



Energy Sustainability on the Pacific Rim

A Systems Engineering Perspective

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SAME Pacific-Northwest Regional Conference

System Sustainability

The Engineering Challenge: Embrace the Whole

- Energy is not fuel alone; it is a set of components in an ecosystem. A dynamic set of forces that support growth only when balanced, and dangerous when outside the balancing mechanisms!
- The opportunity before us is to create a system that can adjust the fuel and energy mix and tune our ecosystem to better support human development.



The Ingredients

- Cleaner Fossil Fuels
- Alternative Fuels
- Renewable Energy
- Biomass Power
- Biomass Fuels
- Nuclear Energy
- Wind, Waves, Solar
- Creativity
- Innovation, IT & IP
- Cross Fertilization
- Education
- Shared Knowledge
- Adaptive Alliances
- Life Cycle Efficiency

The Goal: Adjust Energy Mix to Optimize

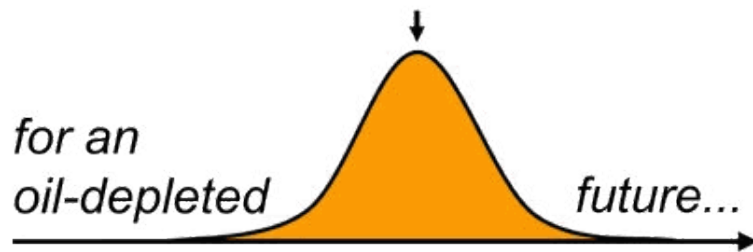
- Economic Health
- Mental Health
- Social Health
- Environmental Health

Integrated Cybernetic Systems

National, Regional and Global

Benefits of Peak Oil Analysis

Prepare now



Peak Oil
www.oilcrisis.com

<http://www.hubbertpeak.com/>

- Despite uncertainties about the data, the model anticipates the impact of excess reliance on limited resources.
- It also shows the benefits of early planning and using renewable alternatives.

Asia, Peak Oil, Mercantilism?

Asian Oil and Gas Trends

- Oil demand, imports will drive global market
 - 75% of recent growth, 50% of future growth
 - Economic growth, rising per capita incomes
 - Motorization, vehicle boom
 - Poor production prospects
 - Weak demand management policies
- Asian state energy security policies reflect fears over global oil outlook, regional mistrust
- Responding with increasingly aggressive "Energy Nationalism": regional cooperation weak
- Will become major force on global oil markets
- Gas import dependence likely to reinforce this trend

Response: Energy Nationalism

“Too Important to be Left to the Markets”

- Asian powers aligning strategic ties to energy needs
- Bilateralism rather than regional or multilateral
- Oil and gas diplomacy and alliances with exporters
- Regional competition for oil supplies, fields
- Competition to control transportation & maritime routes
- National competition for global equity supplies
 - China
 - Japan
 - India
- Self-help: SPRs in China, India
- Limited progress in regional cooperation

China's Energy Market in Search of a Strategy

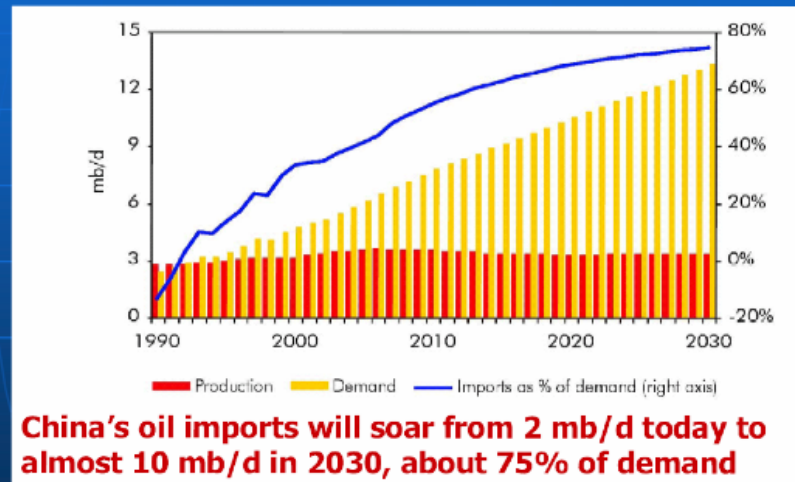
China has started 5000 Recycling Industries and built 25,000 Industrial Parks.

E-Waste recycling:

2002: 0 Tons

2004: 5100 Tons

China's Oil Imports Rising



Source: IEA WEO 2004

State Council
2005-2006 Plan:

1. Resource efficient Production.
2. Circular Economy
3. Save Water and Energy
4. Comprehensive use life cycle plans.
5. Clean Production
6. Legal System Reform

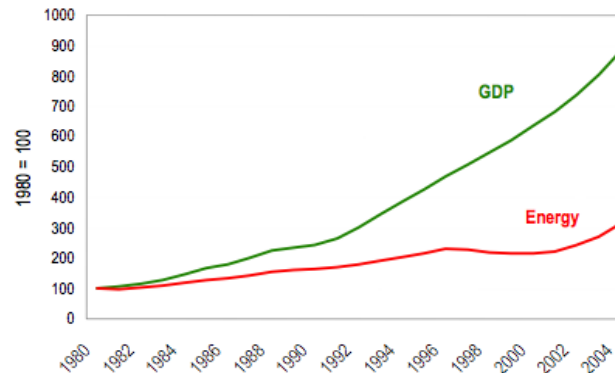
- At the same time -- Tens of billions of dollars of unapproved investments in new Chinese power plants are prompting a crackdown by the central government. Local governments refuse to wait for a plan.

- MANILA, Dec. 9, 2004 (Xinhua) -- The Asian Development Bank (ADB) has approved a 35 million-US dollar loan for a hydroelectric project in northwestern Chinese province of Gansu.

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Efficiency: Some Progress -- And Retreats

China has demonstrated that a rapidly developing nation can decouple energy and GDP growth with bold policies initiated in 1980



- **China 1950-1980: Inefficient Energy consumption outpaced GDP**
- **China 1980-2000: GDP outpaced energy consumption (more efficient) due to R&D, Management, Incentives, Education, IT.**
- **China 1993-2001 Transition to Consumer Goods -- less efficiency.**
- **China 2001-2004 very inefficient power; shortages in 24 provinces.**
- **USA 1980-1999: GDP outpaced energy consumption.**

Compare China and USA

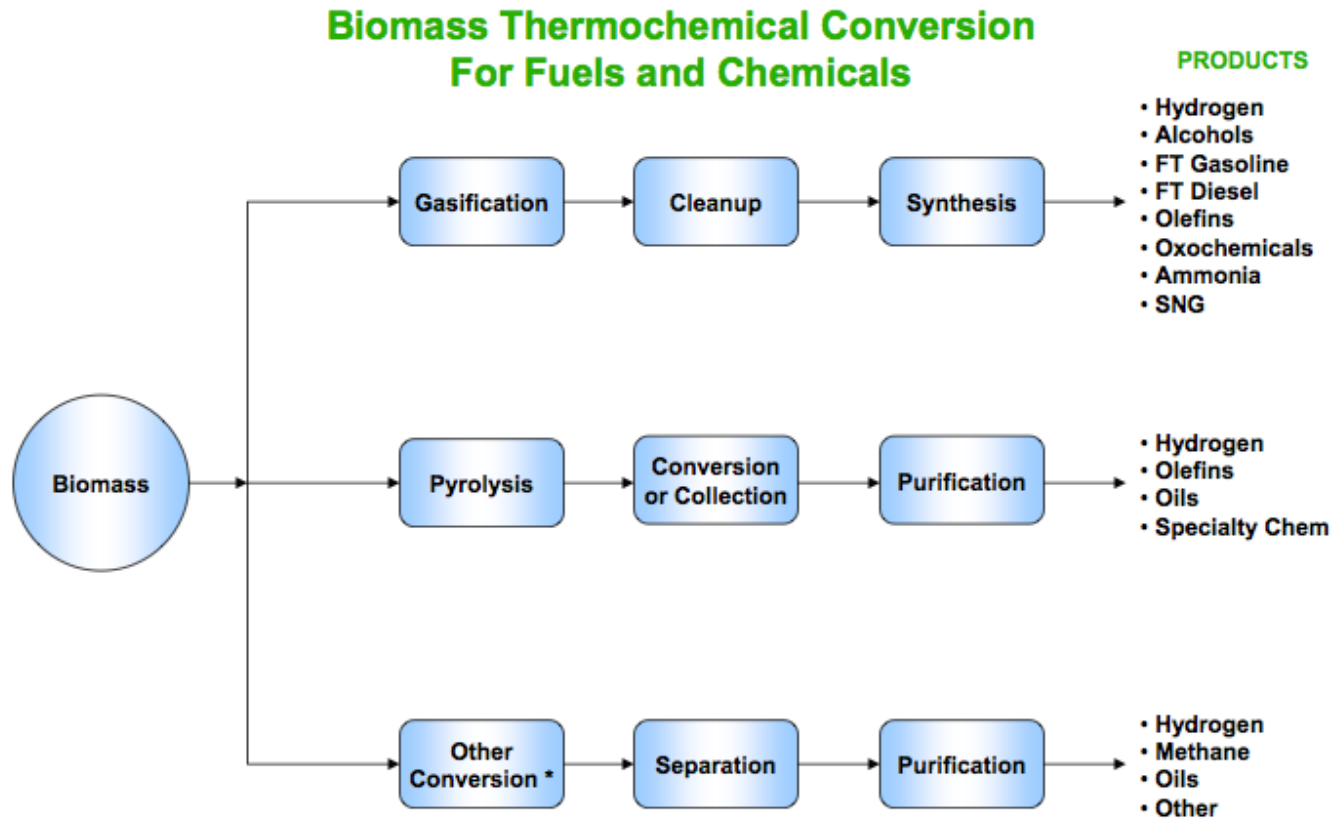
- **Consumer goods emphasis and “free market” in China and the USA drove down energy efficiency and drove intensity up in since the late 1990’s.**
- **Both Free Market and Mercantilism externalize costs whenever possible, promoting waste and inefficiency.**
- **Widespread power shortages increased in both economies since 2001 without effective guidance.**
- **Now it is time for Governmental and private Engineers to team up, show some serious creativity, and do more with less.**

A sign for the Future in a Chinese Park



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The Science of Biomass Waste Recovery with Energy Generation



* Examples: Hydrothermal Processing, Liquefaction, Wet Gasification

An Adaptive/Creative System

- It supports adaptive economic, social and political growth
- It empowers cultural and social diversity
- It promotes exchanges to generate more creative solutions
- It encourages constructive competition in creating energy efficiency, reducing emissions and recovering waste
- It discourages destructive competition, such as war

What we Have Today: A Mixture

- Limited Resources and Limited Vision
- Economies of Scale/ Cheap Transportation
- Dangers from Peak Oil, Gas, and Coal
- Externalized Costs - Lack of full cycle analyses
- Zero-Sum Gamesmanship
 - Energy Mercantilism
 - The Politics of Scarcity
- **Innovative, Creative Engineers and politicians offering new Paradigms and Educating Decision-makers**

How Did We Get Here?

- Paradigms that do not adapt
 - Scientific and Engineering: Thomas Khun
 - “The Structure of Scientific Revolutions”
 - Political and Economic: Money over Value
- Single factor analyses
- Reification of Concepts and Organizations
- Educational processes divorced from creative problem solving

Available Options

1. Let the system self-correct: wait for Peak Oil (gas, coal and war) to force new paradigms, or
2. Collaborate and integrate: put our engineering expertise and creativity to work building flexible systems and regenerative solutions
 - Expand with the universe -- into infinity.
 - Teach Murphy's Laws! Enjoy Solving Problems!
 - Create Open Source IP when appropriate: ISO models
 - Discover efficiencies of location and community

Recommendations

- Don't Wait or Nature; Take Charge!
- Collaborate and Innovate
- Embrace Change; It Will Come Anyway
- Create Sustainable Adaptive Change
- Integrate Energy, Economy, Environment
- Get Stakeholder Input; Educate Each Other on How to Achieve Beneficial Change.