

# Climate Change Health Problems & Healthy Solutions



**The Institute of Medicine**  
**11 September 2007**



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HARVARD MEDICAL SCHOOL



# LIFE CYCLE ANALYSIS

## OIL

Exploration

Extraction

Transport Crude

Refining

Transport Refined

Spills  
&  
Leaks



Harm

Marine

Mammals

Shore birds



Benzene

MERCURY



Fisheries

Consumers

Livelihoods

Petrochemicals

Combustion

Air Pollution

Acid Rain

Climate Change

Eutrophication

NO<sub>x</sub>s

Warming Oceans

Coral Reefs

SLR Heatwaves

EWEs Spread of EIDs

Melting Polar Ice



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# LIFE CYCLE ANALYSIS

## COAL

### Mining

#### Underground

Silicosis

Injuries

Mortality

US: 50/y past 3 yrs

#### Mountaintop Removal

Clear cutting – CO<sub>2</sub> Sink

Appalachia, Montana,  
Colombia, China

valleys & streams

1000 miles buried

### Combustion

NO<sub>x</sub>s & SO<sub>x</sub>s

O<sub>3</sub> & Brown haze



HABs



Particulates

Mercury

CO and CO<sub>2</sub>



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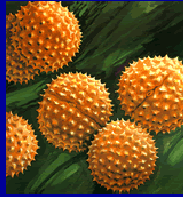
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# CO<sub>2</sub> Terrestrial uptake



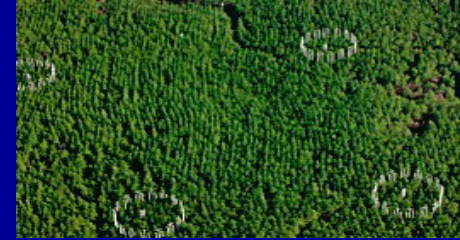
Poison Ivy

↑  
Urushiol



Ragweed

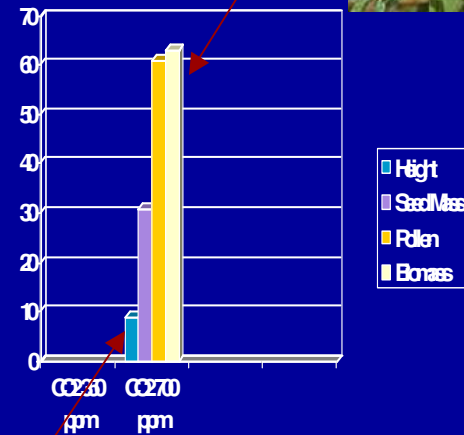
# Loblolly Pines



Agricultural weeds



# Pollen



Stalks

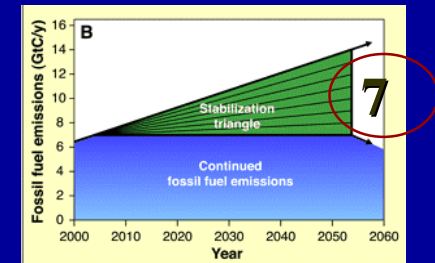
Fungal  
Spores



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# Stabilization Wedges



## *Energy Efficiency & Conservation*

1. Public transport; plug-in hybrids
2. 'Smart grid' –distribution, storage, use
3. Green buildings
4. Conservation

## *Renewables*

5. Wind
6. PV/Solar thermal
7. Geothermal
8. Biofuels

## *Natural Sinks*

9. Forest mgmt/nurturing
10. Conservation tillage

## *Fossil Fuel-based*

11. Switch from Coal to Nat. Gas
12. C Capture & Storage (CCS)
13. H<sub>2</sub> Fuel Cells
14. Coal-to-Liquid w/ CCS
15. Nuclear fission

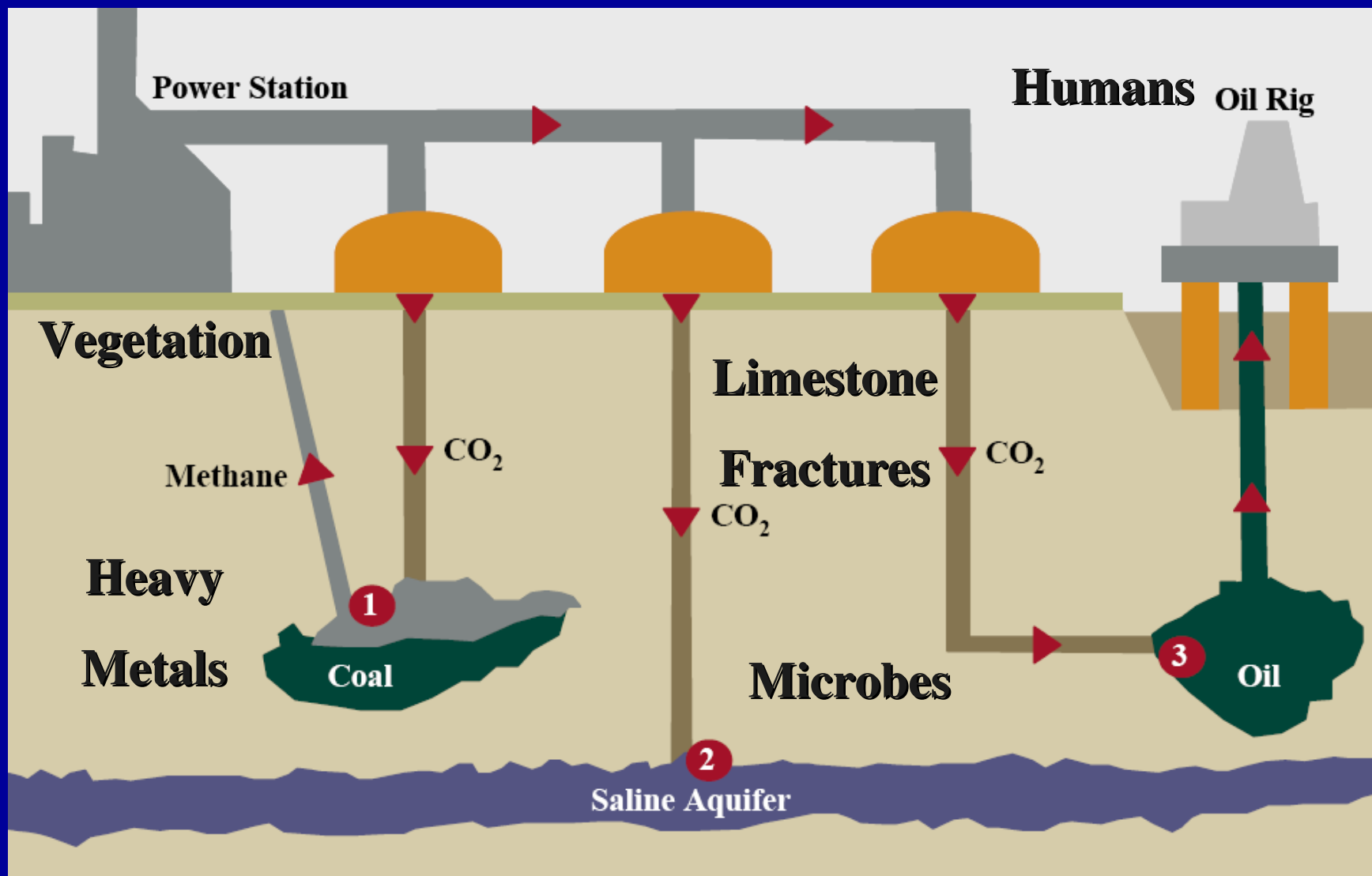


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No regrets

Study needed

# Carbon Capture and Sequestration



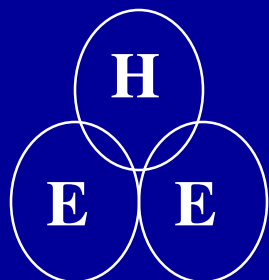
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*World Coal Institute*

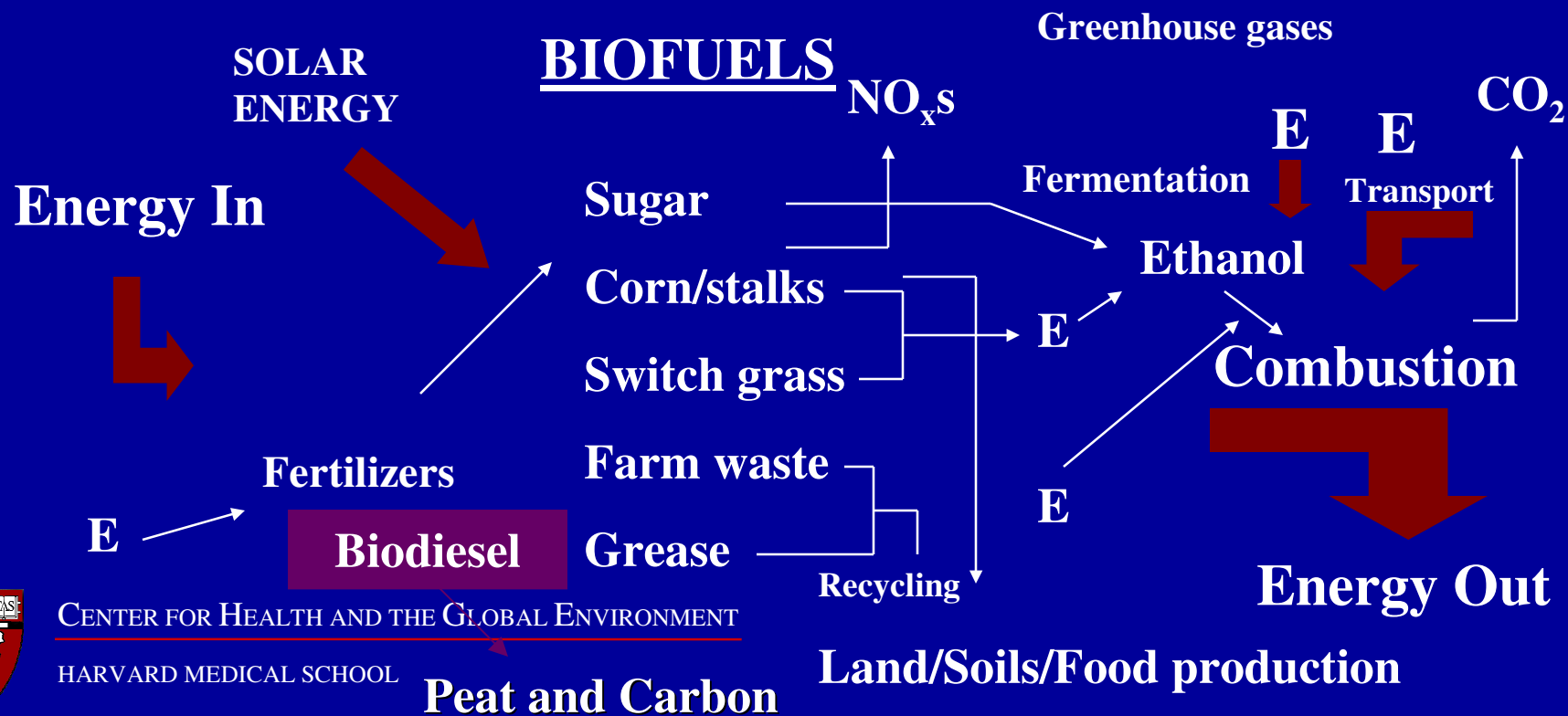
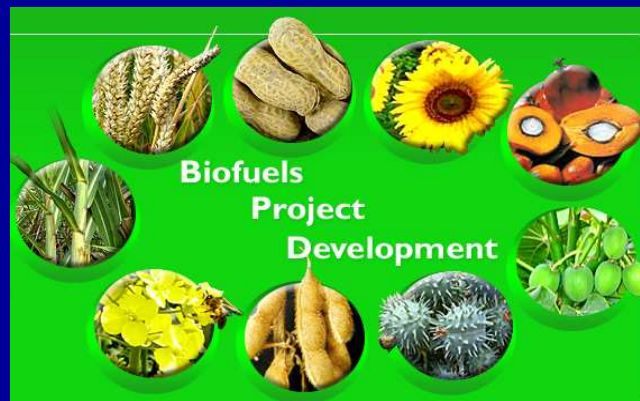
# BIOFUELS

## EIO-LCA



Energy In and Out

← Life Cycle Analysis



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# Health and “The Yellow Cake Road”

- **Mining**                      worker safety
- **Milling**                     worker and community exposure
- **Transport**                 safety, security
- **Processing**                worker and community exposure
- **Energy plants**            ground water contamination, accidents, cooling water and heat waves
- **Temporary Storage**
  - US                      "low level" waste, e.g., Savannah River  
worker and community exposure
  - Europe                plutonium reprocessed and stored  
worker and community exposure
- **Long-term Storage unsolved**
  - **One ‘Yucca Mountain’ q5-10 years**

• **Security: thefts and attacks**



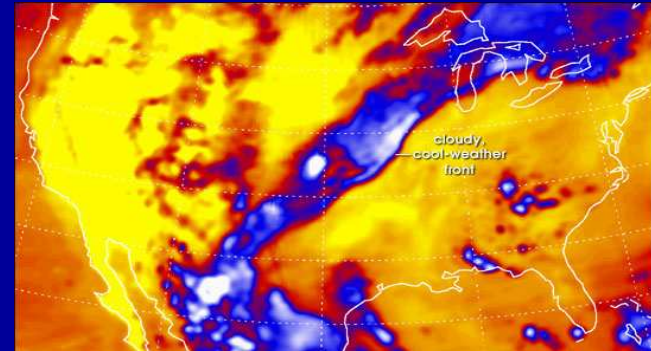
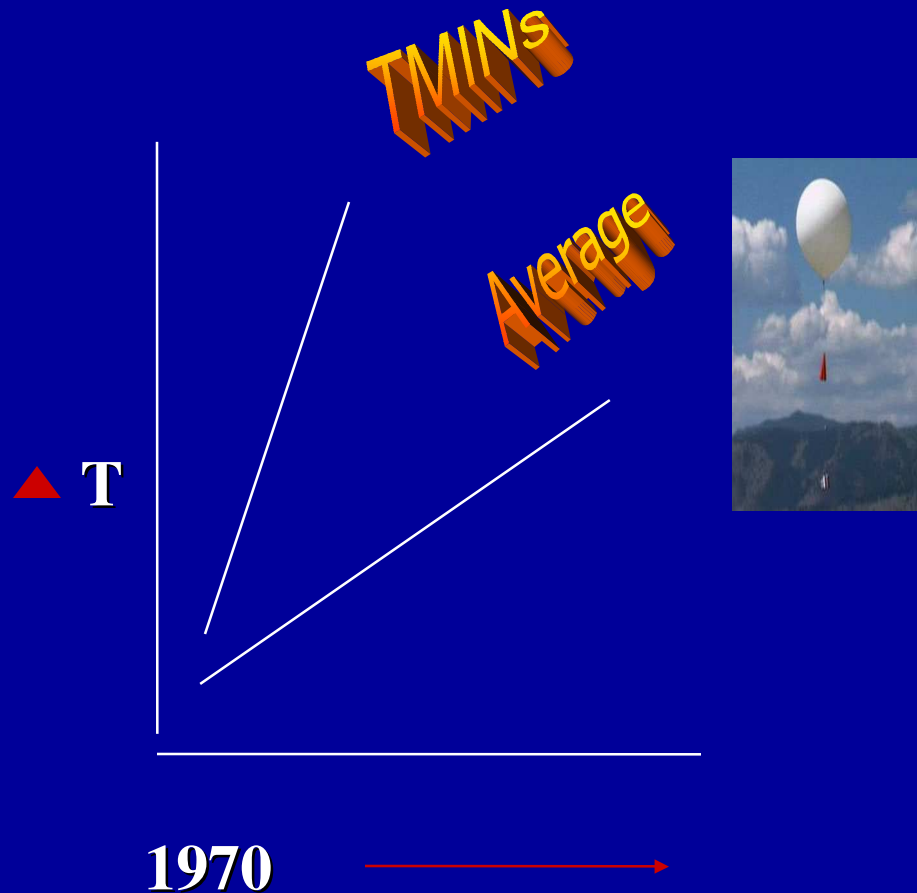
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## HW Scenario

# Nighttime & Winter Temps



## Heatwaves and Climate Change

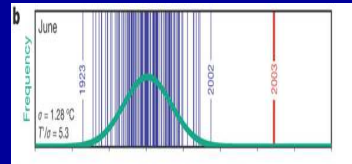
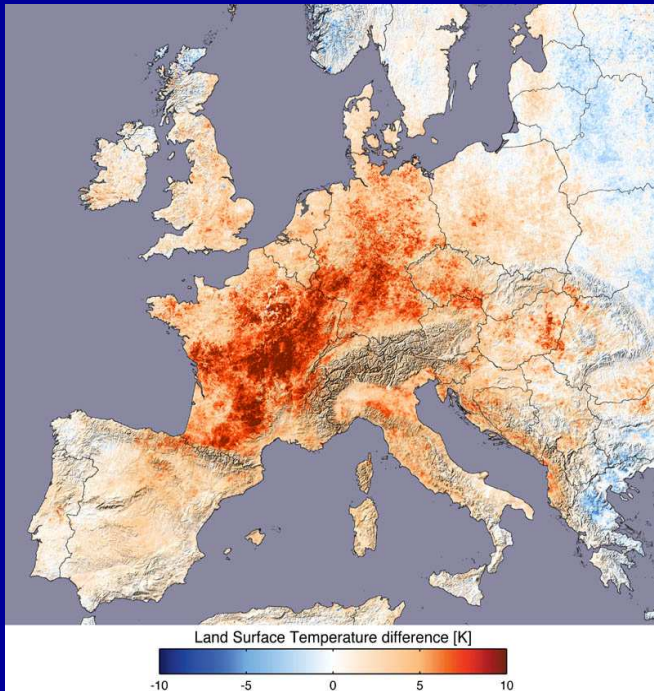
1. Probability
2. Frequency
3. Intensity
4. Duration
5. Breadth
6. Heat indices
7. TMINs



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# European Heatwave: Summer 2003



Temp 11°F >30yr average  
6 std. dev. from the mean



- Deaths: 21-35,000
- Crops & livestock:  
US\$12.3 billion
- Wildfires:  
1.2 million acres
- Nuclear plant shutdowns
- Hydropower reduced
- Alpine glaciers: 10% lost

-Schar *Nature* 2004



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## HW Scenario

# Sector impacts

- Public health
- Municipal services
- Water
- Farms
- Forests
- Fisheries
- Energy
- Business interruptions
- Information system
- Financial markets
- Birth rates
- Social cohesion



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# HW Scenario **Reactive Adaptation**

- **Back-up generators**

- Fuel cells



- **A/C**

- Malls

- Movie theaters

- **Surge capacity**

- Hotels

- **Transport**



- **Priority populations**

- Old age and nursing homes

- Psychiatric hospitals

- Infants

- **Critical functions**

- **Treatment facilities**

- **Social networks**

- **Response teams**



» **Coordination**



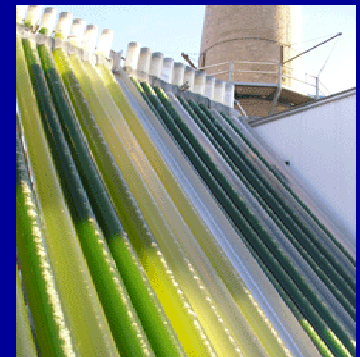
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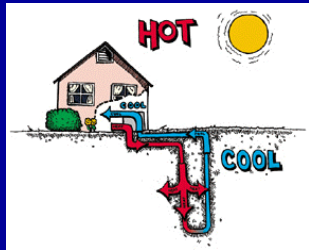
HW Scenario

Prevention

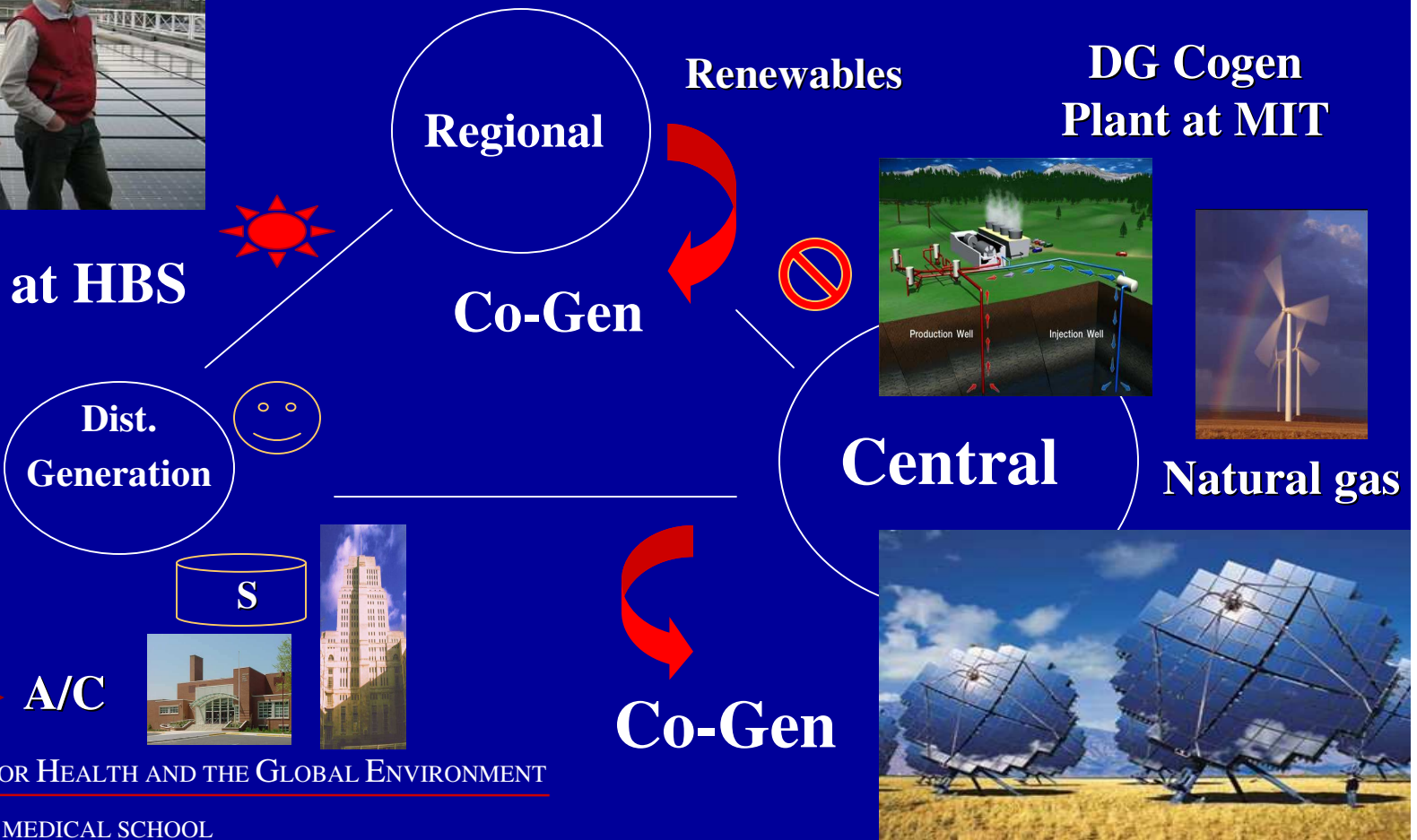
'Smart, Self-Healing Grid'



Solar roof at HBS

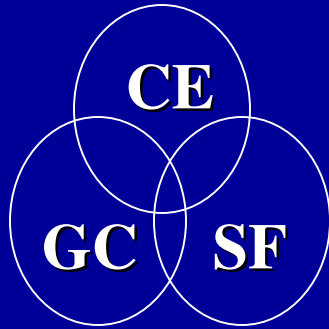


Geothermal → A/C



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# Green Buildings



## Estimated Savings

**Respiratory disease: \$6 to \$14 billion**

**Allergies and asthma: \$1 to \$4 billion**

**Sick building syndrome: \$10 to \$30 billion**

**Worker performance: \$20 to \$160 billion**

## Studies

Lawrence Berkeley National Lab

### Schools with natural light

**20% faster on math tests**

**26% faster on reading tests**



**Stores with natural light: 40% more sales**

**Hospitals with better lighting & ventilation:  
improved patient outcomes**



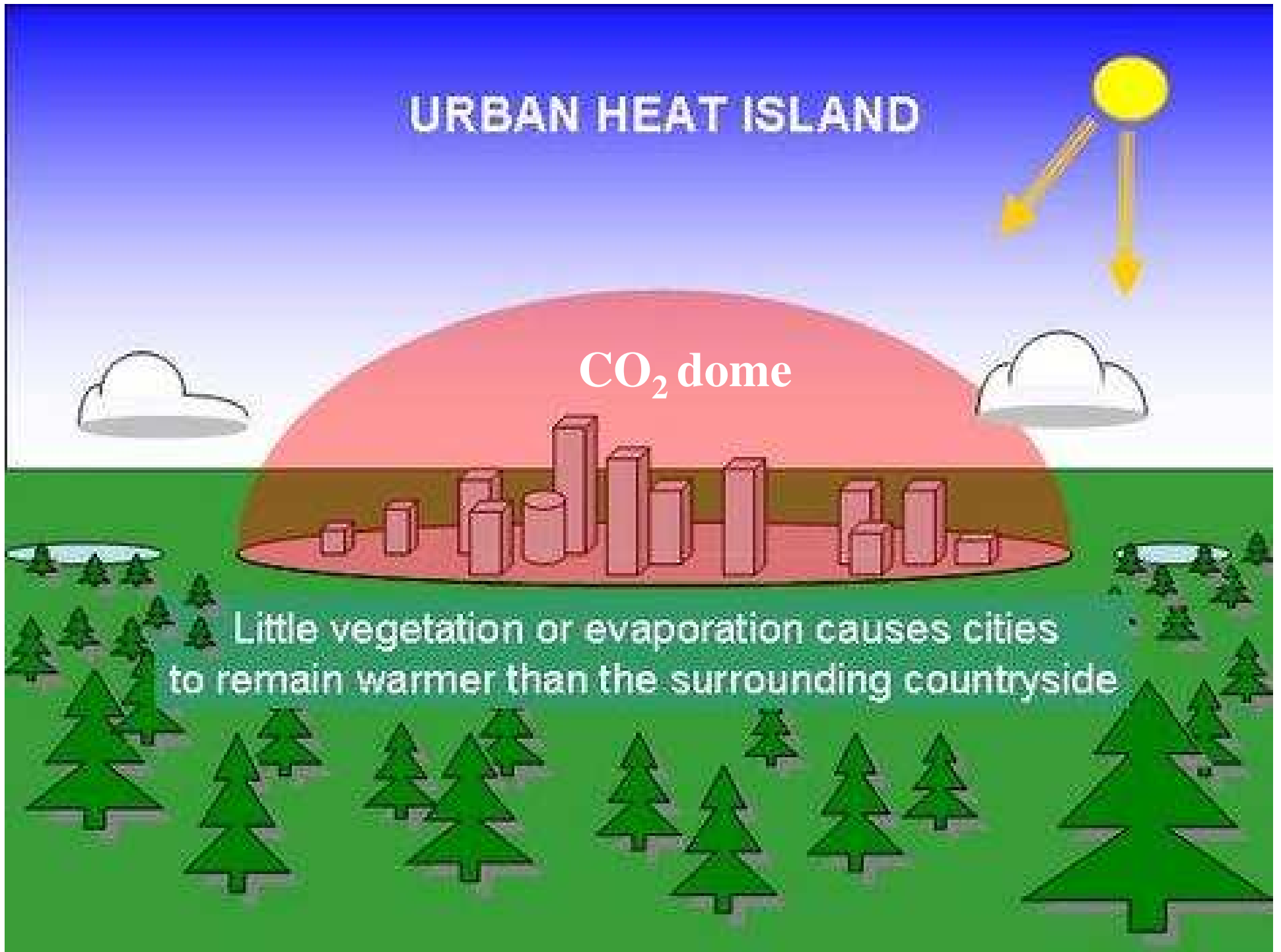
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# URBAN HEAT ISLAND

CO<sub>2</sub> dome

Little vegetation or evaporation causes cities to remain warmer than the surrounding countryside



# Clean Energy

## Optimizes Adaptation and Mitigation



### *Distributed Generation*

#### Water

Purification

Pumping

Irrigation

Desalination

Cooking

Clinics

Schools

Homes

Computers



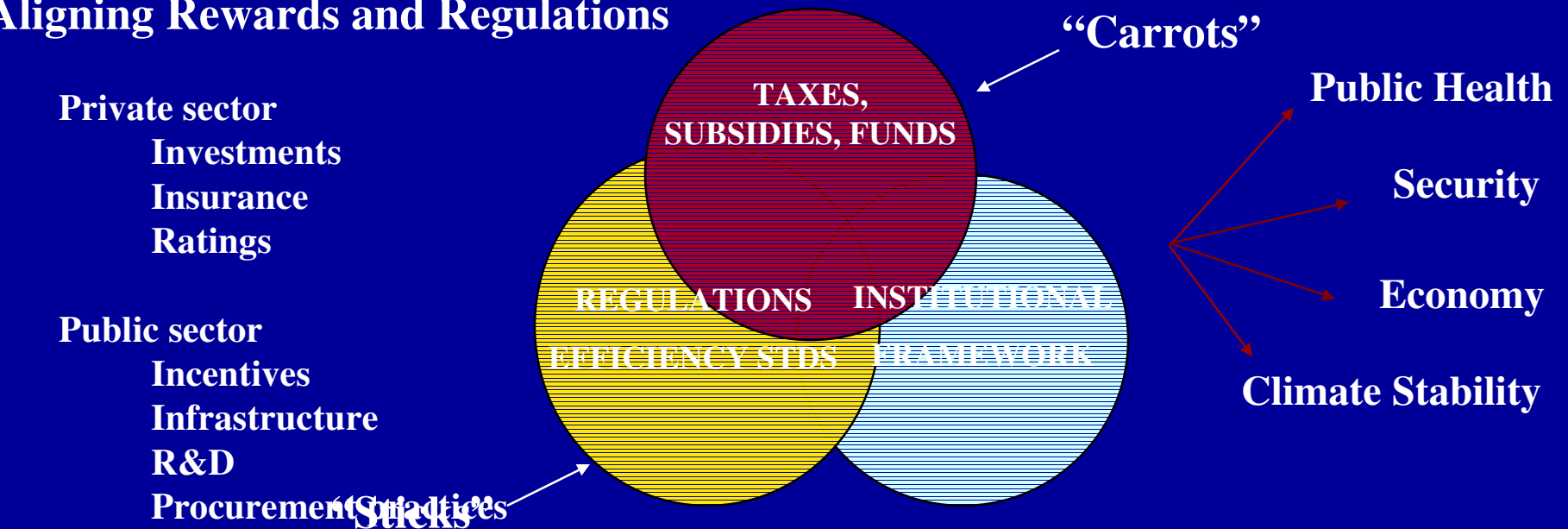
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# Financial Instruments for a Clean and Sustainable Energy Transition (FICSET)

## Aligning Rewards and Regulations



## New Energy Plan

Transport  
Utilities  
Buildings

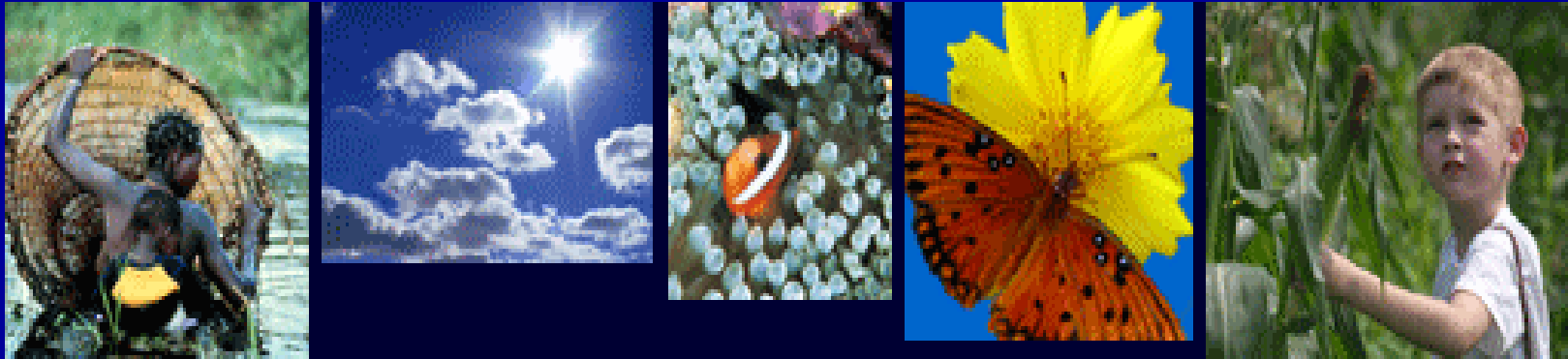
Corn Coal Nuclear  
Lobbies

THE ENGINE OF  
GROWTH  
for the  
21<sup>st</sup> CENTURY



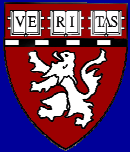
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<http://chge.med.harvard.edu>

<http://www.climatechangeofutures.org>



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