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Point for discussion this month **Sustainable forms of Energy**

Eternal Words

I am the earth. You are the earth. The Earth is dying. You and I are murderers.

~Ymber Delecto

So bleak is the picture... that the bulldozer and not the atomic bomb may turn out to be the most destructive invention of the 20th century.

~Philip Shabecoff, New York Times Magazine, 4 June 1978

For 200 years we've been conquering Nature. Now we're beating it to death.

~Tom McMillan, quoted in Francesca Lyman, The Greenhouse Trap, 1990

Dear Readers,

Five elements as described in *Vedas* are convertible energy and matter forms. From water (aap), wind (vayu), earth (Prithvi), Space (aakash) you get energy to be converted in to electricity (tej).The attempts are being made to maximize energy production to carry the "work". All the physical, chemical and ecological principles of exchanges of matter and energy help in developing economy, market and sustainability. So the canvas of sustainability is to be painted richly with primary colours of matters, energy and processes and with secondary colours of health, food and water quality security and tertiary colours of economy, market and good governance.

In this issue the article explains the different take on energy and environment in new millennium.

The cover photo is of beautiful water body which absorbs the solar radiation and helps in translating it into direct components of ecosystem. These transformations are non violent, simple, symbiotic and for entropy at every stage. There is ecological sink to hold in the ecosystem.
Human being has to learn a lot from ecological processes to make life comfortable and sustainable.

Thank you,

Chief Editor

Millennium of Energy and Environment

- Sandeep Joshi

Energy, the spirit of human development, is the ability to perform work. It can neither be created nor destroyed. It is only converted from one type into another type. The energy available from the particular functions goes on decreasing as a function of time. Hence the entropy of the energy tends to increases.

Invention of fire gave an impetus to the cultural development of human being. With the help of discovery of other forms of energy, man climbed the steps of development. Around 1850, Carl Auer, an Australian chemist suggested use of gas for the home and street lighting known as 'weblash Mantle' or 'incandescent mantle'. It was supplanted by the invention of Thomas Edison's "Electric Bulb'. And now electricity and electrical equipments are ubiquitously utilized everywhere. If electricity had not been discovered, man would have been continued living in 'stone-age' yet. Electricity has brought real speed and comfort of life.

Till 19th century, the development centred on steam and machines; in 20th century focus was oil and infrastructure but now it is symbiosis of energy and environment for the growth and comforts of human life. Urban areas and industrial units are the prodigal consumers of energy. The fossil fuels are being consumed at a rate of 1,00,000 times faster than they are being formed and it seems that the remaining amount of recoverable resources is very finite.

In the 'future shock' one of the best sellers, Alvin Toffler explains the imminent doomsday because of ultra-rapid growth and changing life styles with unprecedented energy demand. He ascertains that now the world requirement of energy per day is equivalent to the total energy demand since from the antiquity.

Energy resources are grossly categorized into two renewable and non-renewable resources. The source, which are once utilized are unavailable for next process e.g. coal, mineral, oil etc. Renewable resources are those which are available with certain time intervals or can be continuously utilized e.g. water, sun-light, vegetation, etc. Table no. 1 shows the quality of energy resources.

Coal and oil shares are 26% and 40% respectively in the fulfilment of global energy requirement

Abundance of energy resources is expressed in Power Equivalent (x 10^{15} KWH) shown in following graph -

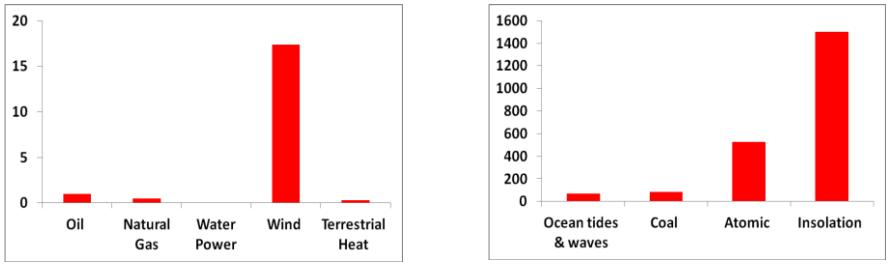
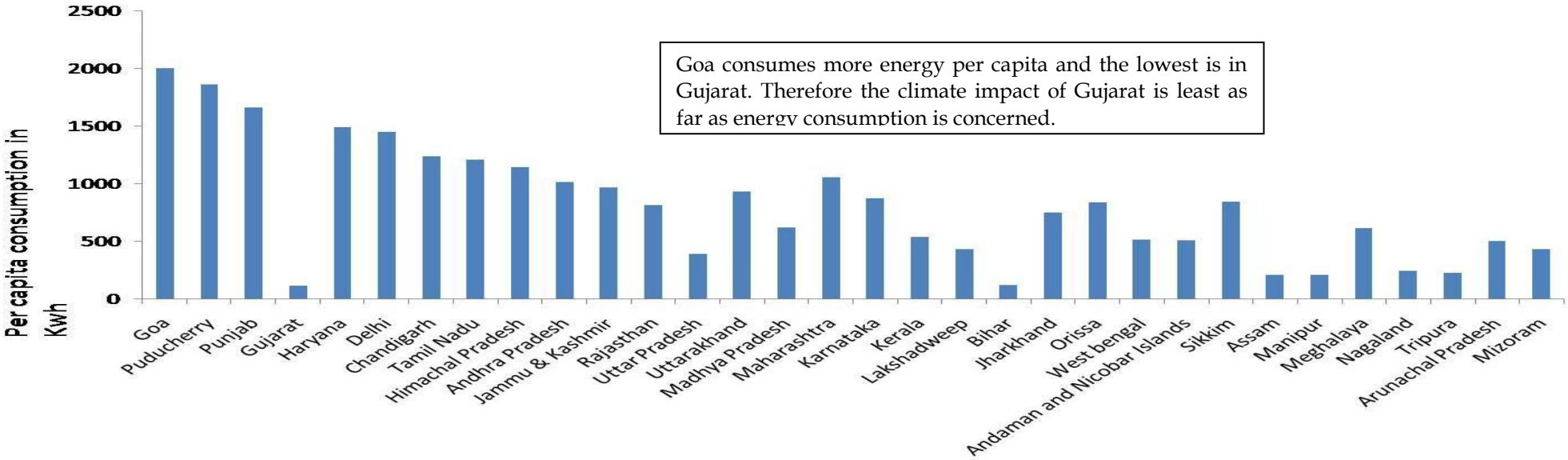


Fig. 1 Abundance of energy rsources

Indian scenario –

Per capita consumption of electricity is shown graphically as -
(Source of information: Wikipedia)



Goa consumes more energy per capita and the lowest is in Gujarat. Therefore the climate impact of Gujarat is least as far as energy consumption is concerned.

The rate of Energy consumption is the most vital indicator of economic growth. The demands for energy in India are on the continuous increases because of incessant growth in population and for improving the standard of living of the citizens. India's per capita consumption of energy is 206 Kg of oil equivalent (oe) compared to world's average of 1540 kg. Per capita consumption of energy increased with a rate of 701% per annum in 20th century. But even then in December 2011, over 300 million Indian citizens had no access to electricity.

Over one third of India's rural population lacked electricity, as did 6% of the urban population. Of those who did have access to electricity in India, the supply was intermittent and unreliable. In 2010, blackouts and power shedding interrupted irrigation and manufacturing across the country.

The per capita average annual domestic electricity consumption in India in 2009 was 96 kWh in rural areas and 288 kWh in urban areas for those with access to electricity, in contrast to the worldwide per capita annual average of 2600 kWh and 6200 kWh in the European Union.

Power development in India was started in Darjeeling in 1897, followed by hydropower station at Sivasamudram in Karnataka during 1902. India's growth of electricity generation was very slow from 1950 to 1985 when compared to developed nations but since 1990, India became one of the fastest growing markets for new electricity generation.

The country's annual electricity generation capacity has increased in last 20 years from about 66 GW in 1991 to over 185 GW in 2011. International Energy Agency estimates India may add between 600 GW to 1200 GW of additional new power generation capacity before 2050.

Resources of India

India's energy requirements are met from a variety of sources. Both despite the substantial increases during the last four decades in the supply of commercial sources of energy such as coal, oil, gas and electricity, non-commercial sources dominated by fuel woods, wood still meets around half of our energy needs, particularly in the rural area.
Our country has vast reserves of coal i.e. about 148.8 billions tones. 84 billions tones of coal are in the proven category and remaining is in the 'indicated' and 'inferred' categories. The growth in the imports should be lessened to some extent with emphasis on fuel economies and larger use of Natural Gas.

Natural gas as a fuel has significant advantage in terms of ease of operation, total control and regulation of combustion. Application of natural gas saves about 15% of capital investment and 5% of energy as compared to naphtha based plants. The natural Gas is a premium source of energy for domestic and commercial sector.

Thermal power

Thermal power plants transfer energy rich fuel into electricity. Types of fuels include coal, natural gas, petroleum products, agricultural waste and domestic trash / waste etc. Sweden's waste-to-energy are short of supply of waste and now they import waste from nebouring countries. Other sources of fuel include landfill gas and biogases. India is ranked 6th after Kazakistan in use of coal for thermal power plants while South Africa's dependency of thermal power on coal is 93% ranked one and that of Germany is 44% ranked 10th.
Wind energy depends on wind speed, and hydropower energy on water levels, thermal power plants account for over 65% of India's generated electricity. India's electricity sector consumes about 80% of the coal produced in the country.

Hydropower

It is the most widely used, least polluting form of renewable energy. India is blessed with immense amount of hydro-electric potential and ranks 5th in terms of exploitable hydro-potential on global scenario. Installed capacity was approximately 37000 MW i. e. 22% of total electricity generation in India in 2011. India's economically viable hydro potential assessed as 84,000 MW at 60% load factor plus 6,780 MW in form of small, mini, and micro hydel projects.

Nuclear Power

India had 4.8 GW of installed nuclear power generation capacity fuels in 2011. India's nuclear power plant development began in 1964. India's nuclear venture will be completing 50 years shortly on the backdrop of two controversial ambitious nuclear power plants of Kudankolam and Jaitapur. A properly networked approach with technological innovations, social acceptance and rehabilitation and waste management policies and action plans, nuclear energy can contribute to national growth.

Energy management and environment management

Energy intensive industries are proliferating in India since 1950. Energy consumption in the industrial sector is about approximately 60% of commercial energy consumption. It is three times more than that of the transport sector and thirty times more than that of agriculture. Reasons for this are successive development plans emphasized on a self-radiant industrial sector and infrastructure viz- steel, cement, aluminium, fertilizers, chemicals, refineries, petrochemicals, pulp and paper, etc. India's total domestic, agricultural and industrial per capita energy consumption estimate varies between 400 to 800 kWh in 2008–2009. In December 2011, India had an installed capacity of 22.4 GW using renewal technologies, more than that of total installed capacity in Austria technologies.
It is a prime need to conserve and to optimize the energy available to overcome the problems of energy demand and deficiency. Burgeoning demand for energy is posing threats to the ecosystems and giving rise to environmental problems which are directly or indirectly hazardous to human health. Coal, oil and radioactive substances are finite resources for energy production. Ruthless exploitation and wasting of these materials will lead to unavailability of energy resources and ubiquitous pollution. Energy management approach is essential to curtail unnecessary and/or wasteful consumption of energy (e.g. losses of electricity during transmission and distribution). Economical utilization of energy resources will to ensure their continuous and steady supply for future generation.

We need smart and practical approaches because energy, as a driver of development, plays a central role in both fighting poverty and addressing climate change.

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