The Next Wave in Effective Green Investing

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Conclusions

implications for investing

- We face risks depending on current energy supply practices
- We face risks associated with climate and environmental changes caused by current energy practices
- Solutions will come from the private sector – not Governments
- Financing solutions will differ from other technology commercialization models – like IT, telecom, biotech…
- This creates large opportunities for investing (Khosla – “5 Google opportunities from coal gasification…”)
- Buildings, accounting for nearly one-half of energy consumption, are a major source and target of opportunity—monetizing energy and materials savings

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Backdrop: Growth and Value Investing Changes through Time

- % of Energy Stocks in S&P (1980): 33%
- % of Energy Stocks in S&P (2000): 6.5%
- 1960-1980: Energy stocks are growth
- 1980-2000: Energy and materials stocks are deep value stocks
- Soaring consumption + strained energy and raw materials supplies = soaring need for investment capital + innovation need

Primary Capital Markets Need for the Coming Two Decades

- Gas and Liquid Fuels: $20 Trillion worldwide (in contrast with $0 net of depreciation from 1980-2000)
- Building Materials & Techniques
  - Even if we got everything else right with investing and the environment, building stick-frame structures alone for 2 billion people moving from subsistence to moderate consumption levels would precipitate an ecological, economic, and natural resources disaster

Why Consider Clean Energy?

- "Dirty" (high emission and low efficiency) energy is going to become increasingly expensive both as sources become harder to access and as the environmental cost is added to the market cost via regulation and incentives.
- The increasing cost of dirty energy creates a real business opportunity for clean energy solutions.

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Part 1 - Energy Supply

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Energy

Two Scenarios 180º Apart

1. As prices increase we will find more oil and gas which can be economically brought to the market. No serious problem for 50+ years. By then new technologies and sources will be available.

2. The existing reserves are grossly overestimated and the entire energy supply chain is about to break. Prices are on a steep upward climb. Economies will be seriously damaged and energy will increasingly become a cause for conflict impacting our children and grandchildren.

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If the Energy Industry is Correct
(i.e. Scenario 1 is right)

- We have nothing to worry about for the next 30 years except environmental concerns
- Oil and gas will continue to be plentiful and relatively cheap
- No major modification needed in our behavior and policies

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If we are on the edge of an energy crisis

(i.e. Scenario 2 is right)

- We face severe economic impact
- Potential social upheaval
- Need to act immediately

This scenario is articulated in several books and papers by Matthew R Simmons, e.g. “Twilight in the Desert”

Energy Use Has Not Followed Predictions

Consumption growth exceeding supply growth

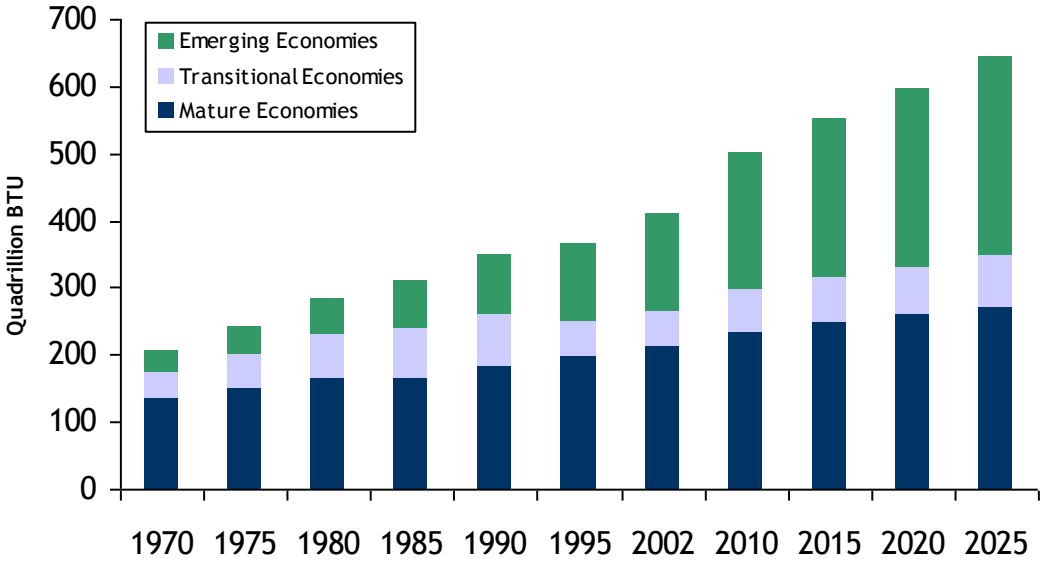
- China and India consumption growth
- Cost increases not creating major shifts in consumption in the West
- View that OPEC has left money on the table is limiting downward price pressure
- Proven reserves might be much smaller than thought

Photos - Industrial growth in China
Source - Simmons & Company International

Energy Market Outlook

Global energy demand is growing rapidly

Forecasted Global Energy Use (1970 - 2025)



- Total world consumption of marketed energy is expected to expand from 412 quadrillion British thermal units (Btu) in 2002 to 645 quadrillion Btu in 2025, or a **57-percent increase** over the 2002 to 2025 time period
- The emerging economies, driven by China and India, will account for nearly **two-thirds** of the increase in world energy use, surpassing energy use in the mature market economies for the first time in 2020.

Approximately $17 trillion in new investment will be needed over the next 25 years to meet future energy demand

Source - Energy Information Administration

The Supply Chain Was Near a Breaking Point Before Katrina, Rita and Alaska Shutdown

- All aspects of the system from the wellhead to pipelines and tankers to drilling rigs to refineries were at or near 100% before Katrina.
- Capacity lost by Katrina and Rita exceeded spare capacity
- Massive capital requirements to upgrade refinery infrastructure
- Is the system breaking?

Source - Simmons & Company International

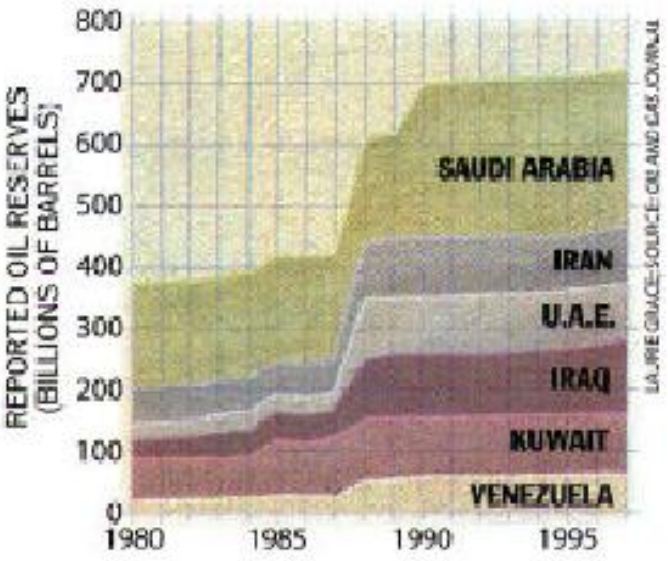
Security Risk of Oil Supplies

Increasing dependence on politically and economically unstable countries for oil and gas imports

- Terrorism in Nigeria, Saudi Arabia, and Iran
- Ongoing dispute in Iraq
- Political philosophies in Venezuela

Are Reserves Real?

- Five major Saudi fields are 30 years old and more than 50% depleted
- No new major discoveries of comparable magnitude
- Cost of extraction increases rapidly after 50% depletion
- Data on reserves are suspect at best – the industry and producing countries are more motivated to exaggerate reserves



SUSPICIOUS JUMP in reserves reported by six OPEC members added 300 billion barrels of oil to official reserve tallies yet followed no major discovery of new fields.

Sources - Simmons & Company International and *Scientific American* March 1998

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Colin J Campbell and Jean Laherrere

Quote from “The End of Cheap Oil”

***Scientific American* March 1998**

- *"The next oil crunch will not be so temporary. Our analysis of the discovery and production of oil fields around the world suggests that within the next decade, the supply of conventional oil will be unable to keep up with demand. This conclusion contradicts the picture one gets from oil industry reports, which boasted of 1,020 billion barrels of oil (Gbo) in "Proved" reserves at the start of 1998. Dividing that figure by the current production rate of about 23.6 Gbo a year might suggest that crude oil could remain plentiful and cheap for 43 more years—probably longer, because official charts show reserves growing.*
- *Unfortunately, this appraisal makes three critical errors. First, it relies on distorted estimates of reserves. A second mistake is to pretend that production will remain constant. Third and most important, conventional wisdom erroneously assumes that the last bucket of oil can be pumped from the ground just as quickly as the barrels of oil gushing from wells today. In fact, the rate at which any well—or any country—can produce oil always rises to a maximum and then, when about half the oil is gone, begins falling gradually back to zero."*

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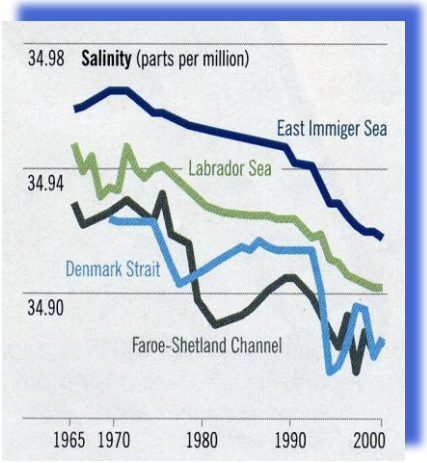
Part 2 - Environmental Issues

Effects of Energy/CO_2 on the Environment

- Climate Change
  - Gradual change (temperature, rainfall)
  - Extreme events (hurricanes, droughts)
- Surface Ocean Change
  - Warmer, fresher, more acidic
- Sea-level Rise, due to
  - Glacial melting
  - Thermal expansion of water
- Changes to Ecology
- Disease Vectors, spreading to new places

Environmental Concerns

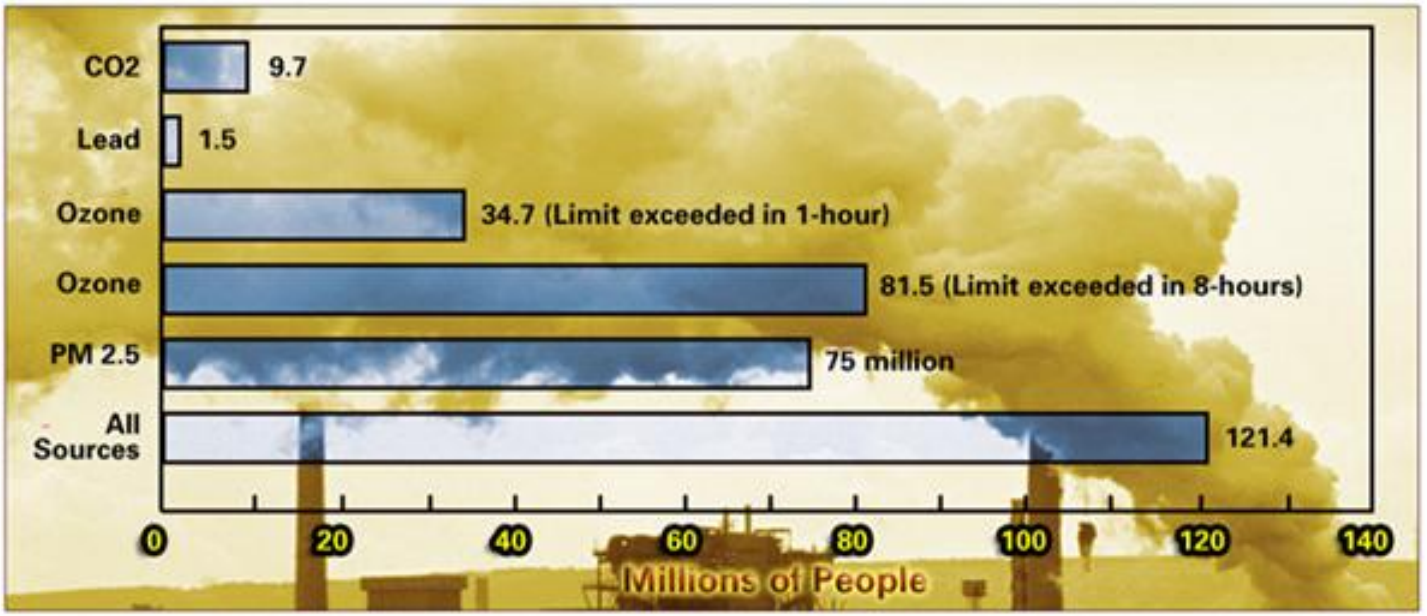
Declining Salinity in N. Atlantic Ocean:



Satellite Views of Arctic Icecap in 1970 and 2003:

- "Data from Arctic ice suggest that atmospheric changes preceding earlier collapses [Ice Ages] were dismayingly similar to today's" **Fortune, 2/9/2004**
- Historical data suggest abrupt climate changes—dramatic transitions unfold over a decade
  - –3-4% of ice cap has melted/decade since 1970
  - –2003: Arctic's largest ice shelf (443 km^2) broke up releasing an ice-dammed fresh-water lake into the ocean (similar to event 8,200 years ago that precipitated an ice age)[1]
  - –N. Atlantic's salinity has declined continuously over last 40 years
  - –Flow of cold, dense water that N. Atlantic Norwegian channel has dropped 20% since 1950—suggesting a weakening current

Environmental Concerns (cont.)



Number of people living in counties where air quality levels exceed safe standards established by NAAQS (National Ambient Air Quality Standards). PM2.5 is particulate matter less than 2.5 microns. (EPA, Latest Findings on National Air Quality: 2000 Status and Trends.)

–More than 75 million people in the U.S. live in areas where the air concentrations of particulate matter smaller than 2.5 microns (PM2.5) exceeds "safe" levels.

–60,000 people die prematurely in the US from air pollution.

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More Americans die from inhaling particulates than from auto accidents.[1]

- **Elderly:**
  - **–Exacerbates symptoms and side-effects of diabetes**
  - **–Enhanced risks of emphysema, lung cancer, cardiovascular diseases, respiratory diseases**
- **Children:**
  - **–Enhanced incidence of asthma, ENT infections**
    - **•Deeper inhalation, trapping more particulates**
    - **•Higher metabolic rates, breathe more than adults**
    - **•More outside exposure**

[1]Based on NRDC study. Boston Globe, Scott Allen. Example, in Eastern MA, 792 persons died from PM air pollution, 410 killed in auto accidents.

	Metropolitan Area	Estimated Annual Cardiopulmonary Deaths Attributable to Particulate Air Pollution
1	LOS ANGELES-LONG BEACH, CA	5,873
2	NEW YORK, NY-NJ	4,024
3	CHICAGO, IL	3,479
4	PHILADELPHIA, PA-NJ	2,599
5	DETROIT, MI	2,123
6	RIVERSIDE-SAN BERNARDINO, CA	1,905
7	SAN FRANCISCO-OAKLAND, CA	1,270
8	PITTSBURGH, PA	1,216
9	ST. LOUIS, MO-IL	1,195
10	CLEVELAND, OH	1,161
11	PHOENIX, AZ	1,110
12	ANAHEIM-SANTA ANA, CA	1,053
13	SAN DIEGO, CA	999
14	ATLANTA, GA	946
15	HOUSTON, TX	939
16	TAMPA-ST. PETERSBURG, FL	938
17	BALTIMORE, MD	861
18	NEWARK, NJ	819
19	BOSTON-LOWELL-BROCKTON-. .MA	792
20	DALLAS-FORT WORTH, TX	743
21	MIAMI, FL	645
22	CINCINNATI-HAMILTON, OH-KY-IN	617
23	NASSAU-SUFFOLK, NY	605
24	WASHINGTON, DC-MD-VA	588
25	MILWAUKEE, WI	518
26	KANSAS CITY, MO-KS	507
27	SEATTLE-EVERETT, WA	501
28	MINNEAPOLIS-ST. PAUL, MN-WI	495
29	INDIANAPOLIS, IN	494
30	FRESNO, CA	488
30	SACRAMENTO, CA	488

How Will Environmental Costs be Converted to Market Costs?

- Regulations:
  - Kyoto Protocol
  - Robust European & Asian renewable energy mandates
  - State Renewable Portfolio Standards in 22 states
  - California AB 32 Global Warming Solutions Act
  - Regional Green House Gas Initiative
  - **Kyoto II (?)**
- Incentives
  - EU Emissions Trading Scheme
  - 2005 U.S. Energy Bill (PV and BioFuel tax credits)
  - **Kyoto II (?)**

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Part 3 – The Business Opportunity for Clean Energy

Cleantech 2.0

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If an energy or environmental crisis is probable, why isn't the US government addressing the problem?

- Experts in "old technologies" and "old ways of thinking" dominate government policies.
- Inertia for old ideas can create barriers for new ideas (e.g. Fuel Cells and a "Hydrogen Economy.")
- Private sector has much more flexibility to experiment with radical ideas.

"We cannot solve today's problems by thinking the way we thought when we created them." Albert Einstein

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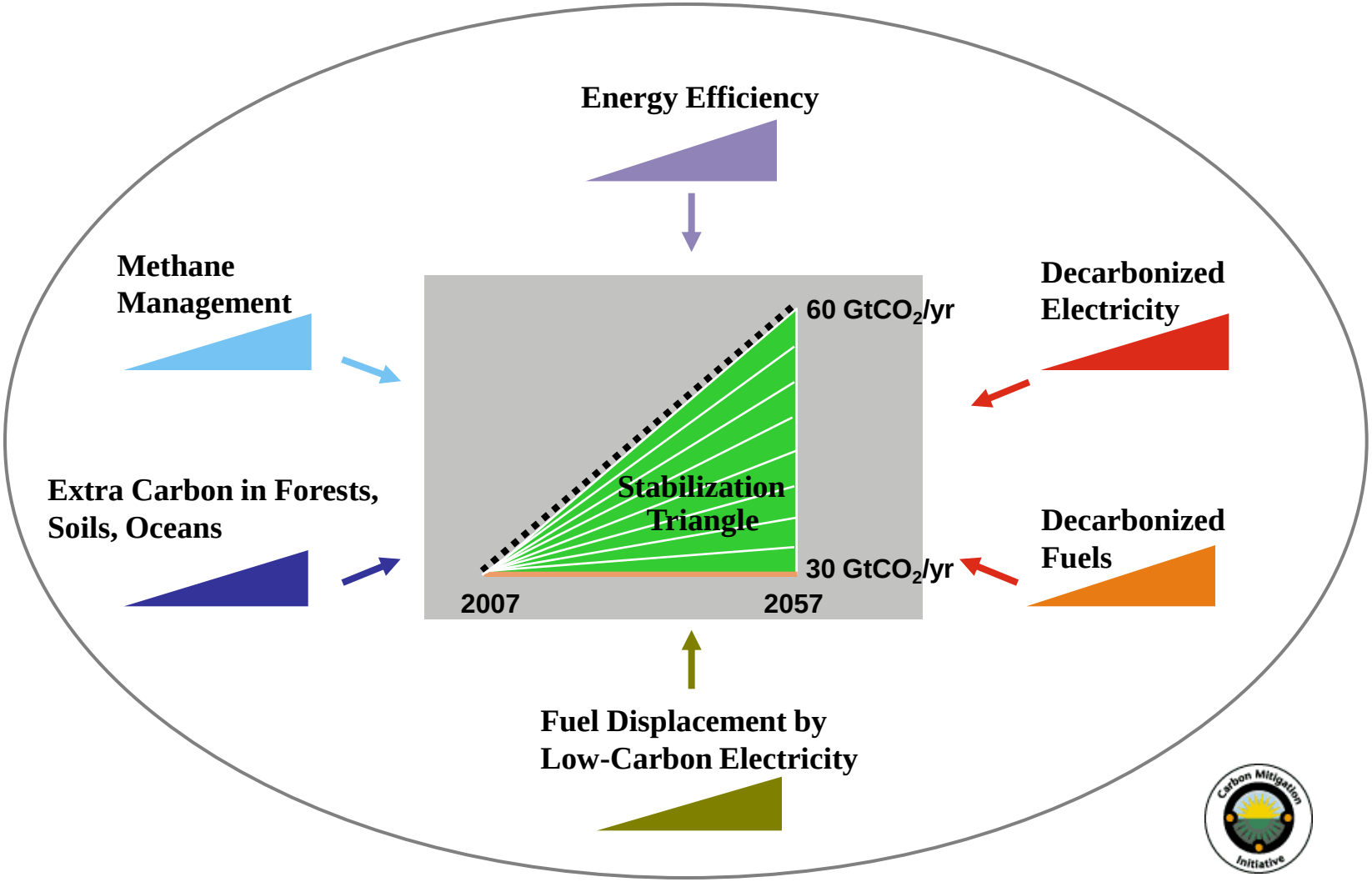
Why hasn't venture capital solved our energy problems by stimulating innovation in energy?

- Larger capital requirements to demonstrate commercial viability.
- Longer liquidity cycles.
- Innovators do not have a history of interacting with venture capitalists (<1% of VC investments in 2003 were in the energy sector.)
- Many VC general partners lack energy sector knowledge and energy innovation expertise.

What is the Solution?
"Cleantech 2.0"

- Multiple approaches are needed to fight climate change and pollution such as:
  - Technology innovations
  - Scale up financing
  - Conservation and shifting to more efficient energy use
  - Shift sources of energy

Fill the Stabilization Triangle with Eight Wedges in Six Broad Categories



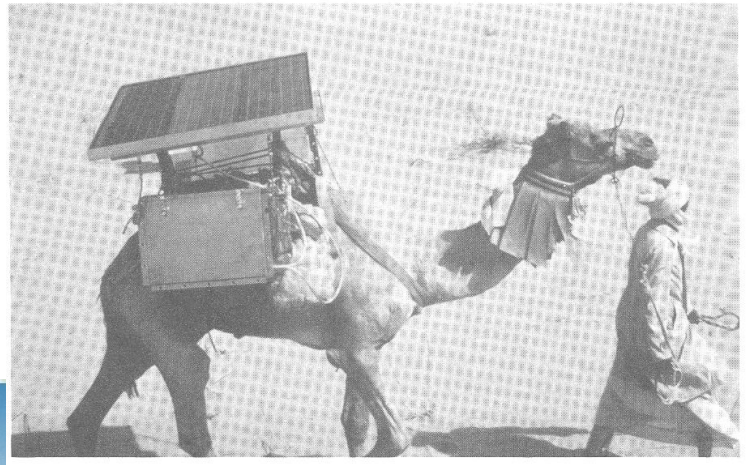
Efficient Use of Electricity

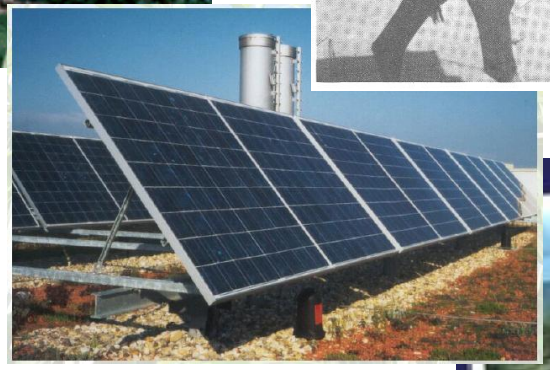
cogeneration

Effort needed by 2055 for 1 wedge:

25% reduction in expected 2055 electricity use in commercial and residential buildings.

Photovoltaic Power





Effort Needed by 2055 for one wedge:

2000 GW_{peak} (400 x current capacity.)

2 million hectares (80 x 100 miles.)

Photos - DOE Photovoltaics Program

Power with Carbon Capture and Storage

The Wabash River
Coal Gasification Repowering Project

Photo - DOE Office of Fossil Energy

Effort needed by 2055 for 1 wedge:

Carbon capture and storage (CCS) at 800 GW coal power plants.

CCS at fuels-from-coal plants producing 30 million barrels per day.

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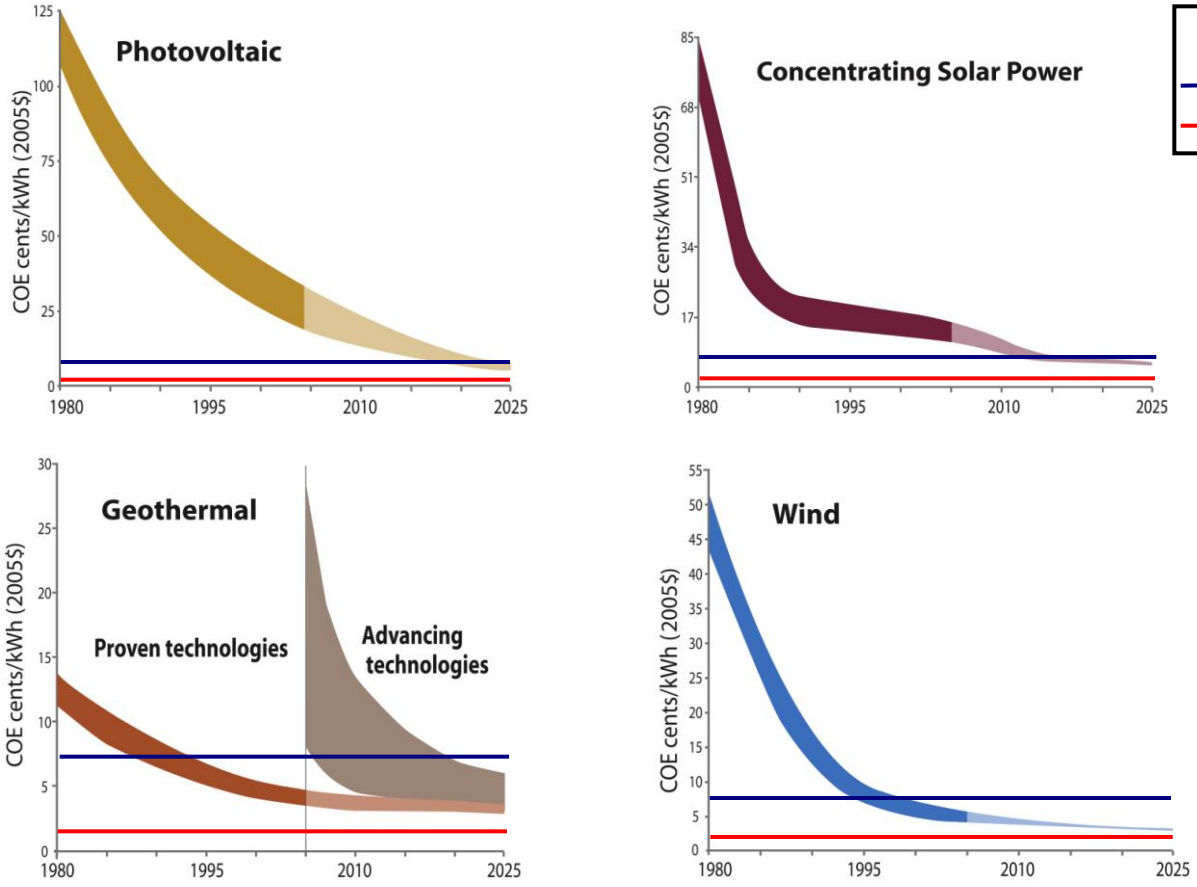
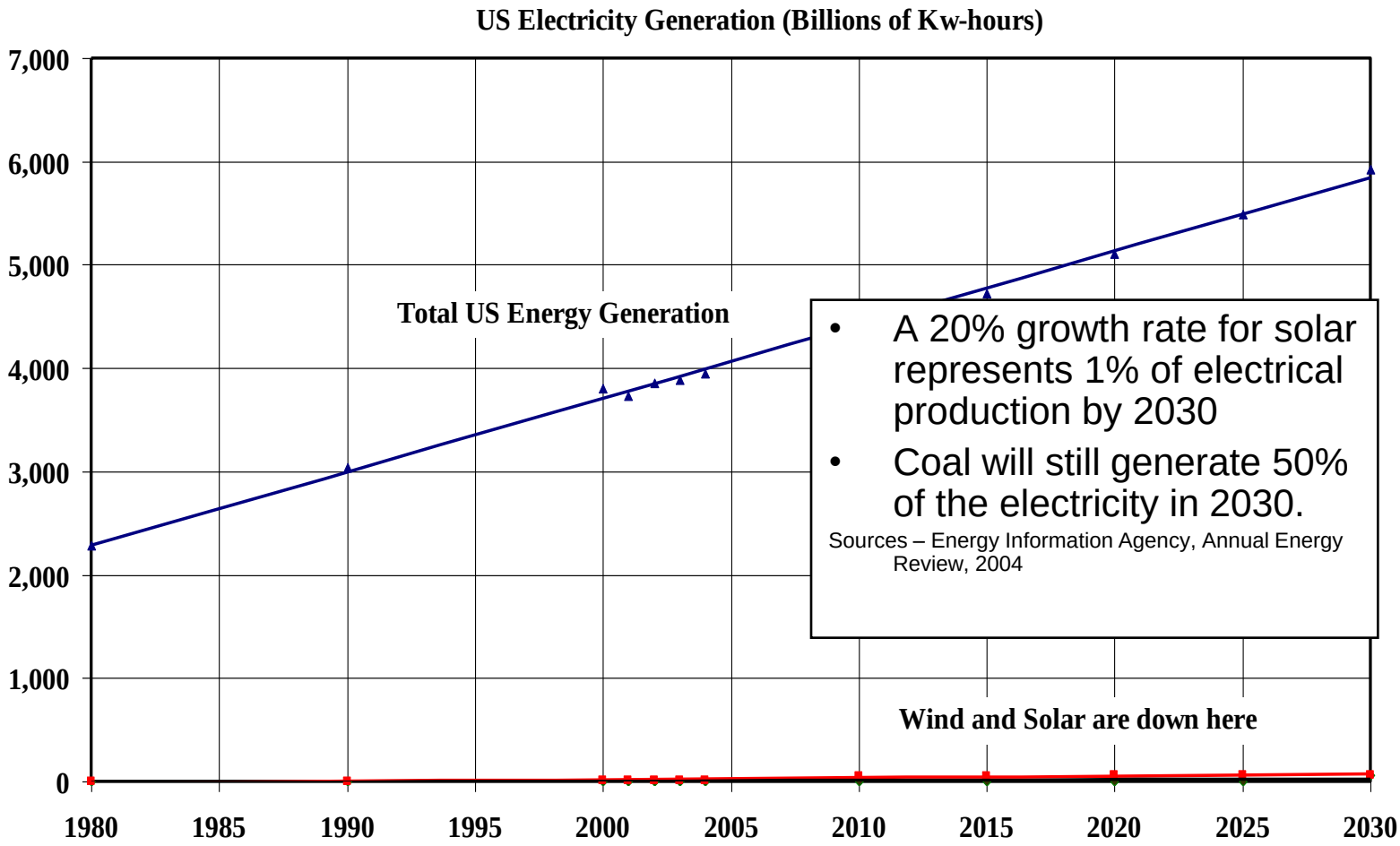
Renewable Energy Costs on Path to be Competitive with Gas and Coal

Forecast and Historical Real Cost Trends of Renewable Energy



Source: NREL Energy Analysis Office
Costs are based on constant 2005 dollars

Coal will be most of the mix in 2030



- A 20% growth rate for solar represents 1% of electrical production by 2030
- Coal will still generate 50% of the electricity in 2030.

Sources – Energy Information Agency, Annual Energy Review, 2004

What is Cleantech 2.0

Funding at Critical Mass

- The need to invest throughout the spectrum from venture startup to commercial scale-up

Capable of De-risking Technology Investing

- Energy solutions will be multi-disciplinary – we need broad expertise in science and engineering

Value Added Investing

- Hands on – governance and network of connections

Target Areas

- Green Buildings
- Clean Technology
- Natural Resources (energy, materials, timber...)

Green Buildings

- Buildings ~ 40% of consumption
  - Innovative financial solutions for green investments
  - Technology solutions show the possibility to reduce building consumption by 60% or more while making a superior and more desirable product.
    - Insulation – new aero gels, no air or water penetration 2.5 cm = 25cm of conventional insulation.
    - New lighting
    - New Controls
    - New skin – fiber reinforced composite eliminates seals and joints integrates windows
    - New construction techniques – very light weight, prefab, far less weight moved to site, fewer trades, much less water, much lower carbon footprint, computer controlled machining
    - Access to scale – large projects that enable new construction techniques

Conclusions (revisited)

- Energy and materials technology advances are likely to be center stage in the world from an investment and basic research perspective
- Environmental and ecological imperatives will become increasingly binding but also the source of new investment opportunities
- Both retrofitting and new construction will be major areas for new business expansion