

# Hydrogen Futures And Technologies

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Rohsenow Symposium on Future Trends In Heat Transfer  
Massachusetts Institute of Technology  
Cambridge, Massachusetts  
May 17, 2003

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# Why the Hydrogen Economy?

*National Security*

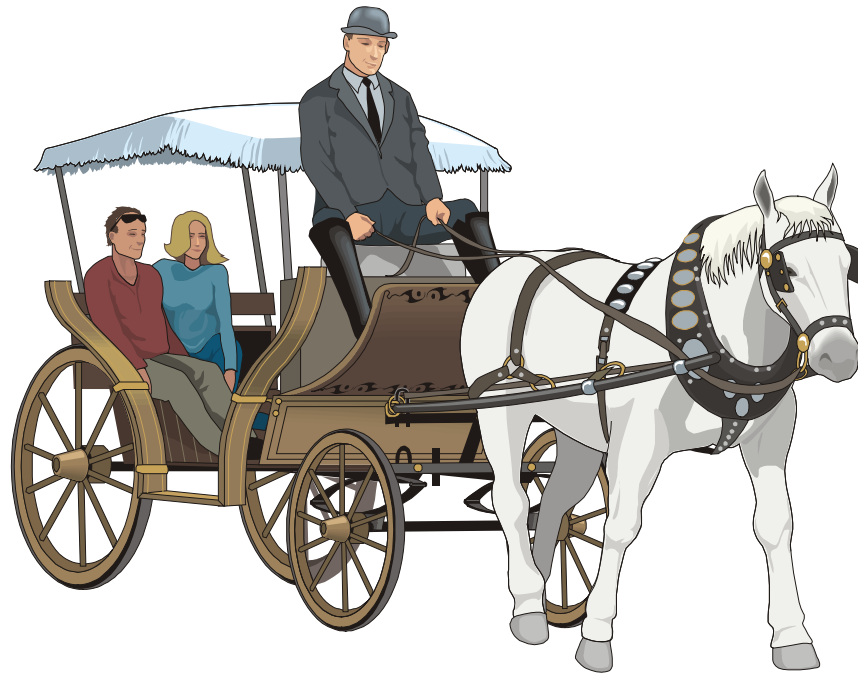


Imported Oil

*Protect the Environment*

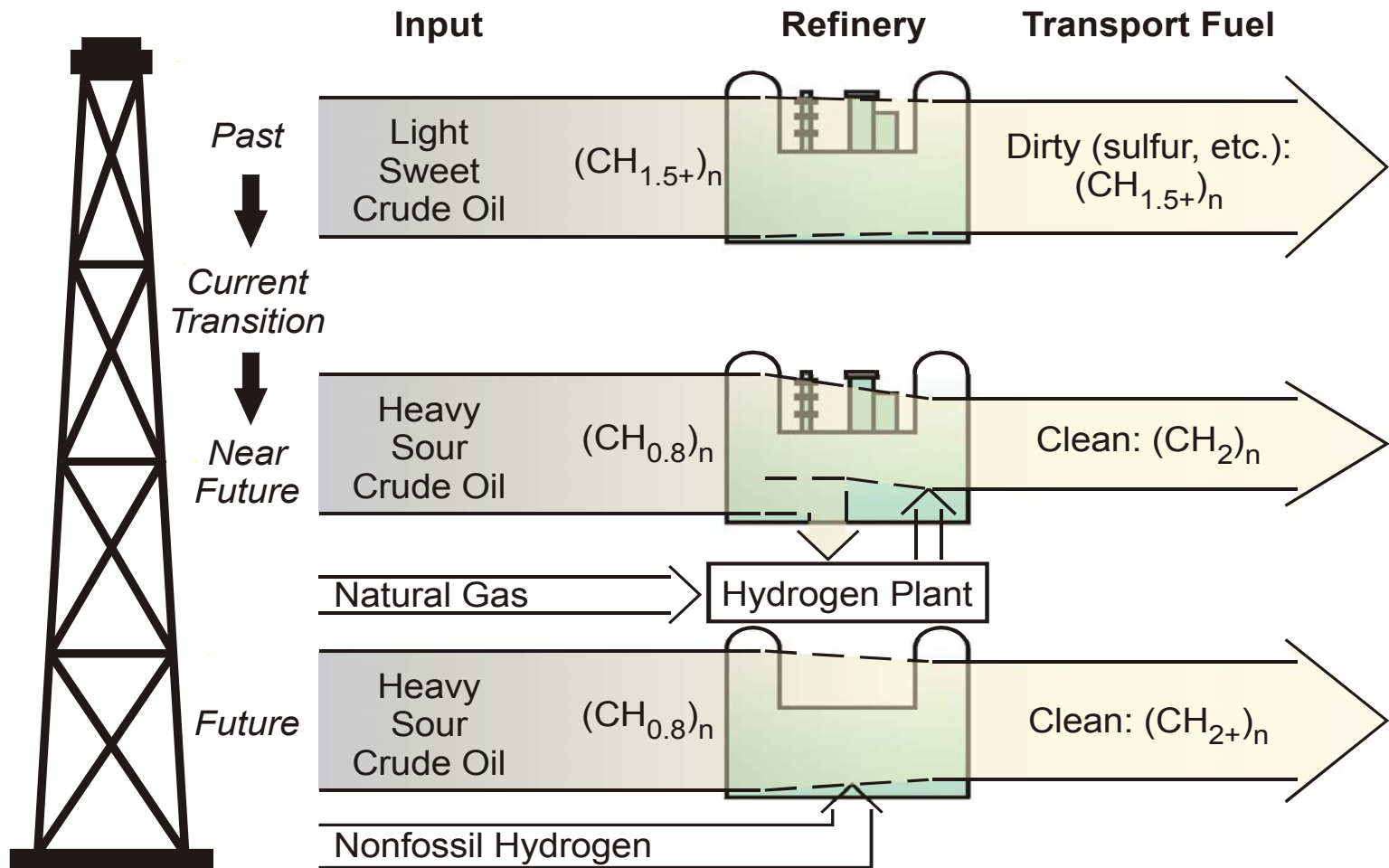


# Large Scale Hydrogen Production Is an Old Business: Town Gas

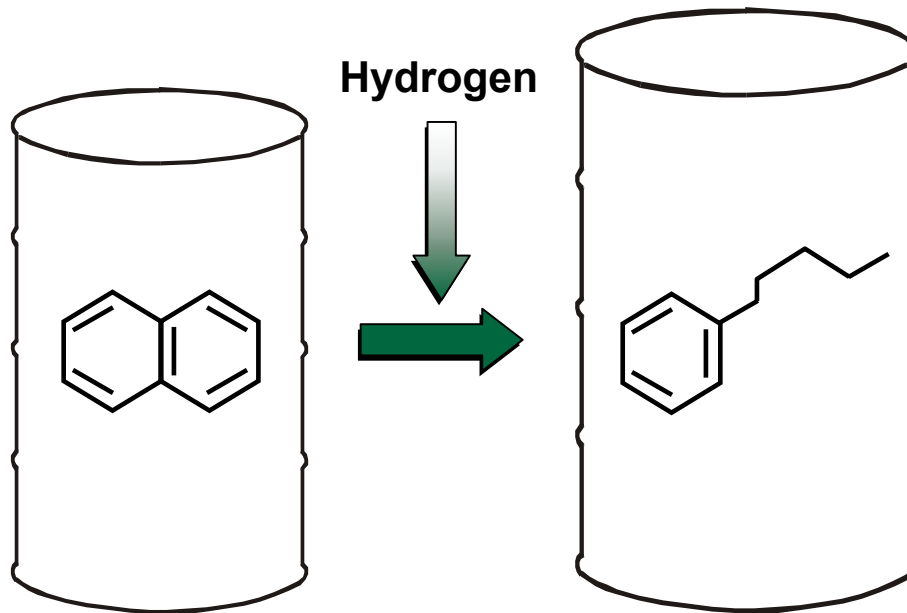


# Liquid Fuels Production Is Rapidly Becoming the Major Market for Hydrogen

(Worldwide All Uses: 50 Million Tons/Year)



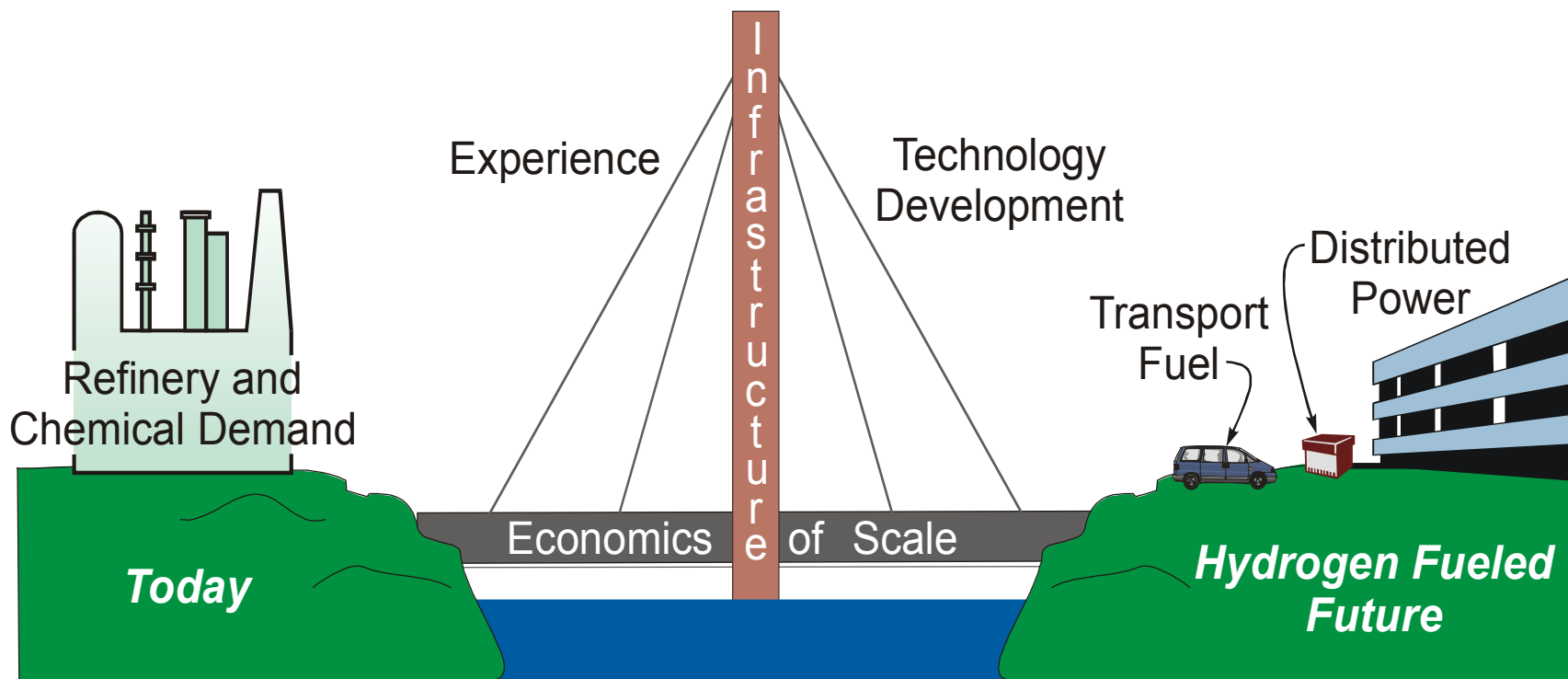
# Addition of Hydrogen Can Increase Liquid Fuel Yields per Barrel of Oil by Up to 15% (Transition to the Hydrogen Economy)



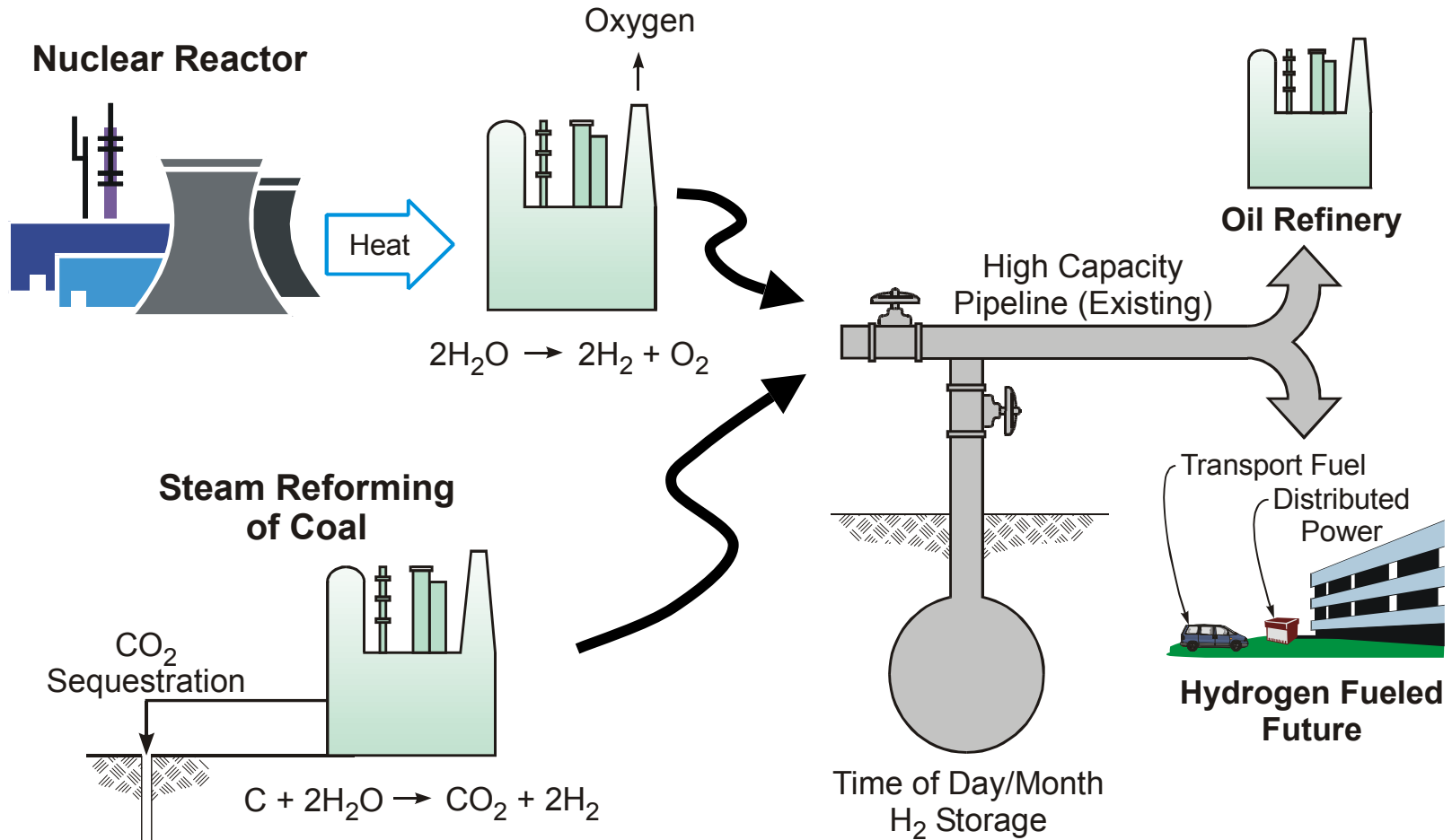
## Benefits

- Lower imports
- Reduced CO<sub>2</sub>
- Reduced NO<sub>x</sub>
- Reduced sulfur
- Reduced diesel particulate

# The Growing Hydrogen Demand Creates a Bridge to the Hydrogen Economy—With a Future Hydrogen Energy Demand That May Exceed That for Electricity

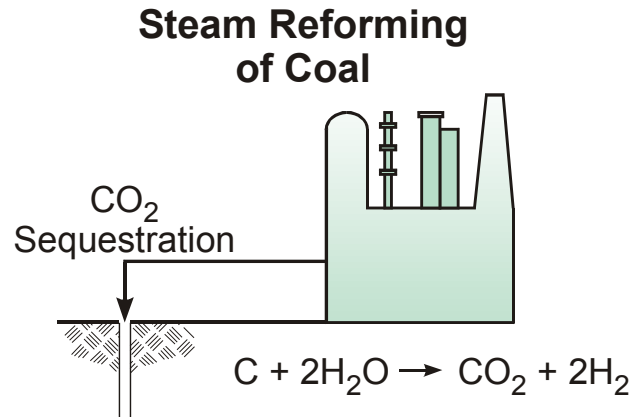
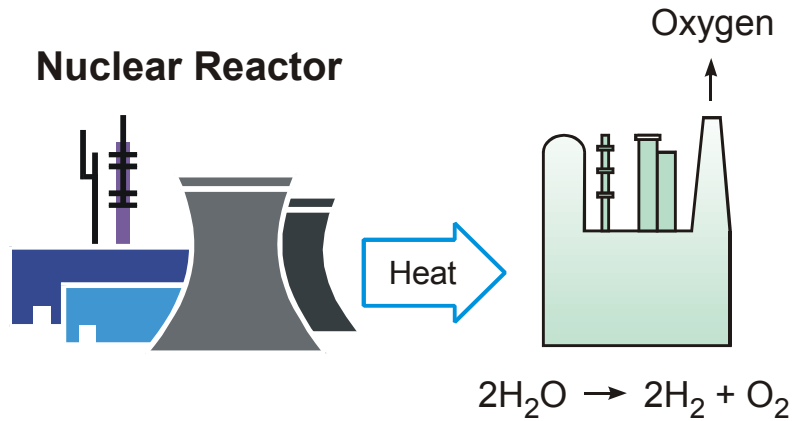


# The Hydrogen Economy

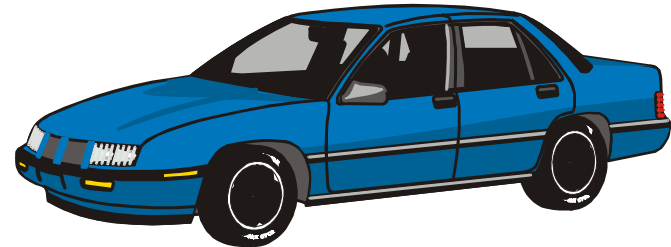


# The Big Barriers to the Hydrogen Economy

## Hydrogen Production



## Vehicle On-Board Hydrogen Storage



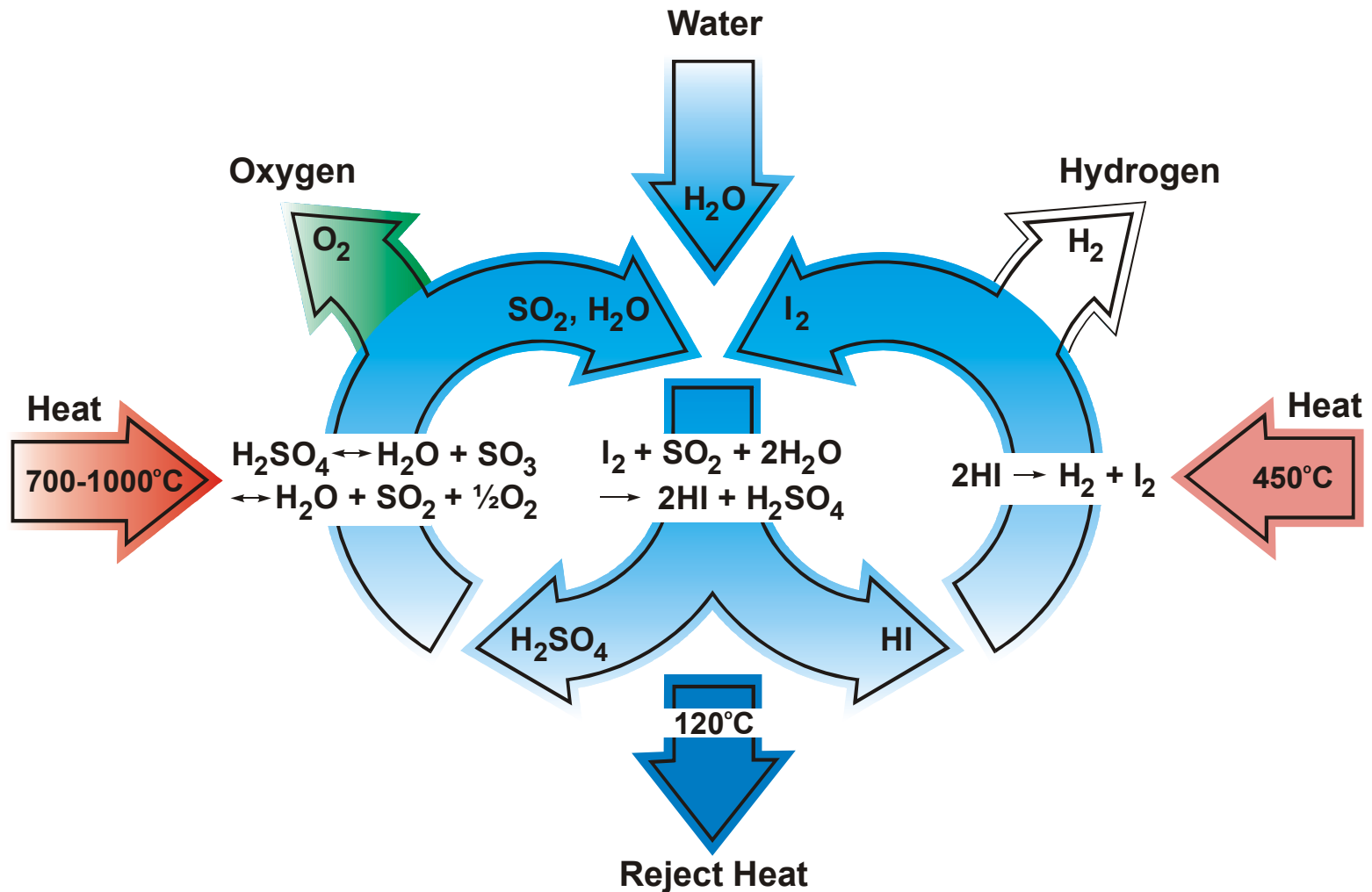


# Heat Transfer Challenges

## Hydrogen Production

**Example: Nuclear Energy**

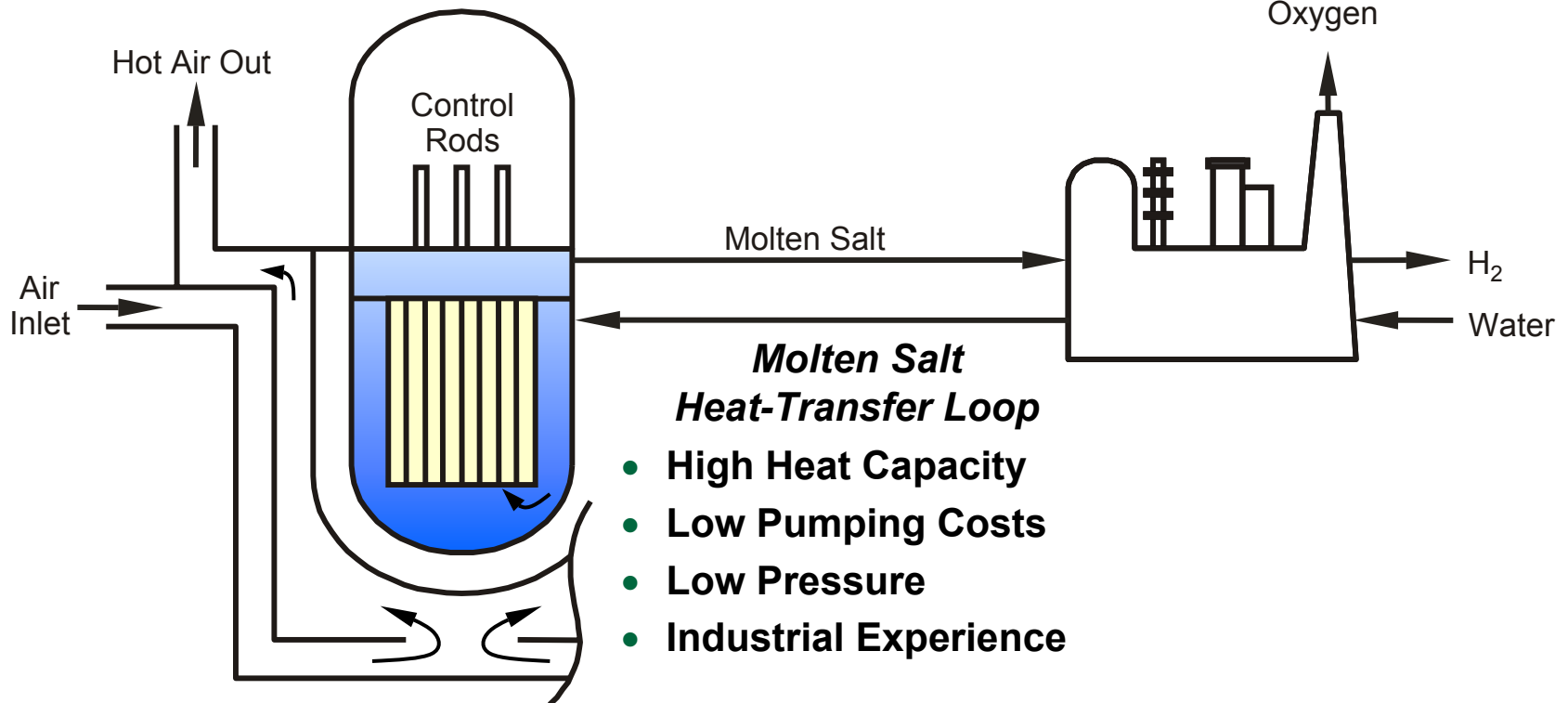
# Sulfur Iodine Process For Hydrogen Production



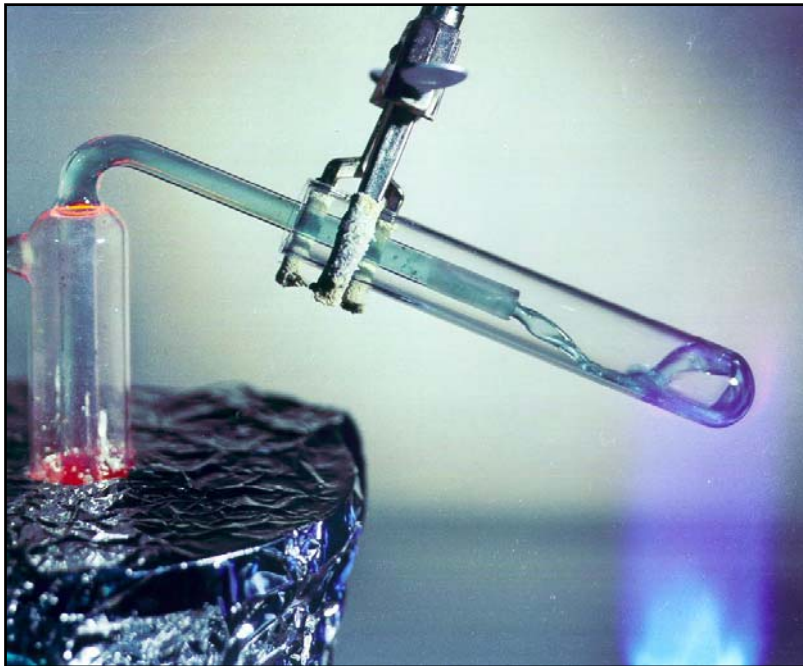
# The Reactor and Hydrogen Production Facility Will Be Physically Separated to Ensure Safety

## *Nuclear Safety by Isolation*

## *Hydrogen Safety by Dilution*



# Challenges in High-Temperature Molten Salt Heat Transfer



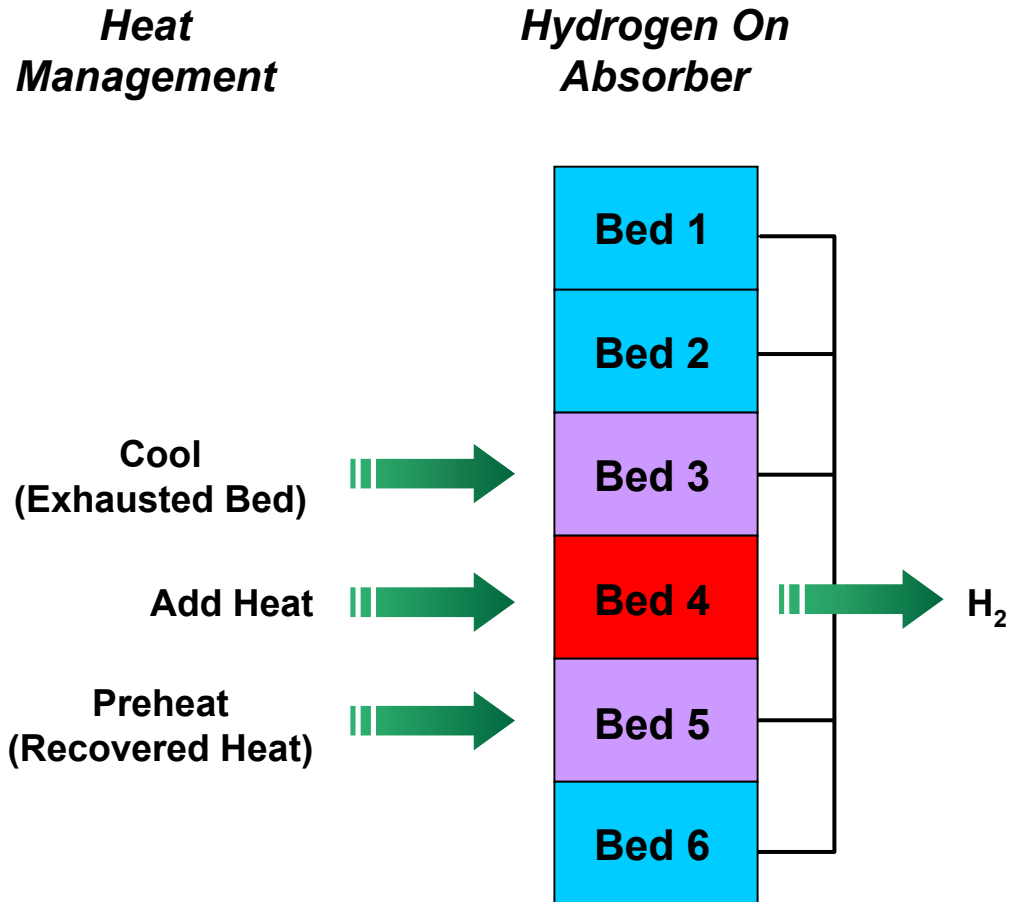
- Temperatures 750 to 1000°C
- Radiation Heat Transfer Important
- Can control transparency
- How should system be designed to maximize capabilities?

# Heat Transfer Challenges

## Vehicle On-Board Hydrogen Storage

### Example: Hydrogen Absorbers

# Hydrogen Storage Heat-Transfer Challenges in Vehicles



# Conclusions

- **Hydrogen economy**
  - **Great Benefits**
  - **Great Challenges**
- **Key Challenges**
  - **Low-cost environmentally acceptable hydrogen production**
  - **Vehicle on-board hydrogen storage**
- **Major heat transfer challenges**