dishes are most efficient to use in the oven and can reduce the temperature required for cooking.</b></p>	<p><b>Light your stove only after you have kept all the ingredients within your reach and ready for cooking. Put off an idle flame at once.</b></p>
<p><b>Cutting food into smaller pieces will speedup cooking</b></p>	<p><b>Use optimum quantity of water for different pots and pans. Surplus water consumes additional fuel which could otherwise be saved.</b></p>
<p><b>Using the fan assist option allows you to set the oven at a lower temperature compared to when using the static cooking option.</b></p>	<p><b>Sizeable savings in fuel are possible if you soak cereals in water before cooking.</b></p>

Source: U Switch Limited, UK & Petroleum Conservation Research Association, India

# 2 WATER



**W**ater covers 70 per cent of our planet giving an impression that water will always be plentiful. However, freshwater is extremely rare. Only 3 per cent of the world's water is fresh water but 2.5 per cent is frozen in glaciers, Arctic or Antarctica or otherwise unavailable for our use. Therefore, humanity must do with only 0.5 per cent of the freshwater available for our consumption. Fewer than 10 countries possess 60 per cent of the world's available fresh water supply including Brazil, Russia, China, Canada, Indonesia, U.S., India, Columbia and the Democratic Republic of Congo (UN Water, 2002). Biggest user of water is agriculture; some of the countries use as much as 80 per cent of their water for agriculture. More than one in every six people in the world is water stressed, meaning that they do not have access to potable water. All of these water stressed people (1.1 billion) live in developing countries.







*Rainwater Harvesting is the best solution to the water crisis*



# HARVESTING RAIN WILL REVERSE THE WATER DRAIN

Harvesting rainwater is a technique to collect rain in large natural reservoirs, or its infiltration into aquifers, or to collect water from dew or fog through nets. Rainwater harvesting is practiced in many countries in rural as well as urban areas. Harvesting in bigger reservoirs besides providing water for many purposes, also recharges ground water. Rainwater harvesting in urban areas through rooftops has also become popular. Many countries have passed legislation to make rainwater harvesting mandatory. Earliest available evidences dating back to 3rd century BC suggest that rainwater harvesting was practiced in Balochistan (now in Pakistan, Afghanistan and Iran) and in Kutch, Gujarat in India. In Medieval times, many beautiful structures and reservoirs were made in the states Rajasthan, Madhya Pradesh and Chhattisgarh and Maharashtra.

The city of Venice, Italy was also completely dependent on rainwater once upon a time. China and north east Brazil have deployed huge number of rooftop water harvesting projects



A Rajasthan village now no longer depends on a trickling government water supply—it meets its demand through water harvesting and has become a role model for other villages.<sup>20</sup> All the 145 houses in Jhunjhunu’s Ismailpur village have built a 13-foot-deep underground tank which can store 20,000 liters of rainwater. The tank is charged with rooftop water during the monsoon through pipes.<sup>21</sup> Every member of a family of six (average size) uses his share of eight liters per day with a self-discipline which helps the family keep the stock going till the next monsoon.<sup>22</sup>

Singapore, which has limited land resources and a rising demand for water, is on the lookout for alternative sources and innovative methods of harvesting water. Almost 86 per cent of Singapore’s population lives in high-rise buildings. Light roofing is placed on the roofs to act as catchment. Collected roof water is kept in separate cisterns on the roofs for non-potable uses.<sup>23</sup> Such collected and treated water accounts for 28 to 33 per cent of the total water used, resulting in savings of approximately USD 390,000 per annum.<sup>24</sup>





*Bucket bath saves 30 litres every bath*



## JACUZZI IS A NO, USE SHOWER HEADS WHICH ARE EFFICIENT AND LOW

Avoiding bath or Jacuzzi and taking short showers can reduce water footprint significantly. An inefficient showerhead can use between 15 litres and 25 litres of water every minute while an efficient low shower head gives a high quality shower using as little as 6 litres to 7 litres every minute. The reduction in hot water also means less energy is needed for water heating. Low flow shower heads are inexpensive and save 136.07 kg of CO<sub>2</sub> per year for electrically heated water, or 36.28 kg for gas-heated water.<sup>25</sup>



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*Hit by fourth year of historic drought, the state of California, USA will adopt strict limits on shower heads and faucets.<sup>26</sup> Current rules, established in 1994 at the federal level, allow a maximum flow of 2.5 gallons per minute from a shower head. Effective next July, the limit will fall to 2.0 gallons per minute and will be reduced again in July 2018, to 1.8 gallons, giving California the toughest standard of any U.S. state.<sup>27</sup>*

## SWITCHING TO BUCKET BATH, YOU CAN SAVE 30 LITRES PER BATH

By eliminating the use of showers and switching to a bucket bath, one can save 30 litres per bath and 10950 litre per year! If we were to calculate that for a building of 30 flats, it would be 13 lakh litres on an annual basis, which is equivalent to planting 10 trees.<sup>28</sup>





*Toilet use has big potential for water use reduction*

## USE DUAL, LEST SINGLE FLUSH MAKES YOU BLUSH

Dual flush toilets have been in use since 1980s and improving with time. Replacing a 12 Litres single flush with a 4.5/3 Litres dual flush in a household of four people could save more than 60,000 Litres of water a year.<sup>29</sup> Many flushes also reuse water from hand washing. Never throw a paper napkin or cigarette bud and flush the toilet, it will waste at least 3 Litres even if you use half flush; throw them in the dustbin instead.

Dual flush toilets have been universally adopted in Australia, New Zealand, Singapore and Israel, with legislation making it mandatory to have dual flush toilets in new constructions.



In India, the Bureau of Indian Standards (BIS), country's national standardization agency that involves in issuing quality certification, has planned to amend the existing criteria to certify toilet's flush so that the attached cistern can discharge water for flushing as per needs. Accordingly, a 10 liters cistern can discharge either 10 liters or five liters and similarly six liters flushing cistern can discharge either six liters or three liters in one go depending on the option selected by the users. Using six liters of water per flush can save 30 liters of water a day per person in the country.<sup>30</sup>

In Australia 6-3 liters dual flush system save 32,000 liters of water per year per average Australian household.<sup>31</sup> Installing a dual flush system is now compulsory in the new buildings in most Australian states.<sup>32</sup>



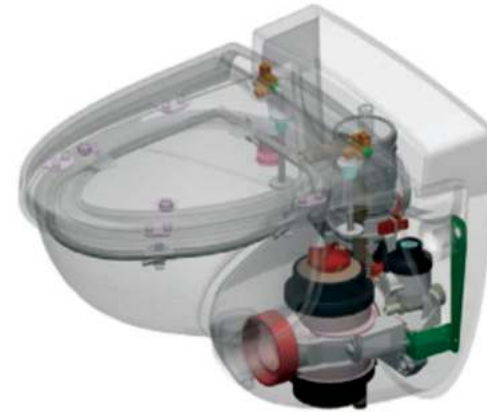


*Construction of toilets in school as a part of Prime Minister Narendra Modi's Swachh Bharat Campaign*



## TOILETS; MAKE SOME ROOM, BRING VACUUM

Vacuum toilets are flush toilets that use suction. The use of vacuum toilets provides a similar level of comfort as traditional flush toilets, but they use much less water due to air sucked into the toilet when flushing, thereby producing a vacuum. This results in a minimal requirement of water (0.5 to 1.5 liters). Vacuum toilets can be installed in single households, hotels, or whole communities and are also adapted for train, ships or airplanes.



The first prototype of a 'hybrid vacuum toilet' has already been installed in the Delhi-Dibrugarh Rajdhani on a trial run.<sup>33</sup> The prototype, installed in the First AC coach of the Dibrugarh Rajdhani consists of a custom designed vacuum toilet adapted from a commercially available vacuum toilet that is used in aircraft.<sup>34</sup>



Railways will provide 17,000 bio-toilets in trains and additional toilets at 475 stations across the country by March-end this year and has set a target of 30,000 bio-toilets in the next financial year.<sup>35</sup> Continuing with Swachh Rail Swachh Bharat Mission, 74 more trains have been added under On-board Housekeeping Service (OBHS) and another 400 are to be covered soon, leading to a total number of almost 1000 trains under the scheme.<sup>36</sup>





*Restoration and cleaning of rivers is a major challenge*



## LEAKING TOILETS AND PIPES; MEND IT BEFORE ANYBODY TAKES A JIBE

Fix leaking toilets immediately. A slow, barely visible leak can waste more than 4,000 Litres a year. Visible, constant leaks can waste more than 96,000 Litres. A tap leaking at the rate of one drop a second wastes more than 12,000 Litres of water a year.<sup>37</sup>



## CLEANING CAR AND DRIVEWAY; PUT THAT HOSE AWAY



A hosepipe uses 1,000 litres of water an hour. Clean the car using a pail of soapy water. Use the hose only for rinsing, this simple practice can save as much as 567.81 kg when washing a car. Use a spray nozzle when rinsing for more efficient use of water. Water your garden with a watering can rather than a hosepipe. Mulching your plants (with bark chippings, heavy compost or straw) and watering in the early morning and late afternoon will reduce evaporation and also save water. Sweeping the driveways rather than hosing will reduce water use significantly.

## JUST WET YOUR TOOTHBRUSH; CLOSE THE TAP EVEN IF YOU ARE IN A RUSH

There is no need to keep the water running while brushing your teeth. Just wet your brush and fill a glass for mouth rinsing. Turn off the tap when you brush your teeth this can save 6 litres of water per minute. A family of four typically wastes enough water brushing teeth in a year to fill an above-ground pool. Five minutes of running water uses as much energy as a 60-Watt light bulb left on for 14 hours.





*Rivers are lifelines of cities and are facing pollution challenge*



## BOSTON-WATER CONSERVATION STORY



Boston in US is an outstanding example in urban water conservation. Back in 1980 Boston faced water demand problem, its 412 billion gallon reservoir was on the verge of extinction. The region was using 350 million gallons a day when safe levels were 300 million gallons per day. To overcome this problem Water Authority diverted the Connecticut to supply water to the Quabbin reservoir. To overcome the environmental issues like ecological impact and potential efforts to restore the Atlantic salmon Massachusettes Water Resource Authority (MWRA) was created. Today the Quabbin reservoir is brimming with water and this conservation method produced a steep and steady decline in Boston's water demand a 43 percent drop from the 1980 peak. The MWRA provides water efficient retrofit kits (low-flow shower heads, low-flow faucet aerators, leak detection dye tablets, and installation guide) at no cost to member communities, individual customers, housing authorities, property managers, etc. within the service area.

**Source:**

<http://www.mwra.com/comsupport/conservation/hometips.htm>

<http://www.mwra.com/comsupport/waterconservationmain.htm#ici>

<https://www3.epa.gov/region1/npdes/mwra/excsum.html>

3

TRANSPORT



Emissions from transport form a significant part of country's emissions. Emissions from transport sector contribute to the 14 per cent of global emissions. However, in different countries contribution from transport can go higher (USA-26 per cent). While transport including international aviation contributed to 14.9 per cent of EU's emissions in 1990, it increased to 23.2 per cent in 2014. In EU road transport alone accounts for the 1/5th of its emissions, and road transport is the only sector, where emissions have been still increasing (Eurostat, 2016). Burning fossil fuels for running cars, trucks, busses, trains, ships and planes are the main source of transport emissions. Transport also accounts for significant part of an individual's personal emissions. It ranges from 0.1 tCO<sub>2</sub>e per capita in Chad, to less than 01.15 tCO<sub>2</sub>e per capita in many countries including Nigeria, Ethiopia, Nepal, Tanzania, Kenya etc., to 3.45 tCO<sub>2</sub>e in UAE, 4.89 tCO<sub>2</sub>e in Canada, to 5.25 in the USA, to 10.87 tCO<sub>2</sub>e in Luxemburg.

There are many ways in which we can reduce our transport emissions.







*Replacing short haul flights with train journeys saves lot of emissions*

# FLY FLY FLY TILL YOUR CARBON BUDGET IS DRY

Air travel is highly carbon intensive and can be the biggest part of our carbon footprint. Currently contributing less than 3 per cent of global emission, they are projected to rise hugely by 2050. UK's emissions from aviation doubled between 1990 and 2000 and are projected to double again by 2030.<sup>38</sup> Developing countries aviation emissions are also rising rapidly.



One return flight from London to New York creates emissions of 2.25 tonnes of CO<sub>2</sub>. Air crafts use maximum fuel in takeoff and landing, therefore short haul flights are more carbon intensive as compared to long haul flights. If you travel business or first class, per person emission goes up as in these classes fewer seats occupy more space than in economy. Many short haul flights can be replaced by other forms of public transport such as trains or buses.

While the CO<sub>2</sub> emission by travelling through flight varies from 110-180 gm per passenger km, the same while traveling by rail would lead to 60 gm per passenger km.

Table 3: Comparison of carbon emission from different modes of travel

Means of transport	Km per litre (or equivalent)	Emissions of CO <sub>2</sub> per kilometer
the most fuel efficient available car	18 - 23 kilometres per litre	130 - 100 grams CO <sub>2</sub> per kilometre
Average Car	9 - 16 kmpl	260 - 145 grams CO <sub>2</sub> per kilometre
Large Cars models, SUVs etc	3 - 9 kmpl	500 - 250 grams CO <sub>2</sub> per kilometre
Rail - normal suburban	18 - 52 kmpl per passenger	130 - 45 grams CO <sub>2</sub> per kilometre
Rail - high speed, few stops	14 - 28 kmpl per passenger	165 - 80 grams CO <sub>2</sub> per kilometre
Bus - well used service	28 - 50 kmpl per passenger	80 - 45 grams CO <sub>2</sub> per kilometre
Air - (below 500 miles)	4 - 8 kmpl per passenger ( including radiative forcing index at 1.9)	460 - 330 grams CO <sub>2</sub> per kilometre
Air - (long journeys)	8 - 12 kpl per passenger ( including radiative forcing index at 1.9)	330 - 210 grams CO <sub>2</sub> per kilometre

Source: How do emission from different modes of travel compare, [www.aef.org.uk/downloads/Howdoesairtravelcompare.doc](http://www.aef.org.uk/downloads/Howdoesairtravelcompare.doc)





*BRT saves lot of time and carbon too*



## BE A SPORT; GET ON THE PUBLIC TRANSPORT

If an individual switches a 20-mile roundtrip commute to public transportation, his or her annual CO<sub>2</sub> emissions will decrease by 4,800 pounds per year.<sup>39</sup> Compared with private vehicle use, for every passenger mile traveled, public transportation produces 95 percent less carbon monoxide, 92 percent fewer volatile organic compounds and nearly half as much carbon dioxide and nitrogen oxide.<sup>40</sup>



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The use of public transport is quite high in Asian countries as six of the world's ten busiest metro systems are in Asia, of which four can be found in China alone while the busiest, the Tokyo Subway, is in Japan.<sup>41</sup>



## TRY RAPID TRANSIT; GOOD WAY TO REDUCE YOUR FOOTPRINT

In terms of bus services, Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities in which buses travel on dedicated routes. BRT is already widely implemented in both the developed and developing worlds.

New research shows that BRT can reduce travel time by millions of hours for commuters worldwide. In Johannesburg, BRT users save an average of 13 minutes each way during their daily commutes.<sup>42</sup> In Istanbul, the savings are even greater – the typical Metrobüs passenger saves 52 minutes per day.<sup>43</sup>

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Bogoto's TransMilenio is regarded as a "model BRT system". In the TransMilenio bus rapid transit system saves almost 250,000 tons of carbon dioxide (CO<sub>2</sub>) each year, and employs 40,000 workers with provision for social security benefits such as pension schemes and healthcare.<sup>44</sup>



*Mumbai Local trains are lifeline of the city with daily ridership of 7.585 million*

## Smart driving tips



Keep you car healthy	Keep you car in best health, change oil every 5000 kms gives optimum efficiency
Drive safe and respect speed limits	Observing speed limits can increase efficiency up to 30 per cent, Driving fast and jack rabbit starts consume more fuel
Don't idle unnecessary	If stopping for more than 10 second stop the engine
Keep your car light	A light car is more fuel efficient than a heavy one
Minimize air conditioning	AC make the car use more fuel, and adds to the HFCs emissions

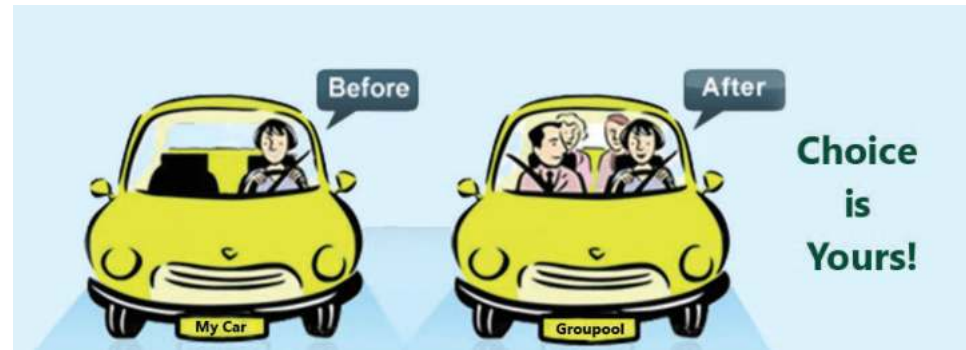




*Pooled rides are environment friendly*



## LONE DRIVER; CATCH FRIENDS ON THE WAY, BE MERRIER



A great way to lessen your carbon footprint is to reduce the number of cars on the road. One carpool takes away atleast three cars off the road.

Every rideshare helps remove four cars from the road — the equivalent of planting 4,000 trees.<sup>45</sup> The CO<sub>2</sub> emission by travelling alone in a small car fuelled by gas is 1.4 kg per passenger per km; carpooling will split the emission between 4 riders making per passenger emissions as minimal as 35 gm. A once-a-week shift to carpool can reduce a commuter's carbon footprint by 20 percent.<sup>46</sup>

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In Europe, long-distance car-pooling has become increasingly popular over the past years, thanks to Germany's Mitfahrgelegenheit (carpooling.com), and France's BlaBlaCar. LetsPool is one of the best ridesharing app in India that offer for both sharing bike ride & car ride in both intercity and intracity.



*Cycling keeps you fit and makes you climate smart*



## LOVE CLIMATE CYCLE, OWN A BICYCLE

Active transportation, such as walking, cycling is a great way to reduce GHG emissions. Cycling 5 km each way to work would save 750 kg of greenhouse gas emissions each year.<sup>47</sup>



The Netherlands is a country with more bicycles than people. On average, the Dutch own 1.11 bicycles per person and the number of bicycles sold in the Netherlands is also high: 1.2 million bicycles in 2005, for 16 million residents.<sup>48</sup> In cities like Amsterdam and The Hague up to 70 per cent of all journeys are made by bike.<sup>49</sup> It is possible to take bicycles with you on trains, aircraft (foldable in each case) and ferries.



## WALK TO SCHOOL; HAVE KIDS, TEACHERS AND PARENTS DROOL

Half of U.S. schoolchildren are dropped off at school in the family car. Over the past 20 years, the percentage of children travelling to school by car in UK has doubled, almost 40 per cent of primary and 20 per cent of secondary age children are now driven to school each day. Most of these journeys are less than two miles.<sup>50</sup>

If 20 per cent of those living within two miles of school were to bike or walk instead, it would save 4.3 million miles of driving per day nationally in the US. Over a year, that saved driving would prevent 356,000 tons of CO<sub>2</sub> and 21,500 tons of other pollutants from being emitted in the US.<sup>51</sup>

International Walk to School Month (IWALK) is an annual global event taking place each October. It is a mass celebration of active transportation and its related issues are used to introduce communities to the Active & Safe Routes to School (ASRTS) program. In 2011, millions of children, parents, and community leaders from 40 countries around the world joined together in celebration of International Walk to School Month in October.<sup>52</sup>

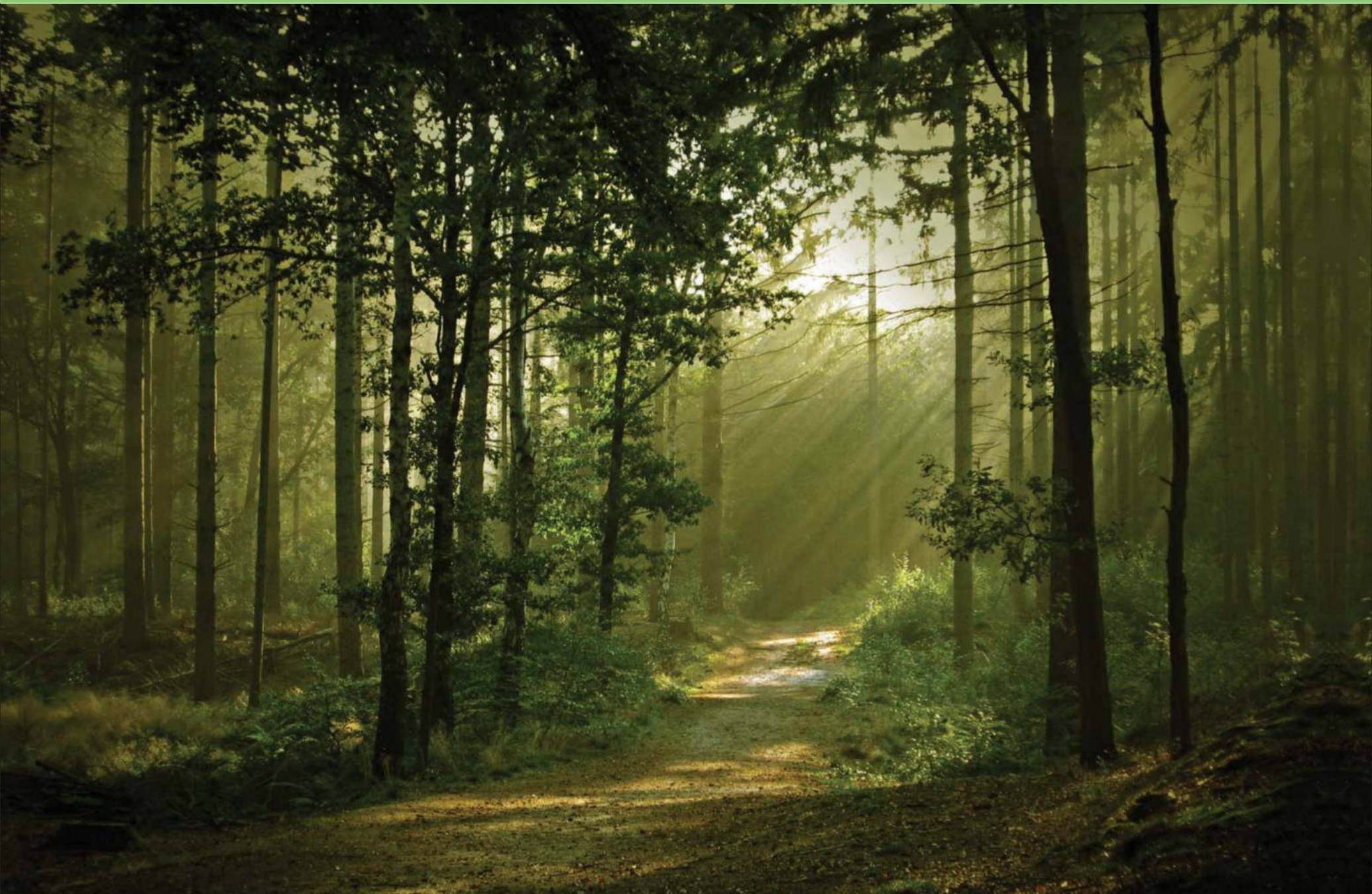
4

PAPER

Soft Tissues are Hard on the Environment. Worldwide, the pulp and paper industry is the fifth largest consumer of energy, accounting for four percent of the entire world's energy use. The pulp and paper industry uses more water to produce a tonnes of product than any other industry. Pulp and paper is the third largest industrial polluter to air, water, and land in Canada and the United States. Every 10000-20,000 A4 sheets takes one tree away from this planet.<sup>53</sup>







*Global toilet paper production consumes 27,000 trees daily*

## A HANDKERCHIEF A DAY; PUTS YOUR PAPER MISCHIEF AWAY

During an average year, an American uses approximately 2,200 napkins — around six each day. If everyone in the U.S. used one less napkin a day, more than a billion pounds of napkins could be saved from landfills each year. Imagine what would happen if everybody started using a handkerchief!



## REDUCE USING TOILET PAPER; WATER CAN SERVE YOU BETTER



Global tissue consumption reached 31.5 million tonnes in 2012, up by 1.14 million tonnes from 2011.<sup>54</sup> China, Latin America, North America and Eastern Europe continued to drive the global tissue market expansion. On average, consumers use 8.6 sheets per trip – a total of 57 sheets per day. That's an annual total of 20,805 sheets.

Americans use an average of 23.6 rolls per capita per year. An average household will flush away nearly 80,000 sheets a year. And that doesn't include the paper that is used for other purposes such as blowing noses, cleaning spectacles and so on.

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Toilet papers can be reduced with the existing practice of using water instead of paper. The bidet shower is very common in parts of South & South East Asia and North Africa. This includes India, Turkey, Iran, United Arab Emirates, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Singapore, Vietnam, China, and Cambodia.<sup>55</sup> In Europe, it is used in Finland,<sup>56</sup> and is also very common in Brazil,

Global toilet paper production consumes 27,000 trees daily. One tree produces about 100 pounds (45 kg) of toilet paper. The average American uses 50 pounds (23 kg) of tissue paper per year which is 50 per cent more than the average of other Western countries or Japan. Millions of trees are harvested in North and South America leaving ecological footprint deep. As of 2009, between 22 per cent and 48 per cent of the toilet paper used in the United States comes from tree farms in the U.S. and South America, with most of the rest coming from second growth forests, and only a small percentage from virgin forests.

Source: [https://en.wikipedia.org/wiki/Toilet\\_paper](https://en.wikipedia.org/wiki/Toilet_paper)





*Each cup, taking into account the paper, the paper sleeve, production and shipping, emits about 0.11 kilograms of CO<sub>2</sub>*



## ACT UP; DROP THAT COFFEE PAPER CUP

Over 6.5 million trees were cut down to make 16 billion paper cups used by US consumers only for coffee in 2006, using 4 billion US gallons (15,000,000 m<sup>3</sup>) of water and resulting in 11.5 million tonnes of waste. Overall, North Americans use 58 per cent of all paper cups, amounting to 130 billion cups.

Most people are under the impression that the takeaway cups handed out by the coffee shop chains can be recycled along with other paper waste. However, most paper cups are coated with a plastic resin (i.e., polyethylene) for durability and convenience, therefore making both their composting and recycling uncommon and raising the chances of carcinogenic chemical leeching. According to a study on the environmental impacts of paper cups, each cup, taking into account the paper, the paper sleeve, production and shipping, emits about 0.11 kilograms of CO<sub>2</sub>.<sup>57</sup>



In 2009, student-run coffee shop at Victoria College in Canada, became possibly the first Toronto retailer to completely do away with disposable cups.<sup>59</sup> In 2016, Eden Café in New Zealand took stand against disposal cups. The cafe typically served about 190 takeaway cups a day. Now, that's no longer an option. This step has prevented 1,000 cups heading to landfill each week!<sup>60</sup> In 2016, Starbucks, the top hot beverage selling brand in the UK, is set to trial a fully recyclable coffee cup in its UK shops, which could eventually divert huge numbers of cups away from landfill.

In September, 2016, France became the first country in the world to ban disposable plastic cups and plates . A new French law will require all disposable tableware to be made from 50 per cent biologically-sourced materials that can be composted at home by January of 2020. That number will rise to 60 per cent by January of 2025.<sup>58</sup>





*Recycling 1 tonne of paper saves 1 tonne of greenhouse gases emissions*



## JUST DON'T SIT IDLE; BRING YOUR PAPER FOR RECYCLE

A tonne of paper made from recycled paper, as opposed to virgin paper, saves the equivalent of 4,100 kilowatt hours of energy, 26,497.88 kg of water, 27.2 kg of CO<sub>2</sub> emissions, and 3 cubic yards of landfill space.

Recycling one tonne of newsprint saves about one tonne of wood while recycling one tonne of printing or copier paper saves slightly more than two tonnes of wood. The EPA has found that making paper from recycled materials results in 74 per cent less air pollution and 35 per cent less water pollution. This means that every tonne of recycled paper keeps almost 60 pounds of pollutants out of the atmosphere that would have been produced if the paper had been manufactured from virgin resources.<sup>61</sup>

The world's top 5 paper recycling countries are Switzerland, Sweden, Austria, Netherland and USA.<sup>62</sup>



The recycling programs in the US have been remarkably successful, and serves as a testament to how responsibly run recycling programs can actually improve the economy, while simultaneously preserving the environment. Many cities in the US have mandatory recycling laws. While businesses are required to sort all paper, cardboard and yard waste, households are expected to recycle all of the basic recyclables such as paper, aluminum, cardboard, plastic and glass. In New York City, Department of Sanitation provides weekly pickups and has a comprehensive list of recyclable materials and detailed information about recycling in New York City on the NYC Zero Waste website.

Recycling one tonne of paper can save 17 trees, 7000 gallon of water 380 gallons of oil, 3.3 cubic yards of landfill space, 4000 kilowatts of energy and reduce greenhouse gas emission by one metric ton of carbon equivalent.

Source: <http://www.recycling-revolution.com/recycling-facts.html>





*Buying fresh locally produced food and using a reusable bag can reduce one's footprint*

## REUSABLE SHOPPING BAG; IT'S TRENDY AND NOT RAG

Over 100,000 whales, seals, and turtles die every year as a result of eating or being trapped by plastic bags.<sup>63</sup> In India, an estimated number of 20 cows die per day as a result of ingesting plastic bags and having their digestive systems clogged by the bags.<sup>64</sup>

Some governments have encouraged or required the use of reusable shopping bags through the regulation of plastic bags with bans, recycling mandates, taxes or fees.



The Bangladesh government was the first to do so in 2002, imposing a total ban on the bag.<sup>65</sup> Such a ban has also been applied in countries such as Rwanda, China, Taiwan and Macedonia . Some countries in Western Europe impose a fee per bag. Bans, partial bans, and fees have been enacted by some local jurisdictions in North America, Australia, the United Kingdom, and Myanmar.<sup>66</sup> Concurrently with the reduction in lightweight plastic bags, shops have introduced reusable shopping bags.





*Recycled paper can be used in many forms*

## ECO-FRIENDLY NEWSPAPER-PENCILS; TOWARDS NATURE SO GENTLE



Globally 15-20 billion pencils are made each year. US alone consumes 3.5 billion pencils every year. Each tree gives 1,70,000 pencils. Imagine how many trees are cut to make 20 billion pencils!<sup>68</sup>

An alternative to the conventional wooden pencils are the eco friendly pencils which are 100 per cent wood or polymer free and made completely of used paper of all kinds: newsprint, printer paper, stationery, etc.

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Chinese pencils made from newsprint have been in the market for a long time and are doing well. Some initiatives have kickstarted in other countries too with organizations like Eco'me, Ecosave, and Paper Tree in India and Tree smart in US that have been encouragingly involved in making eco-friendly pencils.



# 5 LIGHTING

Almost a fifth of global electricity is used for lighting, which accounts for 1.9 Gigatonnes of CO<sub>2</sub> every year. That's equivalent to the emissions from 70 per cent of the world's passenger vehicles. Electricity is produced mostly by fossil fuel till now. Lighting contributes 20 per cent of the household electricity consumption. However, more than 1.2 billion people in the world do not have access to electricity and 2.7 billion people don't have access to clean cooking fuel. More than 95 per cent of these are in Sub Saharan Africa and developing Asia and more than 80 per cent of them are in rural areas (IEA, 2016). Easiest way of reducing emission is to reduce electricity consumption. Reduced electricity use in the urban areas will free electricity to be made available in rural areas if it does not suffer from transmission impediments. There are a number of ways in which one can reduce its electricity consumption conveniently.







*Access to electricity helps access to education and other basic facilities*

## BE LED BY THE BRIGHT IDEA

Replacing incandescent and CFL bulbs and tube lights with LED lights can significantly reduce electricity consumption and carbon emissions. LED lights are more efficient, use less electricity and lasts many times longer. An estimate suggests that replacing all lights in the world with LED lights can save emissions worth 1.4 Gigatonnes of carbon and save USD 3 billion (Phillips, 2015). A 10 Watt LED Bulb gives equal light as 14 Watt CFL or 60 Watt incandescent bulb. LEDs are costlier than CFL or incandescent bulbs, however, savings in the electricity bills can recover the price in less than one year. A person can avoid 146 kgCO<sub>2</sub> emissions by replacing 1 incandescent bulb with the LED light. A household using 5 lights can reduce 730 kgCO<sub>2</sub> (0.73 tonnes) every year. That's equal to annual CO<sub>2</sub> emission of a person in Guatemala. People in many countries emit less than 0.73 tonnes in a year.



The Government of India has distributed over 17 crore LED bulbs across the country under the Unnat Jyoti by Affordable LEDs for All (UJALA) scheme (as on 4th November 2016). These LED bulbs are already saving Rs 25 crore per year. Energy saved from this initiative is 4,576 MW and 50,724 tonnes CO<sub>2</sub> reduction per day.<sup>69</sup>





*Solar powered LED street lights help address lighting needs*

South Africa launched Africa's largest energy-saving lighting deal – a joint initiative between local power utility Eskom and global electronics giant. Philips, with the help of Eskom, planned 200,000 lamps from its Master LED range to commercial consumers such as banks, casinos, hotels and retail outlets, at a discounted price. The 200,000 lamps could potentially save as much as Rand 41-million (USD 5.1-million) per year, and prevent the emission of up to 50 000 tonnes of carbon dioxide.<sup>70</sup>

More than 1.9 million LED lights were installed in over 20,000 street lights the Beibei district of Chongqing, China in the country's largest municipal intelligent lighting control project, which includes nearly 16 miles of highway, 119 streets, and one tunnel. Officials estimate the installation will result in annual maintenance and electricity savings of more than RMB 19.5 million (approximately USD 3 million) and 17.6 million kWh.<sup>71</sup>

Fifty housing societies in Pune, India comprising 8,187 households saved 43,000 units of electricity in three months.

The methods used by the societies involved making small changes like using white colour on building walls, using compact fluorescent light (CFL) and light-emitting diode (LED) lights.

To create awareness about energy conservation, Green Energy Foundation and Racold Thermo company jointly organised 'Switch 2 Green'. A team of experts audited the energy consumption of the societies from September to November 2013.

<http://www.dnaindia.com/pune/report-societies-go-for-small-changes-save-power-in-pune-1931375>





*President House in New Delhi observed the Earth Hour on 19th March 2016*

## SWITCHING OFF; AN HOUR MAKES HUGE DIFFERENCE

Reducing the use of light in unoccupied rooms for an hour everyday in a household having 5 lights can reduce emission by 12 kgCO<sub>2</sub> every year. Installing occupancy and movement sensors in rooms and staircases can reduce the electricity consumption significantly.



Earth Hour is a worldwide grassroots movement organized by WWF. The event held worldwide towards the end of March annually encouraging individuals, households, communities and businesses to turn off their non essential lights for one hour. Since first Earth Hour in Sydney in 2007, it has grown to engage more than 7000 cities and towns worldwide.<sup>72</sup> Thousands of people across the country joined the global community by switching off extra lights in private and government buildings to mark Earth Hour 2016. President House in New Delhi observed the Earth Hour and switched off its light for an hour on 19th March marking Earth Hour 2016.<sup>73</sup>





*Hofburg Palace, Vienna during Earth Hour 2016*

# REDUCED ENERGY CONSUMPTION BY EARTH HOUR

- According to WWF Thailand, Bangkok decreased electricity usage by 73.34 MW, which, over one hour, is equivalent to 41.6 tonnes of carbon dioxide.
- Philippine Electricity Market Corp. noted that power consumption dropped by about 78.63 MW in Metro Manila, and up to 102.2 MW on Luzon
- Ireland, as a whole, had a reduction in electricity use of about 1.5 per cent for the evening. In the three-hour period between 6:30 p.m. and 9:30 pm, there was a reduction of 50 MW, saving 150 MW-hours, or approximately 60 tonnes of carbon dioxide
- The best result was from Christchurch, New Zealand, with the city reporting a drop of 13 per cent in electricity demand.<sup>74</sup>

The Alliance to Save Energy established the Green Schools Program in 1996 to help school districts save on energy costs and empower students to become environmental stewards and energy-efficiency advocates in their schools, homes, and communities.

During the 2009-10 school year, 54 schools across all three participating school districts – Murrieta Valley, Temecula Valley, and Lake Elsinore – reduced energy use by an average of 15.5 per cent. Collectively, the 2009-10 Green Schools saved 5.7 million kilowatt hours of electricity, equivalent to USD 911,693 and preventing 3,156 tonnes of carbon dioxide from being emitted into the atmosphere!

Source: <http://www.ase.org/>





*Stand by power consumption contribute to 1 per cent of global CO<sub>2</sub> emission*

## UNPLUGGED

Appliances in standby mode also consume power. The IEA (2007) estimated that standby power consumption produce 1 per cent of global CO<sub>2</sub> emission. Just to put that in a context, global aviation emission is less than 3 per cent of total emissions. Many studies estimate that in households power consumption from standby appliances range from 5 per cent-13 per cent of the total household electricity consumption. Any appliances that has a remote control or LED display uses standby power, but appliances without these functions can also use standby power. Therefore, it's better to unplug the appliances when not in use. One can also use power strip to cut power from many appliances by single push of the switch.



## PHANTOM POWER



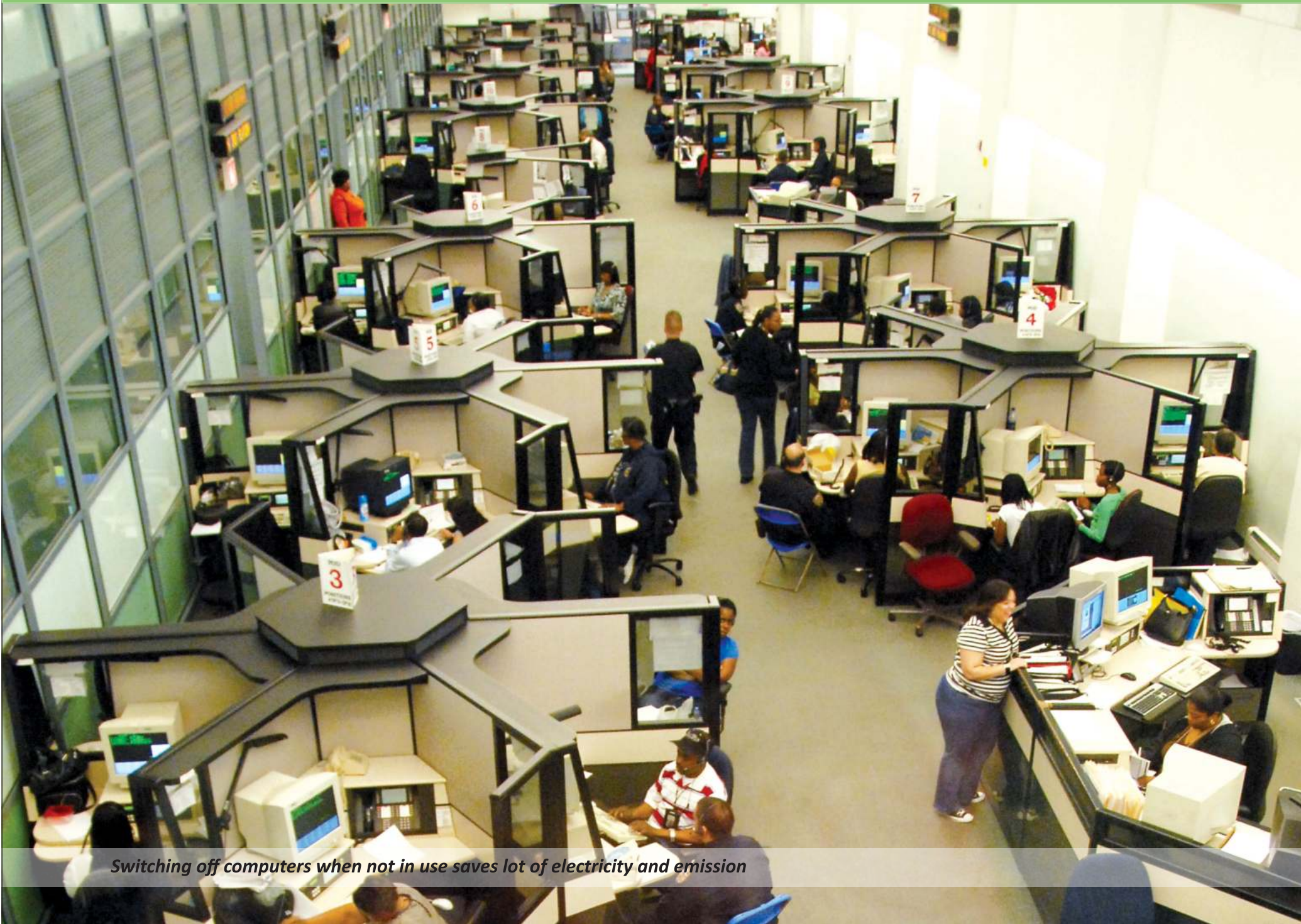
A mobile phone charger, plugged into a fully charged phone uses 2 Watts, a phone that is charging uses nominally higher power 3 Watts. Just having the power supply plugged in, without any phone, uses 0.25 Watts. A computer display in full use gobbles up 65 Watts but still uses 12 Watts when in sleep mode. When off it uses 0.8 Watts. Some laser printers actually uses more power in standby mode – 6.4 Watts on ready and only 6.1 Watts when fully on. A cordless phone uses 2.8 Watts when the handset is in place and ready to use, but only 1.9 Watts when you are actually on the phone.<sup>75</sup>

## One Watt Initiative

In 1999, the IEA launched a campaign called “One Watt Initiative” to ensure through international cooperation that by 2010 all new appliances sold in the world use only one watt in standby mode. This was supposed to reduce CO<sub>2</sub> emissions by 50 million tons in the OECD countries alone by 2010; the equivalent to removing 18 million cars from the roads. Many countries including European Union, the USA, Australia, South Korea have made standards in this regard.

Source: Wikipedia



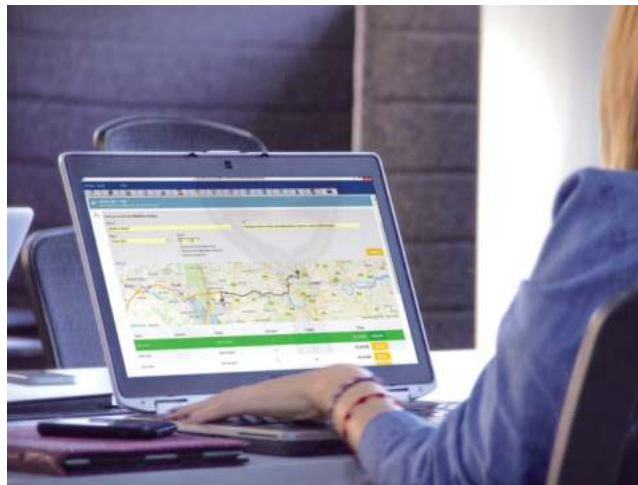
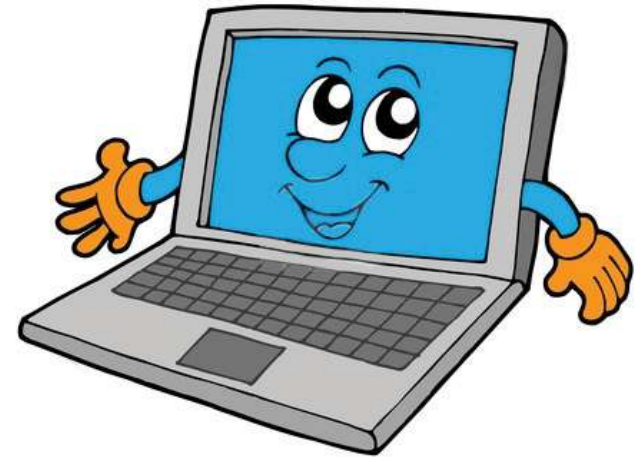


*Switching off computers when not in use saves lot of electricity and emission*



## ONE IN LAP IS BETTER THAN ONE ON THE TABLE

Laptops are far more energy efficient than desktop computers. Laptops can use up to 80 per cent less energy than a desktop.<sup>76</sup> A desktop uses an average of 200 Watt per hour when it is being used (including loudspeakers and printer). A computer that is on for eight hours a day uses almost 600 kWh and emits 175 kg of CO<sub>2</sub> per year. A laptop uses between 50 and 100 Watt/hour when it is being used, depending on the model.<sup>77</sup> A laptop that is on for eight hours a day uses between 150 and 300 kWh and emits between 44 and 88 kg of CO<sub>2</sub> per year. The power footprint for 10,000 hours of use for Apple Mac Pro desktop and Apple Pro 15 laptop are respectively 1.7 tonnes and 0.107 tonnes of CO<sub>2</sub>.



Desktop also has higher embedded emissions (emissions in the manufacturing process) than a laptop. While Apple Mac Pro desktop has an embedded emission of over a tonnes of carbon dioxide, apple laptops have half of those embedded emissions. It's also very helpful to switch off the monitor when taking a break as it uses the maximum power.





*Mobile and internet provides connectivity but also contributes to emission*

## MOBILES ARE FUN ONLY WHEN YOU ARE ON THE RUN

Mobiles have relatively high carbon footprint. One minute of mobile to mobile call can typically produce emission of 0.05 kg carbon dioxide equivalent and in one year it can go up to one tonne of carbon dioxide, or a trip from London to New York, or a 15th of the average UK person's total carbon consumption.

An estimate for the emissions caused by manufacturing the phone itself is just 16 kg CO<sub>2</sub>, equivalent to nearly 1kg of beef. If one includes the power it consumes over two years that figure rises to 22 kg. But the footprint of the energy required to transmit mobile calls across the network is about three times all of this put together, implying an emission of 94 kg CO<sub>2</sub> in two years, or 47 kg per year.

If you want to reduce the footprint of your communication habits, texting is a much lower-carbon option. Landlines are better still as it takes about one-third of the power to transmit a call over a fixed landline network than it does when both callers are on a mobile.<sup>78</sup>



## INTERNET STREAMING STEAMS THE PLANET

The internet releases around 300 million tonnes of CO<sub>2</sub> a year, as much as all the coal, oil and gas burned in Turkey or Poland, or more than half of the fossil fuels burned in the UK. Data centres use lots of electricity, both for powering the machines they contain and more than that for the air conditioning needed to keep the servers from overheating. According to a report, the data centres already account for around a quarter of the energy consumed (and the carbon emitted) by the information and communication technology (ICT) sector as a whole; in other words, around half a percent of global CO<sub>2</sub> emissions. By an estimate, the world's PCs and monitors are even more power hungry, accounting for around 40 per cent of the total ICT energy demand and 0.8 per cent of global CO<sub>2</sub> emissions. Internet data is growing by 20 per cent a year and video streaming is by the far the biggest culprit. ICT's footprint is due to climb by 60 per cent by 2030, the same report suggests.<sup>79</sup>





*Cool Biz campaign in Japan allows employees to wear informal clothes to office*

## TOO COLD OR TOO HOT; CAN PUT YOU IN THE SPOT

Buildings contribute 30 per cent of all greenhouse gases emissions. Half of the household energy world over is used for heating. An American average home uses about 20,000 kilowatt hours of energy via gas use in a year. Improved insulation can reduce the energy use for heating significantly. We should be careful not to overcool or overheat the houses. The ideal air conditioning setting for thermal comfort level of human beings is 19 degrees Celsius in winters and 25 degrees Celsius in summers. Lowering thermostat just two degrees during winter saves 6 percent of heating-related CO<sub>2</sub> emissions. That's a reduction of 190 kg of CO<sub>2</sub> per year for a typical home. Regular cleaning of air filters can save 5 percent of the energy used which amounts to saving emissions of 80 kg of CO<sub>2</sub> per year.



The Prime Minister of Bangladesh in 2009 ordered male government employees to stop wearing suits, jackets and ties to save electricity.<sup>80</sup>



United Nations also launched an initiative "Cool UN" in August 2008 which involves increasing the air conditioning temperature setting from 22.2 degrees Celsius to 25 degrees Celsius in the majority of the Secretariat building, and from 21.1 degrees Celsius to 23.9 degrees Celsius in the conference rooms.<sup>81</sup>

The Cool Biz campaign is a Japanese campaign initiated by the Japanese Ministry of the Environment from summer 2005 as a means to help reduce Japanese electricity consumption by limiting the use of air conditioning. This was enabled by changing the standard office air conditioner temperature to 28 degrees Celsius (or about 82 degrees Fahrenheit) and introducing a liberal summer dress code. Initially the campaign was from June to September, It now runs from May to October. The ministry estimated that the campaign in 2005 resulted in a 460,000-tonnes reduction in CO<sub>2</sub>emission, the equivalent volume of CO<sub>2</sub> emitted by about 1 million households for one month. The results for 2006 were even better, resulting in an estimated 1.14 million-ton reduction in CO<sub>2</sub> emission.<sup>82</sup>

Warm Biz, on the other hand, encourages offices to keep the heating temperature at 20 degrees Celsius in order to save energy during winter. Similar movements have started in other countries, such as Hong Kong, China and South Korea.<sup>83</sup>





*A solar water heaters of 100 Litres can prevent emission of 1.5 tonnes CO<sub>2</sub> every year*

## TURNING DOWN THE GEYSER; CAN STILL GIVE YOU ENOUGH PLEASURE

Geysers come with a factory setting of 60 degrees Celsius but water at 40 degrees Celsius is enough for a comfortable bath. We can reduce annual CO<sub>2</sub> emissions by 172 kg and reduce annual electricity bills by Rs 1247 by setting the thermostat accordingly. Bathing in quick succession and not keeping the geyser on for longer than necessary can reduce annual CO<sub>2</sub> emissions by 344 kg and reduce annual electricity bills by Rs 2493.



## HEATING WATER; NOTHING CAN BEAT THE SOLAR

Water heating accounts for more than 20 per cent of the household's electricity bill. Solar water heaters can reduce electricity by more than half.

Table 4: Comparison of Solar to Conventional Water Heater

<b>SOLAR WATER HEATER: FREE energy from the Sun</b>	<b>STANDARD WATER HEATER: COSTLY gas or electric</b>
Annual operating cost: \$50	Annual operating cost: \$500+
Storage Capacity: 80-120 gal	Storage Capacity: 40-50 gal
Life expectancy: 15-30 years	Life expectancy: 8-12 years
Lifetime operating cost: USD 1,000	Lifetime operating cost: USD 10,000
Does NOT pollute environment	Depletes fossil fuels
Increases equity in your home	No added value to your home
25 per cent return on your investment	No return on utility payments
25 per cent return on your investment	At mercy of utilities/government
Hot water during blackouts!	No hot water during blackouts

Source: <http://www.solardirect.com/swh/swh.htm>





*Solar water heaters reduce electricity use for water heating to half*



Grameen Shakti (a nonprofit organization based in Bangladesh) has brought solar power systems to about 1.5 million Bangladeshi homes, or about 8.4 million people! More than 60 thousand people each year are installing Solar Heating Substances all over Bangladesh for business or household purposes.<sup>84</sup>

The Department of Energy (DoE) of South Africa launched a solar water heater programme to install 1,75-million SWH installations by 2019 and further established a long-term target through the National Development Plan (a cumulative target of 5-million SWHs by 2030). The programme has installed 400,000 units so far.<sup>85</sup>







*Children can be the harbingers of lifestyle transformation*



## PUMP UP EFFICIENT WAY

Pumps currently account for 10 per cent of the world's total energy consumption. If every inefficient pump were replaced with one that is energy optimised, it could result in savings of 4 per cent of the world's total electricity consumption.<sup>86</sup> This is equal to the residential electricity consumption of one billion people. In two thirds of pumps and pump systems currently installed, it is possible to save up to 60 per cent energy by switching to pumps with high-efficiency motors and variable frequency drives. Most efficient (small) pumps have efficiencies of 50-70 per cent (if operated at BEP). If the pumps are not designed properly and also not maintained properly, their efficiency can go down up to 10-20 per cent.



IIEC's (International Institute of Energy Conservation) Mumbai Energy Alliance did a project with 12 residential societies in Mumbai to test effectiveness of energy efficient pumps. The results showed increase in efficiency in the range of 15 per cent-37 per cent. The saving in the electricity costs ranged from around USD 300-750 and saving in units measured from 1200 units to 1600 units. The payback periods also ranged from 2 years to 5 years.<sup>87</sup>





*Cool roofs reduce the use of air-conditioning in homes*

# ROOFS CAN BE COOL TOO

The world's urban areas are rapidly expanding, and the density of city populations is increasing as they grow. By 2045 more than 6 billion people may live in urban areas.<sup>88</sup> Urban heat-island (UHI) is a common phenomenon where urban temperatures are significantly higher than those of its surrounding suburban and rural areas in summertime. A higher air temperature tends to increase cooling needs and reduce working efficiency of cooling systems for built environments, resulting in higher power demand and energy use. For example, a study estimated that an increase of 1 DC in air temperature would require the addition of about 500 MW for air-conditioning for buildings in the Los Angeles Basin.



Light coloured buildings and 'cool roofs' are time honoured techniques for reducing indoor temperatures in various warm regions. Roofing materials with high reflective properties can reflect up to 85 per cent of incident radiation.<sup>89</sup>

How rooftops of two cities differ



Dark rooftops in Delhi



White rooftops in Jaisalmer

According to the Lawrence Berkeley National Laboratory's Heat Island Group, retrofitting all possible urban flat roofs to white and sloped roofs to cool colors in the tropical and temperate zones of the world would offset 24 Gigatons of carbon over a 20-year span, or 1.2 Gigatonnes per year — the equivalent of emissions from about 300 million cars. (Buranen, 2013)

Cool roof demonstration by IIT Hyderabad reduced average summer-time daily maximum roof-surface temperature of a two-storey building from 55 degrees Celsius to 41 degrees Celsius. The air conditioning energy for the top floor would reduce by 14-26 per cent for commercial buildings with cool roof compared to black roof in Hyderabad. An estimated annual savings of 13-14 kWh/m<sup>2</sup> of roof area could be achieved by applying white coatings to uncoated concrete roofs on buildings in the region, corresponding to cooling energy savings of 10-19 per cent. The annual direct CO<sub>2</sub> reductions associated with the reduced energy use by whitening concrete roofs were estimated to be 11-12 kg CO<sub>2</sub>/m<sup>2</sup> of flat roof area.<sup>90</sup>



# 6

## RENEWABLE ENERGY

**R**enewable Energy or alternative energy is energy generated from natural resources such as sunlight, wind, rain, tides and geothermal heat, which are renewable (naturally replenished). Renewable energy technologies range from solar power, wind power, hydroelectricity/micro hydro, geothermal, biomass and biofuels. Renewable energy sources are infinite and have a much lower environmental impact and emissions than conventional energy technologies. In addition, wind and solar energy require very little water to operate and thus do not pollute water resources or strain supply by competing with agriculture, drinking water systems, or other important water needs. In contrast, fossil fuels can have a significant impact on water cycle.

By the end of 2015, while fossil fuel generated 76.3 per cent, renewables produced an estimated 23.7 per cent of global electricity generation. Hydropower provided about 16.6 per cent (3,940 TWh) of total global electricity generation in 2015, followed by wind 3.7 per cent, bio-power 2.0 per cent, solar 1.2 per cent, with geothermal, concentrating solar power and ocean power accounting for a combined 0.4 per cent.

Investment in renewable energy was higher in the world's poorest countries than the richest ones for the first time in 2015. A total of about £196.5 billion was spent on renewable power and fuels globally in what was a record year for investment in the sector, according to the Renewables 2016 Global Status Report. But more than £107 billion of that total, which doesn't include large hydropower schemes and heating and cooling technologies, took place in developing countries such as China, India and Brazil.

Currently China (153 GW), United States (105 GW), and Germany (85 GW) lead the world in renewable energy capacity, followed by Italy and Spain (32GW), and then Japan and India (31GW).

Renewable energy provided 7.6 million jobs by the end of 2014 including direct and indirect employment. Solar PV industry provided maximum jobs (2.49 million) followed by biofuels (1.78 million), Biomass (0.82 million) and solar heating and cooling (0.76 million). (REN 21, 2016)





*95 per cent of people not having access to electricity live in Sub-Saharan Africa and developing Asia*



## SOLAR HOMES LIGHTS; MAKES DARK HOMES BRIGHT

In spite of rapid developments in clean energy solutions 1.2 billion people still live without access to any form of electricity. Of the world's total energy poor, 95 per cent reside in Sub-Saharan African and developing Asia, of which 84 per cent are in rural areas. In Asia, India is the largest affected nation with nearly 300 million people living without access to clean lighting alternatives.<sup>91</sup> A research study published by the IFC-World Bank Lighting Global program finds that replacing all kerosene lamps in use with solar lights would reduce the equivalent of 5 percent annual greenhouse gas emissions in the United States, or 12 percent of India's annual emissions.<sup>92</sup> Each solar lantern and home lighting system in its life of 10 years replaces about 500-600 Litres of kerosene, mitigating about 1.5 tonnes of CO<sub>2</sub>.<sup>93</sup>



There are probably more than 10 million solar home systems in use. Over three million homes have been supplied through the IDCOL programme in Bangladesh, in which Ashden Award-winners Grameen Shakti and Rahimafrooz Renewable Energy are major partners. The work of the REDP led to the installation of over 400,000 systems in rural China. Kenya is the largest market for solar home systems in Africa, with a large number of independent businesses involved and about 350,000 systems in use.<sup>94</sup>

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**Lighting a Billion Lives© is a global initiative started in 2007 to facilitate clean energy access and launched on-ground operations in 2008 with a revised mission of reaching a billion people across the globe. The initiative enables energy poor communities to transition from traditional and inefficient energy sources to modern, more efficient and sustainable energy solutions. As on March 2015 it has disseminated 1.7 lakhs solar lanterns by installing 7600 solar home lighting systems.<sup>95</sup>**





*Off-grid solar systems has lighted millions of villages all across the world*



Project Chirag was started as a student initiative at H.R. College, Mumbai in March 2010. As on July 2015 it has provided solar lighting to 243 villages in 7 Indian states – Maharashtra, Rajasthan, Karnataka, Uttar Pradesh, Uttarakhand, Meghalaya and Assam.

In 2010 UK-based charity SolarAid set up a trading subsidiary, SunnyMoney, to catalyse the rural market by starting with sales campaigns through headteachers. By end March 2013, 408,000 lights had been sold in Africa, with 57 per cent in Tanzania, 27 per cent in Kenya, and 16 per cent in Malawi and Zambia. With around 390,000 lights in use, 2 million household members benefit from better quality light without kerosene fumes. Replacement of kerosene lamps is saving about 15 million Litres per year of kerosene, and cutting greenhouse gas emissions by 36,000 tonnes per year CO<sub>2</sub> e.<sup>96</sup>



Children on the outskirts of Dakar use a solar-powered reading light to do their homework

© Bruno Demeocq/Lighting Africa





*India aims to generate 100 GW of solar energy by 2022*

## SPV; ON-GRID, OFF-GRID CROSSING MILESTONES AS WE SEE

Total global solar PV capacity rose to 177 GW by the end of 2014. Germany, China, Japan, Italy and United States lead the world in total PV capacity, while China, Japan, United States witnessed maximum capacity addition in 2014. According to GlobalData's latest report, the global installed capacity of solar PV will increase from 271.4 GW in 2016 at a compound annual growth rate (CAGR) of 13.1 per cent to 756.1 GW in 2025.<sup>98</sup>

The state of Madhya Pradesh, India has approved a 750 MW SPV Plant in Rewa district. The plant, to be developed in three phases of 250 MW, once completed will become the world's largest solar power plant. At present, the largest SPV plant is the Topaz Solar Farm (550 MW) in California's San Luis Obispo county, US, which was commissioned in 2014.<sup>99</sup>

India has added 513 MW of rooftop solar capacity over the past 12 months, growing at 113 per cent over previous 12 months, reaching total installed capacity of 1,020 MW during 2015-16.<sup>100</sup>



The first significant PV-based rural electrification programme was the Narshingdi project, installed with French funds. Since the introduction of the solar home system (SHS) in 1996, this has become the biggest renewable energy programme in Bangladesh and over 2 million units have been installed through an integrated programme undertaken by the government through IDCOL 16. This program is recognized worldwide as a successful SHG installation model. The govt. has a target to generate more than 200 MW power from diverse renewable energy sources through IDCOL.<sup>101</sup>

In Nov 2015 around a dozen farmers in Dhundi, Gujarat about 90 km from Ahmedabad came together to form a solar cooperative and set up solar panels in the fields to generate electricity. They are using this solar energy for pumping water for irrigation. They are even selling excess electricity to the power board for Rs. 4.63 per unit. The cooperative also signed an agreement with a government-run power distribution company to sell excess electricity. Even while the project develops, farmers can earn up to Rs. 4,500 per month by selling solar power.<sup>102</sup>





*Solar lighting has enhanced quality of life in far off areas not connected by grid*



One of the world's biggest off-grid PV systems has begun operation in Afghanistan's Bamyan Province, whose name means "the place of shining light." The 1 MW solar installation is providing electricity to 2,500 homes, businesses and government buildings in the province.



Source: [http://www.pv-magazine.com/news/details/beitrag/1-mw-off-grid-pv-system-goes-online-in-afghanistan\\_100014091#ixzz4OSGHPjX](http://www.pv-magazine.com/news/details/beitrag/1-mw-off-grid-pv-system-goes-online-in-afghanistan_100014091#ixzz4OSGHPjX)

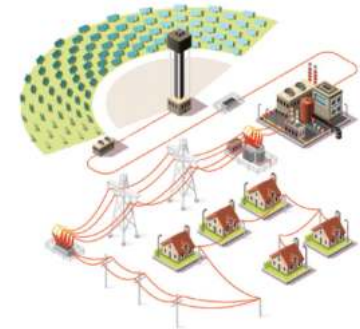




*India's first CSP in Rajasthan (2013)*

# CONCENTRATED SOLAR POWER; EMPOWERING MILLIONS, BENEFITS SHOWER

Total global CSP capacity rose to 4.4 GW in 2014 witnessing 27 per cent growth as compared to 2013. United States and India are leaders in annual capacity addition in 2014, while Spain, United States and India has the maximum capacity by the end of 2014.<sup>103</sup>



The Ivanpah CSP in California currently the world's largest CSP Plant generates about 392 MW of power. Morocco's Ouarzazate solar power plant will provide about 580 MW of power once it's complete in 2020.<sup>104</sup>

The Dubai Electricity and Water Authority (DEWA) has announced the launch of the world's largest concentrated solar power (CSP) project in June 2016. The first phase of the project is expected to be completed either in late 2020 or 2021, at which time it's expected to generate 1,000 MW of power. By 2030, this plant could be churning out 5000 MW five times that amount—enough to raise the emirate's total power output by 25 percent.<sup>105</sup>

Noor I, the first section at the town of Ouarzazate, provides 160 MW of the ultimate 580 MW capacity, helping Morocco to save hundreds of thousands of tonnes of carbon emissions per year.<sup>106</sup>

India's ambitious JNNSM programme aims to install 20,000 MW of solar power capacity in the country by 2022, which includes both solar PV and CSP technologies.

India's first concentrated solar power (CSP) plant under the Jawaharlal Nehru National Solar Mission (JNNSM) has been commissioned by Godawari Green Energy Limited (GGEL) in June 2013. This 50-MW state of the art power plant is located near the Nokh Village in Jaisalmer district of Rajasthan. The electricity produced at the plant could be used to light around 2.5 million homes in the country with clean energy.<sup>107</sup>





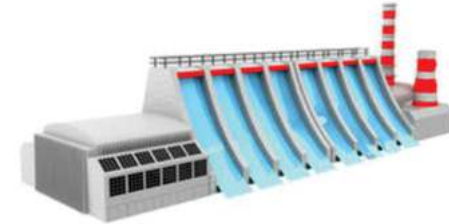


*Hydropower supplies at least 50 per cent of electricity production in 66 countries*



# HYDRO POWER; BIGGEST RENEWABLE ENERGY DRAWER

Hydro power is the biggest constituent of the renewable energy currently with global capacity of 1055 GW out of total 1712 GW RE at the end of 2014 and contributing to more than 16.6 per cent of total electricity production.<sup>108</sup> Hydropower supplies at least 50 per cent of electricity production in 66 countries and at least 90 per cent in 24 countries (MOP, GOI, 2016). China (27 per cent), Brazil (8.5 per cent) and USA (7.5 per cent) are the world leaders in hydropower capacity, while China, Brazil and Canada are top hydropower generating countries. India stands at 6th position with 4.3 per cent of the total global capacity in hydro power (REN 21, 2016).



In 2012, the Three Gorges Dam in China took over the number 1 spot of the largest hydroelectric dam (in electricity production), replacing the Itaipú hydroelectric power plant in Brazil and Paraguay. The Three Gorges Dam has a generating capacity of 22,500 megawatts (MW) compared to 14,000 MW for the Itaipu Dam. In the United States, the Grand Coulee Dam on the Columbia River, Washington, is the largest, with a generating capacity of about 6,800 MW (5th overall worldwide).<sup>109</sup>





*India has an estimated 20,000 MW of potential capacity through small hydro projects*



# SMALL HYDRO; CREATING ENERGY FROM SMALL RIVULETS AND RESERVOIRS

Though categorization of hydro power plants varies in countries, Mini (100 KW to 1 MW), Micro (5 KW to 100 KW) and Pico (0 KW to 5 KW) are smaller than small (1 MW to 10 MW), medium (10 MW to 100 Mw) and large (more than 100 MW) hydro electric projects. Mini, micro and Pico projects are particularly helpful in generating electricity in remote areas with small streams of water. Smaller plants can be set up by individuals and community operated cooperatives. Since small hydro projects usually have minimal reservoirs and civil construction work, they are seen as having a relatively low environmental impact compared to large hydro. This decreased environmental impact depends strongly on the balance between stream flow and power production.



As of 2012, global installed capacity of small plants of 10 MW or less was estimated at 75 GW. Small hydropower has been credited for its suitability for improved rural electrification and for its potential for socially inclusive and sustainable development (REN 21 2016). In 2008, of the total global capacity installed in small hydro China led by a big margin (65GW) followed by Japan (3.5 GW), US (3 GW) and India (2 GW).<sup>110</sup>

India has an estimated 20,000 MW of potential capacity that can be generated through small hydro projects, out of which less than 4000 MW is currently being utilised.<sup>111</sup>

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*In July of 2011, the AEPC, Alternative Energy Promotion Centre (AEPC), an autonomous government-agency piloted the first micro-hydro mini-grid system in the western district of Baglung, a remote hilly area, close to a tributary of the Kali Gandaki River. They connected six micro-hydro plants (ranging in capacity from 9 kilowatts to 26 kilowatts) within a distance of 8 kilometres, to form a 100 kilowatt capacity mini-grid. The system serves 1,180 households and is owned by the local community . By 2014, more than 1,000 MHPs with total generation capacity of 22 MW had been developed, providing off-grid electricity access to 20 per cent of the population.<sup>112</sup>*





*India aims to generate 60 GW of power by wind by 2022*

# WIND POWER; REAL MINDBLOWER

After Hydro, wind power contributes maximum to renewable energy global installed capacity estimated at 370 GW by 2014 rising from 48 GW in 2004. China, USA, Germany, Spain and India are the world leaders in wind power capacity. Wind generated more than 20 per cent electricity in many countries including Denmark, Nicaragua, Portugal and Spain.<sup>113</sup>



Far back as 1950's wind energy was being used in India to pump water for domestic use and irrigation and as an alternative to diesel pump-sets. A total capacity of 22,465 MW has been established up to December, 2014, mainly in Tamil Nadu, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Rajasthan. Wind electric generators of unit sizes between 225 KW and 2.1 MW have been deployed across the country. India now ranks 5th in the world after China, USA, Germany and Spain in grid connected wind power installations. A cumulative total of over 179 billions units of electricity have been fed to the State Electricity Grids up to March, 2014.<sup>114</sup>



The Netherlands has experienced the growth in renewable energy, with the number of energy co-operatives increasing from 19 in 2008 to 500 in 2015. In Scotland, an estimated 508 MW of community and locally owned capacity began operation in 2015, already exceeding the government's 2020 target of 500 MW. (REN 21, 2016)

In 2010, UNDP and the Eritrean government piloted a wind energy project in Southern Red Sea region, consisting of a wind farm with a capacity of 750 kilowatts in the port city of Assab.

- More than 35,000 people now have direct access reliable energy. Wind energy has improved the supply of electricity to water systems, schools, health facilities and small-scale businesses.
- A diesel power plant in Assab is now saving 680,000 Liters of diesel per year, or nearly USD 730,000 per year in diesel costs.
- CO<sub>2</sub> emissions have been reduced by 1718 metric tonnes per year with the added benefit of minimizing smoke-related health complications.<sup>115</sup>



# REFERENCES

1. Carbon emissions slow for first time in 15 years, the Observer, last accessed 3rd November, 2016, <http://www.gladstoneobserver.com.au/news/emissions-slowed-as-paris-deal-loomed/2866921/>
2. World Bank 2015 estimates that global per capita emission was 5 tco2e in 2014
3. Carbon and Inequality; from Kyoto to Paris, Nov. 2015, Chancel and Piketty (2015) estimates that top 10% emitters are responsible for 45% of global emissions, while bottom 50% emitters only contribute to 13% of global emissions.
4. <http://www.davidsuzuki.org/what-you-can-do/reduce-your-carbon-footprint/reduce-home-heating-and-electricity-use-by-10/>
5. Carbon Footprint of 5 diets compared, last accessed 28th October, 2016, <http://shrinkthatfootprint.com/food-carbon-footprint-diet>
6. New mayor wants to turn Turin into Italy's first 'vegan city' by Patrick Brown [patrick.browne@thelocal.com](mailto:patrick.browne@thelocal.com), 21 July 2016, <https://www.thelocal.it/20160721/new-mayor-wants-to-turn-turin-into-italys-first-vegan-city->
7. The new mayor of Turin has outlined a plan to promote a plant-based diet in the city - but not everybody is happy about it. By Lauren Sams 26 JUL 2016 Updated 26 JUL 2016, <http://www.sbs.com.au/food/article/2016/07/26/will-turin-become-italys-first-vegan-city>
8. What's cooking in India's largest biogas plant by Nidhi Jamwal | Saturday 15 March 2003, <http://www.downtoearth.org.in/coverage/whats-cooking-in-indias-largest-biogas-plant-12615>
9. Dalberg Global Development Advisors February 2013, [http://cleancookstoves.org/resources\\_files/india-cookstove-and-fuels-market-assessment.pdf](http://cleancookstoves.org/resources_files/india-cookstove-and-fuels-market-assessment.pdf)
10. World Markets for Organic Fruit and Vegetables. Produced by Economic and Social Development Department, <http://www.fao.org/docrep/004/y1669E/y1669e04.htm>
11. National Organic Program Miles McEvoy, Deputy Administrator , <https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program>
12. <http://www.icar.org.in/>
13. <http://www.kvk.pravara.com/>
14. Reducing our carbon footprint,, last accessed 30th October, 2016 <http://australianmuseum.net.au/reducing-our-carbon-footprint>,
15. Food and Water watch
16. Water vending machines at railway stations by year end NEW DELHI, October 7, 2015 by Siddhartha Roy <http://www.thehindu.com/news/cities/Delhi/water-vending-machines-at-railway-stations-by-year-end/article7732457.ece>
17. New Delhi station gets water vending machines. NEW DELHI, March 2, 2016 by Siddharth Roy <http://www.thehindu.com/news/national/other-states/new-delhi-station-gets-water-vending-machines/article8301818.ece>
18. The Land & Amenities Directorate; Railway Board (Ministry of Railways) [http://www.indianrailways.gov.in/railwayboard/uploads/directorate/land\\_amen/downloads/Manual%20for%20WCS%20\(Vol%201-%20Main](http://www.indianrailways.gov.in/railwayboard/uploads/directorate/land_amen/downloads/Manual%20for%20WCS%20(Vol%201-%20Main)
19. Water vending machines at all ECR railway stations. By Kumod Verma |TNN|Apr 25, 2015,11.19 IST <http://timesofindia.indiatimes.com/city/patna/Water-vending-machines-at-all-ECR-railway-stations/articleshow/47053913.cms>



20. UNEP by Stockholm Environment Institute [http://www.unwater.org/downloads/Rainwater\\_Harvesting\\_090310b.pdf](http://www.unwater.org/downloads/Rainwater_Harvesting_090310b.pdf)
21. Water Warriors: Rainwater Harvesting to Replenish Underground Water (Rajasthan, India). Author: Amanda Suutari and Gerry Marten Posted: June 2005 Site visit assistance and editorial contributions: Steve Brooks and Ann Marten, <http://www.ecotippingpoints.org/our-stories/indepth/india-rajasthan-rainwater-harvest-restoration-groundwater-johad.html>
22. This Rajasthan hamlet leads in rainwater harvesting <http://www.hindustantimes.com/ranchi/this-rajasthan-hamlet-leads-in-rainwater-harvesting/story-wxb1V41e2t20WlsMY1ttJ.html>
23. An Environmentally Sound Approach for Sustainable Urban Water Management: An Introductory Guide for Decision-Makers, <http://www.unep.or.jp/ietc/publications/urban/urbanenv-2/9.asp>
24. Nanyang Technology University, Singapore, by Adhityan Appan consultant and researcher, <http://www.downtoearth.org.in/coverage/urban-water-harvesting-singapore-16048>
25. Reducing water demand of your home, last accessed 29th October, 2016 <http://www.yourhome.gov.au/water/reducing-water-demand>
26. California's latest water-saving measure: slowing the flow of showerheads <https://www.theguardian.com/us-news/2015/aug/12/california-showerhead-water-conservation-toilet-lawn-rebates>
27. <http://www.sacbee.com/news/state/california/water-and-drought/article30932241.html>. Title- California sets low-flow standards on new shower heads by Renee C. Byer [rbyer@sacbee.com](mailto:rbyer@sacbee.com).
28. <https://yourstory.com/2016/02/reduce-carbon-footprint/> last accessed 29th October, 2016
29. Reducing water demand of your home, last accessed 29th October, 2016, <http://www.yourhome.gov.au/water/reducing-water-demand>
30. <http://www.bis.org.in/>
31. Environmental Issues: People's Views and Practices, Mar 2007 LATEST ISSUE Released at 11:30 AM (CANBERRA TIME) 06/12/2007, <http://www.abs.gov.au/ausstats/abs@.nsf/0/0CD2F26C6B32102DCA2573A80011AB16?opendocument>
32. <http://www.pmenginner.com/articles/87582-dual-flush-technology-in-australian-w-c-design> Issue: 6/02 Editor's Note: This article was reprinted from the published technical proceedings of the 1999 CIB W62 Symposium on Water Supply and Drainage for Buildings held in Edinburgh, Scotland.
33. United States Environmental agency, <https://www3.epa.gov/region1/npdes/mwra/excsum.html>
34. <http://www.thehindu.com/news/cities/Delhi/first-vacuum-toilet-on-track/article7666781.ece>
35. Bio Vacuum toilets to be equipped in premier trains, Sat, 27 Feb 2016-08:39pm, New Delhi, PTI <http://www.dnaindia.com/money/report-bio-vacuum-toilets-to-be-equipped-in-premier-trains-2183138>
36. HEEB, J.; JENSSEN, P.; GNANAKAN, K.; CONRADIN, K. (2007): Annex: Overview of Conventional Wastewater Treatment Systems. In: HEEB, J.; JENSSEN, P.; GNANAKAN; CONRADIN, K. (2008): Ecosan Curriculum 2.3. Switzerland, India and Norway.
37. Reducing water demand of your home, last accessed 29th October, 2016, <http://www.yourhome.gov.au/water/reducing-water-demand>
38. UK's emission from aviation, How does air compare to other means of travel, in terms of CO2 emissions?, last accessed 3rd November, 2016, [http://webcache.googleusercontent.com/search?q=cache:GwJnwfHQ\\_\\_UJ:www.airportwatch.org.uk/wp-content/uploads/How-does-air-travel-compare.doc+&cd=13&hl=en&ct=clnk&gl=in](http://webcache.googleusercontent.com/search?q=cache:GwJnwfHQ__UJ:www.airportwatch.org.uk/wp-content/uploads/How-does-air-travel-compare.doc+&cd=13&hl=en&ct=clnk&gl=in),
39. Public transportation: Moving America forward. 2010. American Public Transport Association, pg5. Retrieved on 3 November 2016 from [http://www.apta.com/resources/reportsandpublications/Documents/APTABrochure\\_v28%20FINAL.pdf](http://www.apta.com/resources/reportsandpublications/Documents/APTABrochure_v28%20FINAL.pdf)

40. Kodransky, Michael. 30 Dec 2008. How to green your commute: carpooling and public transport. Retrieved on 3 November 2016 from <http://www.mnn.com/lifestyle/responsible-living/stories/how-to-green-your-commute-carpooling-and-public-transit>
41. The world's top 10 busiest metros. 13 Nov 2014. Retrieved on 3 November 2016 from <http://www.railway-technology.com/features/featurethe-worlds-top-10-busiest-metros-4433827/>
42. King, Robin. 10 Dec 2013. 4 ways cities benefit from BRT. Retrieved on 3 November 2016 from <http://www.wri.org/blog/2013/12/4-ways-cities-benefit-bus-rapid-transit-brt>
43. King, Robin. 10 Dec 2013. 4 ways cities benefit from BRT. Retrieved on 3 November 2016 from <http://www.wri.org/blog/2013/12/4-ways-cities-benefit-bus-rapid-transit-brt>
44. Leds in Practice. May 2016, pg 1. Retrieved on 3 November 2016 from [http://ledsgp.org/wp-content/uploads/2016/05/LEDS-GP\\_Create-Jobs\\_final\\_web\\_May15.pdf](http://ledsgp.org/wp-content/uploads/2016/05/LEDS-GP_Create-Jobs_final_web_May15.pdf)
45. Kodransky, Michael. 30 Dec 2008. How to green your commute: carpooling and public transport. Retrieved on 3 November 2016 from <http://www.mnn.com/lifestyle/responsible-living/stories/how-to-green-your-commute-carpooling-and-public-transit>
46. Kodransky, Michael. 30 Dec 2008. How to green your commute: carpooling and public transport. Retrieved on 3 November 2016 from <http://www.mnn.com/lifestyle/responsible-living/stories/how-to-green-your-commute-carpooling-and-public-transit>
47. Department of Transport and Main Roads. "cycling Benefits" Queensland Government. Retrieved on 3 November 2016 from <http://www.tmr.qld.gov.au/Travel-and-transport/Cycling/Benefits.aspx>
48. Cycling in the Netherland. 2009. Ministry of Transport, Public Works and Water Management. Retrieved on 3 November 2016 from <http://www.fietsberaad.nl/library/repository/bestanden/CyclingintheNetherlands2009.pdf>
49. Why is cycling so popular in the Netherlands? 8 Aug 2013. Retrieved on 3 November 2016 from <http://www.bbc.com/news/magazine-23587916>
50. Martinko, Katharine. 8 Oct 2014. "Four ways that walking to school can benefit kids". Retrieved on 3 November 2016 from <http://www.treehugger.com/culture/4-reasons-why-walking-school-benefits-kids.html>
51. Safe Routes to Schools. Dec 2008. Pg 13. Retrieved on 3 November 2016 from [http://www.saferoutespartnership.org/sites/default/files/pdf/SRTS\\_GHG\\_lo\\_res.pdf](http://www.saferoutespartnership.org/sites/default/files/pdf/SRTS_GHG_lo_res.pdf)
52. The official website of International walk to school. Retrieved on 3 November 2016 from <http://www.iwalktoschool.org/>
53. Bob Schildgen, Sierra Club, Jul 2014
54. Global Tissue Consumption reaches a new high. 8 Oct 2013. Retrieved on 3 November 2016 from <http://technology.risiinfo.com/tissue/global/end-user-projects/global-tissue-consumption-reaches-new-high>
55. Bidet Shower, Wikipedia. Retrieved on 3 November 2016 from [https://en.wikipedia.org/wiki/Bidet\\_shower](https://en.wikipedia.org/wiki/Bidet_shower)
56. A hose: Always next to every Finnish toilet. Retrieved on 3 November 2016 from <http://en.biginfofinland.com/hose-always-next-every-finnish-toilet/>
57. Raghavan, R and Notaras, M. 3 Mar 2009. Sad demise of the paper coffee cup. Retrieved on 3 November 2016 from <https://ourworld.unu.edu/en/storm-in-a-paper-cup>
58. Eastaugh, S. 20 Sep 2016. France becomes the first country to ban plastic cup and plates. Retrieved on 3 November 2016 from <http://edition.cnn.com/2016/09/19/europe/france-bans-plastic-cups-plates/>



59. Howell, J. 22Oct 2009. Ditching the paper cup. Retrieved on 3 November 2016 from <http://magazine.utoronto.ca/blogs/ban-on-paper-coffee-cups-toronto/>
60. Awesome Café Bans Disposable Coffee Cups. 4 Mar 2016. Retrieved on 3 November 2016 from <http://www.onegreenplanet.org/news/cafe-bans-takeaway-coffee-cups/>
61. Recycling Paper. 1990. "Why recycle paper?" Paper Stock Institute.
62. Top ten paper recycling countries. Retrieved on 3 November 2016 from <http://www.mapsofworld.com/world-top-ten/world-top-ten-paper-recycling-countries.html>
63. Taneja, R. Stop white pollution-ban plastic bags. Retrieved on 3 November 2016 from <https://www.change.org/p/supreme-court-of-india-health-ministry-of-india-stop-white-pollution-ban-plastic-bags>
64. Phaseout of light weight plastic bag. Retrieved on 3 November 2016 from [https://en.wikipedia.org/wiki/Phase-out\\_of\\_lightweight\\_plastic\\_bags](https://en.wikipedia.org/wiki/Phase-out_of_lightweight_plastic_bags)
65. Omara, J. 11Sep 2013. Plastic bag backlash gains momentum. Retrieved on 3 November 2016 from <http://www.bbc.com/news/uk-24090603>
66. Phaseout of light weight plastic bag. Retrieved on 3 November 2016 from [https://en.wikipedia.org/wiki/Phase-out\\_of\\_lightweight\\_plastic\\_bags](https://en.wikipedia.org/wiki/Phase-out_of_lightweight_plastic_bags)
67. How many trees are used to make pencils each year? Retrieved on 3 November 2016 from <http://www.pristineplanet.com/eco-info/how-many-trees-are-used-to-make-pencils-each-year.asp>
68. Streeter, A.K. 9 Sep 2010. 9 billion pencils and a school supply quandary. Retrieved on 3 November 2016 from <http://www.treehugger.com/culture/2-billion-pencils-and-a-school-supply-quandary.html>
69. National Ujala Dashboard, retrieved on 2nd November 2016 from <http://www.ujala.gov.in/>
70. Deal flips switch on South Africa's LED lighting, 1st December 2011, retrieved on 3rd November 2016 from <http://www.medioclubsouthafrica.com/tech/2693-011211-philips#ixzz40BRyiQrA>
71. Solar Powered LED Street Lights to Nairobi, 15th October 2012, <https://shaikmohasin.wordpress.com/tag/solar-powered-led-street-lighting/>
72. Celebrating Earth Hour, <https://www.earthhour.org/celebrating-earth-hour>
73. Earth Hour 2016: Cities turn off lights to call for action on climate change, <http://indianexpress.com/photos/picture-gallery-others/earth-hour-2016-climate-change-asia/4/>
74. Wikipedia
75. Does Having Appliances on Standby Use Power?, Kathryn, 1 October 2016 from <http://www.energysavingsecrets.co.uk/does-appliances-standby-use-power.html>
76. How to reduce your carbon footprint, [http://green.wikia.com/wiki/How\\_to\\_reduce\\_your\\_carbon\\_footprint](http://green.wikia.com/wiki/How_to_reduce_your_carbon_footprint)
77. <http://www.energuide.be/en/questions-answers/how-much-power-does-a-computer-use-and-how-much-co2-does-that-represent/54/>
78. ShrinkThatFootprint.com & <http://www.apple.com/environment/reports/>
79. The Guardian, 2010 & How Bad Are Bananas? The Carbon Footprint of Everything by Mike Berners-Lee, 2010
80. Bangladesh suit ban to save power, Mark Dummet, 2 September 2009, [http://news.bbc.co.uk/2/hi/south\\_asia/8234144.stm](http://news.bbc.co.uk/2/hi/south_asia/8234144.stm)

81. Cool United Nations, Chun Knee Tan, 26 August 2008, <https://ourworld.unu.edu/en/cool-united-nations>
82. Wikipedia
83. <https://ourworld.unu.edu/en/cool-united-nations>
84. October 25th, 2014 by Zachary Shahan, The Solar Energy Revolution Everyone's Ignoring... Is In Bangladesh
85. Solar water heater rollout programme gains momentum, 14 January 2016, Mike Rycroft, <http://www.ee.co.za/article/solar-water-heater-rollout-programme-gains-momentum.html>
86. The surprising truth about pumps, <http://energy.grundfos.com/en/facts-on-pumps-energy/the-surprising-truth-about-pumps>
87. <https://www.bijlibachao.com/pumps/energy-efficient-pumps-can-help-residential-complexes-save-on-electricity-bills.html>
88. The Conversation, 30 June 2016, retrieved on 28 October 2016 from <http://theconversation.com/green-and-cool-roofs-provide-relief-for-hot-cities-but-should-be-sited-carefully-60766>
89. <http://www.indiaenvironmentportal.org.in/files/file/aeee%20energy%20efficiency%20final.pdf>
90. Akbari Hashim, Sathaye A Jayant, Surekha Tetali, Tengfang Xu, 2011, Quantifying the direct benefits of cool roofs in an urban setting: Reduced cooling energy use and lowered greenhouse gas emissions.
91. [http://labl.teriin.org/energy\\_access.php](http://labl.teriin.org/energy_access.php)
92. IFC-World Bank Study Establishes Significant Climate Benefit Of Solar Lighting Products, 2014, <https://www.lightingafrica.org/ifc-world-bank-study-establishes-significant-climate-benefit-of-solar-lighting-products/>
93. <http://www.iahv.org/in-en/program/sustainabledevelopment/light-a-home/>
94. <http://www.ashden.org/solar>
95. [http://labl.teriin.org/energy\\_access.php](http://labl.teriin.org/energy_access.php)
96. Ashden Case Study, SolarAid, Africa, <http://www.ashden.org/files/SolarAidwinner.pdf>
97. Installed Solar PV Capacity Will Surpass 756 GW By 2025, Global Data by Joshua S Hill, June 2016, <https://cleantechnica.com/2016/06/28/global-installed-solar-pv-capacity-will-surpass-756-gw-2025-globaldata/>
98. World's largest solar photovoltaic plant of 750 MW to be built in Rewa district of Madhya Pradesh, May 2, 2015, last accessed 3rd <http://www.jagranjosh.com/current-affairs/worlds-largest-solar-photovoltaic-plant-of-750-mw-to-be-built-in-rewa-district-of-madhya-pradesh-1430568666-1>
99. Topaz Solar Plant, last accessed 3rd November, 2016, [https://en.wikipedia.org/wiki/Topaz\\_Solar\\_Farm](https://en.wikipedia.org/wiki/Topaz_Solar_Farm)
100. India's Rooftop Solar Power Capacity Crosses 1 Gigawatt Mark: Report, 19 October 2016, <http://www.ndtv.com/india-news/indias-rooftop-solar-power-capacity-crosses-1-gigawatt-mark-report-1476264>
101. Bangladesh Case Study, Christianaid, <http://dib.dk/wp-content/uploads/file/Low%20carbon%20Bangladesh%20Case%20Study.pdf>
102. With Solar Power, A Gujarat Village Is Irrigating Its Fields For Free, 22 May 2016, <http://www.ndtv.com/india-news/with-solar-power-a-gujarat-village-is-irrigating-its-fields-for-free-1408800>
103. REN 21, Renewables 2016 Global Status Report, last accessed 3rd November 2016, <http://www.ren21.net/status-of-renewables/global-status-report/>
104. Dubai Is Building the World's Largest Concentrated Solar Power Plant, George Dvorsky, 6/06/16, <http://gizmodo.com/dubai-is-building-the-worlds-largest-concentrated-solar-1780781150>

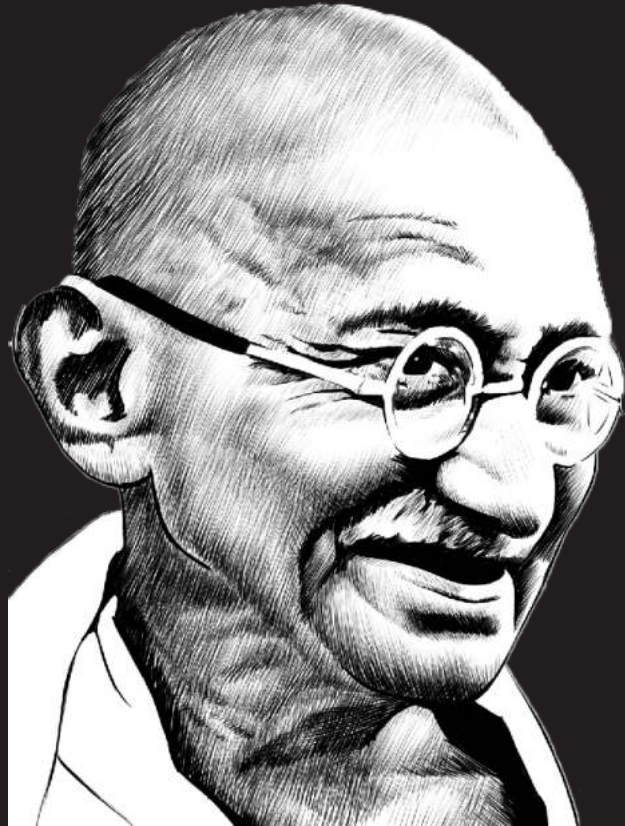


105. Dubai Is Building the World's Largest Concentrated Solar Power Plant, George Dvorsky , 6/06/16 , <http://gizmodo.com/dubai-is-building-the-worlds-largest-concentrated-solar-1780781150>
106. Morocco to switch on first phase of world's largest solar plant, Arthur Neslen, 4 February 2016, <https://www.theguardian.com/environment/2016/feb/04/morocco-to-switch-on-first-phase-of-worlds-largest-solar-plant>
107. INDIA'S FIRST CSP PLANT COMMISSIONED UNDER JNNSM, 12 June 2013, <http://www.energynext.in/indias-first-csp-plant-commissioned-under-jnnsm/>
108. REN 21, Renewables 2016 Global Status Report, last accessed 3rd November 2016, <http://www.ren21.net/status-of-renewables/global-status-report/>
109. <http://water.usgs.gov/edu/hybiggest.html>
110. REN 21, Renewables 2016 Global Status Report, last accessed 3rd November 2016, <http://www.ren21.net/status-of-renewables/global-status-report/>
111. Govt turns to small hydro projects to meet power needs, by Amitabh Sinha, March 2015, <http://indianexpress.com/article/india/india-others/govt-turns-to-small-hydro-projects-to-meet-power-needs/>
112. Ensuring the Sustainability of Rural Electrification in Nepal, 27 September, 2015, <http://www.worldbank.org/en/news/feature/2015/09/26/ensuring-sustainable-rural-electrification-in-nepal>
113. REN 21, Renewables 2016 Global Status Report, last accessed 3rd November 2016, <http://www.ren21.net/status-of-renewables/global-status-report/>
114. <http://www.windvigilance.com/about-adverse-health-effects/visual-health-effects-and-wind-turbines>
115. Communities in Eritrea benefit from renewable wind energy, <http://www.er.undp.org/content/eritrea/en/home/ourwork/environmentandenergy/successstories/alternative-energy-for-eritrean-rural-communities.html>

# NOTES







“  
*Possess only  
what you need.*  
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MESSAGE OF THE FOREMOST  
HUMANIST AND ENVIRONMENTALIST



*“The earth, the air, the land  
and the water are not an inheritance  
from our fore fathers but on loan  
from our children.  
So we have to handover to them  
at least as it was handed over to us.”*

*- Mahatma Gandhi*







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