

Subject: CONSERVATIONAL OF NATURAL RSOURCES

Subcode:21cv654

Module 5

Global warming: Concept

Global warming occurs when carbon dioxide (CO₂) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally this radiation would escape into space, but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. These heat-trapping pollutants—specifically carbon dioxide, methane, nitrous oxide, water vapor, and synthetic fluorinated gases—are known as greenhouse gases, and their impact is called the greenhouse effect.

Global warming: Indicators

Temperature Records: Long-term trends showing increasing global average temperatures over decades.

Glacial Retreat: Observation of glaciers worldwide shrinking in size due to warming temperatures.

Sea Level Rise: Measurements showing an increase in global sea levels due to thermal expansion of seawater and melting glaciers and ice sheets.

Ocean Heat Content: Data indicating that the oceans are absorbing more heat, leading to warming ocean temperatures.

Arctic Sea Ice Decline: Satellite observations revealing a significant decrease in the extent and thickness of Arctic sea ice over time.

Extreme Weather Events: Increasing frequency or intensity of extreme weather events such as heatwaves, hurricanes, and heavy rainfall.

Ocean Acidification: Measurements showing that the pH of seawater is decreasing as it absorbs

Global warming: Factor

Greenhouse Gas Emissions: The primary driver of current global warming trends is the increase in greenhouse gases (GHGs) in the atmosphere. These gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases. Human activities such as burning fossil fuels, deforestation, agriculture, and industrial processes release these gases into the atmosphere, trapping heat and causing the Earth's temperature to rise.

Deforestation: Cutting down forests for agriculture, urbanization, and other purposes reduces the number of trees that absorb CO₂ from the atmosphere. This leads to higher levels of CO₂ remaining in the air, contributing to the greenhouse effect.

Industrial Processes: Various industrial activities, including manufacturing, mining, and construction, release GHGs and other pollutants into the atmosphere. These emissions contribute to global warming and also affect air quality.

Transportation: The burning of fossil fuels (like gasoline and diesel) in cars, trucks, airplanes, and ships releases large amounts of CO₂ and other pollutants into the atmosphere, contributing significantly to global warming.

Agricultural Practices: Agriculture is a source of methane and nitrous oxide emissions. Methane is produced by livestock during digestion (enteric fermentation) and from manure management, while nitrous oxide is released from the use of synthetic fertilizers and certain agricultural practices.

Waste Management: Landfills and waste treatment processes generate methane as organic waste decomposes anaerobically. Methane is a potent greenhouse gas with a much stronger heat-trapping capability than CO₂ over shorter time frames.

Global warming: Effects

Rising temperatures: Average global temperatures have been increasing steadily, leading to heatwaves becoming more frequent and intense. This affects human health, agriculture, and increases the risk of wildfires.

Melting glaciers and polar ice: As temperatures rise, glaciers and ice sheets in Greenland and Antarctica are melting at accelerated rates. This contributes to rising sea levels, threatening coastal communities and habitats.

Sea level rise: Melting ice and the thermal expansion of seawater due to warmer temperatures lead to higher sea levels. This increases the risk of flooding, particularly during storms and high tides, impacting low-lying coastal areas and islands.

Extreme weather events: Global warming can intensify and alter patterns of extreme weather events such as hurricanes, typhoons, droughts, and heavy rainfall. These events can cause widespread damage to infrastructure, agriculture, and ecosystems.

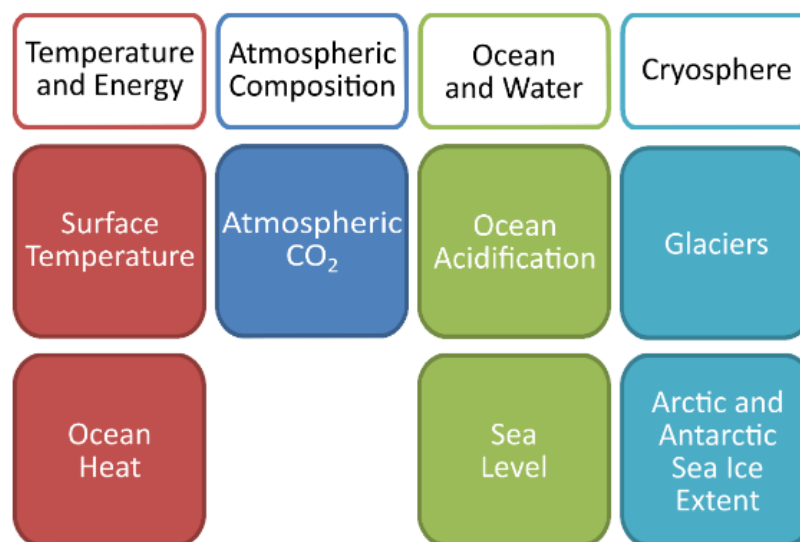
Ocean acidification: Increased carbon dioxide levels in the atmosphere lead to higher absorption by the oceans, causing ocean acidification. This harms marine life, especially organisms such as coral reefs and shellfish that rely on calcium carbonate to build their shells and skeletons.

Disruption of ecosystems: Many plant and animal species are affected by changing climate conditions. Some may shift their ranges towards cooler regions or higher altitudes, while others may face increased risk of extinction due to habitat loss and inability to adapt quickly enough.

Impact on agriculture and food security: Changes in temperature, precipitation patterns, and extreme weather events can disrupt agricultural production, affecting crop yields and livestock. This can lead to food shortages and price increases, particularly in vulnerable regions.

Health impacts: Global warming contributes to increased heat-related illnesses, the spread of infectious diseases, and worsened air quality due to higher levels of ground-level ozone. Vulnerable populations such as the elderly, children, and those with pre-existing health conditions are particularly at risk.

Global climate change-indicators



The Global Climate Indicators are a set of parameters that describe the changing climate without reducing climate change to only temperature. They comprise key information for the most relevant domains of climate change: temperature and energy, atmospheric composition, ocean and water as well as the cryosphere.

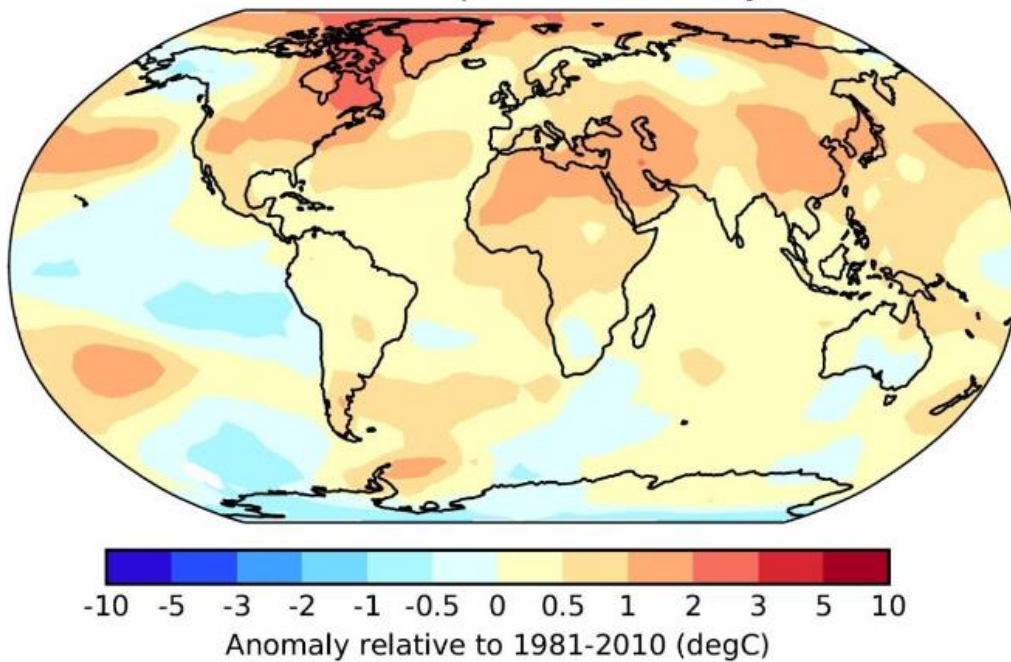
Atmosphere

Carbon dioxide (CO₂) is the most commonly addressed greenhouse gas, and its atmospheric concentration is measured by parts per million (ppm). **Methane (CH₄)** and **nitrous oxide (N₂O)** are also extraordinarily important for the global climate and are measured by parts per billion (ppb).

Land

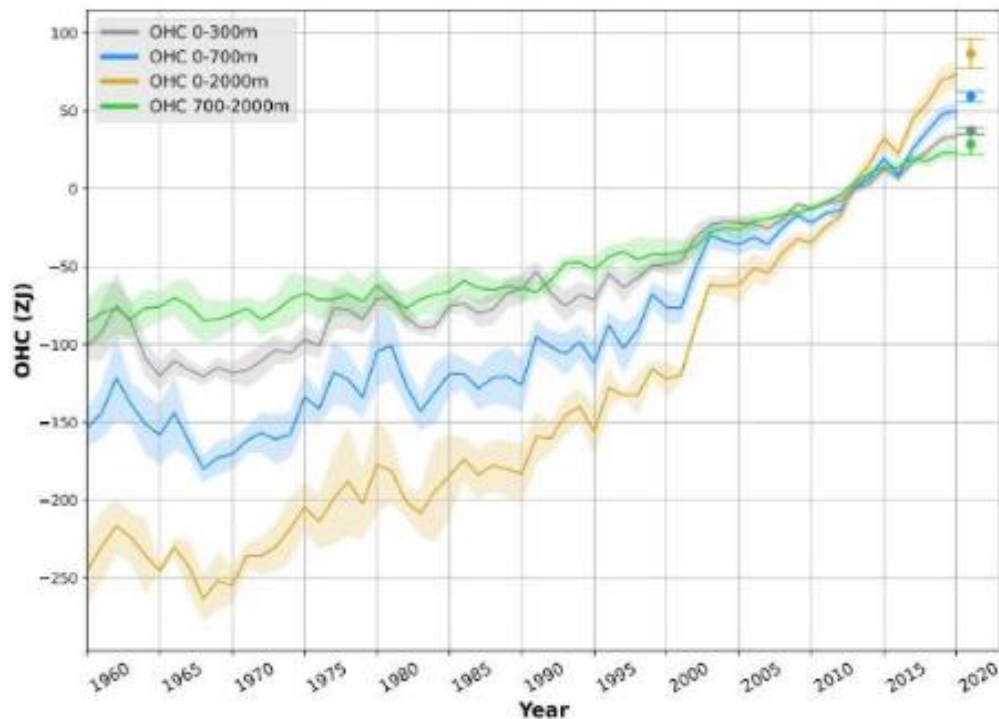
As greenhouse gas concentrations rise, so does global mean surface temperature (GMST). GMST is measured using a combination of air temperature over land, and sea surface temperature in ocean areas, typically expressed as an anomaly from a baseline period.

Annual mean temperature anomaly, 2021



Ocean

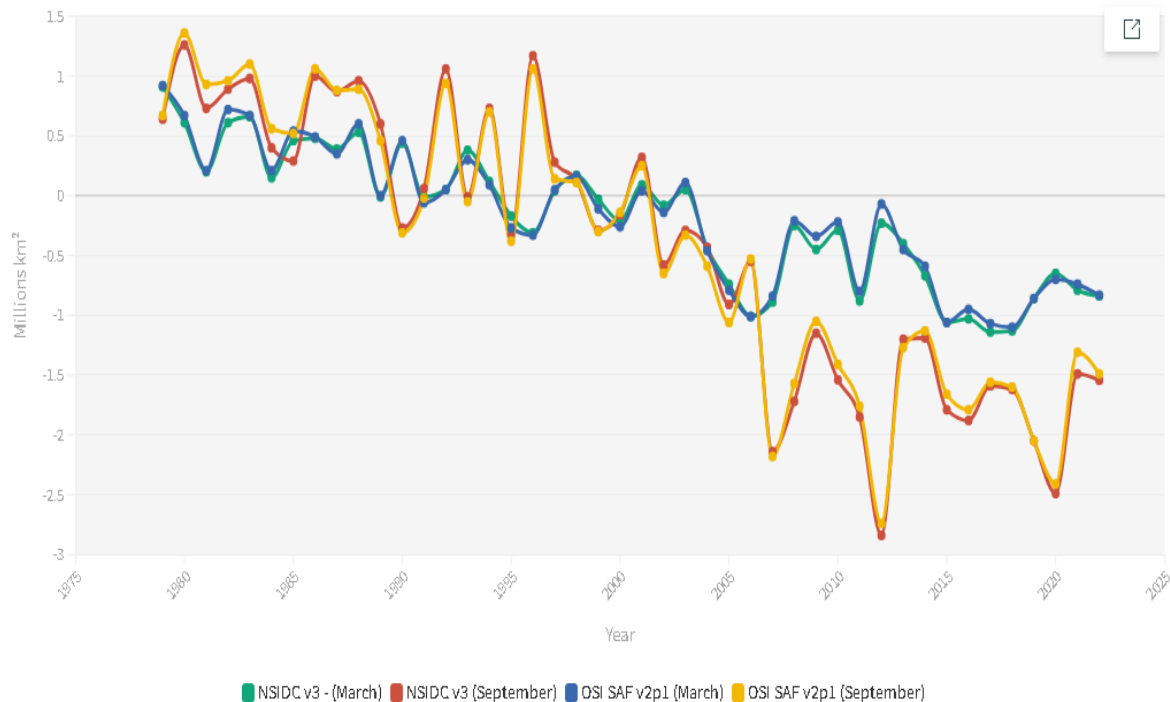
Ocean Heat Content (OHC) is a measure of this heat accumulation in the Earth system. It is measured at various ocean depths, up to 2000m deep.



Cryosphere

Sea ice extent **measures areas covered by an ice concentration greater than 15%.**

It serves as a useful indicator of climate change particularly given how quickly change occurs in the Arctic



Health impacts

1. Impact of Excess Heat on the Human Body

The human body requires evaporative cooling to prevent overheating, even with a low activity level. With excessive ambient heat and humidity, adequate evaporative cooling does not take place.

2. Impact on Disease

2.1. Impact on Infectious Diseases

Warming oceans and a changing climate are resulting in extreme weather patterns which have brought about an increase of infectious diseases—both new and re-emerging.

Impact of warmer and wetter climates

Mosquito-borne diseases are probably the greatest threat to humans as they include [malaria](#), elephantiasis, Rift Valley fever, yellow fever, and dengue fever.

Impact of warmer oceans

The warming oceans are becoming a breeding ground for toxic algae blooms (also known as red tides) and cholera.^[16] As the nitrogen and phosphorus levels in the oceans increase

Impact on Mental Health

While the physical health impacts of climate change are well known, the impact on mental health has only begun to be recognized in the last decade

Direct impacts

Direct impacts on mental health happen when a community experiences extreme weather and changed environment.^[46] Direct impacts like [landscape](#) changes, impaired place attachment, and psychological trauma are all immediate and localized problems resulting from extreme weather events and environmental changes.

Indirect impacts

Indirect impacts on mental health occur via impacts on physical health and community well-being. Physical health and mental health have a reciprocal relationship.^[47] If the physical health of an individual is negatively impacted, the decline in mental health will soon follow.

Psychological impacts

Psychological impacts are the effects that heat, drought, migrations, and climate-related conflicts have on social life and community life. This includes post-disaster adjustment.

3. Climate Change and Permafrost

Permafrost is an important part of our environment and plays an important role in maintaining the stability of many ecosystems around the world. Permafrost is integral to soil stability in arctic regions.^[58] Melting permafrost causes the surrounding soil to become unstable and settle.

4. Impact on Natural Resources

4.1. Drinking Water

Global Health Corps reports that when interruptions in the regular water supply, "forces rural and impoverished families to resort to drinking the dirty, sediment-and-parasite-laden water that sits in puddles and small pools on the surface of the earth

5. Impact on Livestock

Climate change is beginning to lead the global population into a food shortage, greatly affecting our livestock supply.

6. Impact on Plant Based Food

Climate change has many potential impacts on the production of food crops—from food scarcity and nutrient deficiency to possible increased food production because of elevated carbon dioxide (CO₂) levels—all of which directly affect human health.

7. Impact on Nutrition

Another area of concern is the effect of climate change on the nutritional content of food for human consumption. Studies show that increasing atmospheric levels of CO₂ have an unfavourable effect on the nutrients in plants.

8. Oceans and Human Health

Perhaps one of the most recent adverse effects of climate change to be explored is that of ocean acidification. Our oceans cover approximately 71 percent of the Earth's surface and support a diverse range of ecosystems, which are home to over 50 percent of all the species on the planet.

Global Warming: Effect on biodiversity

Habitat Loss and Fragmentation: As temperatures rise, many species may find their current habitats unsuitable. This can lead to shifts in species distributions and, in some cases, local extinctions as species move to find suitable conditions. Fragmentation of habitats due to human development exacerbates this issue, making it harder for species to migrate or adapt.

Changes in Ecosystem Structure and Function: Climate change affects the availability of resources such as water and food, as well as the timing of key life cycle events like flowering and migration. This can disrupt ecosystem interactions and alter food webs, leading to cascading effects on biodiversity.

Increased Extinction Risk: Species that are already at risk due to factors like habitat loss, pollution, and overexploitation are further threatened by climate change. The combination of stressors can push species beyond their ability to survive, increasing the likelihood of extinction.

Coral Bleaching and Marine Ecosystem Decline: Rising sea temperatures contribute to coral bleaching events, where corals expel the symbiotic algae that provide them with food.

and color. This weakens corals and increases their susceptibility to disease and death, leading to declines in coral reefs and the diverse marine ecosystems they support.

Polar Regions Impact: Polar regions are particularly sensitive to climate change, with Arctic sea ice declining rapidly and affecting species like polar bears and seals that depend on ice for hunting and breeding. Changes in sea ice also affect the entire Arctic food web, from phytoplankton to marine mammals.

Altered Species Interactions: Climate change can disrupt the timing of biological events (phenology), such as the emergence of insects or the availability of prey species. This can affect species that depend on synchronized interactions, such as pollinators and their plant partners, leading to mismatches in timing that reduce reproductive success.

Invasive Species Spread: Warmer temperatures can facilitate the spread of invasive species into new areas, where they can outcompete or prey upon native species that may not have evolved defenses against them.

Loss of Genetic Diversity: Populations that are forced to adapt quickly to changing conditions may experience reduced genetic diversity, making them more vulnerable to diseases and environmental stresses.

Changes in Species' Physiology: Some species may undergo physiological changes in response to warmer temperatures, altering their metabolism, growth rates, and behavior. These changes can affect their ability to survive and reproduce in their natural habitats.

Cumulative Impacts: The cumulative effects of climate change, combined with other stressors such as habitat destruction, pollution, and overharvesting, pose significant challenges to the resilience and survival of many species.

Introduction to global efforts in conservation of biodiversity.

The conservation of biodiversity is important to prevent the loss of genetic diversity of a species, save a species from becoming extinct and protect ecosystems damage and degradation. Thus the conservation efforts can be grouped into the following two categories:

1. ***In-situ (on-site) Conservation:*** *In-Situ* conservation includes the protection of plants and animals within their natural habitats or in protected areas. Protected areas are land or sea dedicated to protect and maintain biodiversity. The in-situ strategy emphasizes protection of total ecosystems for the conservation of overall biodiversity of genes, populations, species, communities and the ecological processes. The in-situ approach includes protection of a group of typical ecosystems through a network of protected areas as recognised by the UNEP and the World Conservation Union (IUCN).

National Parks and Wildlife Sanctuaries

Marine Protected Area: been promoting establishment of global system of marine protected areas.

Biosphere Reserves: biosphere reserves are a special category of protected areas of land or coastal environments where people are an integral component of the system.

2. **Ex-situ (off-site) Conservation:** conservation of plants and animals outside their natural habitats. These include botanical gardens, zoo, and gene banks; seed bank, tissue culture and cryopreservation.

Seed Gene Bank: the crop species diversity have declined with the onset of modern agricultural techniques, which will have severe implications on food security of the planet given environmental degradation, pests, epidemics and climate change.

In-vitro Gene Bank: these are short and medium term storage for a range of crops woody species, fruit trees and horticultural species using tissue culture techniques. Tissue culture systems allow the propagation of plants with high multiplication rates in an aseptic environment. The cells are grown on a gel and fed with suitable nutrients and hormones to give rise to entire plants.

DNA Bank Network: this is a worldwide unique concept. DNA bank databases of all partners are linked and are accessible via a central web portal, providing DNA samples of complementary collections (microorganisms, protists, plants, algae, fungi and animals).

Biodiversity Conservation Council of India (BiCCI)

Biodiversity Conservation Council of India is a non-profitable public charitable trust formed with an intention to conserve and manage the biodiversity of India.

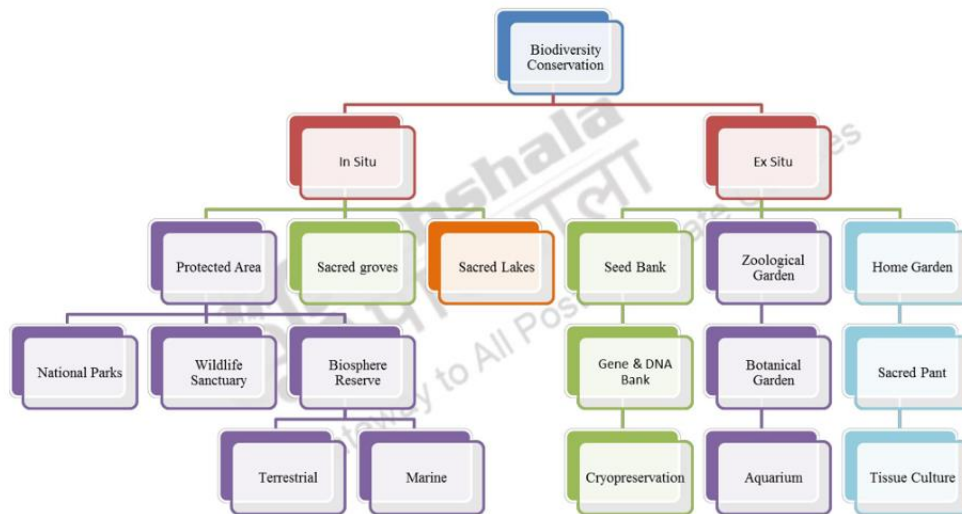
One of its primary objectives is to document all traditional farming, pastoralist systems and livestock practices and create bio-cultural protocols for communities and ecosystems on the lines of established practices.

The objectives of *BiCCI* include documenting the indigenous bio-diversity of flora and fauna, raising awareness on the bio-diversity wealth and its importance in ecological balance.

BiCCI aims to protect and promote traditional knowledge being practiced in farming, medicine, livestock keeping, food etc., impart training in the same, protect our ecosystem from invasion of non-native species of plants or animals and to work on eradication of the invasive alien species.

BiCCI endeavours to support in-situ conservation, ex-situ and crypto preservation of native livestock, promote research in the indispensability of native livestock/plants in farming, food security of the country, economical freedom of rural households, and empowerment of women through sustainable means.

Process of Biodiversity Conservation



EIA regulations in India

Introduction

- Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.
- UNEP defines Environmental Impact Assessment (EIA) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers.
- Environment Impact Assessment in India is statutorily backed by the **Environment Protection Act, 1986** which contains various provisions on EIA methodology and process.

History of EIA in India

- The Indian experience with Environmental Impact Assessment began over 20 years back. It started in 1976-77 when the Planning Commission asked the Department of Science and Technology to examine the river-valley projects from an environmental angle.
- Till 1994, environmental clearance from the Central Government was an administrative decision and lacked legislative support.
- On 27 January 1994, the then Union Ministry of Environment and Forests, under the Environmental (Protection) Act 1986, promulgated an EIA notification making Environmental Clearance (EC) mandatory for expansion or modernisation of any activity or for setting up new projects listed in Schedule 1 of the notification.

- The Ministry of Environment, Forests and Climate Change (MoEFCC) notified **new EIA legislation in September 2006**.
 - The notification makes it **mandatory for various projects** such as mining, thermal power plants, river valley, infrastructure (road, highway, ports, harbours and airports) and industries including very small electroplating or foundry units **to get environment clearance**.
 - However, unlike the EIA Notification of 1994, the new legislation has **put the onus of clearing projects on the state government** depending on the size/capacity of the project.

The EIA Process

EIA involves the steps mentioned below. However, the EIA process is cyclical with interaction between the various steps.

- **Screening:** The project plan is screened for scale of investment, location and type of development and if the project needs statutory clearance.
- **Scoping:** The project's potential impacts, zone of impacts, mitigation possibilities and need for monitoring.
- **Collection of baseline data:** Baseline data is the environmental status of study area.
- **Impact prediction:** Positive and negative, reversible and irreversible and temporary and permanent impacts need to be predicted which presupposes a good understanding of the project by the assessment agency.
- **Mitigation measures and EIA report:** The EIA report should include the actions and steps for preventing, minimizing or by passing the impacts or else the level of compensation for probable environmental damage or loss.
- **Public hearing:** On completion of the EIA report, public and environmental groups living close to project site may be informed and consulted.
- **Decision making:** Impact Assessment Authority along with the experts consult the project-in-charge along with consultant to take the final decision, keeping in mind EIA and EMP (Environment Management Plan).
- **Monitoring and implementation of environmental management plan:** The various phases of implementation of the project are monitored.
- **Assessment of Alternatives, Delineation of Mitigation Measures and Environmental Impact Assessment Report:** For every project, possible alternatives should be identified, and environmental attributes compared. Alternatives should cover both project location and process technologies.
- Once alternatives have been reviewed, a mitigation plan should be drawn up for the selected option and is supplemented with an Environmental Management Plan (EMP) to guide the proponent towards environmental improvements.

- **Risk assessment:** Inventory analysis and hazard probability and index also form part of EIA procedures.

Stakeholders in the EIA Process

- Those who propose the project
- The environmental consultant who prepare EIA on behalf of project proponent
- Pollution Control Board (State or National)
- Public has the right to express their opinion
- The Impact Assessment Agency
- Regional centre of the MoEFCC

Salient Features of 2006 Amendments to EIA Notification

- Environment Impact Assessment Notification of 2006 has decentralized the environmental clearance projects by categorizing the developmental projects in two categories, i.e., **Category A (national level appraisal)** and **Category B (state level appraisal)**.
 - Category A projects are appraised at national level by Impact Assessment Agency (IAA) and the Expert Appraisal Committee (EAC) and Category B projects are appraised at state level.
 - State Level Environment Impact Assessment Authority (SEIAA) and State Level Expert Appraisal Committee (SEAC) are constituted to provide clearance to Category B process.
- **After 2006 Amendment the EIA cycle comprises of four stages:**
 - Screening
 - Scoping
 - Public hearing
 - Appraisal
- **Category A projects** require mandatory environmental clearance and thus they do not undergo the screening process.
- **Category B projects** undergoes screening process and they are classified into two types.
 - **Category B1 projects (Mandatorily requires EIA).**
 - **Category B2 projects (Do not require EIA).**
- Thus, Category A projects and Category B, projects undergo the complete EIA process whereas Category B2 projects are excluded from complete EIA process.

Importance of EIA

- EIA links environment with development for environmentally safe and sustainable development.
- EIA provides a cost effective method to eliminate or minimize the adverse impact of developmental projects.
- EIA enables the decision makers to analyse the effect of developmental activities on the environment well before the developmental project is implemented.
- EIA encourages the adaptation of mitigation strategies in the developmental plan.
- EIA makes sure that the developmental plan is environmentally sound and within the limits of the capacity of assimilation and regeneration of the ecosystem.

Shortcomings of EIA Process

- **Applicability:** There are several projects with significant environmental impacts that are exempted from the notification either because they are not listed in schedule I, or their investments are less than what is provided for in the notification.
- **Composition of expert committees and standards:** It has been found that the team formed for conducting EIA studies is lacking the expertise in various fields such as environmentalists, wildlife experts, Anthropologists and Social Scientists.
- **Public hearing:**
 - Public comments are not considered at an early stage, which often leads to conflict at a later stage of project clearance.
 - A number of projects with significant environmental and social impacts have been excluded from the mandatory public hearing process.
 - The data collectors do not pay respect to the indigenous knowledge of local people.
- **Quality of EIA:** One of the biggest concerns with the environmental clearance process is related to the quality of EIA report that are being carried out.
- **Lack of Credibility:** There are so many **cases of fraudulent EIA studies** where erroneous data has been used, same facts used for two totally different places etc.
- Often, and more so for strategic industries such as nuclear energy projects, the EMPs are kept confidential for political and administrative reasons.
 - Details regarding the effectiveness and implementation of mitigation measures are often not provided.
 - Emergency preparedness plans are not discussed in sufficient details and the information not disseminated to the communities.

Way Forward

- **Independent EIA Authority.**
 - Sector wide EIAs needed.
 - Creation of a centralized baseline data bank.
- Dissemination of all information related to projects from notification to clearance to local communities and the general public.
- **Applicability:** All those projects where there is likely to be a significant alteration of ecosystems need to go through the process of environmental clearance, without exception.
- No industrial developmental activity should be permitted in ecologically sensitive areas.
- **Public hearing:** Public hearings should be applicable to all hitherto exempt categories of projects which have environmental impacts.
- The focus of EIA needs to shift from utilization and exploitation of natural resources to conservation of natural resources.
- It is critical that the preparation of an EIA is completely independent of the project proponent.
- **Grant of clearance:** The notification needs to make it clear that the provision for site clearance does not imply any commitment on the part of the impact Assessment agency to grant full environmental clearance.
- **Composition of expert committees:** The present executive committees should be replaced by expert people from various stakeholder groups, who are reputed in environmental and other relevant fields.
- **Monitoring, compliance and institutional arrangements:**
 - The EIA notification needs to build within it an **automatic withdrawal of clearance if the conditions of clearance are being violated** and introduce **more stringent punishment for noncompliance**. At present the EIA notification limits itself to the stage when environmental clearance is granted.
 - The composition of the NGT needs to be changed to include more judicial persons from the field of environment.
 - Citizen should be able to access the authority for redressal of all violation of the EIA notification as well as issues relating to non-compliance.
- **Capacity building:** NGOs, civil society groups and local communities need to build their capacities to use the EIA notification towards better decision making on projects.

Status of EIA in India

Present Status of EIA in India In India, EIAs of development projects were first started in 1977-78 when the Department of Science and Technology took up environmental appraisal of river valley projects.

Subsequently, various other projects were brought under the purview of EIA. It was, however, in 1994 when EIA was made mandatory in India under the Environmental Protection Act of 1986.

The Ministry of Environment and Forests (MoEF), Government of India, has prepared environmental guidelines, to help the project proponents to work out an EIA.

Guidelines have been prepared to bring out specific information on the environment required for environmental clearance.

The agencies, which are primarily responsible for the respective sectors are closely involved in preparing the guidelines.

River valley projects, thermal power projects, mining projects and industries, ports and harbours, development of beaches, highway/railway projects are the sectors for which guidelines have already been prepared.

These guidelines basically consist of aspects regarding planning and implementation of development projects.

Projects where EIA is mandatory and requires clearance from central government as of now, EIA clearance is required for 30 categories of industries.

The project proponent is required to submit an application along with duly filled up questionnaire, EIA and environment management report, public hearing proceeding and the No Objection Certificate (NOC) from the state pollution control board.

The MoEF has set up five multidisciplinary expert committees in the areas of industry, thermal power, river valley, mining and infrastructure and miscellaneous project to evaluate the environmental impact of proposed project.

The committee evaluate the environmental impacts of the proposed project and wherever necessary, site visits and independent assessment of environmental aspects are also undertaken.

Based on such examination the committee make recommendation for the approval or rejection of the proposal which are then processed in the ministry for approval or rejection.

In case of site specific project, such as mining, river valley, ports and harbours etc the project proponent has to obtain site clearance before applying for environmental clearance of the project.

In India, public consultation have been made compulsory component of EIA by an amendment dated April 10, 1997 to the EIA notification 1994.

The State Pollution Control Board and concern district collectors are responsible for the public consultation process through duly constituted public hearing panel.

The members of a public hearing panel are:

- (i) Representative of State Pollution Control Board
- (ii) District Collector or his nominee
- (iii) Representative of State Government dealing with the subject of Power
- (iv) Representative of Department of State Government dealing with Environment
- (v) Not more than three representatives of the local bodies such as Municipalities or Panchayat
- (vi) Not more than three senior citizens of the area nominated by the District Collector.

List of projects needing environmental clearance under EIA notifications

Mining , extraction of natural resources and power generation (for a specified production capacity)

- Mining of Minerals
- Offshore and Onshore oil and gas exploration, development & production
- River Valley Projects
- Thermal Power Plants
- Nuclear Power Projects and Processing of Nuclear Fuel

Primary Processing

- Coal Washeries
- Mineral beneficiation

Materials Production

- Metallurgical industries
- Cement Plants

Materials Processing

- Petroleum refining industry
- Coke oven plants
- Asbestos milling and asbestos based products
- Chlor-alkali industry
- Soda ash industry
- Leather/skin/hide processing industry

Manufacturing/ Fabrication

- Chemical Fertilisers
- Pesticide industry and pesticide specific intermediates

- Petro-chemical complexes
- Man made fibres manufacturing
- Petrochemical based processing
- Synthetic organic chemicals industry
- Integrated paint industry
- Pulp and Paper industry
- Sugar industry

Service Sectors

- Oil and gas transportation pipe line
- Isolated storage and handling of hazardous chemicals

Physical Infrastructure including Environmental Services

- Airports
- All ship breaking yards including ship breaking units
- Industrial estates/parks/complexes/areas, Export Processing Zones, and Special Economic Zones, Bio-tech Parks, Leather complexes.
- Common hazardous waste treatment , storage and disposal facilities
- Ports , Harbours, break waters, and dredging
- Highways
- Aerial ropeways
- Common Effluent Treatment Plants
- Common Municipal Solid Waste Management Facility

Building/Construction projects/Area Development Projects and Townships

- Building and Construction projects
- Townships and Area Development Projects
- Category A projects requires clearance from the Central Government in the Ministry of Environment and Forest (MoEF) on the recommendations of an Expert Appraisal Committee (EAC)
- Category B projects excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, will require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA) . In the absence of a duly constituted SEIAA or SEAC, a Category 'B' project shall be considered at the Central Level as a Category B project.

Case study of hydro power projects

Five biggest hydroelectric power plants in India

1. Tehri Hydropower Complex – 2,400MW

Topping the list of hydroelectric power plants in India is the Tehri Dam in Uttarakhand, the highest hydroelectric power project in the country. Commissioned in 2006, first construction began in 1978 helped by technical collaboration from the former USSR.

Located at the confluence of the Bhagirathi and the Bhilangana rivers, near the city of Tehri, the dam is a multi-purpose rock and earth-filled embankment dam, and at 260.5 metres is the tallest in India.

It is also the eighth-tallest dam in the world and the second-tallest in Asia. The length of the dam is 575 metres, while the base width is 1,128 metres and the crest width is 20 metres.

With a maximum planned capacity of 2,400MW, the Tehri Hydropower Complex consists of the Tehri Dam and the Tehri Pumped Storage Hydroelectric Power Plant, and also includes the 400MW Koteshwar Dam.

Its reservoir stores water not just for the generation of hydroelectricity (which is about 1,000MW in addition to 1,000MW of pumped storage hydroelectricity) but also for irrigation and municipal water supply to other states of North India too, such as Uttar Pradesh, Haryana, Punjab, Delhi, Chandigarh, Himachal Pradesh, Jammu & Kashmir and Rajasthan.

Owned and operated by Tehri Hydro Development Corporation (THDC) until recently, the Indian government approved NTPC taking over the project in November 2019.

2. Koyna Hydroelectric Project – 1,960MW

Located near Patan, in Maharashtra's Satara district, close to the Koyna River, the Koyna Hydroelectric Project is India's largest completed hydroelectric power plant with a capacity of 1,960MW.

Owned and operated by MAHAGENCO and Maharashtra State Power Generation, the Koyna Project has four dams, the largest of which is constructed across the Koyna River.

As the dam is located in the Western Ghats mountain range, all the generators of the power plant have been installed deep inside the mountains requiring extensive excavation works.

Construction began in 1954, and the project has been developed in four stages.

3. Srisailem Dam – 1,670MW

Third on the list is the 1,670MW-capacity Srisailem Dam.

Owned by the Government of Andhra Pradesh via operator APGENCO, Srisailem Dam is located on the Krishna River in the Nallamala Hills near Srisailem temple, which falls under the districts of Kurnool and Mahabubnagar.

Both these districts are situated at the border of the two states of Andhra Pradesh and Telangana, respectively.

Construction of the dam began in 1960, but took more than two decades for completion, being unveiled only in 1981.

With a length of 512 metres and a height of 145 metres, plus 12 radial crest gates, [Srisailem Dam](#) is considered to be India's third-largest working hydroelectric power project. It has a reservoir measuring 616 square kilometres.

4. Nathpa Jhakri Dam – 1,530MW

Himachal Pradesh's Nathpa Jhakri Dam, with a capacity to generate 1,530MW of electricity, ranks fourth in this list.

This concrete gravity dam, which is 185 metres long and more than 67 metres high, was constructed across the Satluj River in Kinnaur district's Nathpa village.

Owned and operated by Satluj Jal Vidyut Nigam (SJVN), the dam is powered by six 250MW Francis-type turbines.

Started in 1993, construction of the dam was completed in 2004 to make Nathpa Jhakri India's biggest underground hydroelectric power project.

Nathpa Jhakri also has the county's largest de-silting chambers, the largest and longest headrace tunnel, the largest and deepest surge shaft.

5. Sardar Sarovar Dam – 1,450MW

In fifth place is the Sardar Sarovar Dam, which has a capacity of 1,450MW and is operated by the Sardar Sarovar Narmada Nigam.

This concrete gravity dam is located on the Narmada river, near Navagam in the state of Gujarat.

The largest dam of the Narmada Valley Project, Sardar Sarovar Dam supplies water and electricity to four Indian states—Gujarat, Maharashtra, Rajasthan and Madhya Pradesh.

Although the foundation stone was laid in 1961, the project began to take form in 1979 with the help of a World-Bank funded development scheme, and construction began in 1987.

Environmental opposition stalled construction efforts, and the dam was finally inaugurated in 2017.

This dam counts as the world's second largest concrete dam—after Grand Coulee which sits across River Columbia in the US—in terms of the volume of concrete used in its construction.

It measures 1,210 metres long and more than 138 metres high, and is powered by six 200MW Francis-type turbines.



Sardar Sarovar Dam (Credit: Bishnu Sarangi/Pixabay)

Case study thermal power projects

NTPC SIMHADRI

Transforming Lives



ENERGY SAVIOR

Case Study Snapshot

Industry	Power Generation
Product/Service	Thermal Power
Location	Andhra Pradesh, India
Energy performance improvement percentage (over the improvement period)	1.27 % improvement 6 years
Total energy cost savings (over 6 years)	11.96 Million USD
Cost to implement Energy Management System (EnMS)	USD 2064
Total energy savings (over 6 years)	4.78 GJ
Total CO₂-e emission reduction (over the improvement period)	100661 Metric Tons

Organization Profile / Business Case

NTPC Simhadri is the first coal fired, coastal thermal power station set up by NTPC which uses sea water for condenser cooling and for ash transportation. The project was launched in the year 1997. The station has an installed capacity of 2000MW (4x500MW). The station has largest sea water intake well in the Bay of Bengal. It has set a benchmark for 500MW greenfield project by commissioning first unit within a record time of 39 months from “ZERO” date. Simhadri Plant meets more than 85% of its water needs from Sea, thereby contributing to the Nation's efforts in conserving Fresh Water. 25MW floating solar system installed and commissioned in the year 2021.

Our Motivations/Drivers: SIMHADRI Energy Policy

- Efficient utilization of input resources like coal, water and oil by following proven operational practices and innovative methods.
- Sustaining energy efficiency gains through objectives and targets and procurements of energy efficient products and services.
- Compliance to all applicable legal and other requirements related to energy usage and efficiency.
- Establish an energy management system and ensure its periodic review.

Role of Energy Management in the organization's larger Business Strategy

NTPC SIMHADRI has been a pioneer in the energy conservation policy. Our energy management system is robust and mainly deals with heat rate (HR), Auxiliary Power Consumption (APC), Specific oil and water consumption. It aims at minimising the losses and maximising the efficiency. To achieve this objective on a consistent basis, implementation of ISO 50001 has become quite easier. The broader frameworks of the energy management system are as follow:

- Regular assessment energy management system.
- Involvement of employees & interested parties.
- Formulation of Baseline performance data of Energy performance indicators (EnPI) like Heat Rate, Auxiliary Power consumption , Specific oil consumption.
- Assessment of energy performance indicators like Heat Rate, APC Gap.
- Setting the Energy consumption saving target based on the baseline data & deviation from design value.
- Formulation of action plan to achieve the set targets of EnPI.
- Top management’s review at different forums and getting the feedback.
- Monitoring and verification at the end of year.

“NTPC SIMHADRI’s achievement in reducing the GHG and substantial energy saving has become possible through the successful implementation of ISO 50001.”

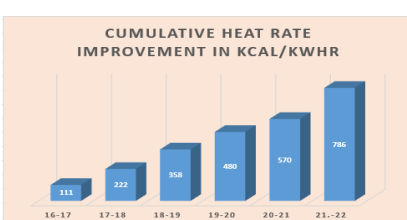
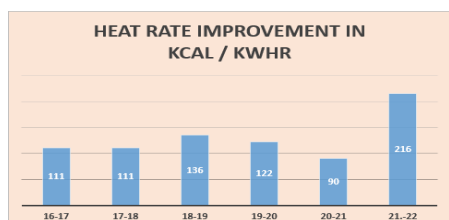
—Girish Chandra Choukse, Head of the Plant

Business Benefits

Implementing EnMS & ISO 50001 have yielded significant benefits beyond energy and energy cost savings. It has guided NTPC Simhadri to create additional market value and to be better prepared for government/utility sponsored energy efficiency programs, carbon or energy taxes and international climate agreements. Some of the business benefits achieved so far are as follow:

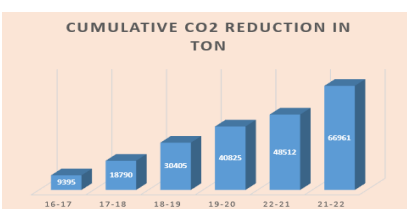
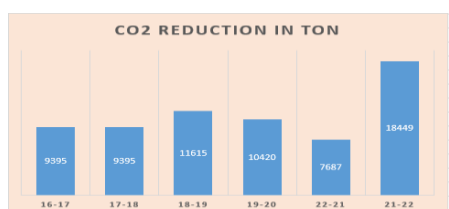
(i) Energy Performance Improvement & Cost Saving:

From Jan 2016 to March 2022, the total energy savings into the monetary benefits of 11.96 Million USD.



(ii) Environmental benefits: Reduction in Co2 emission

Upon implementation of EnMS, there was consistent reduction in the Co2 emission. This has resulted in substantial gains in Co2 savings.



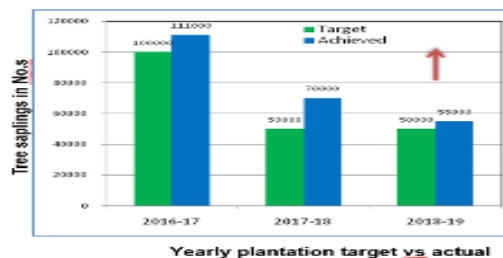
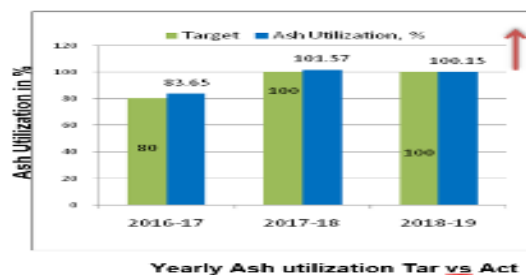
The above Co2 reduction figure is exclusively for coal. NTPC Simhadri has installed and commissioned 25MW floating solar plant and the same is commercialized on 21st Aug 2021. It's contribution towards Co2 reduction from its date of commercialization upto 31st March 2022 is 33700T.

(iii) Benefit on Statutory Compliance

Performa Achieve & Trade (PAT) is the initiative of Ministry of Power, Govt. of India under Enhance Energy Efficiency Mission. Under this scheme, the Energy Improvement Target for each PAT cycle (every three years) are set which has to be achieved during Assessment Year (AY). Due to implementation of EnMS, our station has surpassed the given target of both PAT-1 cycle (Cycle I AY 2014-15). Station achieved a NHR of 2452 kcal/kwhr against the target NHR of 2468 kcal/kwhr. Thus, Station as awarded with 11511 nos. Escerts equivalent to around 0.015 Million USD.

(iv) Non Energy & other associated benefits

NTPC Simhadri has planted more than 6 Lakh trees in and around NTPC Simhadri and 5.50 Lakh Trees in and around the city of Visakhapatnam under “**Green Visakha Plantation**” program. NTPC Simhadri was awarded the ‘Certificate of Merit’ in the year 2017 by Honable Dist. Collector as Best Performing station for its contribution towards Green Visakha. Apart from the above, 2.8 Lakh trees are planted in Paderu under Accelerated Afforestation program and 40000 tree plantations in progress in association with Social forestry department, Government of Andhra Pradesh. NTPC-Simhadri has conducted Ash utilization Awareness workshops for various ash users in the radius of 300 kms. This has led to increases fly ash users from 120 to 310. 100% ash utilization has been achieved consistently from 2017 onwards.



(v) Improved thrust on solar power integration to reduce Emission:

EnMS has guided us to use renewable energy to its full extent. In addition to the energy saving, it has resulted into considerable amount of reduction in GHG. Our main achievements in terms of RE are as follow:

- Installation and commissioning of 25MW floating solar on reservoir.
- Installation and commissioning of solar tree of 3.3kwp capacity comprising of 10 leaves, each having 300wp solar PV panels.
- Installation of EV use and charging station.



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(vi) Recognition & Brand Building

- Station received “International Safety Award -2022” by British safety Council.
- Station received prestigious “Safety Innovation Award” for the year 2021 for implementing innovative safety management.
- Station received GOLD AWARD for “Environment Excellence” from APEX India Green Leaf for the year 2020.
- Station awarded with “Energy Efficient unit “by CII for 2020-21.



Plan

Top Management’s Commitment towards EnMS:

Energy Performance through EnMS is the continuous process. NTPC Simhadri’s top management is committed for its continual improvement. To sustain and grow the business, energy efficiency is the key driving force which enhances operational profit margin with regulatory compliances. For achieving the Energy efficiency target set for every year, provision is made to sufficiently allocate the budget which is required for new project implementation or renovation and modernization. It is always ensured by top management that the entire budget is getting utilized on regular basis. As per ISO 50001 guidelines, management approves the Energy Policy for the station and form the EnMS team led by Certified Energy Auditor & Energy Managers with a coordinating members of other departments.

Present Energy Consumption Pattern in NTPC Simhadri

NTPC Simhadri is a coal fired thermal power plant. The present heat design rate loss for turbine and the design boiler efficiency loss and their detailed break up are as follow.

Turbine Heat Rate Loss Break Up					Boiler Efficiency Loss Break Up				
	Heat Losses (%)		Design	Test		Heat Losses (%)		Design	Test
1	Load	MW	500.00	499.78	1	Dry Flue Gas Loss	%	4.15	4.84
2	Main Steam Pressure before ESV	kg/cm2	170.00	170.31	2	Hydrogen in Fuel Loss	%	5.47	4.35
3	Main Steam Temp before ESV	Deg C	537.00	539.95	3	Moisture in Fuel Loss	%	2.60	2.10
4	HRH temp	Deg C	565.00	566.14	4	Moisture In Air Loss	%	0.10	0.23
5	SH Spray	TPH	25.00	23.60	5	Unburnt Carbon Loss	%	1.50	1.09
6	RH Spray	TPH	0.00	7.35	6	Mill Reject Loss	%	0.01	0.49
7	HPT Efficiency	%	93.41	88.39	7	Radiation Loss	%	0.23	0.23
8	IPT Efficiency	%	93.79	89.64	8	Unaccounted Loss	%	0.95	0.95
					9	Total Loss	%	15.01	14.29
					10	Boiler Efficiency	%	84.99	85.71

Gross Turbine Cycle Heat Rate and Boiler Efficiency tests are performed in every month. In addition to these, APH , Condenser & Cooling Tower Performance tests conducted on the regular basis. Offline monthly field tests of major equipment are carried out to find out energy gaps.

EnMS Team’s Support in Strategy & Target:

Once the test reports are generated, EnMS team assesses the energy gap against the expected values & baseline data and they put up their observations and recommendations with the target improvements to the top management for approval. EnMS team is always a part of monthly strategic review meeting of top management.

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Process of Review & Analyzing Energy Use, prioritizing resource & action:

- Exhaustive past energy data collection.
- Performance gap analysis: Actual Vs Design performance.
- Comparison with similar equipment performance.
- Identification of potential improvement area & fixing the target.
- Energy Efficiency Performance Monitoring System at different levels is as follow:

Energy Efficiency Performance Monitoring System			
Meetings	Frequency	Chaired By	Management Remark
Planning Meeting	Daily	O&M Head	Corrective actions generated from monitoring & review meetings implemented in O & M Practices
Operational Review Meeting	Monthly	Plant Head	
Regional Operational Review Meeting	Half Yearly	Director	

- Preparation of action plan with responsibility for implementation.
- Prioritization and recourse allocation are done from O&M and Energy conservation budget.

“Bridging energy gap, protecting earth, branding the business through ISO -50001.”

—Jhimli Dhar, AGM (EEMG)

Energy Efficiency Activities

- ❖ PA Header pressure optimisation at part loads for safe & efficient operation of Fans
- ❖ Single CEP and Single ARCW pump operation at 55% Load
- ❖ Replacing conventional lights with LED lights
- ❖ VFDs for suitable LT Drives
- ❖ Energy Efficient Coating on Pump Impellers
- ❖ Flue Gas duct Modification with CFD Modelling in Unit-3 & Unit-4
- ❖ Boiler Modification in Unit-1 & 2
- ❖ NDCT 3 & 4 Performance Improvement
- ❖ Flue gas heat recovery based de-salination plant (120 TPD)
- ❖ APC – Advanced Process Control Implementation

Do, Check, and Act

Implementation Process & Involvement:

Once the action plan is made, department wise responsibility is fixed. The implementation of the identified areas is taken up either in routine maintenance, short term planning, during Overhaul or renovations & retrofitting.

The responsibility matrix for all the areas is as follow

Responsibility Matrix	
Area	Responsibility
Boiler Efficiency Loss	AGM (BMD)
GTCHR Loss	AGM (TMD)
Condenser HR Loss	AGM (TMD)
AHP HR Loss	AGM (BMD)
Cooling Tower HR Loss	AGM (Offsite)

Top Management’s motivation and support

Top management has always been committed to the implementation of the EnMS. Their support and motivation are always found in the following manner.

- Clear communication to employees about the importance of effective energy management.
- Ensured that the EMS policy is established based on the guidelines of EnMS standards and in line with organization’s long-term goal.
- Ensured the formation of Energy Management Team.
- Timely allocation of the required budget.
- Conducting regular management reviews.

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Improvement undertaken by NTPC Simhadri

Energy Conservation Achievements

FY	Budget (Rs Lacs)	SAVINGS Achieved		
		Energy (MU/MT of Coal)	Rs Lacs	Emission (Tons of CO ₂)
2015-16	41.47	27.92	714	17774
2016-17	6.3	25.55	652	15610
2017-18	194.5	45.59	1163	30694
2018-19	355	7.53 MU / 10248 MT of Coal	654	14082



A Tree Absorbs
1 Ton of CO₂
In its Life
Of 50 years

Continual Improvement in Efficiency

1 KG of Coal with 25% fixed carbon
produces 0.916 KGs CO₂

ENERGY Savings



AREA	TYPE OF ENERGY SAVED	Quantity (Energy) Jan2020			Total savings achieved (MU)
		Due to operating practices	Due to equipment maintenance	Due to modi./ replacement by efficient eqpts.	
Single CEP Operation	Electrical	1.528			1.528
Single ARCW Pump Oprn	Electrical	0.354			0.354
Replacing lights with LED lights	Electrical			2.620	2.620
PA Header pressure Optimization at part loads	Electrical	0.040			0.040
Unit #3 Cooling tower	Electrical		3.858		3.858
Unit #3 ESP Duct	Electrical	0.509			0.509
Unit 1 HPT eff. improvement	Thermal		14.243		14.243
Unit 1 IPT eff. improvement	Thermal		8.445		8.445
Unit 1 Boiler Modification	Thermal		23.301		23.301
Total					54.897

Baseline and Reporting Period:

Both baseline period & reporting period are fixed as per Govt. of India and covered under Perform, achieve & trade (PAT) Cycle. The first PAT Cycle was 2012-13, 2013-14 & 2014-15. It had the baseline period of 2012-13 based on past three years data. The assessment period was FY 2014-15. The baseline data for second cycle was the achieved value of first cycle. The second cycle assessment period was 2018-19. Now the 3rd cycle is going on for the period 2020-21, 2021-22 & 2022-23 and the target year is 2022-23 for monitoring & verification purpose.

Transparency

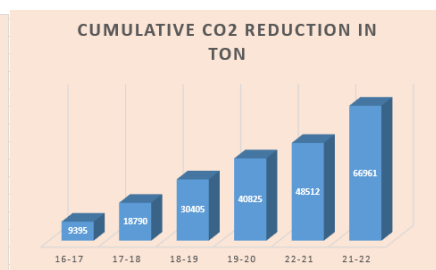
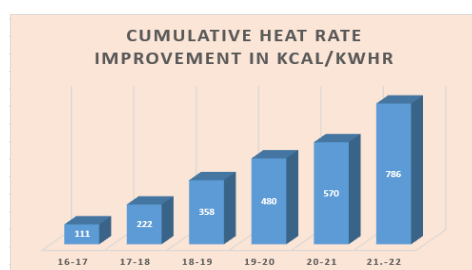
- Publication of integrated annual sustainability report as per GRI by NTPC Ltd.
- Online Environment monitoring screen to pollution Control board of the State Government.
- Submission of audit reports to Government.

What We Can Do Differently

- Display of management instructions regarding EnMS in strategic locations.
- Display of financial impacts on parametric variations affecting the EnPI.
- Minimum Man-days training on EnMS processes & its benefits to all employees in advance
- Advance Budget allocation for EnMS speedy implementation.
- Development of professional expertise through advance training on EnMS.

Quotes and Visuals

“An ISO:50001 Energy management standard promotes sustainability of the business”.



The Energy Management Leadership Awards is an international competition that recognizes leading organizations for sharing high-quality, replicable descriptions of their ISO 50001 implementation and certification experiences. The Clean Energy Ministerial (CEM) began offering these Awards in 2016. For more information, please visit www.cleanenergyministerial.org/EMAwards.