Energy Systems Integration

THEMES

- Asking The Right Questions
- The Tyranny of Existing Systems
- The Opportunity Cost of What We Do Today
- The Myopic Focus on Supply

Why We Are Where We Are Today

Current System Characteristics

- Cost
- Convenience
- Reliability
- Time
- Form
- Place

Some Critical Questions...

- To what extent can biomass sources and systems meet the form, time and place determinants of energy utility that consumers obtain from current sources and systems?

Some Critical Questions (cont.)

- Are the form, time and place determinants the right benchmark?

Some Critical Questions (cont.)

- What are the compelling reasons for current energy sources and systems to predominate, that tie them to consumers and discourage their replacement by other systems and sources?

Some Critical Questions (cont.)

- How might biomass energy successfully integrate into current systems?

Some Critical Questions (cont.)

- What are some of the critical challenges in integrating biomass systems?

Some Critical Questions (cont.)

- What policy issues will have to be dealt with for biomass sources to integrate or successfully create replacements for existing energy systems?

The Utility of Current Systems

- Meeting the form, time, and place requirements

Breaking the Tyranny of the Time, Form, and Place Requirements

- Roger Sant and energy as a provider of services

Our Energy History

- Transportation and liquid fuels
- Coal and natural gas – home heating and electric generation
- Cost and reliability

Limits to Growth

- Resource scarcity under technology and price fixity
- Is this the real world?

Is Our Current Fixity on Form, Time, and Place the Real World?

Why Liquids from Biomass?

- Will ethanol relieve our dependence on imported oil?

(the whole corn crop to ethanol = 14% of total oil imports)
(5 billion gallons of ethanol – 3.5% of current gasoline use)

Caloric Efficiency and Ethanol – Are We Counting the Right Thing?

- The solid, liquid, gas trade-off

Opportunity Cost and a Different View of Energy Services

- CBO study on raising the CAFÉ standards

  (Increase of 3.8 miles per gallon reducing gasoline consumption by 10% at a cost of 3 – 3.6 billion dollars)

Table 1: 1981 Resource Cost ($/bbl) of Transportation Petroleum Equivalents
(@ 5% discount rate)

Area of Development	Cost
Shale Oil	32.21-35.73
Coal Liquids	40.69-46.08
Auto Fuel Economy	25.37-38.23
Biomass	59.00-52.10
Railroad Electrification	22.82-24.88

Whitford, et al. 1981, p.v.

Electricity from Biomass

- Key issue is not supply but firing capacity and transmission

Confounding Characteristics of Generation Today

- The key drivers: Deregulation and Natural Gas

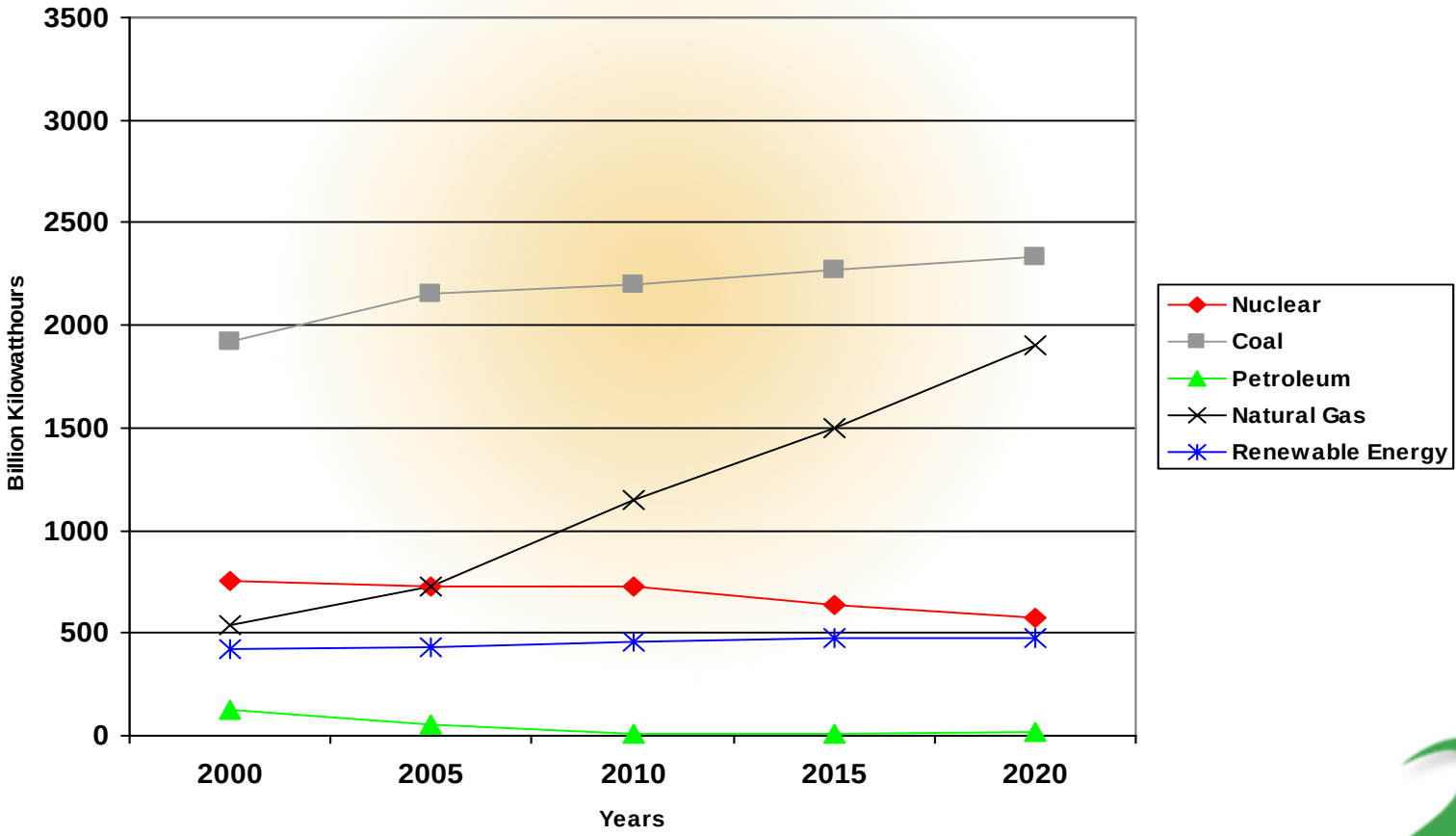
Table 2: Approximate Capital Costs for Different Power Systems

Type of System	$ Cost per KW Capacity
Peaking Gas Turbine	400-500
Combined Cycle Gas Turbine	650-800
Conventional Coal	1,000-1,300
Coal Integrated Gasification-Combined Cycle	1,200-1,500
Nuclear	2,000 ????

Conversations with utility industry staff at the Power Systems Engineering Research Center, 2004.

Where Were We Going as of 2002?

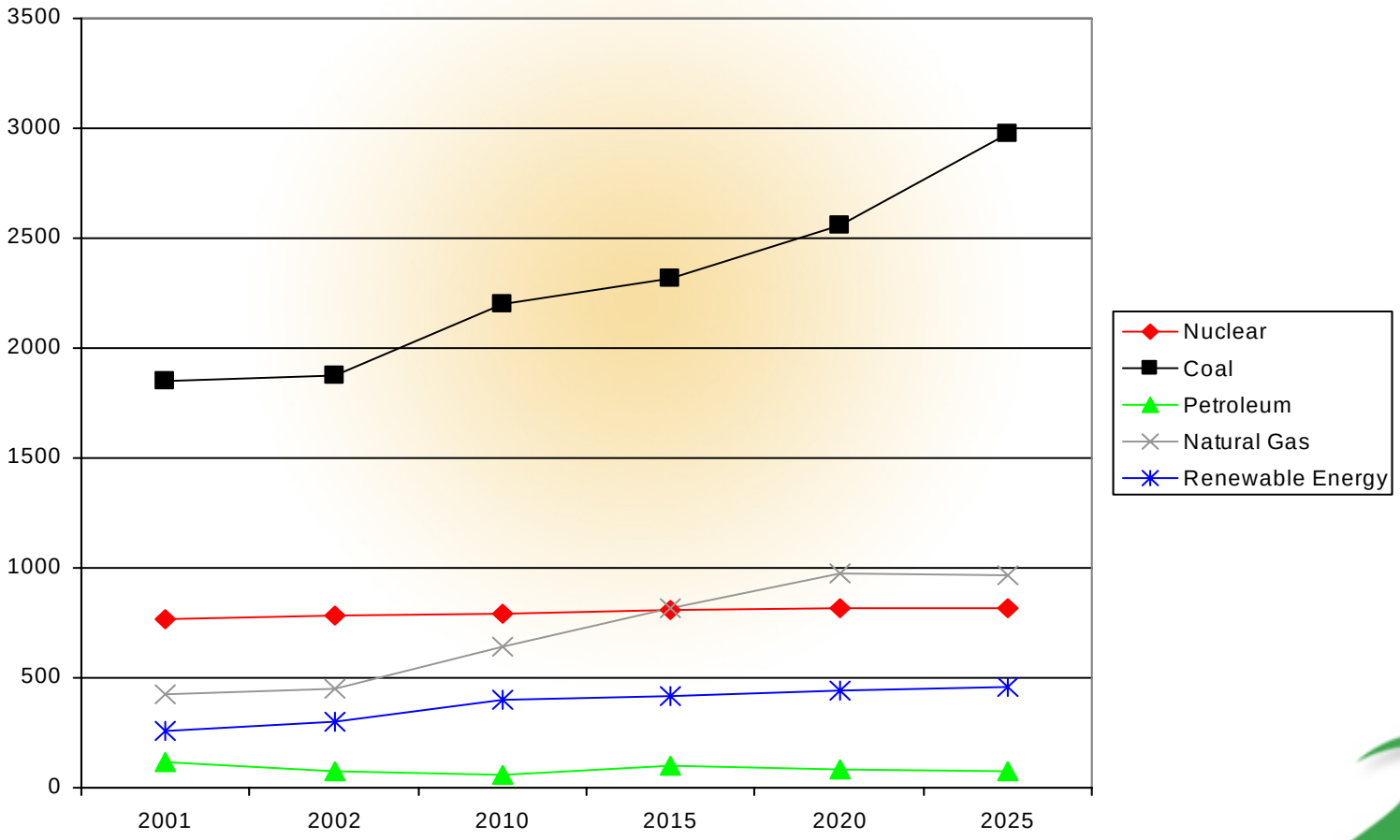
Figure 1. Projections of Electricity Generation by Fuel, 2000-2020



EIA 2004 Annual Outlook Report

Where Are We Going as of 2004?

Figure 2. Projections of Electricity Generation by Fuel, 2001-2025



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The State of Systems Logistics for Electricity from Biomass

- The contrast with Ethanol

Reduced Flexibility – Loss of the Natural Gas Option

- Unrecognized as a premium fuel and feedstock

Impact of the New World of Natural Gas

- Impact on product cost and manufacturing competitiveness
- An increased opportunity for biomass gasification?
- Impact on natural gas now being less reliable as an import

Revisiting Some of Our Original Questions:

- To what extent can biomass sources and systems meet the form, time, and place determinants of energy utility that consumers obtain from current sources and systems?

Revisiting Some of Our Original Questions (cont.)

- What are the compelling reasons for current energy sources and systems to predominate, that tie them to consumers and may discourage their placement by other systems and sources?

Revisiting Some of Our Original Questions (cont.)

- How might biomass energy successfully integrate into current systems, and what are some of the critical challenges in doing this?

Revisiting Some of Our Original Questions (cont.)

- What policy issues will have to be dealt with for biomass sources to integrate or successfully create replacements for existing energy systems?

Integrating Biomass Systems Into Existing Systems is Job One

Additional Policy Concerns

- Break the myopic time horizon
- End the fixation with existing form, time, and place constraints that lead to a predominately supply based policy
- Seriously consider opportunity costs and trade-offs
- Seriously consider our strategic vulnerability