International Partnership on Hydrogen Economy (IPHE)

Steering Committee Meeting
Kyoto, Japan
(14-15 September, 2005)

Presentation on
Indian National Hydrogen Energy Programme

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Transition to Hydrogen

- **Present Scene :**
  Petrol /Diesel /CNG based automobiles & Power Generation
- **Intermediate Stage :**
  Bio-Fuel / Synthetic Fuel based Vehicles, Electric & Hybrid Vehicles & Power Generation
- **Ultimate Objective :**
  Environment Friendly and Carbon Free Hydrogen Based Vehicles & Power Generation

HYDROGEN ENERGY ACTIVITIES IN INDIA

Importance of Hydrogen in India

- Hydrogen has significant potential as a clean energy source for broad range of applications including power production and transportation.
- Large areas in the country do not have access to electricity which can be provided de-centralised power based on hydrogen energy.
- Hydrogen and fuel cells vehicles can progressively replace petroleum based vehicles specifically two & three wheelers.
- Hydrogen energy for energy security and environmental protection.

ACTIVITIES TAKEN UP SINCE THE FIRST MEETING OF IPHE IN NOVEMBER, 2003

- Setting up of National Hydrogen Energy Board (NHEB) in October,2003
- Fist Meeting of NHEB on 23rd February, 2004
- First Meeting of Steering Group on 21st April, 2004
- Report of the Group on Hydrogen Energy prepared by the National Planning Commission in May, 2004
- Participation in the 15TH World Hydrogen Energy Conference in Yokohama in Japan in June, 2004.
- National Conference on Fuel Cells in August, 2004

ACTIVITIES TAKEN UP SINCE THE FIRST MEETING OF IPHE IN NOVEMBER, 2003

- National Conference on Hydrogen Energy in August, 2004.
- Second Meeting of NHEB on 15th September, 2004
- Second Meeting of the Steering Group on 6th December, 2004.
- Third Meeting of the Steering Group on 7th July, 2005.
- Draft National Hydrogen Energy Road Map under preparation.
- Co-ordination with Industry Associations including ASSOCHAM, CII, FICCI
- Periodic Review Meetings of R&D Projects

National Hydrogen Energy Board

- NHEB Constituted in October,2003 with Hon'ble Minister (Non-Conventional energy sources) as Chairman
- NHEB has high level representation from other Ministries, Departments, Industry, Industry Associations and Academia
- NHEB to Direct and Guide in preparation of the National Hydrogen Energy Road Map

Draft Indian National Hydrogen Energy Road Map

- Provides long term solution to meet growing energy needs of India while ensuring energy security
- Identifies paths for gradual introduction of hydrogen energy in the country
- Accelerate commercialization efforts
- Facilitate creation of hydrogen energy infrastructure
- Total systems approach for developing hydrogen energy technologies

Draft Indian National Hydrogen Energy Road Map

- Based on Public-Private Partnership
- Roadmap is a Industry driven Planning Process
- Guided by Government, with support from Research Organizations, Academia, NGOs and other stake holders
- Development of sustainable and cost effective Hydrogen Energy technologies & infrastructure
- Issues relating to Production, Storage, Delivery / Transport, Applications, Safety and Awareness, capacity building to be addressed

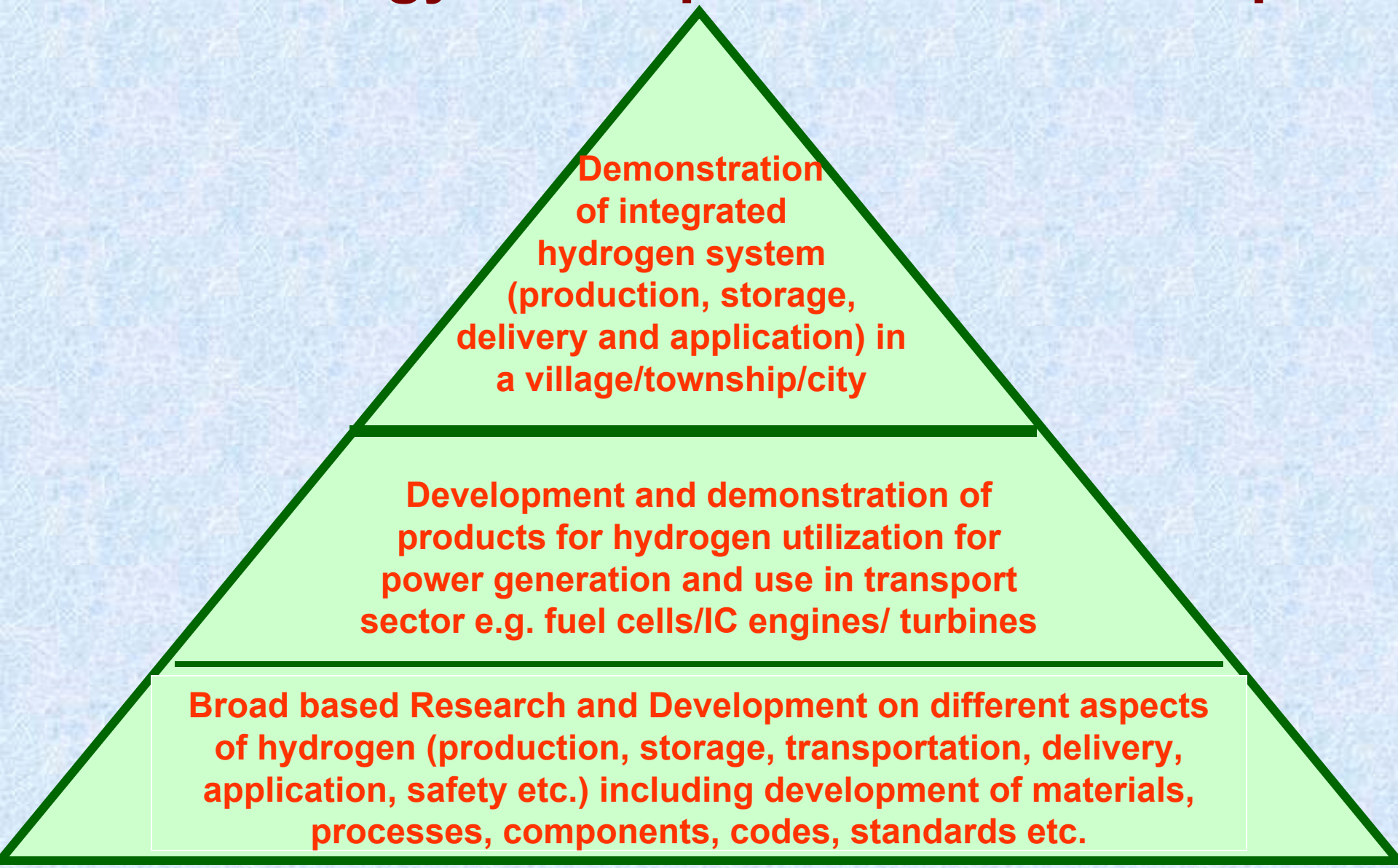
Transition to Hydrogen Energy – India Vision

- **Roadmap for Hydrogen Energy**
- **Two New Initiatives to be achieved by 2020**
  - Green Initiative for Future Transport (GIFT)
  - Green Initiative for Power Generation (GIP)

Strategies

- R&D through Public – Private - Partnership
- Demonstration through Public Private Partnership
- Safety, Standards and Codes
- Awareness and Capacity Building

Technology Development : 3 Tier set-up



Status of Major Technologies and Gaps

Technology	International Status	National Status
Coal Gasification (IGCC)	Commercially available	Efforts underway to set up pilot plant
Biological route for Hydrogen Production	In Pre-Commercial stage	Demonstration Plant set up
Metal Hydrides for Hydrogen storage	Hydrides with 1.5 - 2.0wt% storage capacity for ambient conditions developed	Hydrides with 2.42wt% storage capacity for ambient conditions developed

Status of Major Technologies

Technology	International Status	National Status
Carbon Nano-structures for Hydrogen Storage	In R&D Stage	In R&D Stage, Further R&D efforts required
IC Engine for Hydrogen	Not commercially available	Dedicated engine to be developed
PEM Fuel Cells for Stationary applications and automobiles	Commercially available	Prototype Demonstrated, PEMFC of international specifications and suitable for automobiles yet to be developed
Solid Oxide Fuel Cells	In R & D Demonstration Stage	In early stages of R & D, needs to be developed

Technology Development

Proposed Mission Mode Projects

- Clean Coal Gasification Technologies for Hydrogen Production
- Hydrogen Production through Biological Routes
- Hydrogen Production through Solar Energy (electrolysis, photolytic, photo-electrochemical and thermal splitting)
- Hydrogen Storage in Hydrides
- Hydrogen Storage in Carbon Nanostructures
- Development of IC Engine for Hydrogen fuel
- Development of PEM and SOFC Fuel Cell Technologies

Hydrogen Powered Motorcycle

Hydrogen Powered Motorcycle

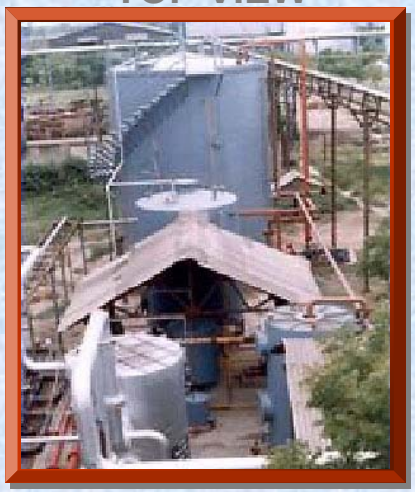
Hydrogen Three Wheeler

Fuel Cell-Battery Hybrid Vehicle

Fuel Cell based 3 kW UPS

Bio Hydrogen Plant

TOP VIEW

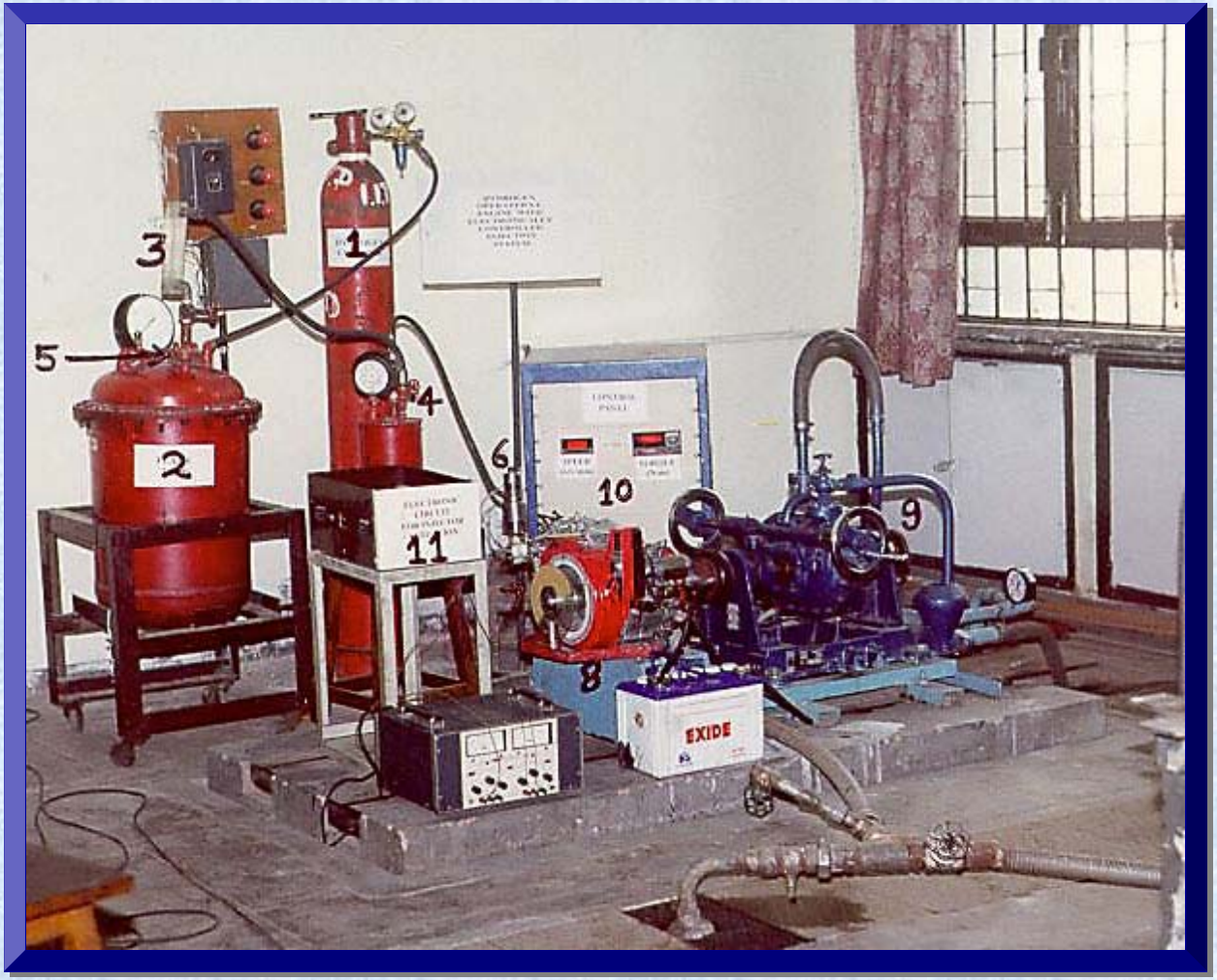


SIDE VIEW

FRONT VIEW

REACTORS

Hydrogen Power Generating System (10 KW)



Hydrogen Fuelled Home Cooker


Thank You