

## Environment and Climate Change - An Indian Perspective



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All over the world no other subject in the recent past has been discussed and debated as much as Environmental sustainability that includes climate change as well. In the past few years the world has witnessed drastic changes in climatic conditions which used to occur once in a while earlier; they have become an annual affair with differing degrees of disastrous consequences on civilisation. Such extreme changes in weather fluctuations and their impact on mankind thereof, has sensitivised the authorities and the public at large towards this - one of the most significant issues for our very own survival. Although concerns over environment, need to preserve natural resources, etc. were talked about, the real thrust came after the Intergovernmental Panel on Climate Change (IPCC) established in 1988 started issuing Assessment Reports on impact of human induced climate change issues. That led to formation of several forums, committees and organisations at global and individual country levels to address specific areas of environment & climate change. Concerted efforts of all these groups have raised the public awareness and also resulted in positive steps towards safeguarding environment. Everyone is now realizing that something needs to be done. However, the ground reality is that the real action taken or initiated at any level is short of the vigour with which the issues are discussed, debated and actions planned, world over. This is primarily due to the syndrome that ‘when everyone is responsible, no one is responsible’ and also to a good extent, costs involved for developed nations and prioritization of growth (even at the cost of environment) for developing countries. Though of late, incidents like pollution in Beijing or our very own Delhi smog in winter has forced us to realize that time is running out and we must act fast.

The discussions and actions to protect environment can be broadly classified into three main categories, viz. reduction of gaseous pollutants including green-house gas (GHG) emission, solid and liquid effluent management and preservation of nature that includes preservation of natural resources, water bodies, forests, wild life, flora & fauna, etc.

While for a country like India, the key economic priority is to alleviate poverty and uplift the economic condition of poorer sections of society, the dichotomy is that such economic development often leads to environmental degradation. While industrial growth is essential for economic development, the energy and other industries also contribute to about 80% of GHG emission in addition to deforestation and water pollution. Hence, the major challenge for India is to continue with economic development programmes and at the same time preserve environment through renewable sources of energy.

Industrialisation is primarily responsible for most of the issues connected with environmental degradation. Hence, it is imperative, that all stakeholders of industrial development, right from Government/ Regulatory Authorities to the Project Developers and consumers must take cognizance of the environmental impact and shoulder the responsibilities that are necessary to mitigate the impacts. As engineering consultants and technology suppliers provide the know how to build the industry, the onus is also on them to take care of environmental considerations and to offer sustainable designs.

Engineering consultants in their role as a designer and advisor to industries have three major roles to play:

- a) Offering innovative, sustainable but economically viable solutions to the industries,

- b) Ensuring compliance to environmental regulations by industries, and
- c) Balancing the growing concerns of environmentalists and also of common public vis-à-vis industry limitations and Government initiatives that are required to move towards a more environment friendly future.

Several programmes /initiatives across all levels are being pursued to lessen the impact on the environment and that includes more stringent regulations, better public awareness, more efforts towards conservation of natural resources, environment friendly alternative processes, improved system efficiencies, reduction in waste and many more. This paper highlights only the major initiatives connected to industries that are initiated in India, their status and the issues that need to be looked into for better implementation and compliance.

**Environmental Degradation - Contribution by Various Sectors**

**Air Pollution**

In general the energy sector is primarily responsible for gaseous pollutants including GHG emission. Agriculture also has a fair share of contribution in GHG emission mostly from livestock farming as per GOI data, of 2015<sup>[1,2]</sup>. Although industries like Iron & Steel, Copper smelting, Cement, etc. are categorized under heavily polluting, overall contribution of these industries towards GHG emission is much less compared to the energy sector as shown in Fig 1.

**Water Consumption & Pollution**

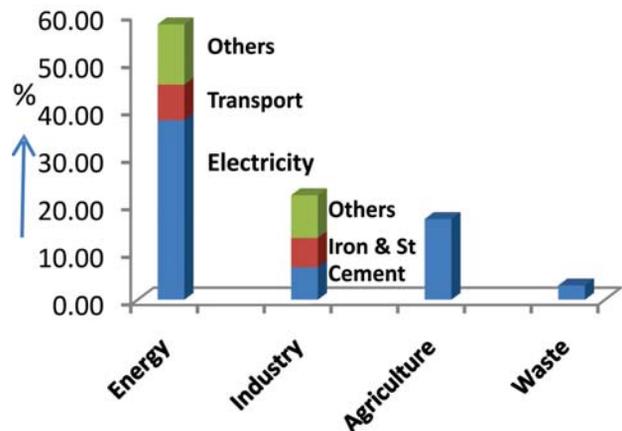
Amongst natural resources, water is the most abused and over used natural resource not only in India but all over the world. As a result, water has now become the scarcest commodity. Recent studies show that if the ever depleting water availability issue is not addressed with the due attention it deserves, then very soon many thickly populated areas would become unsuitable for habitation. The recent announcement by authorities of Cape Town, South Africa to cut off city water supply is an indication of the grim reality that is staring at us.

Unlike developed countries, irrigation consumes about 84% water in India. Thermal power plants consume about 11%. Domestic consumption is about 4% and balance 1% is consumed by others<sup>[3]</sup>. The major water consumption, sectorwise, is shown in Fig 2. In addition, water pollution further reduces the availability of quality water and also affects the entire eco system. More than 80% of water pollution is caused by untreated sewage and domestic waste water followed by industrial waste. Other causes are oil spillage from oil tankers and dumping of solid waste like glass, plastic, Styrofoam, etc.

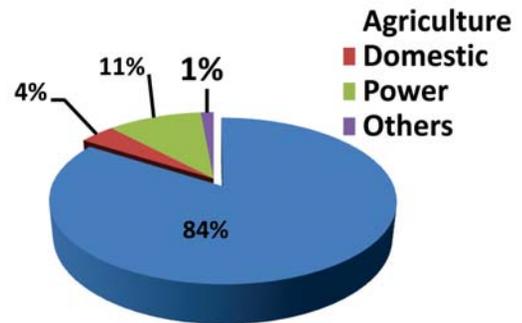
**Energy Sector**

**Electricity Sector**

Amongst energy sectors, electricity sector accounts for maximum GHG emission mainly CO<sub>2</sub>. Heavy dependence on fossil fuel as the prime source of energy is the main challenge in arresting the ever increasing trend of carbon



**Fig 1: Sector wise GHG emission**



**Fig 2: Sectorwise water consumption**

foot print. While most of the developing nations are leaning towards gas, India is dependent on coal as it is the only primary energy source abundantly available at a relatively cheaper price. At present coal contributes about 80%<sup>[4]</sup> of power generation. Its contribution is expected to decline to about 65%<sup>[5]</sup> by 2040 which would still be very significant. Hence, the challenge is to reduce and contain the pollutants from coal fired power plants and at the same time, explore alternate sources of cleaner form of energy that can substantially reduce the dependence on fossil fuel. Major efforts being made to reduce GHG and other air pollutants emission are:

- a) Adoption of clean coal technologies, improving generation efficiency by implementing supercritical/ ultra-supercritical technologies,
- b) Introduction of stricter norms by MOEF & CC for air pollution. Revised limits on SO<sub>x</sub> and NO<sub>x</sub> emissions are in fact comparable and in some cases more stringent compared to internationally acceptable norms such as The World Bank norms or EU norms, and
- c) CO<sub>2</sub> capture and sequestration (CCS) – it is still not implemented but is being actively discussed as the solution to reduce GHG emission. However, sequestration is still an issue to be resolved as the prohibitive cost and energy consumption which in turn generates more CO<sub>2</sub> partly defeats the very purpose of it. Better methods of capturing CO<sub>2</sub> and effective utilization of captured CO<sub>2</sub> rather than merely storing and preserving is the need of the hour and a challenge to engineering fraternity.

Large hydro power and nuclear power plants can provide relatively clean energy but both have their own issues. After the 2013 Uttarakhand flood tragedy, the Expert Review Committee and MOEF & CC did acknowledge the role of large hydro dams in the tragedy. Nuclear power has serious land acquisition issues due to the public's hazard perception, apart from being expensive because of its larger Capex and high gestation period.

The effort in reducing pollution from thermal power plants is supplemented by growing installations of renewable energy plants mainly solar, wind and to some extent biomass greatly supported by GOI mission to install 175 GW renewable energy by 2022 mainly through solar (100 GW) and wind (60 GW). While the focus on solar and wind power is good news for environment, their limitations as reliable and continuous sources of power need to be addressed in order to make renewables as a viable alternative to fossil based power.

The evolution of energy storage (battery) technology as well as its commercial affordability as a viable means to store and supply MW scale energy is extremely critical to support renewable power movement. MW scale battery though available in the market is still under development and would take some more time to fully mature and be available at a commercially competitive price.

The other critical issue for the electricity sector is water consumption. Although water consumption by electricity sector is only a small fraction of the total water consumption, its share amongst industries is substantial as can be seen from Fig 2. MOEF & CC through its recent amendments to environmental norms for thermal power plants have restricted the water consumption by the electricity sector. Once fully implemented, the water consumption in electricity sector is expected to reduce substantially. Water consumption can be reduced by combination of the following measures

- a) Conversion of all once through cooling system to closed cooling system, and
- b) Implementation of ZLD (Zero Liquid Discharge) system.

## Transport Sector

As seen from Fig 1, transport sector comes next as the major source of pollution in which road transport contributes about 90%. Growing menace of pollution from automobiles is being addressed worldwide through:

- a) Better public transport system e.g. intercity rails, metro rail, mono rail, etc.
- b) Better infrastructure – better and wider road connections, bridges, tunnels, etc. to cut down point to point distance,
- c) Better technology and fuel quality upgrade (e.g. using Euro VI grade of transportation fuel) to reduce emission,
- d) Smart systems enabling performance measurement and mitigation actions – smart traffic management, IOT based on line pollution monitoring, etc.
- e) Electric vehicles - National Electric Mobility Mission Plan (NEMMP) 2020 aims to roll out 5 to 6 million EVs every year starting 2020. NEMMP coupled with recent announcement of GOI to stop manufacturing of IC engine based cars by 2030 are expected to give impetus to the growth of EV. While popularizing EV is definitely an environment friendly move, to make the mission successful the following issues must be addressed:
  - i) While pollution in cities will definitely be reduced, detailed evaluation of power source for EVs has also to be done to ensure overall GHG emission does not get adversely affected considering overall efficiency of power supply to EVs vis-à-vis IC engines on per km distance travelled basis.
  - ii) Holistic review of socio economic impact on the connected industries such as IC engine based automotive industry, refineries, etc.
  - iii) Bringing down the cost of EVs to make it affordable and closer to if not at par with IC engine based vehicles and
  - iv) Affordable and easily accessible facilities for fast charging of batteries or perhaps some other innovative means that can make battery charging at par with oil filling in cars in terms of time taken and easy accessibility.

### Industrial Sector

With launching of Make in India movement, the thrust is on to expand the industrial sector in India. While it is a welcome move for economic development, expansion of industrial sector will also add to environmental pollution. To counter such negative impact on environment, MOEF & CC has proposed much stricter norms for most of the polluting industries. While regulatory authorities are trying to contain environmental pollution by imposing stricter norms and incentivising energy efficiency through schemes like PAT (Perform, Achieve & Trade), the Industry must collectively explore other options of environmental sustainability by

- a) Adopting environment friendly technologies that reduce pollution and waste,
- b) Carrying out energy audits and asset management studies and implement recommendations of these studies to reduce carbon foot print. It will also help in implementing PAT scheme.
- c) Ensuring solid and liquid effluent management – would go a long way in preserving water and preventing water pollution. Large section of highly polluting industries do not have any effluent treatment plants and dispose untreated effluents to natural water bodies like lakes, rivers. Also measures like Zero Liquid Discharge (ZLD) could minimize contamination of water bodies.
- d) Using digital technologies like IIoT, data analytics to monitor and better manage the above initiatives

### Agriculture Sector

Agriculture sector is the biggest consumer of water resource. Surface water which is mainly river water accounts for about 50% of agricultural needs. Balance about 50% comes from ground water. Excessive ground water

extraction for agriculture has led to depletion of ground water in many parts of India. India consumes about 2-4 times more water to produce a unit of major food crop than China and Brazil<sup>[3]</sup>. Thus greater emphasis has to be given to better water management to bring it at par with international benchmark.

Launching of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) in 2015 with an aim of ‘*har khet ko pani*’ and ‘more crop per drop’ is a noteworthy development agglomerating many initiatives towards better water availability and efficient water usage. To supplement the movement a structured water management programme with participation from all stakeholders could lead to better sustainable solutions. Some of the focus areas could be:

- a) Switching over to more efficient irrigation methods like sprinkler/ drip irrigation wherever possible,
- b) Better crop selection strategy – careful selection of crop aligning with soil conditions, ground water level, precipitation, etc., and
- c) Use of IOT, digital technology – Arrest leakage in irrigation pipes, use of soil sensors to link moisture content and water release for irrigation, thermal imaging of crops to determine water requirement, etc. are few examples of possible areas of leveraging modern day technologies to improve water conservation in agriculture

### Domestic Sector

Domestic sector is largely responsible for water pollution and pollution by unscientific disposal of municipal solid waste (MSW). Indiscriminate dumping of untreated sewage into water bodies and disposal of MSW in dump yards or as landfill are two of the major reasons of pollution. Study shows about 80% of sewage remains untreated and disposed. Similar is the case for MSW. These issues are being addressed through some of the major initiatives undertaken recently like

- a) Atal Mission for Rejuvenation and Urban Transformation (AMRUT),
- b) Smart city projects,
- c) Clean Ganga Mission, and
- d) MSW management through *Swachh Bharat Abhiyan*.

Providing basic services (e.g. water supply, sewerage, urban transport) to cities are the main purpose of AMRUT projects. On the other hand, Smart City projects are an effort to leverage information and communication technologies to integrate functioning of a city’s assets in a most environmentally sustainable manner in order to improve quality of life and provide impetus to economic growth. 500 cities/ towns under AMRUT mission and 100 cities under Smart City projects are presently being covered. However, there are many challenges being faced in implementation of these projects and those includes regulatory, social, financial issues plus lack of availability of data relating to existing infrastructures and not the least, inadequate availability of personnel with required knowledge base to execute these projects. As a result the project progress is getting affected. Hopefully the learnings from initial phases will help in smoother and faster implementation of subsequent phases of these projects.

### Clean Ganga Mission

Clean Ganga mission is another major initiative towards preservation of water bodies. Rejuvenating and making River Ganga pollution free would be a signification step in preserving the environment. However, failure of earlier Mission of Clean Ganga & Yamuna and the slow pace of the present Clean Ganga Mission is a cause for concern.

Success of AMRUT, Smart City projects and Clean Ganga Mission are extremely critical as otherwise India, which is already a water stressed country, would find it extremely difficult to meet its minimum water requirements and to preserve environment since the latter is heavily dependent on pollution free water.

### **MSW Management**

Unscientific disposal has become a major concern all over the world and India is no exception. The *Swachh Bharat Mission* launched in 2014 has rightly identified MSW management as one of its prime objectives. The most prevalent form of MSW disposal is landfill. However, landfill is no longer being seen as an environmentally sustainable solution since it

- a) Emits Methane, a more harmful GHG compared to CO<sub>2</sub>,
- b) Creates hygiene issues and safety hazard, also requires significant space, and
- c) Causes leaching and ground water contamination

Methane emission has prompted India like many other countries to ban use of bio-degradable material as landfill. For sustainable waste management, segregation, preferably at the source is a critical requirement. The segregation ensures that the inert, hazardous wastes/ recyclables are removed and the remaining combustible waste only goes for 'waste to energy' schemes. However, the segregation at source is one of the key challenges for the civic authorities. Also strict compliance to air and liquid effluent pollution standard is extremely important as noncompliance to environmental regulations could defeat the very purpose of WtE projects.

### **Conclusion**

Environment and Climate Change are issues that influence and impact our daily lives and would continue to do so in future as well. Every human activity affects the environment and unfortunately most of it in a negative way. Hence, all round effort with much more vigour is needed to arrest the ever increasing trend of environmental degradation. The good news is continuous campaign and incessant effort by right minded people from all sections of society and increased public awareness have started yielding results albeit slowly. Numerous initiatives have been launched by Governments, Regulatory Authorities and NGOs at international, national, state, regional and zonal levels to clean up the environment or at least to slow down the rate of degradation. Some of these initiatives have taken off well but others are still lagging behind. This paper has made an attempt to highlight only some of the major initiatives in India. Industry is a necessary growth area for economic development, but it also leads to environmental degradation. Though the industries are becoming much more conscious, as reflected in improved compliance to environmental obligations, the time has come for the industries to go beyond mere compliance and take upon themselves the challenge of making the environment a better place to live. That, together with willingness and proactive participation by all would lead to a better and environmentally sustainable 'clean' India.

### **Acknowledgement**

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