

# GREEN TECHNOLOGIES

## MODULE IV

# High Tech Measures for Reducing Carbon Emissions



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# GREEN TECHNOLOGIES

## MODULE IV

- Some High-tech Measures for Reducing Carbon Emissions :- Use of Solar Power with Satellite-Based Systems ,Use of Carbon Capture and Storage (Sequestration) ,Microorganisms, A Quick SWOT Analysis.
- Recommended Plan of Action :- India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, Few case studies on Projects undertaken by Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

# High Tech Measures

- Solar power with Satellite Based Systems
- Sequestration
- Genetic modifications of microorganisms
- Electric vehicles
- Energy from uranium and thorium

# Solar power with Satellite Based Systems

- **Space-based solar power (SBSP)** is the concept of collecting solar power in outer space and distributing it to Earth.
- Potential advantages of collecting solar energy in space include a **higher collection rate** and **a longer collection period** due to the lack of a diffusing atmosphere, and the possibility of placing a solar collector in an orbiting location where there is no night.
- Space-based solar power systems convert sunlight to microwaves outside the atmosphere

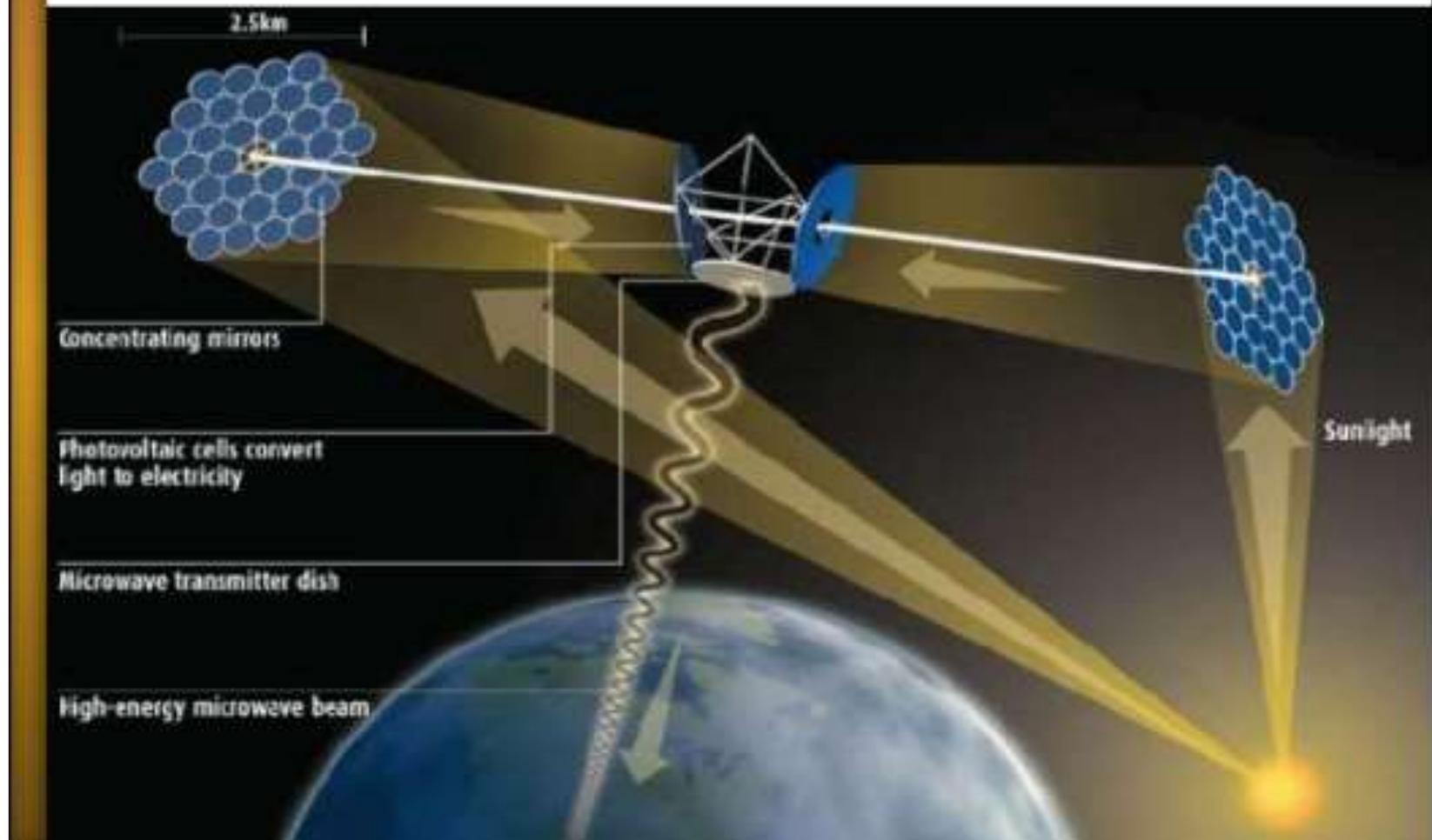
- **History**

- Originally known as satellite solar-power system (SSPS), was first described in November 1968.
- In 1973 **Peter Glaser** was granted U.S. patent for his method of transmitting power over long distances using microwaves from a very large antenna (up to one square kilometer) on the satellite to a much larger one, now known as a rectenna, on the ground.
- Between 1978 and 1981, the US Congress authorized the Department of Energy (DoE) and **NASA** to jointly investigate the concept.
- In 1997 NASA conducted its "Fresh Look" study to examine the modern state of SBSP feasibility.
- In **2008, Japan** passed its Basic Space Law which established Space Solar Power as a national goal and **JAXA** (The Japan Aerospace Exploration Agency) has a roadmap to commercial SBSP.
- In 2015, the China Academy for Space Technology (**CAST**) showcased their roadmap at the International Space Development Conference.

- Requirements for Space Solar Power
- Low-cost, environmentally-friendly launch vehicles.
- **Large scale in-orbit construction and operations:** To gather massive quantities of energy, solar power satellites must be large, far larger than the International Space Station (ISS).
- **Power transmission:** To transmit power from satellites to the Earth's surface with minimal environmental impact.

- Design Space-based solar power essentially consists of three elements:
- **Collecting solar power in space**, for example via solar concentrators, solar cells or a heat engine.
- **Transmitting power to earth**, for example via microwave or laser.
- **Receiving power on earth**, for example via a microwave antenna (rectenna).

# How SPS Works??



Space to  
Ground  
Microwave



Rectenna

## Advantages

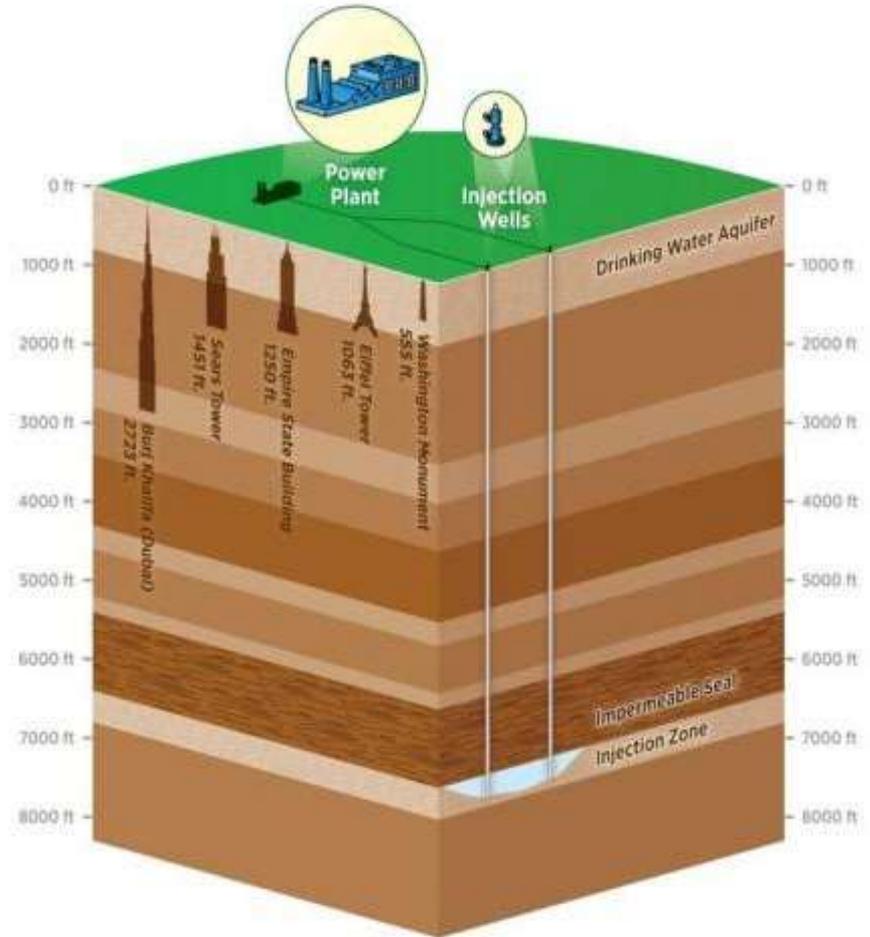
- It is **always solar noon** in space and full sun.
- Collecting surfaces could **receive much more intense sunlight**, owing to the lack of obstructions such as atmospheric gasses, clouds, dust and other weather events.
- Orbiting satellites can be exposed to a consistently high degree of solar radiation, generally for 24 hours per day, whereas earth surface solar panels currently collect power for an average of 29% of the day.
- Power could be relatively quickly redirected directly to areas that need it most. A collecting satellite could possibly direct power on demand to different surface locations based on geographical baseload or peak load power needs.
- **Elimination of plant and wildlife interference.**
- With very large scale implementations, especially at lower altitudes, it potentially can reduce incoming solar radiation reaching earth's surface. This would be desirable for **counteracting the effects of global warming**

# Disadvantages

- **The large cost of launching a satellite into space.** For 6.5 kg/kW, the cost to place a power satellite in GEO cannot exceed \$200/kg if the power cost is to be competitive.
- **Inaccessibility:** Maintenance of an earth-based solar panel is relatively simple, but construction and maintenance on a solar panel in space would typically be done telerobotically.
- In addition to cost, astronauts working in GEO (geosynchronous Earth orbit) are exposed to **unacceptably high radiation dangers and risk and cost** about one thousand times more than the same task done telerobotically.
- The space environment is hostile; PV panels suffer about 8 times the degradation they would on Earth
- **Space debris** is a major hazard to large objects in space, particularly for large structures such as SBSP systems in transit through the debris below 2000 km. Collision risk is much reduced in GEO since all the satellites are moving in the same direction at very close to the same speed.
- The broadcast frequency of the microwave downlink would require isolating the SBSP systems away from other satellites. GEO space is already well used and it is considered unlikely the ITU would allow an SPS to be launched.
- **The large size and corresponding cost of the receiving station** on the ground. The cost has been estimated at a billion dollars for 5 GW by SBSP researcher Keith Henson.
- **Energy losses** during several phases of conversion.
- Waste heat disposal in space power systems is difficult

# Carbon Capture and Storage

- Carbon dioxide (CO<sub>2</sub>) capture and sequestration (CCS) is a set of technologies that can greatly reduce CO<sub>2</sub> emissions from new and existing coal- and gas-fired power plants and large industrial sources.



CCS is a three-step process that includes:

- **Capture of CO<sub>2</sub>** from power plants or industrial processes
- **Transport of the captured and compressed CO<sub>2</sub>** (usually in pipelines).
- **Underground injection and geologic sequestration** (also referred to as storage) of the CO<sub>2</sub> into deep underground rock formations. These formations are often a mile or more beneath the surface and consist of porous rock that holds the CO<sub>2</sub>. Overlying these formations are impermeable, non-porous layers of rock that trap the CO<sub>2</sub> and prevent it from migrating upward.

# Why is it important?

- Carbon dioxide (CO<sub>2</sub>) capture and sequestration (CCS) could play an important role **in reducing greenhouse gas emissions**, while enabling low-carbon electricity generation from power plants.
- As estimated in the **U.S. Inventory of Greenhouse Gas Emissions and Sinks**, more than 40% of CO<sub>2</sub> emissions in the United States are from electric power generation.
- CCS technologies are currently available and can **reduce (by 80-90%) CO<sub>2</sub> emissions from power plants that burn fossil fuels**.
- Applied to a 500 MW coal-fired power plant, which emits roughly 3 million tons of CO<sub>2</sub> per year, the amount of GHG emissions avoided would be equivalent to:
  - Planting more than 62 million trees, and waiting at least 10 years for them to grow.
  - Avoiding annual electricity-related emissions from more than 300,000 homes.

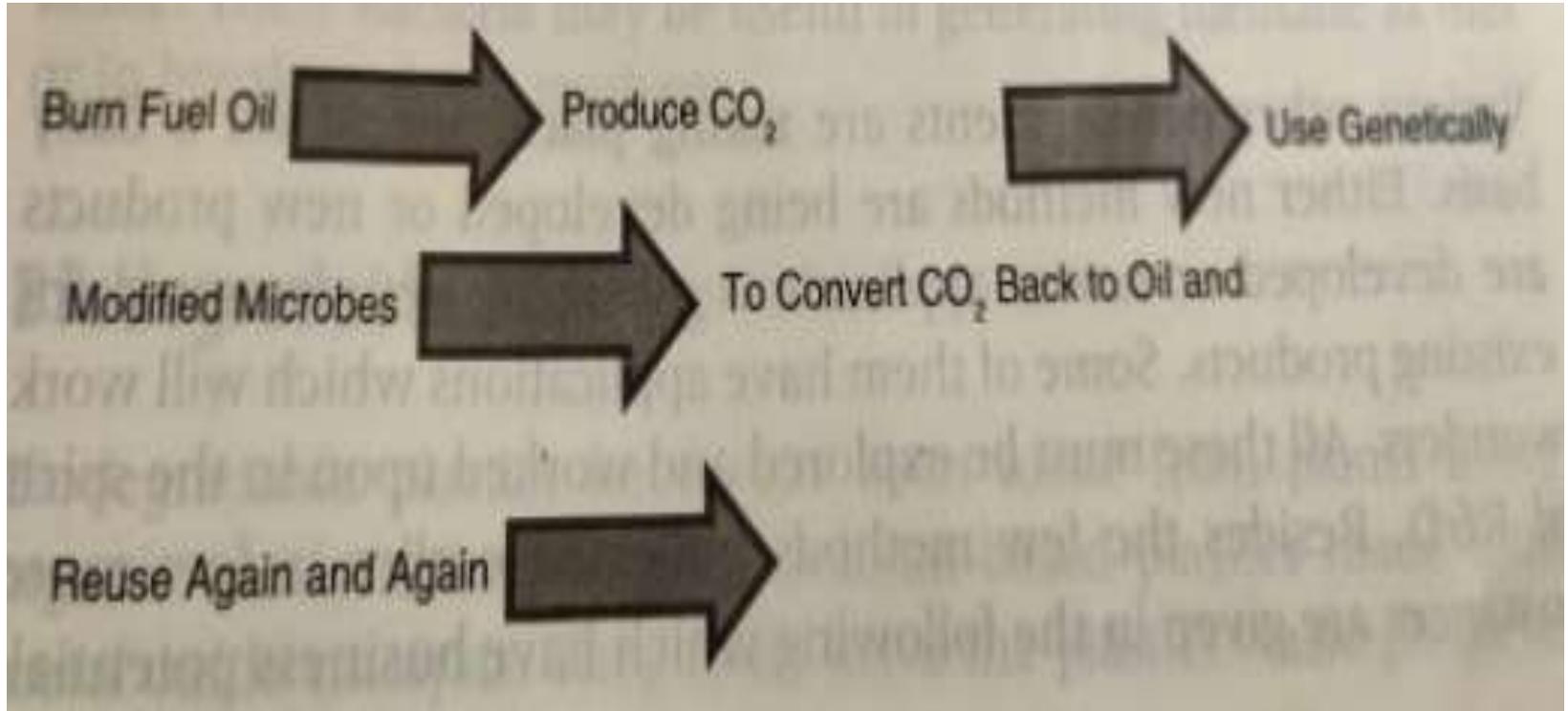
# Where can captured carbon dioxide be stored?

- Storage basins in the form of deep, sedimentary basins have been found suitable for CO<sub>2</sub> storage.
- Use of space related by depleted oil and gas reserves underground.
- Use of CO<sub>2</sub> to increase oil and gas outputs from deposits
- Use of deep saline formations for storage
- Use of CO<sub>2</sub> to improve coal-bed methane recovery

# Issues Involved in Planning CCS Projects

- Limited fundamental knowledge of storage and leakage mechanisms
- Storage engineering
- Safe operation and maintenance of project
- Financial responsibility
- Increase significantly the emissions of acid gas pollutants.
- In ocean storage **carbon dioxide reacts with water to form acid**, so the oceans could become significantly more acidic .
- In addition to the global climate change impact of CO<sub>2</sub> returning to the atmosphere, **leakages pose local risks to health and ecosystems.**

# Genetic Modification of Microorganisms



## Genetic Modification of Microorganisms

- In **the carbon cycle** methanogens convert carbon dioxide to methane in a process called methanogenesis
- In **the nitrogen cycle nitrogen-fixing bacteria** such as Rhizobium fix nitrogen, which means they convert nitrogen in the atmosphere into biological nitrogen that can be used by plants to build plant proteins.
- Photosynthetic algae and cyanobacteria form a major component **of marine plankton**. They play a key role in the carbon cycle as they carry out photosynthesis and form the basis of food chains in the oceans.

# The Sahara CSP Project



# Sahara Forest Project



# The Sahara CSP Project

- Located in North Africa
- To develop a concentrated solar power plant to generate enough electric power to meet the energy needs of Europe
- Use for desalination of sea water for growing crops in green houses located in Sahara
- Distribution of energy from desert to the European countries would pose problems and involve large cost



Search bar with a magnifying glass icon and a blue location pin icon. Below the search bar, the text "y places" is visible.



# India's National Action Plan

- Climate change is one of the most critical global challenges of our times.
- Recent events have emphatically demonstrated our growing vulnerability to climate change.
- Climate change impacts will range from
  - affecting agriculture
  - further endangering food security
  - sea-level rise
  - accelerated erosion of coastal zones,
  - increasing intensity of natural disasters,
  - species extinction, and the spread of vector-borne diseases.
- India released its much-awaited National Action Plan on Climate Change (NAPCC) to mitigate and adapt to climate change on June 30, 2008

- The action plan outlines a number of steps to simultaneously advance India's development and climate change-related objectives. **The National Action Plan on Climate Change (NAPCC)** encompasses a range of measures. It focuses on eight missions, which are as follows:
- **National Solar Mission**: The NAPCC aims to promote the development and **use of solar energy for power generation** and other uses, with the ultimate objective of making solar competitive with fossil-based energy options. It also includes the establishment of a solar research center, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.
- **National Mission for Enhanced Energy Efficiency**: The NAPCC recommends mandating specific energy consumption decreases in large energy-consuming industries, with a system for companies to trade **energy-saving certificates, financing for public–private partnerships to reduce energy consumption through demand-side management programs** in the municipal, buildings, and agricultural sectors, and energy incentives, including reduced taxes on energy-efficient appliances.

- **National Mission on Sustainable Habitat:** The NAPCC also aims at promoting energy efficiency as a core component of urban planning by **extending the existing Energy Conservation Building Code, strengthening the enforcement of automotive fuel economy standards,** and using pricing measures to encourage the purchase of efficient vehicles and incentives for the use of public transportation. The NAPCC also emphasizes on waste management and recycling.
- **National Water Mission:** The NAPCC sets a goal of **a 20% improvement in water use efficiency** through pricing and other measures to deal with water scarcity as a result of climate change.

- **National Mission for Sustaining the Himalayan Ecosystem**: This particular mission sets the **goal to prevent melting of the Himalayan glaciers and to protect biodiversity in the Himalayan region.**
- **Green India Mission**: The NAPCC also aims at **afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23 to 33% of India's territory.**
- **National Mission for Sustainable Agriculture**: The NAPCC aims to support climate adaptation in agriculture through **the development of climate-resilient crops, expansion of weather insurance mechanisms,** and agricultural practices.
- **National Mission on Strategic Knowledge for Climate Change**: To gain a **better understanding of climate science, impacts, and challenges,** the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.
- <https://www.downtoearth.org.in/news/climate-change/india-s-national-action-plan-on-climate-change-needs-desperate-repair-61884>

# Schemes for NAPCCC by Indian Government

- **Namami Gange Programme**

Narendra Modi

The Centre allocated a total of **Rs 20,000 crore to conserve and rejuvenate the river.** While there had been a number of other programmes to improve the state of river Ganga, the Modi-led government stated that it was approaching the problem differently.

It involved the people living on the banks of the river, and helped them attain sustainable livelihoods and feel the impact first-hand. It also roped in grass-root level institutions, including urban local bodies and Panchayati Raj institutions, to work for the same.

Key achievements of include

- creating sewerage treatment capacity,
- river front development and surface cleaning.

The programme is being implemented by the National Mission for Clean Ganga (NMCG) at the national level and State Program Management Groups (SPMGs) at the state level. Moreover, 63 sewerage management projects are implemented in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal.



# NAMAMI GANGE

## INTEGRATED GANGA CONSERVATION MISSION

"A National Mission encompassing every Indian, right from the Prime Minister to the NRI living in America. If we can't do it now, we shall never be able to swear by our mother, Ganga. *Majya Ki Kasam*."

A Presentation By :  
**Mandeep**  
MSc. (Env. Scs.)

# Ujala Yojana | Free LED Bulb Scheme

- Earlier Ujala Scheme was launched with a different name – Domestic Efficient Lighting Programme (**DELP**).
- Now with the new name the programme has been re-launched.
- It has also been revived by providing a lot more benefits to the consumers than it was providing before.
- The main aim of the Yojana is to switch the usage of over 200 million incandescent light bulbs into LED light bulbs. **This will save a power of 10.5 billion kWh as a whole.**

- ***Ujala Yojana Key Features***

- It is **offering subsidized and affordable LED light bulbs** to all.
- It is one of the first and the strongest measures taken by the central government to promote the usage of efficient light bulbs.
- **The aim of the scheme is to preserve the environment.**
- Under this scheme the applicant will be given the LED light bulbs at subsidized prices. The prices are going to be slashed down by 60%. So the reduced price will be 40% less than the market price.
- The Ujala Yojana has brought both the state and the central government to work hand in hand. Earlier a similar scheme was launched but now it has been revived with the Ujala Yojana. It comprises of both the central and the state governments to work together towards achieving the goal.
- The market rate of a common household LED bulb is around Rs. 160. Under this scheme you will get the same LED bulb for Rs. 85 and 3 year replacement warranty.

# Pradhan Mantri Ujjwala Yojana

- Pradhan Mantri Ujjwala Yojana is a scheme of the Ministry of Petroleum & Natural Gas for **providing LPG connections to women from Below Poverty Line (BPL) households.**
- Under the scheme, **five crore LPG** connections are to be provided to BPL households. The Scheme provides a **financial support of Rs 1600 for each LPG connection** to the BPL households, interest free loan to purchase stove and refill by Oil Marketing Companies.
- The administrative cost of Rs. 1600 per connection, which includes a cylinder, pressure regulator, booklet, safety hose, etc. would be borne by the Government.



Largest direct intervention initiative for women of rural & urban households



5,00,00,000 women to directly benefit from an allocation of Rs 8,000 crore



Free LPG connections to BPL households



Providing clean fuel to women



Directly address health hazards due to use of wood, cowdung, etc in cooking



Free women from drudgery of collecting fire wood



Smoke free house - to all including children



Ministry of Petroleum & Natural Gas  
Government of India

**PRADHAN MANTRI UJJWALA YOJNA**

# Atal Jyoti Yojana

- The Ministry of New and Renewable Energy (MNRE)
- **to illuminate dark regions through establishment of solar street lights.**
- It is a sub scheme under off –grid and decentralized solar application scheme of Ministry of New and Renewable Energy (MNRE), Govt. of India. led the Atal Jyoti Yojana (AJAY)
- The Phase I was implemented during September 2016-March 2018. The Phase II is being implemented during 2018-19 and 2019-20.
- Implementation agency Energy Efficiency Services Limited (EESL) has been entrusted to implement the scheme.

- **States covered**
- **Phase I** : The rural, semi-urban and urban areas that **face less than 50%** grid connectivity in **Uttar Pradesh, Assam, Bihar, Jharkhand, and Odisha** will be illuminated with 7 W solar LED street lights. These solar lights were installed on major roads, markets and public conveniences in remote areas to sustainably enhance the citizens' quality of life.
- **Phase II**
  - States covered during Phase I - **Uttar Pradesh, Assam, Bihar, Jharkhand, and Odisha**
  - **Hilly states** of Jammu and Kashmir, Himachal Pradesh and Uttarakhand.
  - **North-eastern states including Sikkim**
  - **Islands of Andaman Nicobar and Lakshadweep**
  - Parliamentary constituencies covering 48 Aspirational districts of states other than those covered above.
- **Funding allocation**
- The total cost of the scheme is Rs 583 crore. MNRE will provide 75% of the cost of street lights and remaining 25% will come from Member of Parliament Local Area Development funds (MPLADS).



# ATAL JYOTI YOJANA DASHBOARD



(A scheme of MNRE, Govt. of India)

Total Solar LED Street Lights Installed as on Date : 10/03/2020

Installation of Solar Street Lighting Systems in the States where household Grid Power coverage is less than 50% as per 2011 census.

# 135677



135677

Total Solar LED Street Lights Installed



161572

Work Started



949739 W

Total Wattage Installed



# National Wind-Solar Hybrid Policy

- India has set an ambitious target of reaching 175 GW of installed capacity from renewable energy sources by the year 2022, which includes 100 GW of solar and 60 GW of wind power capacity.
- Aims and Objective
- The main objective of the Policy is to provide a framework for promotion of large grid connected wind - solar PV hybrid system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and achieving better grid stability.
- Policy also aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants.
- Period of enforcement
- This policy will remain in force unless withdrawn, modified or superseded by the Government. The Government will undertake a review of this Policy as and when required.



 Energynext



MNRE issues National Wind-Solar Hybrid Policy | Energynext

# Scale-Up Of Access To Clean Energy Scheme

- The Ministry of New and Renewable Energy (MNRE), Govt is implementing a project titled "Scale Up of Access to Clean Energy (ACE) for Rural Productive Uses", an initiative **to enhance the use of reliable and affordable renewable energy for rural productive uses/livelihoods in unserved and under-served areas.**

The scheme is being implemented in 3 states; **Assam, Madhya Pradesh and Odisha** for strengthening rural livelihoods, improving income generation and reduce use of fossil fuels.

Initially, a total of 19 districts have been identified in the 3 target states

- **Odisha** : Koraput, Keonjhar, Khurda, Kalahandi, Puri, Mayurbhanj
- Duration of the Scheme: Scheme will be available for FYs 2018-19 and 2019-20.
- **Objectives**
- To enhance access to reliable and affordable RE for rural livelihoods while encouraging replacement of fossil fuels.
- To create atmosphere for effective and innovative use of RE applications

# Solar Study Lamp Scheme for School Going Children

- The Solar Study Lamp is the scheme of Ministry of New & Renewable Energy, Government of India for **distribution of 7 Million solar study lamps for school going children** in the States viz. Assam, Bihar, Jharkhand, Uttar Pradesh and Odisha where household grid connectivity is less than 50% as per the 2011 Census.
- A 'Solar Study Lamp' is a lighting device consisting of a PV module, battery, lamp, and electronics. Battery, lamp, and electronics are placed in a suitable housing.



India Climate Dialogue



Solar lamps transform lives of rural students and women - India ...

# National Biogas and Manure Management

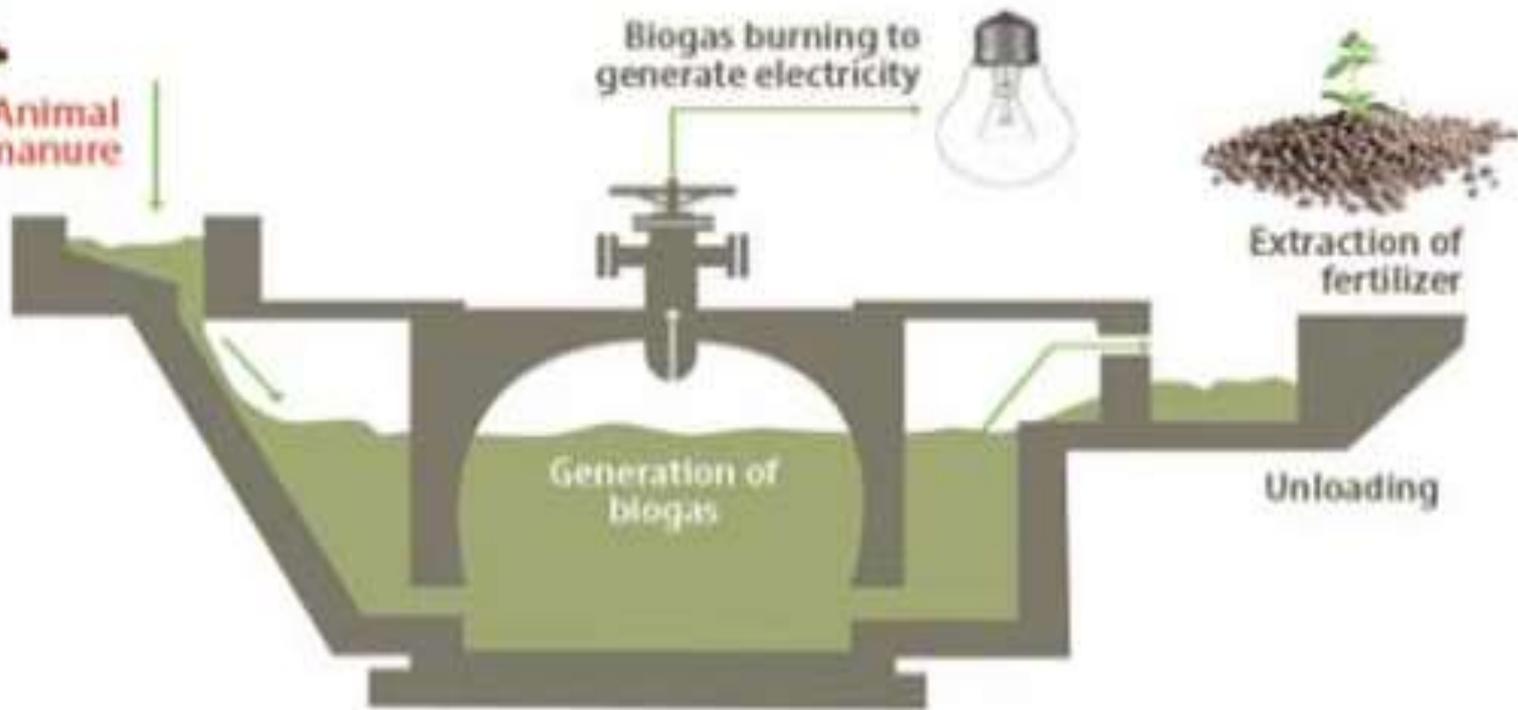
- National Biogas and Manure Management programme (NBMMP)
- **The programme was started in 1981-82 as the National Project on Biogas Development.**
- Objectives
- To provide fuel for cooking purposes and organic manure to rural households through family type biogas plants
- To mitigate drudgery of rural women, reduce pressure on forests and accentuate social benefits
- To improve sanitation in villages by linking sanitary toilets with biogas plants



## National Biogas and Manure Management Programme



Animal manure



# PM KUSUM scheme

- Ministry of New and Renewable Energy (MNRE) has launched the Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM KUSUM) Scheme for farmers for installation of solar pumps and grid connected solar and other renewable power plants in the country.
- The scheme aims to add solar and other renewable capacity of 25,750 MW by 2022 with total central financial support of Rs. 34,422 Crore including service charges to the implementing agencies.
- **Scheme benefits**
- The scheme will open a stable and continuous source **of income to the rural land owners for a period of 25 years by utilization of their dry/uncultivable land.** Further, in case cultivated fields are chosen for setting up solar power project, the farmers could **continue to grow crops as the solar panels are to be set up above a minimum height.**



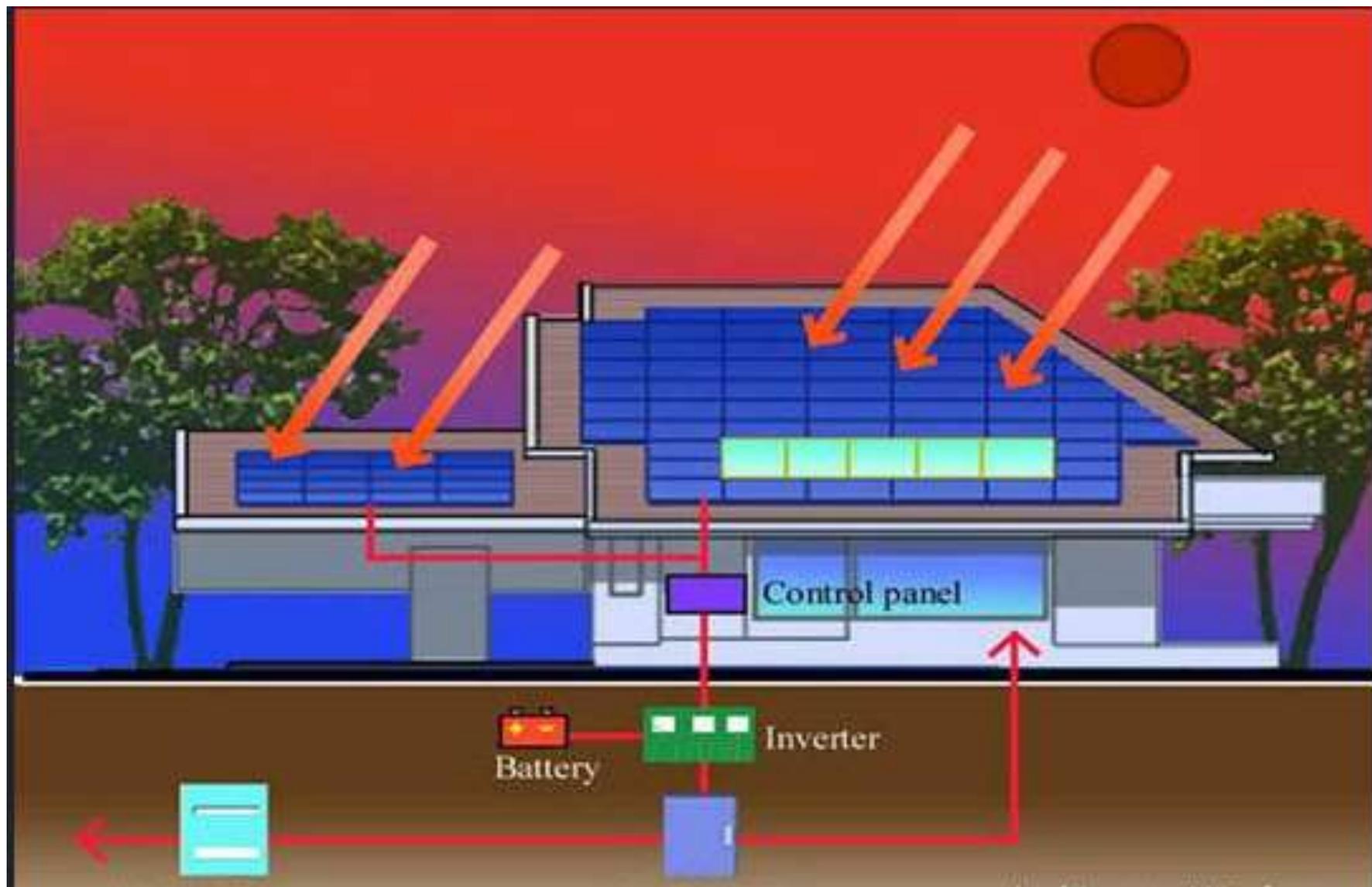
Bright Solar Limited



**KUSUM Scheme : How the KUSUM Scheme Hopes to Benefit Farmers?**

# Bio-Solar homes- Thailand

- Architect Soontorn Boonyatikam
- It needs no Municipal Services
- The Bio-solar home's energy is generated entirely through solar panelling.
- A sufficient water supply is maintained collectively via rain, dew and condensation from a cooling system which can also be recycled and used to replenish the garden
- Wastewater treatment is achieved by using natural process
- Garbage disposal is done by composting





# Low-Carbon city : Turpan



 CGTN



Turpan's low-carbon development practices pay off - CGTN

# Model town- Masdar

- Masdar City broke ground in 2008 to build a template, or "greenprint," for sustainable urban development and to promote an innovation hub in the emirate of Abu Dhabi.
- Today, the city is growing as a thriving community and a genuine innovation ecosystem that has already made great strides in connecting education, R&D, technology and business opportunity.
- The city is a living demonstration of the potential of clean energy deployment, clean-tech innovation, sustainable urban development, and human capital creation.
- There is a wealth of clean energy pilot projects around the development; for example, in solar energy, electricity storage, biofuels, district cooling, and sustainable architecture.



Spatial Narratives - Squarespace



Masdar City - Could be a Sustainable - (Green-Print) - Future ...

# Indian Cities



Aastha Twin City in Telco Colony ...



eGov Magazine - Elets Technomedia



**Chandigarh Moving Towards Resilient and People-Friendly Smart City**



 Around Pune



Lavasa - AroundPune

# The principal thrust area: To improve the Indian Economy

- To improve the Indian economy and at the same time reduce carbon emissions
  - At village level, stimulate growth by providing electricity through renewable along with more water and sanitation
  - At village level, provide energy and micro-finance services through community services centre
  - Promote afforestation and control deforestation
  - At urban level, augment electricity through feed-in from privately owned renewable energy sources

# Cooperative Services Centre (CSC)

- Business model to be developed for serving villages
- **CSC Provides**
  - Electricity from Renewable source operated by CSC
  - Biogas from a community based gohar gas plant operated by CSC
  - Oil extraction facility for biofuel cultivated by villagers and brought it for Oil extraction
  - Cold storage facility for farmers
  - Micro-finance for women activities
  - Solar PV operated School
  - Solar lamps, solar pumps, solar ATMs etc...,
  - Tele- Medicine facility

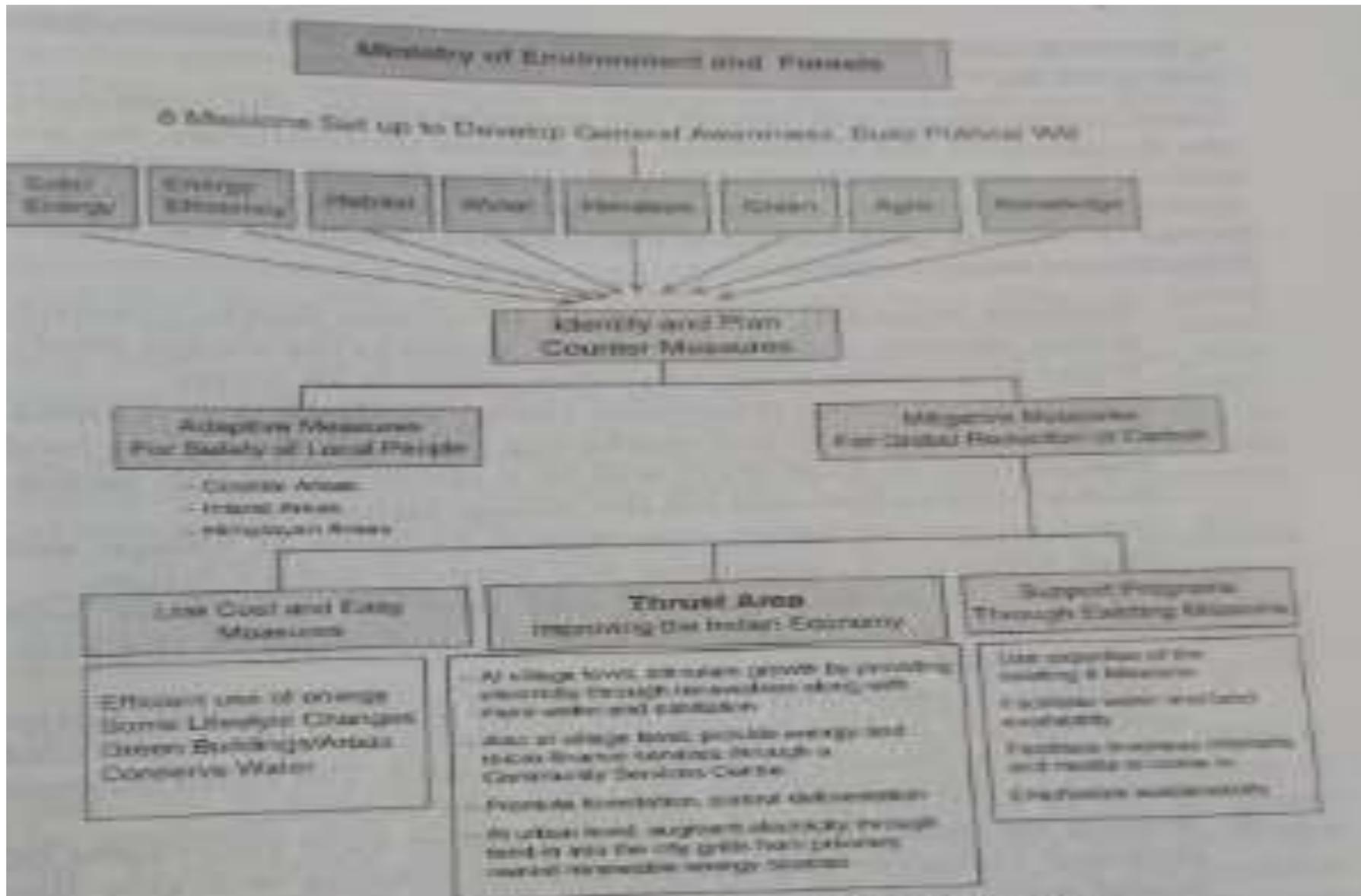


Figure B.3 Outline of proposed plan of action.



## STAY HOME. SAVE LIVES.

Help stop coronavirus

- 1 **STAY** home as much as you can
- 2 **KEEP** a safe distance
- 3 **WASH** hands often
- 4 **COVER** your cough
- 5 **SICK?** Call ahead

14



*THANK YOU*