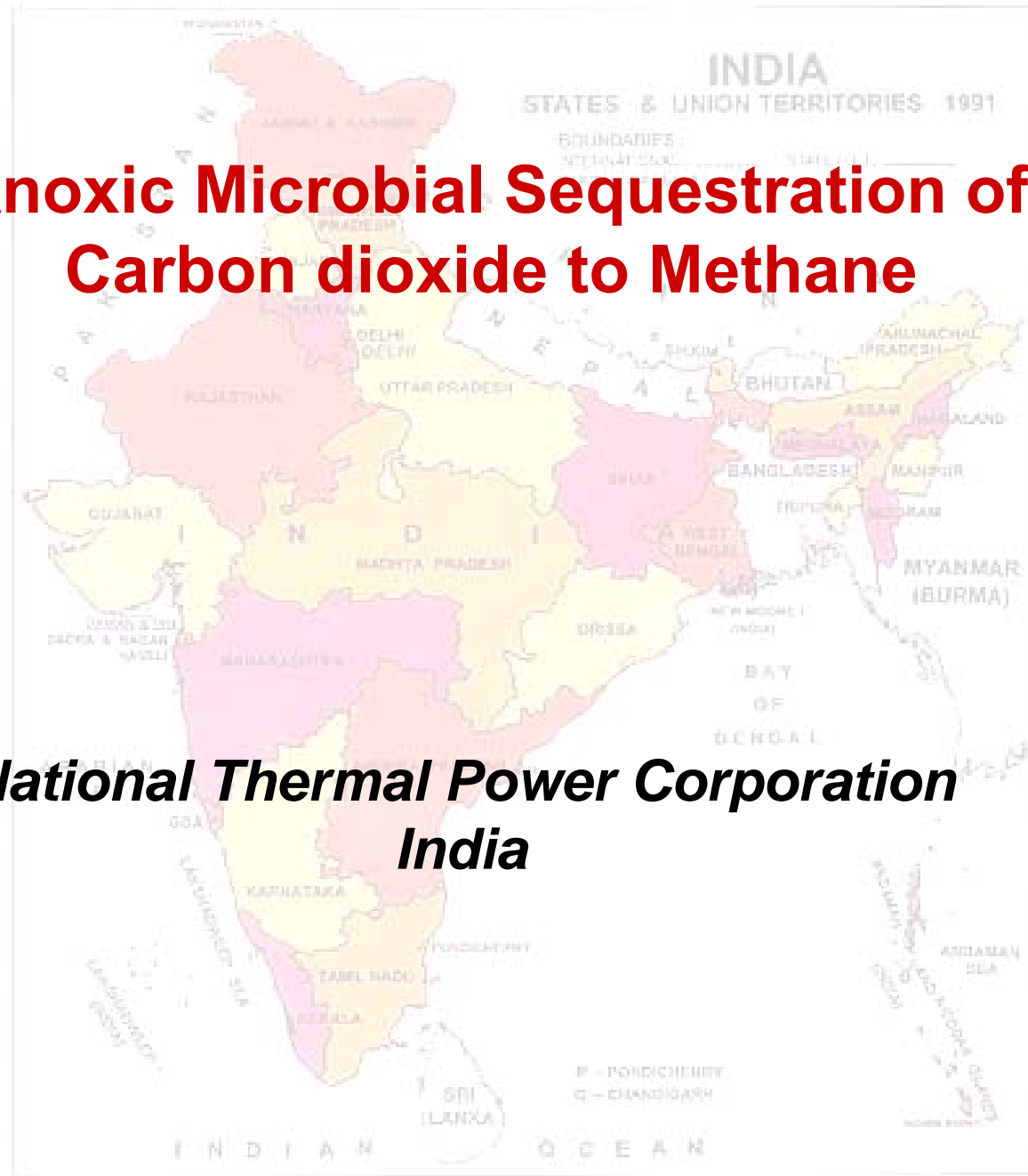


Anoxic Microbial Sequestration of Carbon dioxide to Methane

***National Thermal Power Corporation
India***



Bio-Chemical - A New Approach



- Conventional way on Carbon Sequestration - Energy Intensive
- Storage of CO₂ – Problematic
- Long term Environmental safety - Unknown

• Bio-Chemical intervention may provide break through

- CO₂- Energy paradox : Microbial conversion of CO₂ to Methane
- Carbonic Anhydrase accelerated CO₂ absorption
- Artificial photosynthesis

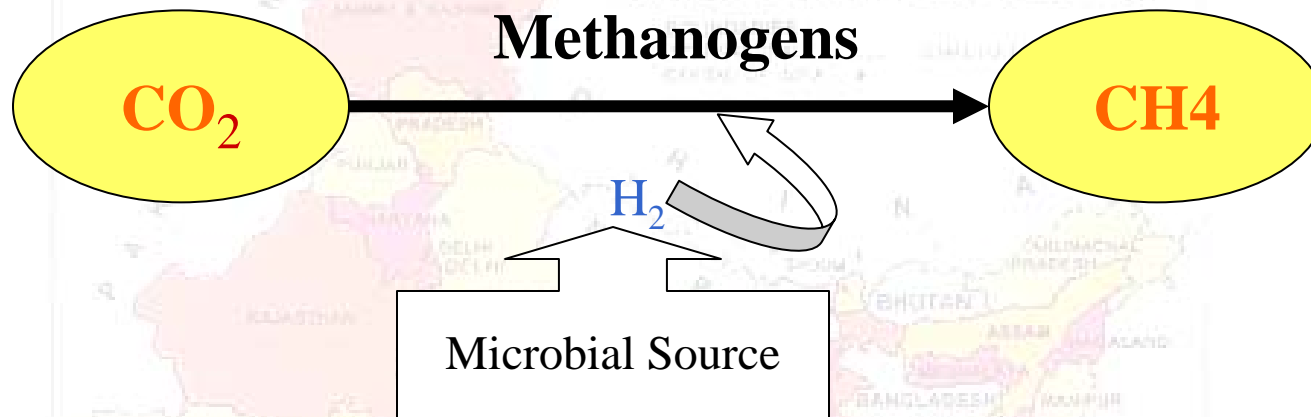
Bio-Chemical Process can provide Break through

Biological Carbon Capture-Basic Problem

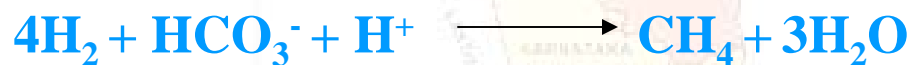
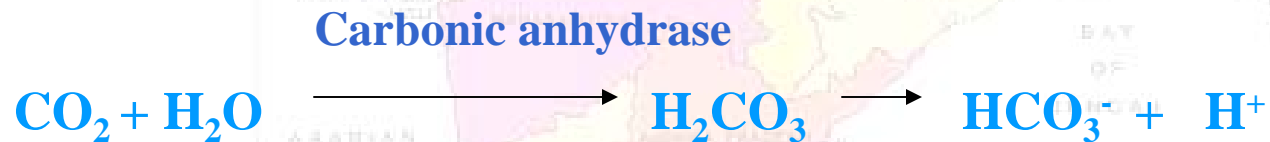
- Carbon fixation by photosynthesis using plants
 - Cannot be done in closed system
 - It requires huge space and time
- Culture of Blue green algae
 - Temp., SO_x, NO_x are limitations
 - Sunlight is required so huge space and time is required

A process / technology is required which can resolve technical, environmental and economical uncertainties

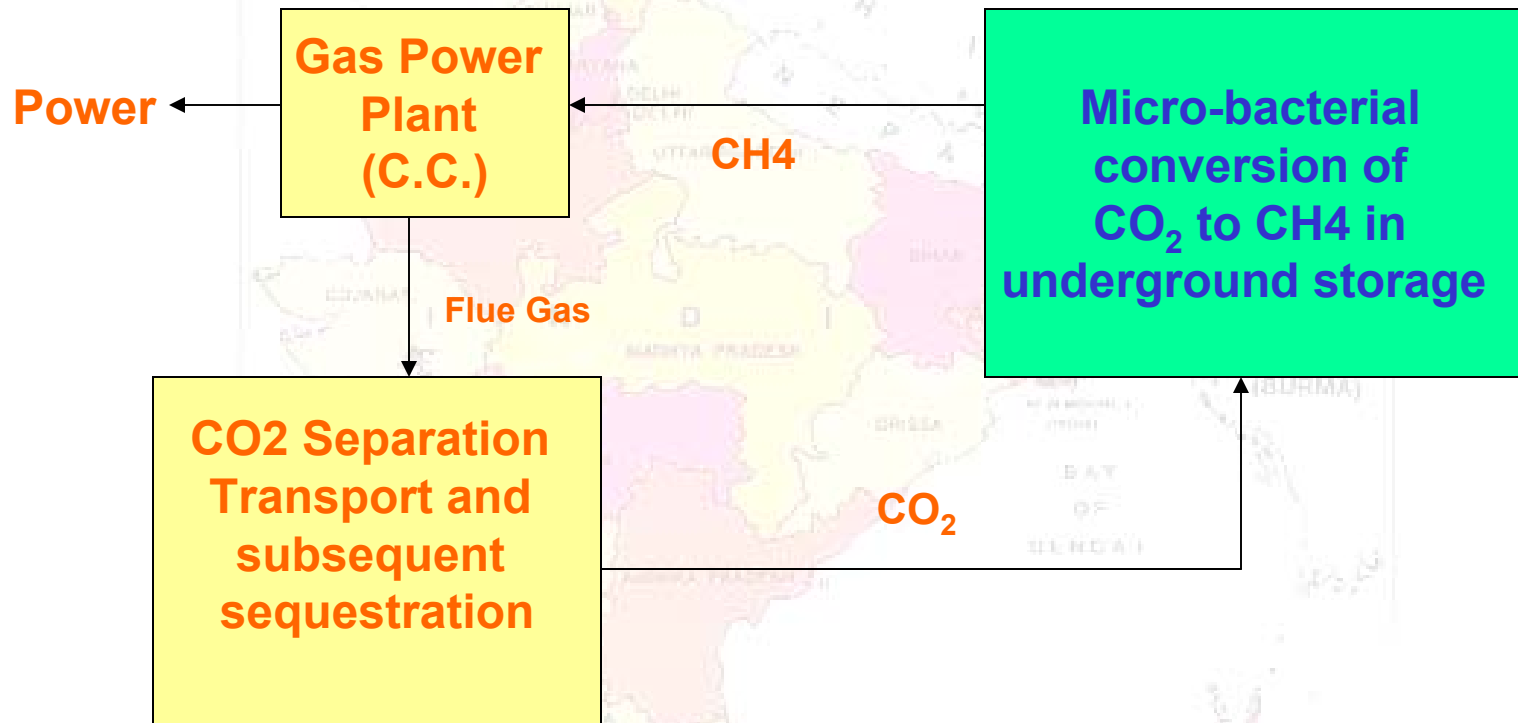
A novel process – Anaerobic capture of CO₂



The Basic Reaction



Conceptual flow diagram for micro-biological Methane-CO₂ cycle



Project Objectives & Significance

- Development of methanogenic bacterial system for sequestration of CO₂ to methane
- Methane gas thus produced may be used with the help of available technology to generate power electricity or as fuel for vehicles.
- The proposed process is biotechnologically sound, environment friendly and sustainable type

PARTICIPANTS

- NATIONAL THERMAL POWER CORPORATION INDIA
- DEPARTMENT OF SCIENCE & TECHNOLOGY INDIA -AGHARKAR RESEARCH INSTITUTE
- *SCOUTING FOR INTERNATIONAL PARTNER*

METHODOLOGY

- Work to be carried out on sequestration of CO₂ by autotrophic methanogens.
- Removal of SO_x and NO_x from the flue gas.
- Consortia development & screening/selection of methanogen
- Development of 1 Litre bioreactor
- Development of 5 litre bioreactor & Optimization
- Improvement of performance by addition of other anaerobic bacteria

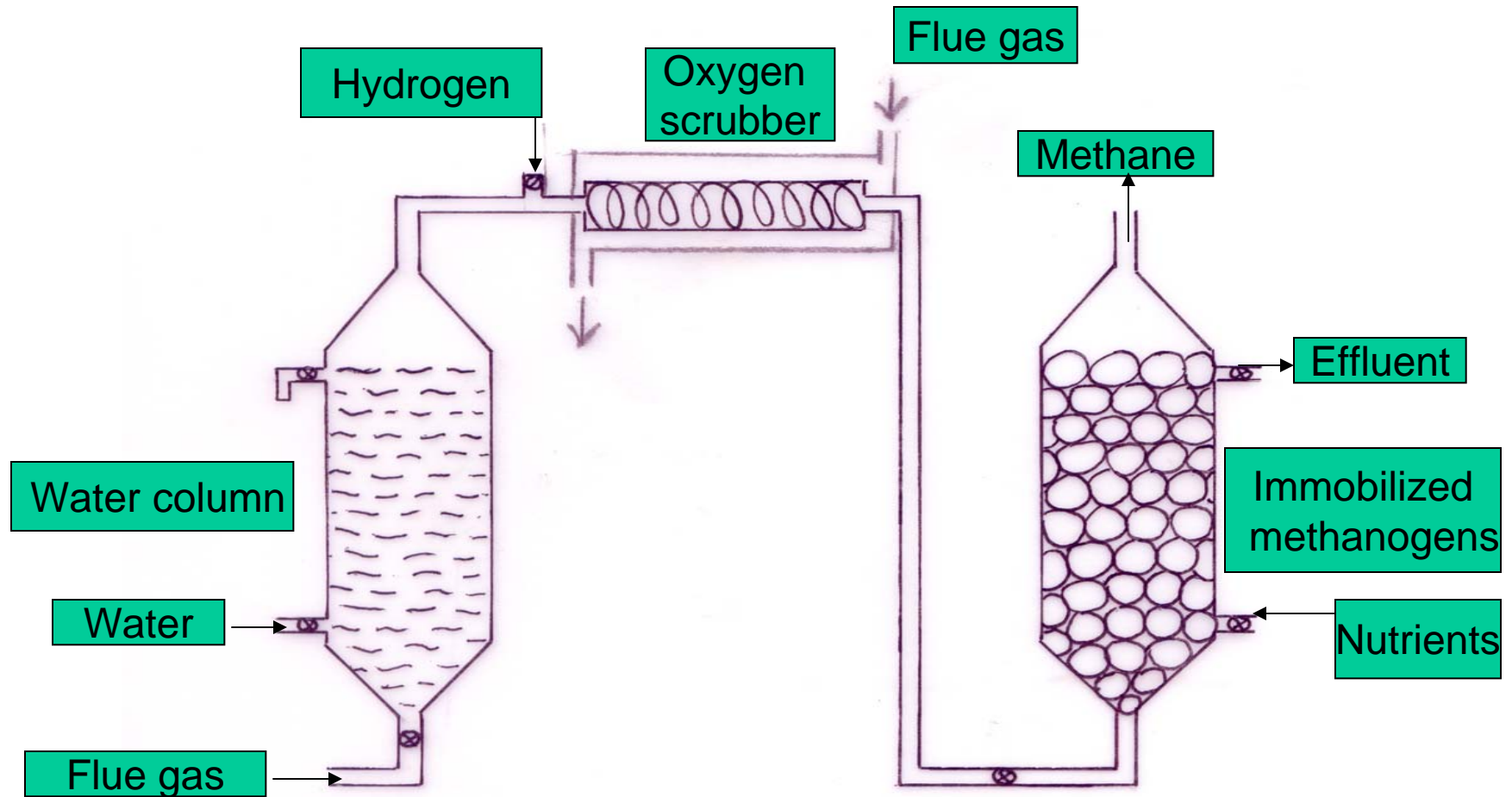
Basic Characteristics of Methanogens

- Anaerobic archaea,
- Grow on limited carbon sources (CO₂, acetate, methanol, methylamines),
- Simple nitrogen source
- Found in anoxic environments,
- Produce methane,
- Unique enzymes, co-enzymes
- Wide temp range for growth

Operation Regime of Hydrogenotrophic Methanogens

Organism	Optimum Temperature °C	Optimum pH
Methanobacterium	30 to 40 , 50 to 70,	6.8 to 8.0
Methanobrevibacter	30 to 40	5.5 to 8.0
Methanococcus	25 to 40	
Methanocaldococcus jannaschii	70	6.3
Methanothermus sociabilis	80	6.5
Methanopyrus kandleri	95	6.0

Schematic presentation of the Bioreactor for sequestration of carbon dioxide to methane



Removal of fly ash, SO_x, NO_x and cooling of gas

FORMULATION OF PROJECT

- **Prototype studies employing biotechnological process to be finished by 2010.**
- **Discussion held with several agencies for partnership**
- **Looking for International partner for pilot plant study**

THANK
YOU