- Products and systems that help reduce water consumption in buildings and conserve water in landscaped areas.

5. Affordability can be considered when building product life-cycle costs are comparable to conventional materials or as a whole, are within a project-defined percentage of the overall budget.

BENEFITS OF GREEN BUILDING

Buildings have an enormous impact on the environment, human health, and the economy. The successful adoption of green building strategies can maximize both the economic and environmental performance of buildings.

1. Environmental benefits 2.Economic benefits 3.Social benefits

1. Environmental benefits:

- Enhance and protect biodiversity and ecosystems
- Improve air and water quality
- Reduce waste streams
- Conserve and restore natural resources

2. Economic benefits:

- Reduce operating costs
- Create, expand, and shape markets for green product and services
- Improve occupant productivity
- Optimize life-cycle economic performance

3. Social benefits:

- Enhance occupant comfort and health
- Heighten aesthetic qualities
- Minimize strain on local infrastructure
- Improve overall quality of life

4.7 GREEN COMPUTING ORGREEN IT OR ICT SUSTAINABILITY

Definition :"the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems — efficiently and effectively with minimal or no impact on the environment"

Introduction:

The primary objective of such a program is to account for the triple bottom line (or "People, Planet, Profit").

The term "green computing" was probably coined shortly after the Energy Star program began.

The goals are similar to green chemistry namely to reduce the use of hazardous materials; maximize energy efficiency during the product's lifetime; and promote recyclability or biodegradability of defunct products and factory waste.
The Green Electronics Council offers the **Electronic Products Environmental Assessment Tool** (EPEAT) to assist in the purchase of "green" computing systems.
Climate Savers Computing Initiative (CSCI) is an effort to reduce the electric power consumption of PCs in active and inactive states. The name stems from the World Wildlife Fund's Climate Savers program, which was launched in 1999. The WWF is also a member of the Computing Initiative.

In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labeling program that is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. Concurrently, the Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from CRT-based computer displays; this program was later expanded to include criteria on energy consumption, ergonomics, and the use of hazardous materials in construction

So why should a company promote green, or energy efficient computing?

- Climate Change: First and foremost, conclusive research shows that CO2 and other emissions are causing global climate and environmental damage
- Savings: Green computing can lead to serious cost savings over time.
- Reliability of Power: Energy efficient systems helps ensure healthy power systems. Also, more companies are generating more of their own electricity, which further motivates them to keep power consumption low.
- Computing Power Consumption has Reached a Critical Point: Data centers have run out of usable power and cooling due to high densities.

Here are some steps that can be taken:

- Power-down the CPU and all peripherals during extended periods of inactivity.
- Try to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times.
- Power-up and power-down energy-intensive peripherals such as laser printers according to need.
- Use liquid-crystal-display (LCD) monitors rather than cathode-ray-tube (CRT) monitors.
- Use notebook computers rather than desktop computers whenever possible.
- Use the power-management features to turn off hard drives and displays after several minutes of inactivity.
- Minimize the use of paper and properly recycle waste paper.
- Dispose of e-waste according to federal, state and local regulations.
- Employ alternative energy sources for computing workstations, servers, networks and data centers.

Approaches to green computing

1. **Virtualization**

Computer virtualization is the process of running two or more logical computer systems on one set of physical hardware. The concept originated with the mainframe operating systems of the

1960s, but was commercialized for x86-compatible computers only in the 1990s. With virtualization, a system administrator could combine several physical systems into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption.

Eg:Intel Corporation and AMD

2. Power management

The Advanced Configuration and Power Interface (ACPI), an open industry standard, allows an operating system to directly control the power saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity. In addition, a system may hibernate, where most components (including the CPU and the system RAM) are turned off. ACPI is a successor to an earlier Intel-Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions.

Some programs allow the user to manually adjust the voltages supplied to the CPU, which reduces both the amount of heat produced and electricity consumed. This process is called under volting. Some CPUs can automatically under volt the processor depending on the workload.

3**. Low performance computers**

As of 2007, several personal computer vendors (e.g., Everex, Linutop, Systemax, Zonbu and OLPC) ship dedicated low-power PCs. These systems provide minimal hardware peripherals and low performance processors, which makes them impractical for applications that require a lot of processing power such as computer gaming and video production. A low power PCs is usually much smaller than traditional desktop. The limited capacity for upgrades, low performance and proprietary may lead to shorter life spans and greater difficulty in repair. **Older laptops** may provide similar performance with low power consumption. Reusing second-hand laptops may be an even more energy and material efficient alternative to such systems.

Routers, such as those compatible with the Linksys WRT54G, may be adapted for use in low power applications using replacement firmware.

4. **More efficient components**

4.1**: Power supply:** Desktop computer power supplies (PSUs) are generally 70–75% efficient, dissipating the remaining energy as heat.

4.2: **Storage:** Smaller form factor (e.g. 2.5 inch) hard disk drives often consume less power than physically larger drives.

4.3: **Display :**LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting diodes(LEDs) in place of the fluorescent bulb, which reduces the amount of electricity used by the display.

5. **Materials recycling**

Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills, but often computers gathered through recycling drives are shipped to developing countries where environmental standards are less strict.

Eg: printer cartridges, paper, and batteries

4.8 NANOTECHNOLOGY

Definition

The systematic manipulation of matter on the length scale 1-100 nm to produce useful new engineered structures, materials, or devices.

Nanotechnology (NT) can be defined as the creation and use of materials, devices and systems in a size range of molecular and atomic scale (Nano-scale1).

As it deals with the manipulation of molecules it is also termed as molecular manufacturing.

The prefix, "Nano" of Nanotechnology describes a scale nanometer.

Nanometre

A nanometre is thousand millionth of a metre (1 nm = 10-9 m). Some practical examples for knowing the nanometre scale are as follows:

It is comparable to

- 1/80.000 of the diameter of a human hair (Institute of Nanotechnology, 2002) or
- 1/10.000 times the size of a bacteria (Drexler, 1986, p.11) or
- 1000 times smaller than the present micro-metre devices or
- 10 times the diameter of a hydrogen atom.

An early promoter of the industrial applications of NT, Albert Franks, defined it as 'that area of science and technology where dimensions and tolerances in the range of 0.1nm to 100 nm play a critical role'

Challenging Environmental Issues

• Legacy Pollutants
  – Chlorinated Solvents
  – PCBs, PAHs, Chlorinated Pesticides (e.g.DDT)
  – Lead, cadmium, chromium
• Emerging Contaminants
  – Pharmaceuticals & Personal Care Products
  – Newer pesticides
  – Engineered Nanoparticles & their byproducts?
• Common water constituents
  – Salinity, hardnes

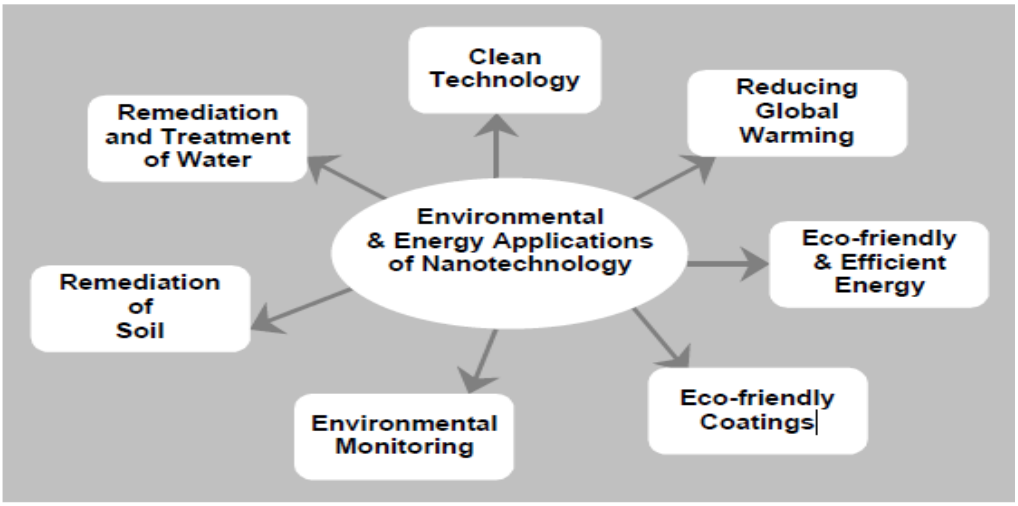
Potential Applications of Nanotechnology

Most environmental applications of nanotechnology fall into three categories:

(i) Remediation and Mitigation
(ii) Pollution Prevention
(iii) Sensors for environmental agents
(iv)Green nanotech

Possible applications of Nano Materials

1. As reactants eg: Nano Zero Valent Iron, Nano Silver
2. As catalysts eg: Nano TiO_2, Nano CeO_2
3. As adsorbents eg: Carbon Nano tubes (CNTs), Mag-PCMAs
4. As sensors eg: CNTs (Carbon nano tubes)



Remediation and Mitigation:

Contamination of subsurface soil and groundwater by organic and inorganic contaminants is an extensive and vexing environmental problem that stands to benefit from nanotechnology. Nanotechnology offers the ability to effectively enable contaminant treatment in situ and ex-situ. The process begins with the injection of nanoparticles into a contaminated aquifer via an injection well. The nanoparticles are then transported to the source of contamination by the groundwater flow where they then degrade the contaminant. Nanoparticles can sequester (via adsorption or complexation), immobilizing them, or they can degrade the contaminants to less harmful compounds. Contaminant transformations are typically redox reactions. When the nanoparticle is the oxidant or reductant, it is considered reactive.

Generating less pollution during the manufacture of materials. One example of this is how researchers have demonstrated that the use of silver nanoclusters as catalysts can significantly reduce the polluting byproducts generated in the process used to manufacture propylene oxide. Propylene oxide is used to produce common materials such as plastics, paint, detergents and brake fluid.

Producing solar cells that generate electricity at a competitive cost. Researchers have demonstrated that an array of silicon nanowires embedded in a polymer results in low cost but high efficiency solar cells. This, or other efforts using nanotechnology to improve solar cells, may result in solar cells that generate electricity as cost effectively as coal or oil.

Increasing the electricity generated by windmills. Epoxy containing carbon nanotubes is being used to make windmill blades. The resulting blades are stronger and lower weight and therefore the amount of electricity generated by each windmill is greater.

Cleaning up of organic chemicals polluting groundwater. Researchers have shown that iron nano particles can be effective in cleaning up organic solvents that are polluting groundwater. The nano particles disperse throughout the body of water and decompose the organic solvent in place this method can be more effective and cost significantly less than treatment methods that require the water to be pumped out of the ground.

Capturing carbon-dioxide in power plant exhaust. Researchers are developing nanostructers membrane designed to capture carbondioxide in the exhaust stacks of power plants instead of releasing it into the air.

Clearing volatile organic compounds (VOC) from air. Researchers have demonstrated a catalyst that breaks down VOCs at room temperatue. The catalyst is composed of porous manganese oxide in which gold nano particles can be embedded.

Reducing the cost of fuel cells: changing the space of platinum atoms used in a fuel cell increases the catalytic ability of the platinum. This allows the fuel cell to function with about 80%, less platinum significantly reducing the cost of fuel cell.

Storing hydrogen for fuel cell powered cars: Using grapheme layers to increase the binding energy of hydrogen to the graphene surface in a fuel tank results in higher amount of hydrogen storage and a lighter weight fuel tank. This could help in the development of practical hydrogen fueled cars.

4.9 ISO 14000

The ISO is a specialized international organization whose members are the national standards bodies of 111 countries.

• All standards developed by ISO are voluntary
• ISO 14000 is a series of international standards on environmental management.
• "ISO 14000" is the first international attempt to standardize environmental management practices around the world.
• ISO 14000 will help integrate the environmental management systems of companies that trade with each other in all corners of the world.

Scope and Status of ISO 14000

Organization Standards that can be used to implement and evaluate the environmental management system (EMS) within an organization. Included are:

- the ISO 14000 series of EMS standards;
- the ISO 14010 series of environmental auditing standards; and
- the ISO 14030 series of standards for environmental performance evaluation.

Product Standards that can be used to evaluate environmental impacts from products and processes. Included in this subgroup are:

- the ISO 14020 series of environmental labeling standards;
- the ISO 14040 series of life-cycle analysis standards; and
- the ISO 14060 series of product standards**.**

Environmental Labeling

– Type I programs are referred to as "practitioner “programs which are product or product category based, similar to the Environmental Choice Program or Germany's BlueAngel Program.

– Type II programs are based on common terms and definitions which can be used for self-declared claims.

– Type III programs are based on a "report card "concept, much like existing nutrition labels.

4.10ROLE OF IT IN THE ENVIRONMENT AND HUMAN HEALTH

Technology has played a key role in the development of human society. Modern technologies such as information technology have changed the human lifestyle. Development of sophisticated instruments like computers, satellites, telecommunication instruments etc have resulted in total revolution in almost all spheres of life.

The important role of information technology in environment and human health are as follows:

1. Remote sensing: Remote Sensing according to Campbell(1987) is the science of deriving information about the earth's land water areas form images acquired at a distance. It relies upon measurement of electromagnetic energy reflected or emitted from the features of interest.

Regardless of the orientation of the various definitions of Remote Sensing, the acquisition of images of earth surface features, using sensors, through the electromagnetic spectrum, the synoptic view advantage and Remote Sensing's ability to provide data for scientific technological and sustainable management and monitoring of the environment offer a convergence.

The Electro-magnetic spectrum (EMS) is the physical basis for Remote Sensing. It is an abstract idea and diagram of forms of electromagnetic energy for illuminating earth surface features. The source of energy is divided according to wavelengths.

Steps:

Briefly stated, the process of Remote Sensing involves

1) Making observation using sensors (camera, scanners, radiometers, radar, and lasers) mounted on platforms (ground, aircraft, satellites, balloons) which may be at considerable height from the earth surface.

2)Then, recording the observations on a suitable medium (photographic films and magnetic tapes) or transmitting/down linking the data to a ground receiving station where the data are corrected for geometric and radiometric distortions.

3) Output products can be provided in computer compatible tapes (CC T) for users that made requests for the data. Remote sensing serves as a tool for environmental resources (biotic, abiotic and cultural) assessment and monitoring. Remote sensing has some fundamental advantages that make it a veritable tool in environmental monitoring and management and impact studies.

2. GIS (GEOGRAPHICAL INFORMATION SYSTEM)

GIS and Environmental Impacts Assessment:

Tomlin (199O) defines a GIS as 'a configuration of computer hardware and software specially designed for the acquisition, maintenance and use of cartographic data'.

GIS as a powerful set of tools for collecting, storing and retrieving at will, transforming and displaying spatial data from the real world.

The point of note is that a GIS is a computer-assisted system for the acquisition, storage, analysis and display of geographically are spatially referenced data. GIS is indeed a new application-

based field that has lend itself to varieties of human endeavors ranging from business, facility management to environmental management and resource application areas. Eedy (1995) has described GIS as a veritable tool in environmental assessment because it:

- Stores large multidisciplinary datasets.
- Identify complex interrelationship between environmental characteristics.
- Evaluate changes over time.
- Can be systematically updated and used for more than one project.
- Serve as a dataset for a variety of mathematical models.
- Store and mampulate3D in addition to 2D files.
- Serve the interests of the general public as well as technical analyst.

Capabilities of GIS:

GIS also have the capability for site impact prediction (SIP), wider area prediction (WAP), cumulative effect analysis (CEA), and environmental audits and for generating trend analysis within an environment.

Rodriquez -Bachiller (1995) commenting on its application in ETA studies submits that it is a veritable tool for generating terrain maps for slope and drainage analysis, land resources information system for land management, soil information system, geo scientific modeling of geological formations, disaster planning related to geographically localized catastrophe monitoring development, contamination and pollution monitoring, flood studies, linking of environmental database and constructing global database for environmental modeling.

Erickson (1994) suggested 4 four ways of using GIS for EIA. These are:

- **Overlay method:** This involves overlaying of different layers of interest of the study area to achieve the needed result.
- **Checklist method:** This is the listing of environmental components, attributes and processes categorized under different groups.
- **Matrix method:** This is the relating of specific project activities to specific types of impacts.
- **Network method:** This defines a network of possible impacts that may be triggered by project activities. It involves project actions, direct and indirect impacts.

Use of GIS in EIA

1 .**In Project definition**: During project identification and definition, the project proponent conducts feasibility studies and defines the usefulness of the study. GIS can be very well used for defining the project by showing the location of the project and its need can be established with respect to other geographical identities like source of raw material, market for selling, source of labourer, climatic conditions favorable for the project etc.

2. **In evaluating environmental and visual impacts**:

Using GIS various types of visual impacts can be evaluated like, how a road will look like? How much portion of the road will be visible from a particular point? By using DEM we can calculate and visualize the impact on ground levels either in filling or cutting and area of quarries etc (Oterholm, 1999).

3 .**In scoping system:** GIS can serve as a basis for scoping of environmental effects. Once the basic databases are available, a GIS based system may provide better-targeted guidelines for EIS. A centralized institutional scoping structure, where by EIS guidelines are issued by a single entity, is found to be important for the operation of such a system as it can enjoy the Economies

of scale and scope involved in setting up and operating a GIS system for scoping purpose (Haklay et al., 1998).

4. **In impact significance determination**: A spatial impact assessment methodology based on the assumption that the importance of environmental impact is dependent, among other things, on the spatial distribution of the effects and of the affected environment. For each environmental component like- air, water, biological resources etc., impact indices are calculated based on the spatial distribution of impacts (Antunes et al., 2001). The fact that GIS is not used in practice to the extent that it could be used in principle may also be the due to a number of limitations of GIS like:

Ø Availability of digital data
Ø Cost of start up
Ø System maintenance
Ø Database construction
Ø Availability of hardware and software

3. National management Information system (NIMS) - database for research and development

4. Environmental Information system (ENVIS): It was been created by MoEF in India for generating network of database for pollution control, clean technologies etc.

Database: Database is the collection of inter-related data on various subjects in computerized form which can be retrieved whenever required. Now the data regarding birth and death rates, immunization and sanitation programs can be maintained more accurately than before in computers at health centers. Database is also available about the diseases like malaria, fluorosis, AIDS etc. The Ministry of Environment and Forests, Government of India has taken up the task of compiling a database on various environmental issues like wildlife, forests cover, wasteland etc.

3. **Human health:** Information technology also plays a key role in human health. It helps the doctors to monitor the health of people of that area. The information regarding outbreak of epidemic diseases from remote areas can be sent more quickly to the district administration to take corrective measures. Now, patients can seek help of a super specialist doctor placed at far off distance. Many hospitals now, take on-line help of experts to provide better treatment and services to their patients. This has become possible only because of advancement of IT in the recent times.