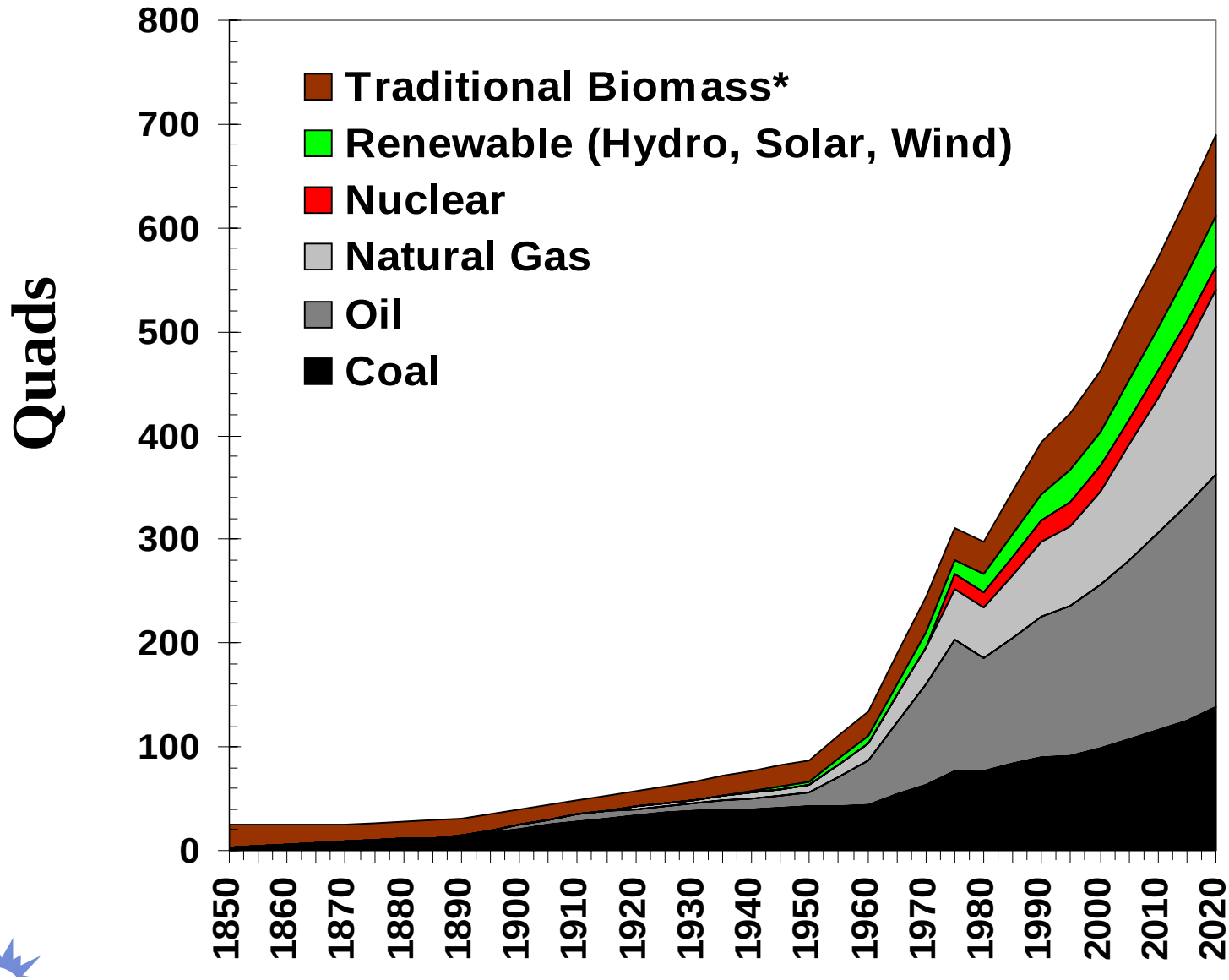
VISION 21

Energy Plant of the Future

Asociacion Mexicana para
la Economia Energetica
Mexico City
June 13-14, 2001

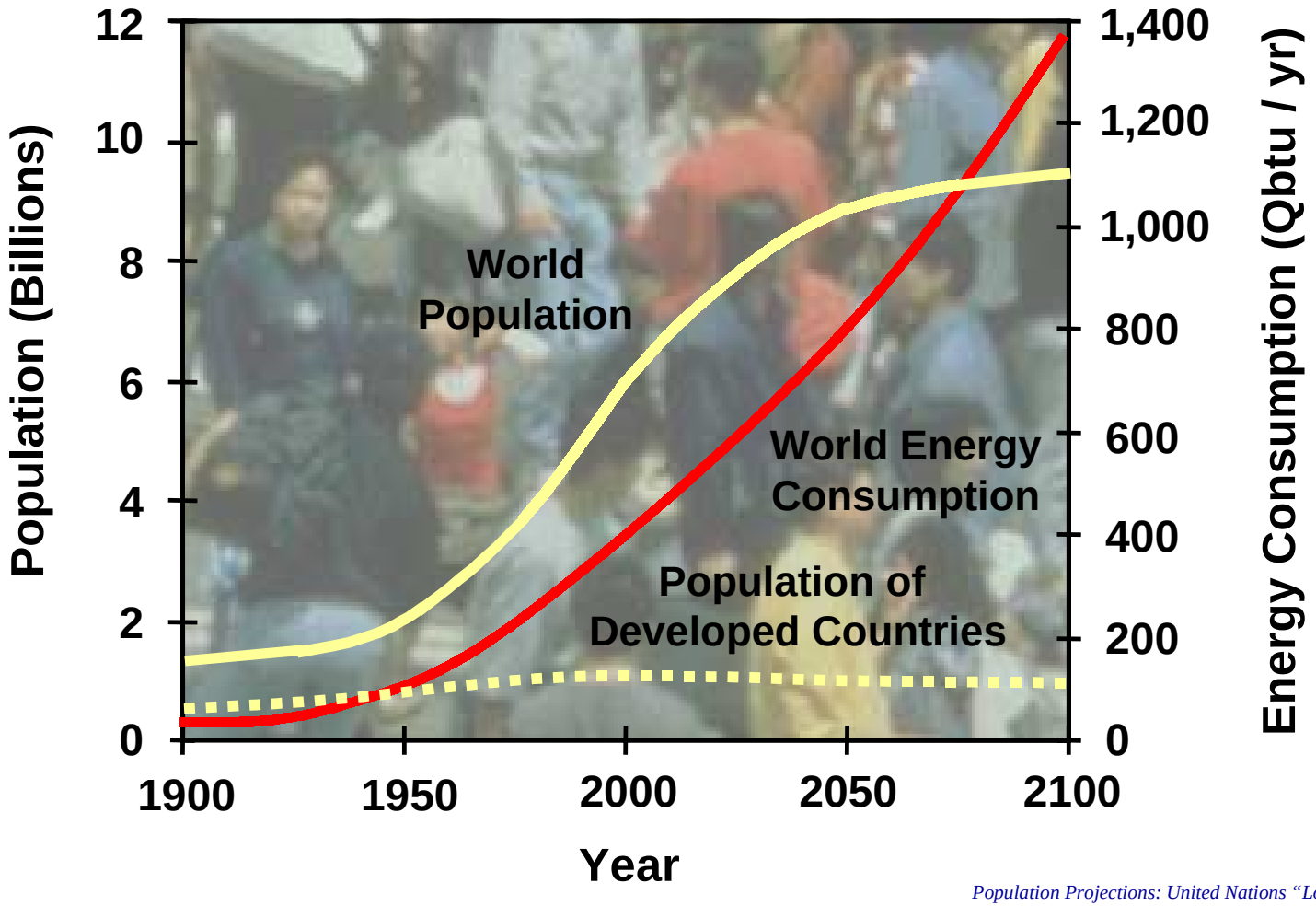
John Ruether
National Energy Technology Laboratory

History and Projections of World Fuel Consumption



Historical data from the World Energy Council and projections from EIA.
*Traditional biomass is mainly wood, charcoal, dung, etc. used in developing countries.

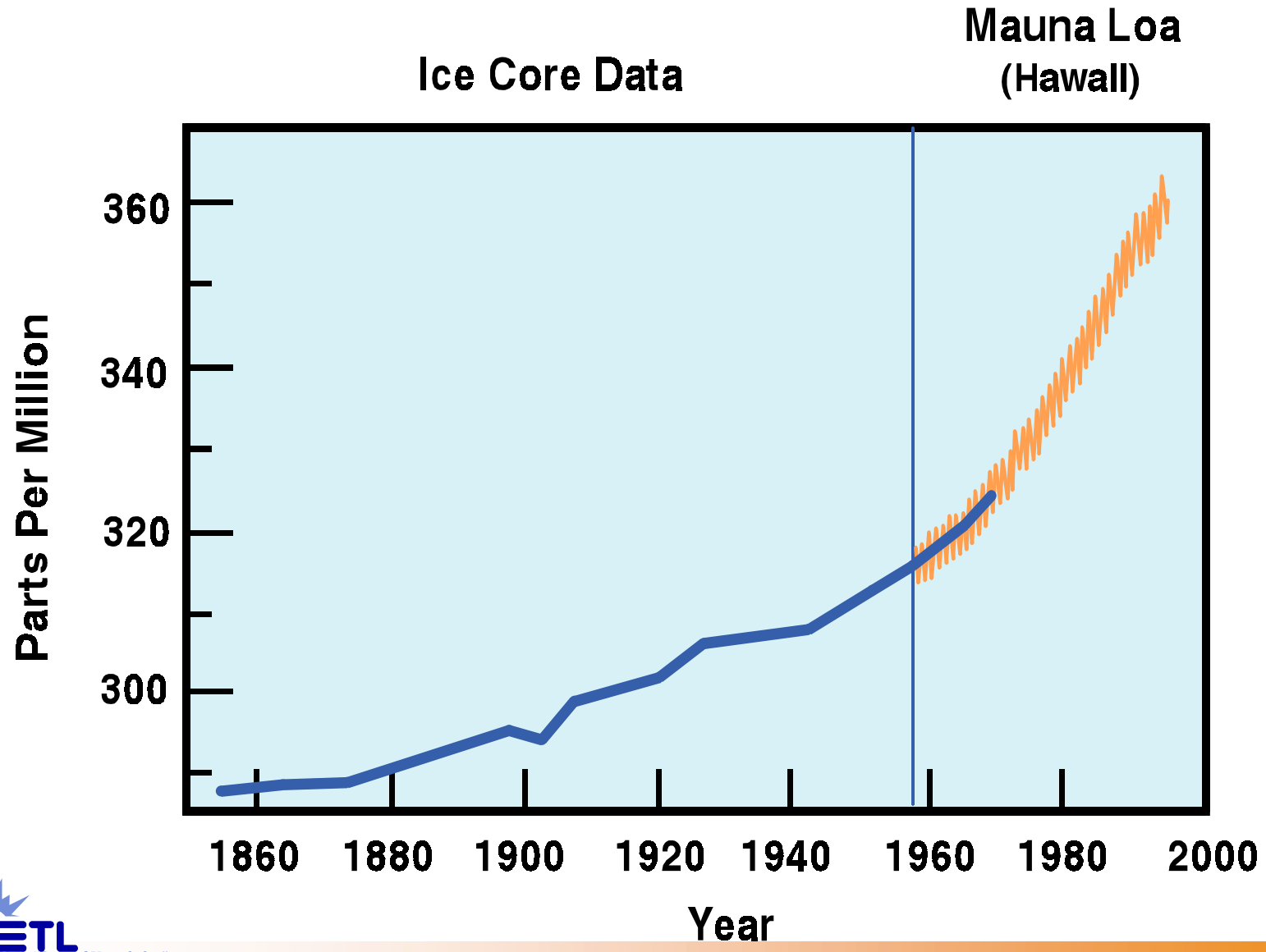
World Energy Use Is Growing Dramatically



Population Projections: United Nations "Long-Range World Population Projections: Based on the 1998 Revision"

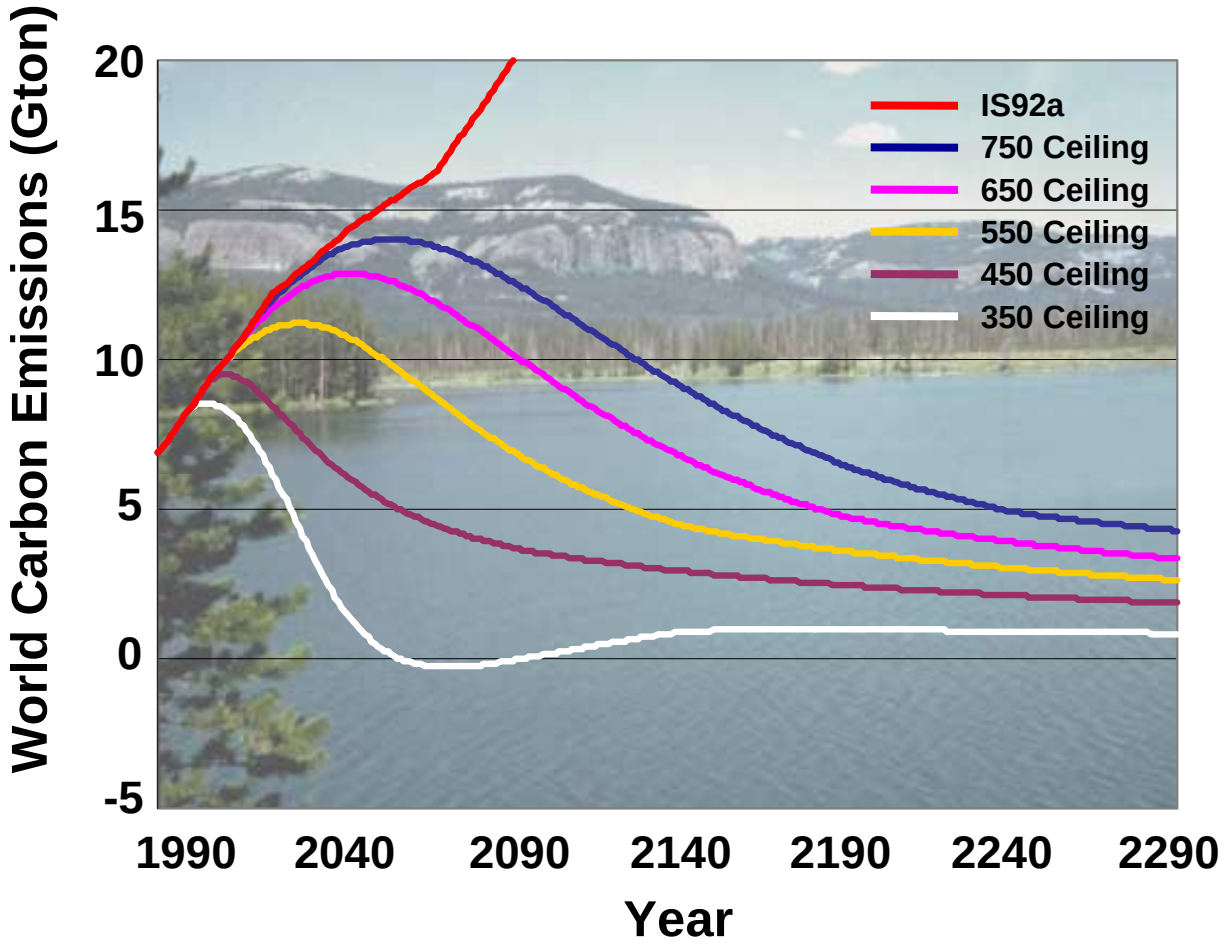
Energy Projections: "Global Energy Perspectives" IIASA / WEC

Atmospheric Carbon Dioxide Concentration



graphic from Ch. 1 "State of Knowledge"
by l.billanti

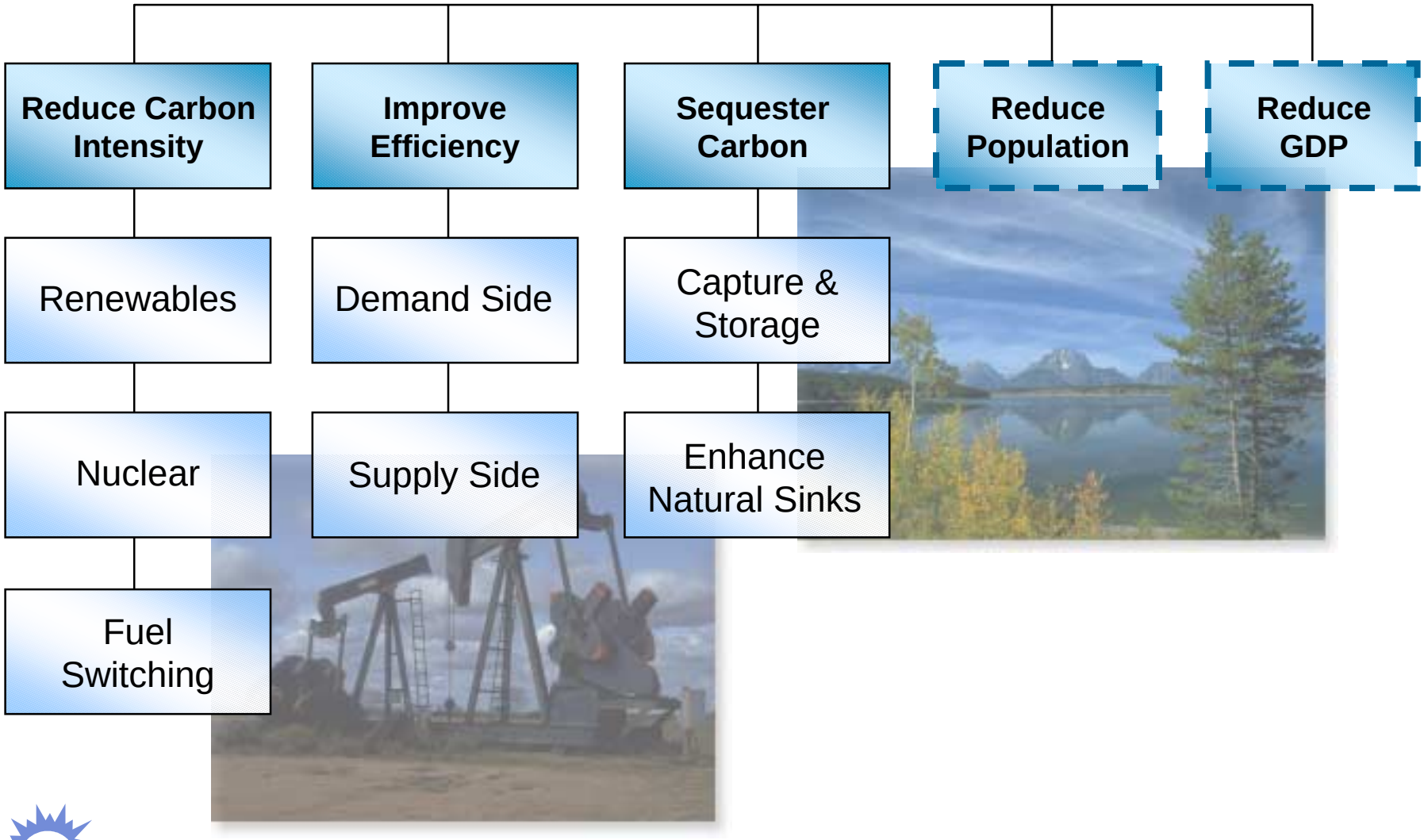
Scenarios to Stabilize CO_2 Concentrations



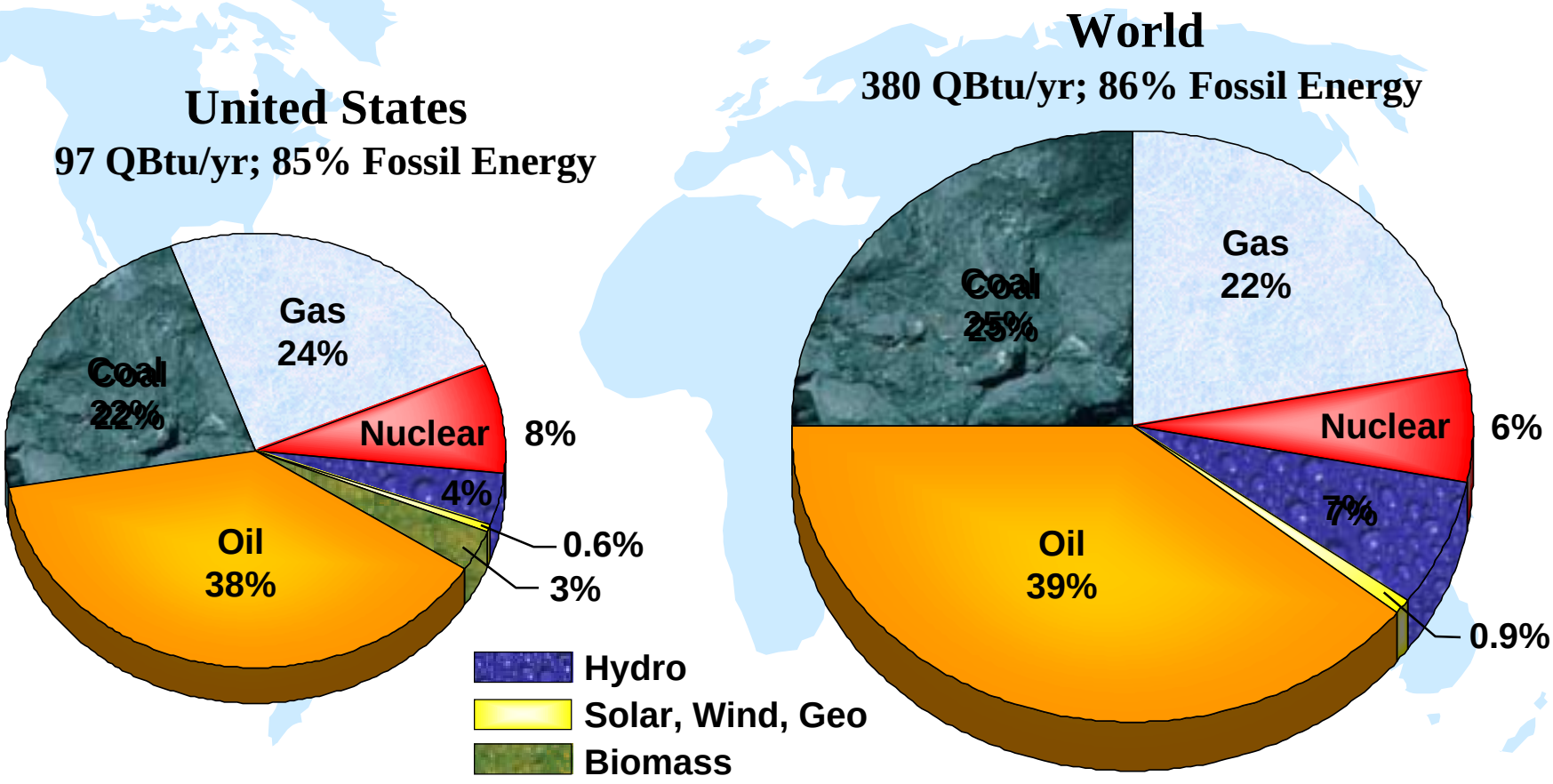
Stabilizing CO_2 concentrations at 550 ppmv implies 60% reduction below 1990 emission rates

Source: Wigley, T.M.L., Richels, R., and Edmonds, J.A. ***Nature 379****, 240-243 (1996)*

CO_2 Mitigation Options



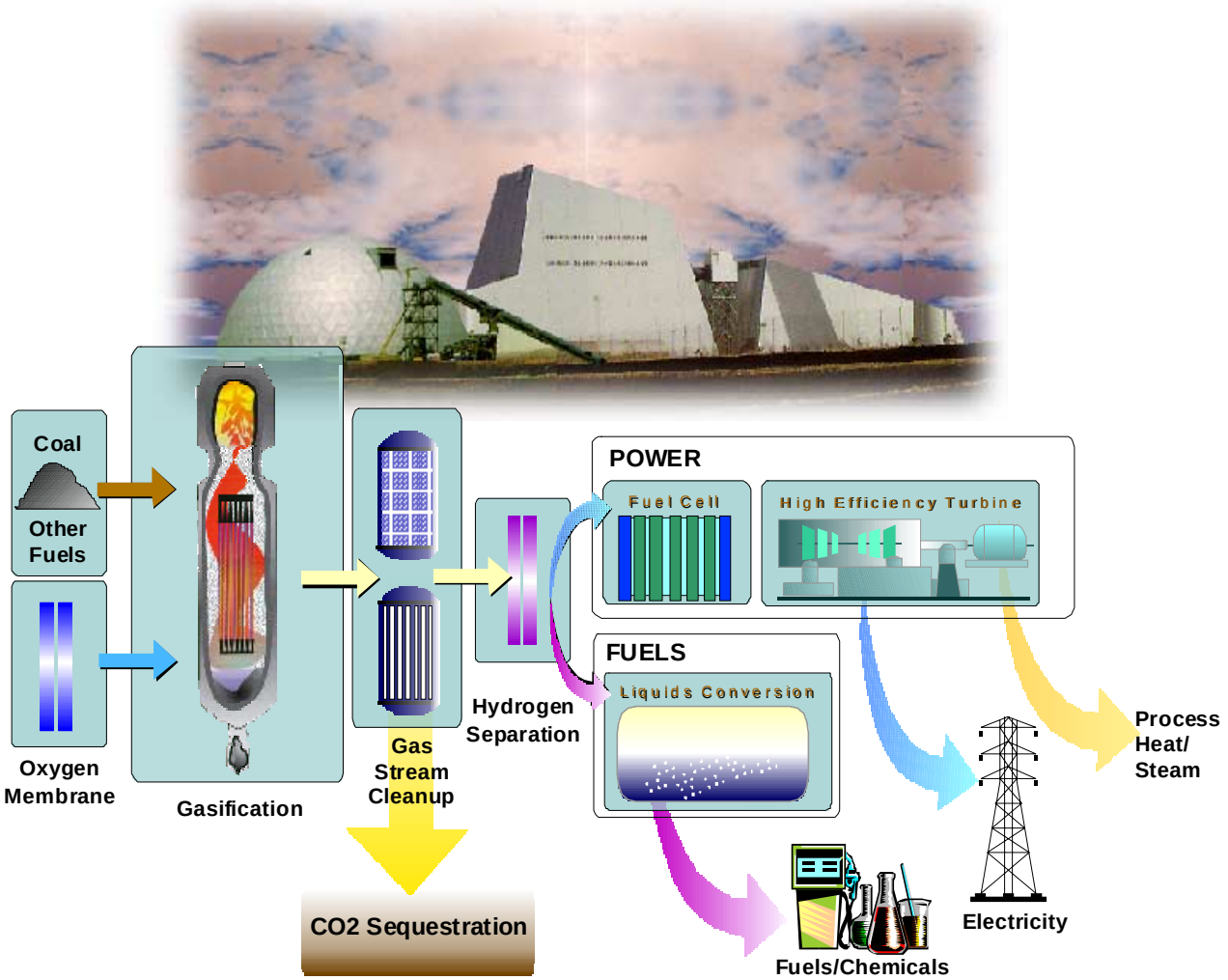
Fossil Fuels Are the World's Dominant Energy Source



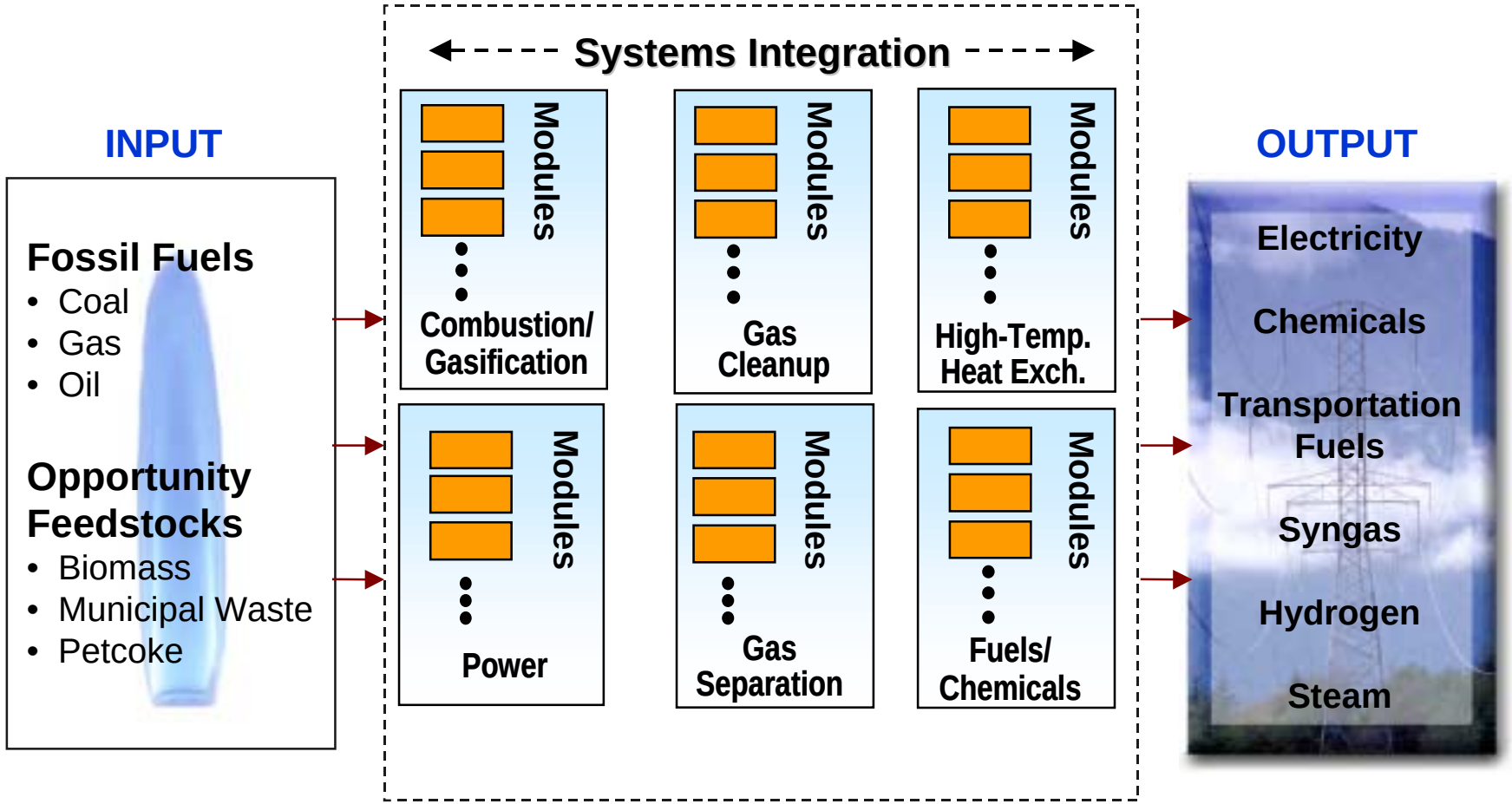
Word Data from EIA96. Does not include non-grid-connected biomass.
U.S. Data from Table 2 of EIA REA 97 & AEO98 Table A2

Vision 21 Is Crosscutting Program

VISION 21 Energy Plant



Modular Technology



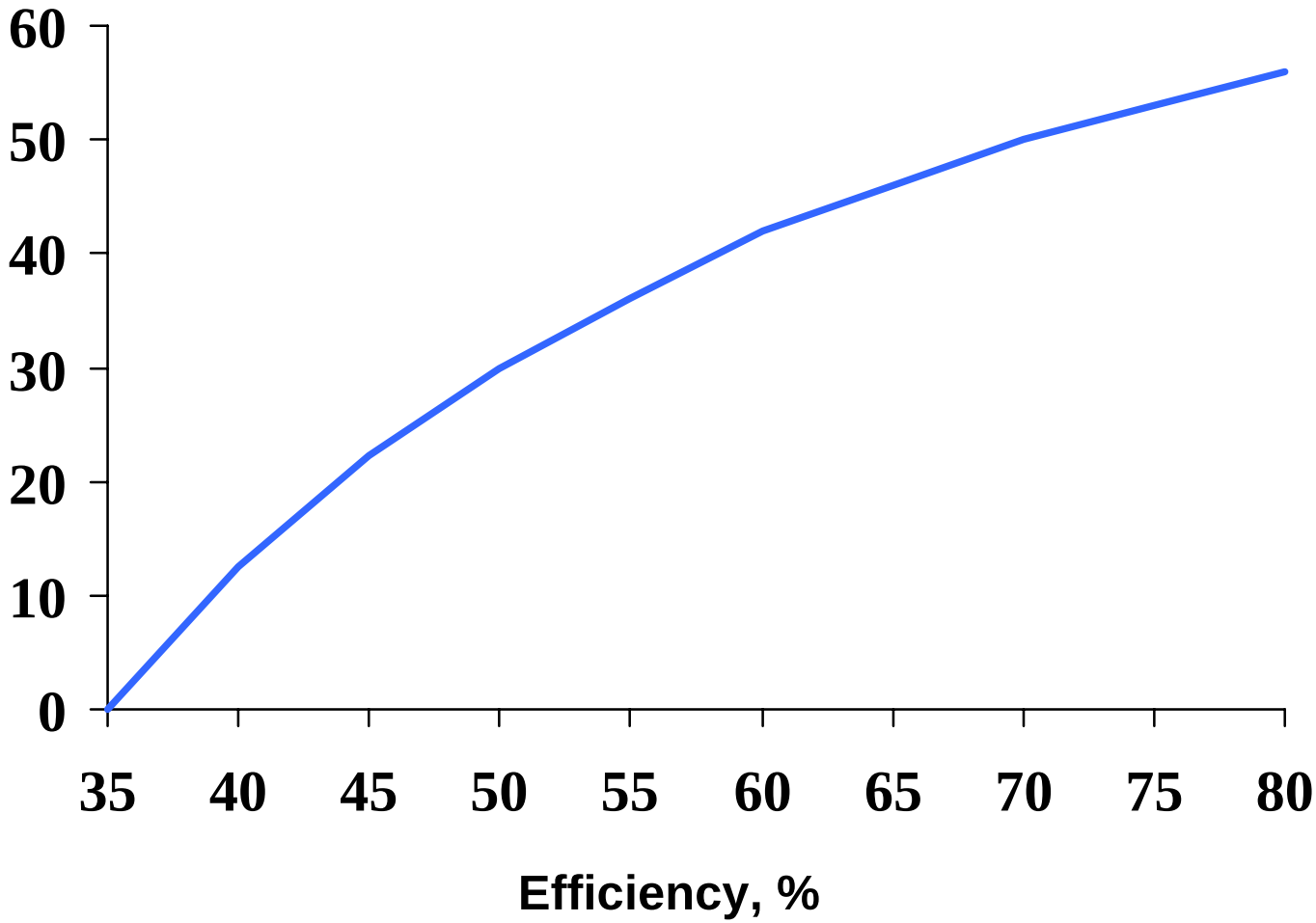
Objectives for the Vision 21 Energy Plant

- **Power generation efficiency**
  - 60% using coal
  - 75% using gas
- **Fuels production efficiency**
  - 75%
- **Emissions**
  - near-zero smog and acid rain-forming pollutants
  - up to 50% CO_2 reduction by efficiency improvement, 100% with sequestration

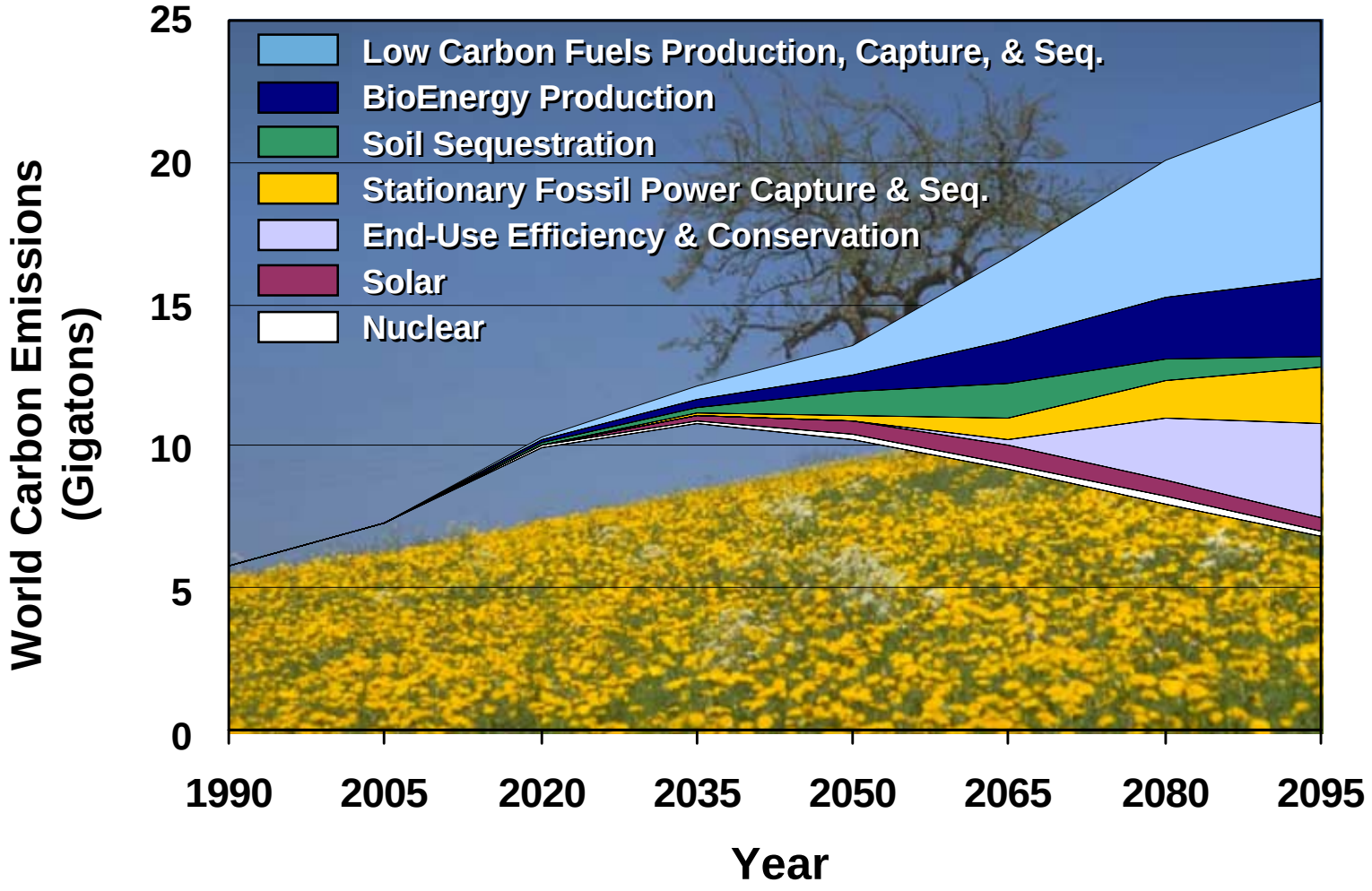
Goal:

Absolutely minimize environmental implications of fossil energy use!

Percent Reduction in CO_2 Emissions
(relative to 35% efficient plant)

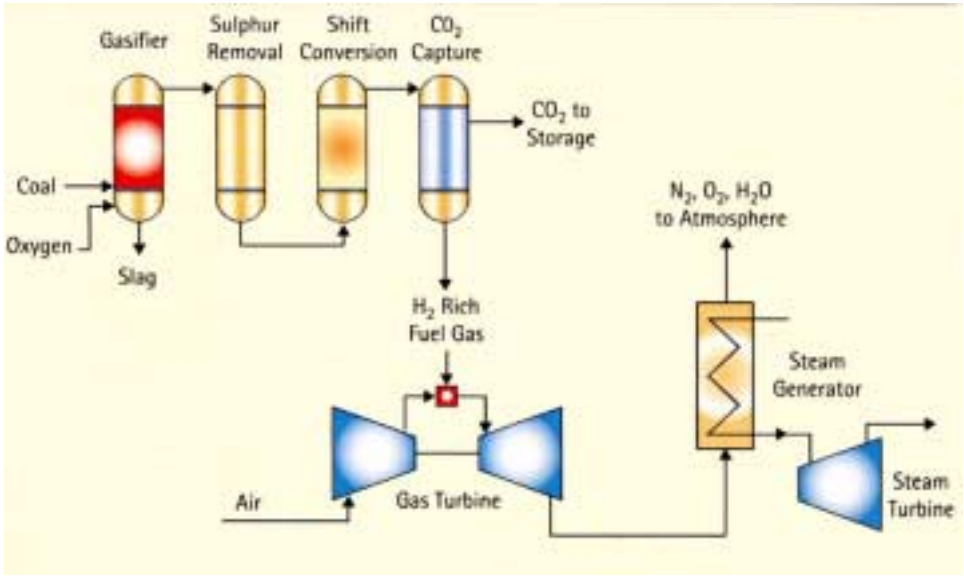


Technologies to Fill the Gap

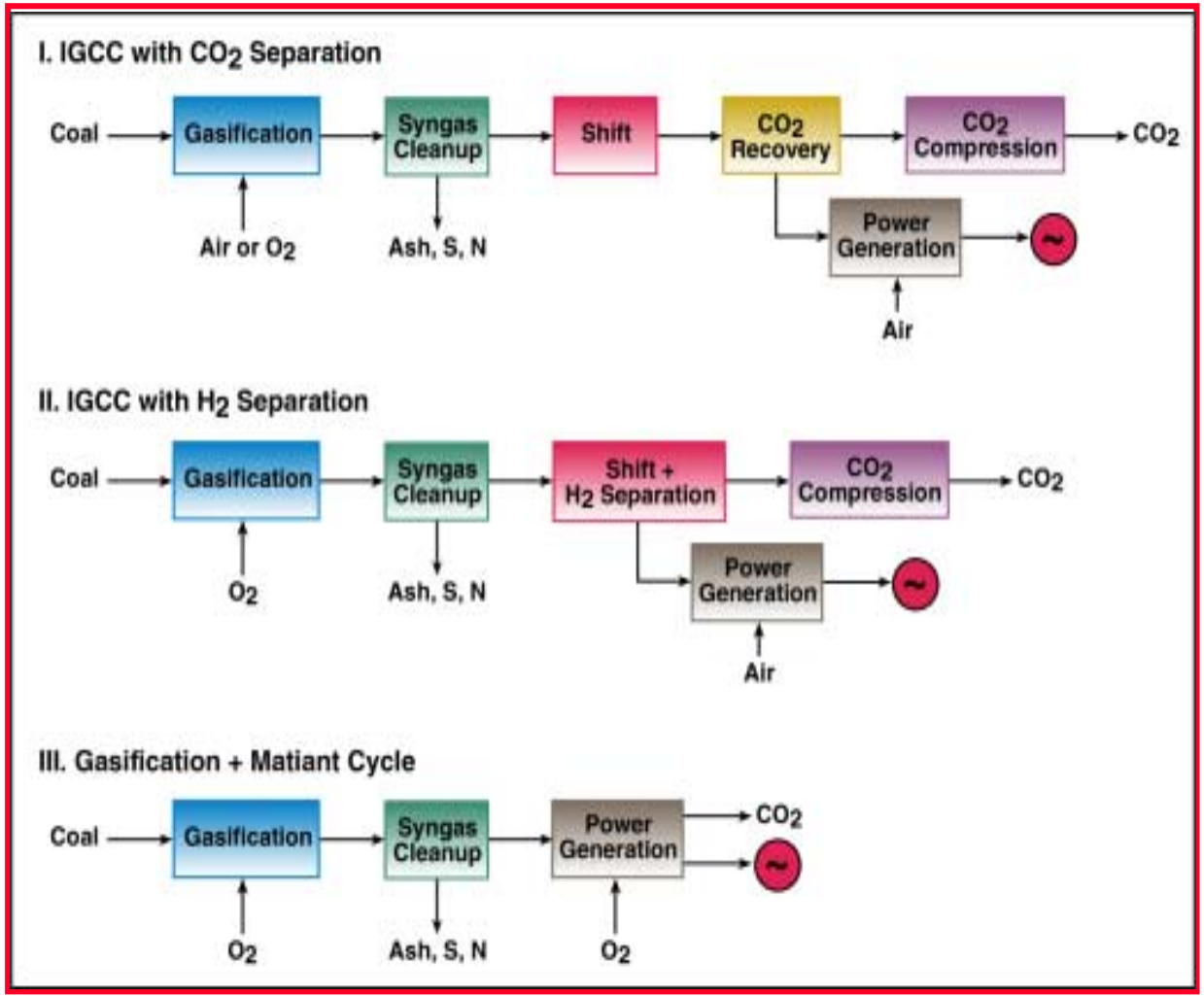


Source: Pacific Northwest National Laboratory

Coal-Fired IGCC with Pre-combustion Capture of CO_2



Three Approaches to Power Generation from Coal with CO_2 Capture



Power Plant Efficiencies and Emissions

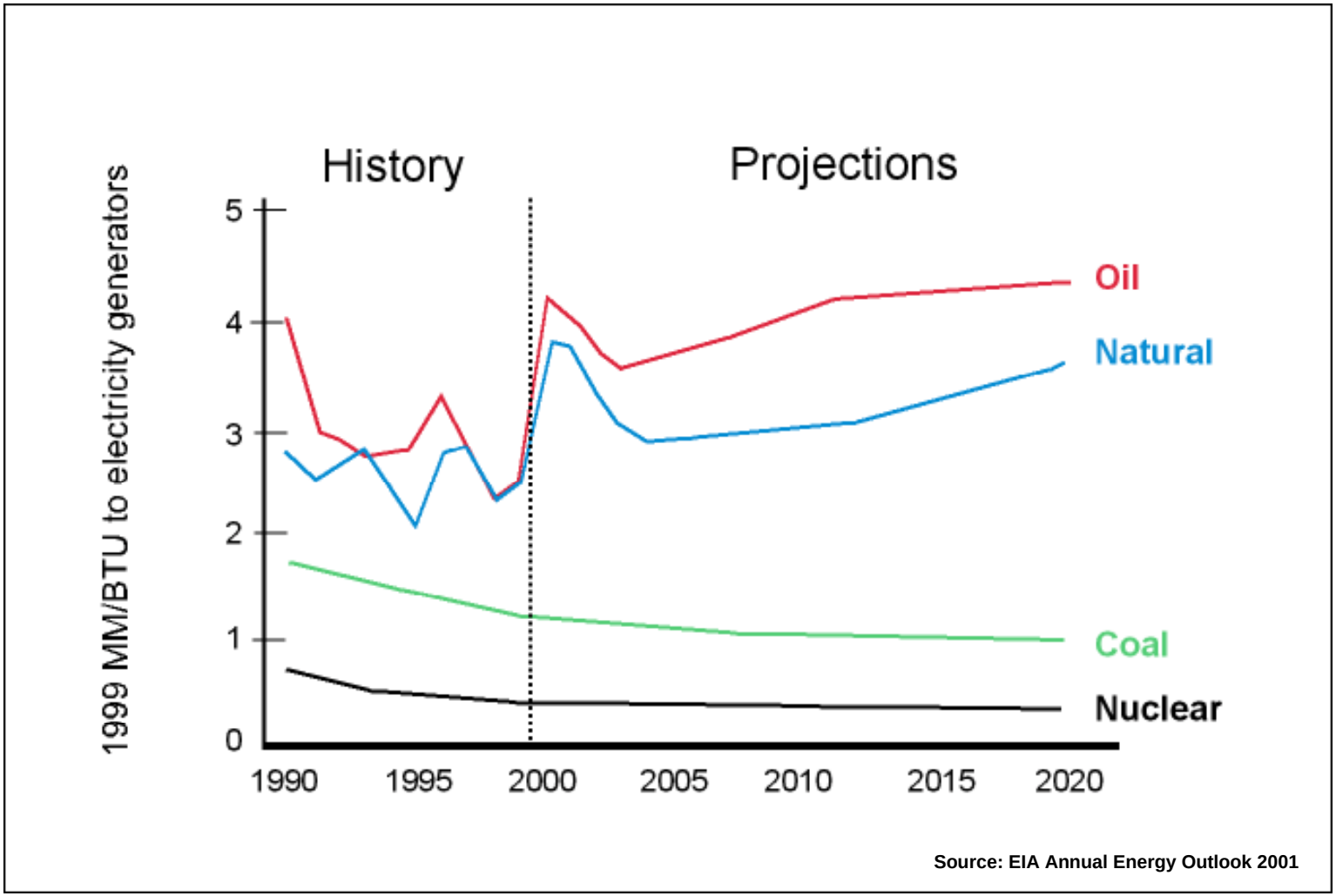
Process	CO_2 Capture	Efficiency (% LHV)	CO_2 Emissions (g/kWh)
NGCC	None	56	370
	Post combustion	47	60
	Pre combustion	48	60
Coal pf	None	46	720
	Post combustion	33	150
Coal IGCC	None	46	710
	Pre combustion	38	130

Drivers Changing Power Industry

- **Deregulation and electric utility restructuring**
  - Market-driven environment
  - Profitability and investment concerns
  - Aversion to risk
- **Low cost of natural gas**
  - Gas technologies favored over alternatives
  - Most new capacity to be gas-fired turbines and combined cycles
- **Environment**
  - Pressure to reduce emissions, especially NOx, fine particulate, mercury
  - Concern over global climate change (CO_2 emissions)

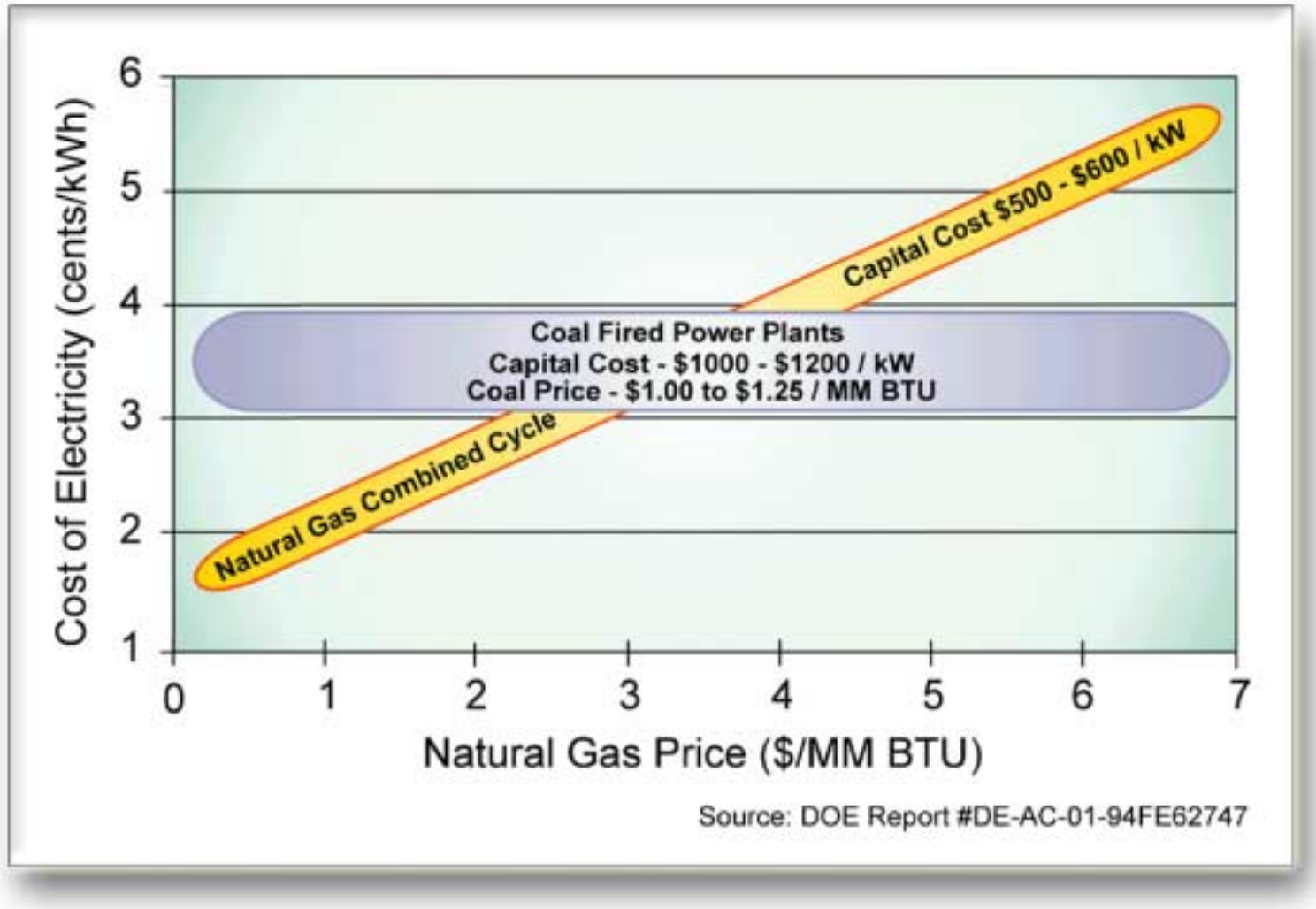
Technology innovation is the best way to address the coming challenges to our electric power and fuel supply infrastructure.

Stable Coal Prices
Erratic, Rising Natural Gas Prices



Source: EIA Annual Energy Outlook 2001

Coal Technologies are Cost Competitive



New Projects Contribute to Ultra-Clean Energy Plant

- **Systems Integration**
  - National Fuel Cell Research Center
- **Computational Modeling & Virtual Simulation**
  - Reaction Engineering International
  - Fluent, Inc.
  - Princeton University
  - CFD Research Corp.
- **High-Temperature Materials**
  - Huntington Alloys
- **Gasification & Combustion**
  - Foster Wheeler
  - GE Energy and Environmental Research Corporation
  - Clean Energy Systems
- **Turbines & Fuel Cells**
  - Fuel Cell Energy
- **Advanced Separation Technology**
  - Siemens Westinghouse
  - Eltron Research
  - ITN Energy Systems

VISION 21

http://www.netl.doe.gov