LECTURE 23
ENERGY LIFELINES
KEYS

- Energy runs the modern economy
  - Resources matter!
- Geographic split of global demand & supply
  - Moving frontier & key role of distribution
- Energy supply is a matter of state
  - But having lots of oil can be a curse
- Electricity use is rising rapidly
  - The grid is crucial
- Deregulation failed
  - How about conservation & alternative supplies?
ENERGY LIFELINES

I. Chain of Fuels
II. The Great Game
III. Electric Avenue
IV. Greener Pastures?
I. Chain of Fuels
   A. Petro-Economy
   B. Profligates & Pretenders
   C. Pumps & Pipelines
Fuel & Industrial Revolutions

US Coal Production

- Bituminous
- Anthracite

Total Production to 1998 = 61.8 Gigatons

US Oil Production and Imports

- Production
- Imports

Year

Millions of Short Tons

1800 1850 1900 1950 2000

1200

11

10

9

8

7

6

5

4

3

2

1

0

1100

1000

900

800

700

600

500

400

300

200

100

0


Million Barrels Day

0

1

2

3

4

5

6

7

8

9

10

11

0

100

200

300

400

500

600

700

800

900

1000

1100
What do we use oil & gas for? EVERYTHING

U.S. Oil Demand by Sector, 1950-2002

- Transportation
- Res'l/Comm'l
- Industrial
- Electric Gen.
- Transp. Sector Share
Industry

- Fuel
- Feedstock
  - Plastics
  - Fertilizer
  - Etc.
- Modern petro-products
Agriculture

- Petro-farming
  - Fuel
  - Fertilizer
  - Pesticides
  - Water pumps
Transport

- Cars
- All supply chains
  - Trucks
  - Trains
  - Planes
  - Ships
- Types of fuels
Light & Heat

- Most domestic use is for heating
- Electric generation
  - (see below)
I. Chain of Fuels

A. Petro-Economy

B. •Profligates & Pretenders

C. Pumps & Pipelines
Global Fuel Consumption
Excess Oil Demand in North
US vs. World

- America, the fuel hog
Bush plan would boost big SUVs

Owners of small businesses could immediately deduct entire cost

By Danvers Habib

DETROIT — The Bush administration's economic plan to boost the sagging sales of the largest vehicles — those that weigh more than 4,500 pounds fully loaded — is expected to provide a windfall for the companies that make them.

The plan, which Congress is expected to consider this week, would allow companies to deduct the entire cost of buying such vehicles, even if they are not used for business purposes.

The move is designed to boost the sagging sales of the largest vehicles, which have faced a backlash from environmental groups and safety regulators.

The plan would also extend the tax benefits to companies that buy smaller vehicles, including gas-electric hybrids and conventional hybrids.

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China Enters the Stage

- Chinese consumption rising fast
- US + China = 50% of global consumption
I. Chain of Fuels

A. Petro-Economy

B. Profligates & Pretenders

C. • Pumps & Pipelines
Energy: World’s Biggest Industry

- Vast production system
- Massive capital investment
- Hugely profitable
- Giant corporations
- Rich states
- Global vanguard
Geographic Frontier

- Geography of supply =
  - Deposits + discovery + access + extraction

- The frontier begins in the core, then moves out
  - Coal fuels industrial revolution in Europe & US
    - Still fueling China & Asia today
  - Oil & gas move farther away
U.S. Coal & Oil

- Coal
  - E. Pennsylvania
  - W. PA. & Appalachia
  - Midwest
  - Rockies

- Oil
  - Penn.
  - Midwest
  - Oklahoma
  - California
  - Texas
  - Louisiana
Coal Still Strong

- Mostly self-supplied
- Intensification

![Coal mining scene]

**Energy Sources Pie Chart**

- Petroleum: 40%
- Nuclear: 8%
- Renewable: 7%
- Natural Gas: 22%
- Coal: 22%
- Solar: 1%
- Hydroelectric: 41%
- Geothermal: 5%
- Biomass: 49%
- Wind: 4%

Total = 99.861 Quadrillion Btu
Total = 6.922 Quadrillion Btu
Mid-20\textsuperscript{th} Century Oil

- Mexico & Venezuela
- Russia & Central Asia
- Persian Gulf
Into the Deep

- California to the Gulf
- North Sea to Africa
New Frontiers

- Africa
- Central Asia
- Amazonia
Distribution – Still Key

- Pipelines
- Ships
- Trains
- Trucks
Oil & Gas Pipelines

- Vast networks
- Hidden from view
Shipping

Major oil trade movements
Trade flows worldwide (million tonnes)

- USA
- Canada
- Mexico
- S. & Cent. America
- Europe & Eurasia
- Middle East
- Africa
- Asia Pacific

2003
Trains & Trucks
And Don’t Forget Processing

- Refining: a key link in the chain
- Multiple inputs, multiple outputs

This simplified drawing shows many of a refinery’s most important processes.
Geography of Refining

- Near markets or sources
Control of Refining

- Past: Rockefeller’s Standard Oil built on control of refining & distribution
- Present: Supplier nations building more refineries to gain value-added
ENERGY LIFELINES

I. Chain of Fuels
II. •The Great Game
III. Electric Avenue
IV. Greener Pastures?
II. The Great Game

A. Prices & Peaks

B. Politics & Great Powers

c. Petro-Curse?
Price-setting

- Contracts & spot markets
- Global markets
  - London: International Petroleum Exchange
  - New York: NYMEX
- Bottlenecks & panic
  - When we notice...
Price trends?

- Long term
- Crisis peaks
- Role of OPEC
OPEC as Boogey Man

- Strength in numbers
  - Post-colonial oil nations organize c 1970

- 1973 war & boycott
  - OPEC becomes the enemy

- In fact, OPEC often lowers prices by raising output
$100 & up!

- Global demand rising
  - Iraq war & supply fears
- Refinery capacity
  - Big oil games?
- Financial speculation
  - Hedge funds 2006-08

A June 2006 US Senate Permanent Subcommittee on Investigations report on “The Role of Market Speculation in rising oil and gas prices,” noted, “…there is substantial evidence supporting the conclusion that the large amount of speculation in the current market has significantly increased prices.”
Fears of Exhaustion

When the world runs out of gas

The world's oil production is expected to peak at current growth by mid-century, however, escalating oil prices might open oil fields that previously could not have been mined profitably.

Possible peak of world oil production*
(In barrels per year)

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak Attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>2047</td>
<td>Least probable peak</td>
</tr>
<tr>
<td>2026**</td>
<td>Most probable peak</td>
</tr>
</tbody>
</table>

*Assumes 2 percent growth and constant decline that follows an American model.
**95 percent probability. Least probable high in 2047 has a 5 percent chance.

Source: Energy Information Administration

Figure 1

- Oil buyer's market → seller's market
- Actual production
- Previous rollovers
- Forecasted production
Projecting Our Own Fears

- US production decline
- US excess consumption
II. The Great Game

A. Prices & Peaks

B. Politics & Great Powers

C. Petro-Curse?
Politics & Great Powers

- Remember about states & economies?
  - States want to secure energy supplies
- Remember imperialism?
  - Great Powers maneuver over energy
War in the Persian Gulf

- Iranian Revolution
  - Panic in the oil markets
  - Iran-Iraq War
- Kuwait & First Gulf War (1990-91)
  - Saddam oversteps
- Iraq War (2003-10)
  - Not just about Iraq’s oil...
Politics of Pipelines

- The Great Game Revisited
  - Russia vs. US
  - Russia vs. EU
  - Russian & Central Asia
  - Wars in Chechnya, Georgia

Kazakhstan, oil firms end dispute

ChevronTexaco and partners can expand operations in Central Asian nation.
From Russia without Love

- Russian revival (2000s)
  - Putin & Russian state
  - Nationalization of oil & gas
  - Growth via rents
- Russia & Europe
  - EU in its grip
  - European pipelines
- Russia & Central Asia
  - Reasserting its presence
  - Cutting oil & gas deals
Into Africa

- Oil >50% of all FDI
  - US oil corps invested $40 billion, 1995-2005
  - US African Command
- Europeans
  - Shell in Nigeria
  - Total in French zone
China Enters the Game

- China in Central Asia
  - Shanghai Coop Org.
  - Deals & investments

- China in Africa
  - Oil, minerals, land
  - Deals & investments

- China in East Asia
  - Vs. Japan over oil & gas
  - SE Asia oil

- Where will it lead?
II. The Great Game

A. Prices & Peaks

B. Politics & Great Powers

c. Petro-Curse?
Oil Wealth

- Rents
  - Natural gifts
  - Cheap to produce & valuable to sell

- Profit
  - Return on capital
  - Search, pumping, refining, distribution

- Oil makes rich, right?
  - Oil men, for sure
Cursed Countries

- When oil wealth is misused
  - Rentier class & waste
    - Conspicuous consumption
    - Overseas banks accounts
  - Failed states
    - Dictatorships & patronage
    - Conflict & civil war
Oil & Development

- National independence & control of resources
- Pushing aside oil corps.
  - Down to 13% of stock
- Investment & urbanization
  - New financial centers in Persian Gulf
- Playing the global game
  - Saudis, Iran, Venezuela, etc.
Oil Rules – even here

- Rockefellers & NY
- Bush & Texas oilmen
- Gulf oil & the blowout
- Coal & Appalachia
- Coal & Global Warming
ENERGY LIFELINES

I. Chain of Fuels
II. The Great Game
III. Electric Avenue
IV. Greener Pastures?
III. Electric Avenue

A. Growth

B. Generation

C. Grids
Growing use of electricity

World of electrical appliances & electronics
Who uses electricity?

- NB: industrial v. household use
III. Electric Avenue

A. Growth

B. Generation

C. Grids
Sources of Electricity

- **Primary**
  - fossil fuel, esp. coal
- **Secondary**
  - hydro
  - nuke
- **Minor**
  - wind
  - thermal
  - solar
  - tidal
Different Places, Different Mixes
US fossil-fuel power plants

Figure H.2  IPM Inputs of U.S. and Canadian Fossil Fuel-Fired Power Plants Showing Locations and Characteristics of the Plants Used in IPM

Source: EPA
Hydropower in US

Legend:
- Orange: High Head/Low Power
- Yellow: Existing Hydroelectric Plant
- Purple: Exclusion Area
Nukes in America
III. Electric Avenue

A. Growth

B. Generation

C. Grids
Multi-scale Grids
Why the Grid?

- Nature of supply
  - long distance
  - no storage
  - shared

- Benefits of the grid
  - Link wide sources & users
  - Smooth variance
ENERGY LIFELINES

I. Chain of Fuels
II. The Great Game
III. Electric Avenue
IV. Greener Pastures?
IV. Greener Pastures

A. Government

B. Greed & Gaming

C. Gaining Ground?
Governing the Grid

- Nationalized systems
  - E.g., France & China
- Regulated systems
  - US, UK, etc.

- Why?
  - Natural monopolies
  - Heavy sunk costs, not profitable
  - Critical infrastructure
    - Everyone depends on it
Deregulation, in Theory & Practice

- Split up system
  - grid, generation, marketing

- Advantages
  - Flexibility (many suppliers, many users)
  - Innovation
  - Profit

- Failures
  - Grid is low profit, undercapitalized
  - Generation underfunded if prices low
  - Brokers can ‘game’ system
  - Poor coordination, no one in charge
Meltdown!!

- Northeast 2002
- Italy 2002

Electricity coming back after U.S. blackout

Is Europe susceptible to U.S.-style power loss?

By Eric Plumer

LONDON: A widespread blackout like the one that struck the United States and Canada on Thursday may be slightly less likely in Europe, experts said Friday, but they warned that regional vulnerabilities mean crippling localized outages could become increasingly common.

The energy industry has suffered from a global shortfall of investment in recent years, and while it may have been most pronounced in the United States, Europe has not been immune, and its potential weaknesses were demonstrated during the recent heat wave.

While European power providers largely managed to meet the strain, increased demand in energy consumption rises -- if, for instance, more Europeans buy air conditioners -- could push the system to the breaking point in the future, analysts said. And vulnerabilities stemming from accidents can never be eliminated entirely.

At the end of the day, anything can happen anywhere, said Jeremy Wilcox, an independent energy consultant in...
Third world’ grid takes blame for power failure

by David Firestone
and Richard Pérez-Peña

WASHINGTON: While energy experts disagreed on the precise cause of the power blackouts, they were in agreement that the extensive failure betrayed the age of the Northeast’s transmission system and its failure to keep up with demand.

“We are a major superpower with a third world electrical grid,” Governor Bill Richardson of New Mexico, the energy secretary in the Clinton administration, said Thursday. “Our grid is antiquated. It needs serious modernization.”

The power system in the Northeast has long been plagued by inadequate transmission capacity and bottlenecks nationwide, especially in the New York metropolitan area.

During times of peak demand, most power is produced in New York City and in nearby Long Island and must be transported by newly available main lines, the former line through the Hudson River and into the New York City area, and the latter through the Long Island Sound. These lines have been in service for years.

“Without excess power in upstate New York, but there’s no way to get it to New York City because of the bottlenecks,” said Denise Van Buren, president of Central Hudson Gas & Electric, which supplies power to eight counties north of New York City. “It’s very difficult to get the grid to work because of the limited transmission capacity.”

A power failure can spread quickly when generators try to send their power to areas that need it, overloading a limited number of high-voltage lines.

Grid problem anticipated

FERC questioned its reliability more than year before blackout

By Brad Foss

Long before many of the Northeast’s utilities joined the regional power pool run by the New England Power Pool, the market was suffering from problems that started with the 1991 blackout.

The Federal Energy Regulatory Commission expressed concern more than a year ago that several Midwestern utilities would join in a Northeastern power pool rather than the local equivalent, the New England Power Pool, which could make the flow of electricity and information there much more complex.

The fundamental problem that worried FERC in the Midwest is that the region is more interconnected, the result of a nationwide power network that is often interrupted by piece of paper over decades, leaving weak spots and gaps in controlling the grid.

“Grids are not one size fits all,” said Jay Apt, executive director of the Electricity Industry Center at Carnegie Mellon University in Pittsburgh.

“A grid that’s too flexible can be a disaster,” he added, “in which the model works best in which region and which regulatory environment.”

Regulators’ concern in the Midwest arose when several utilities, including American Electric Power, Dayton Power & Light and Commonwealth Edison, sought participation in the PJM Interconnection of Pittsburgh, Pa.

FERC commissioners questioned whether the Midwest regional grid that serves the region would be better served if these midwest utilities joined the PJM as independent providers.

The question is whether the grid will be too flexible in the Midwest, where the region is more interconnected.

“This problem is that they literally overlap each other,” said research group.

Little incentive for companies to invest in grid improvement

Government intervention seen as crucial

By Brad Foss

Washington — Companies that deliver electricity have had little incentive to make the kinds of capital improvements that might have helped prevent last week’s blackout.

To change, experts say, utilities will need to be allowed to charge more for power.

The Federal Energy Regulatory Commission has ruled that companies are entitled to charge a rate of return on their investments in the power grid.

“Companies need to come up with a clear and consistent rule,” said John W. Dowd, general counsel, and John R. Taylor, executive director of the PJM Interconnection in Pittsburgh.

Rogers said that companies will need to be allowed to charge more for power.

To that end, $26 billion in new power plant spending is planned over the next five years, according to Rogers.

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IV. Greener Pastures

A. Government

B. •Greed & Gaming

C. Gaining Ground?
California Crisis of 2001

Buckets of trouble

A LOOK BACK AT THE ENERGY CRISIS

Three years ago, in May 2001, Californians got their first practical lesson in energy deregulation, as electricity rates began to soar in San Diego, the city where deregulation’s impact was felt by consumers. In the 1970s, rates were lower, but they changed throughout California, including PG&E, and the state began to impose billions of dollars of regulation. Ultimately, the market for free-market economies did not affect the rate of retail deregulation.

Average Wholesale Electricity Prices (in MWh) in California, 1998–2002

<table>
<thead>
<tr>
<th>Year</th>
<th>Price (in $ per MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1998</td>
<td>$50</td>
</tr>
<tr>
<td>4/1999</td>
<td>$100</td>
</tr>
<tr>
<td>4/2000</td>
<td>$200</td>
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<tr>
<td>4/2001</td>
<td>$300</td>
</tr>
<tr>
<td>4/2002</td>
<td>$400</td>
</tr>
</tbody>
</table>

SOURCES: National Bureau of Economic Research and the California Department of Water Resources.

Price spikes in 2000 and 2001 added almost $40 billion to Californians’ energy bills.
California Gets Gamed...

How wheeling, dealing raised energy prices
Regulators say attempts to drive up power costs were industrywide

By Christian Berthelsen and Mark Martin
Chronicle Staff Writers

In December 2000, a trader in charge of trading natural gas for Reliant Resources Inc.'s California plants began engaging in so-called wheeling trades with an Enron unit selling and reselling natural gas at prices that his plants could use. During some periods, the trades cost at a rate of $1.5 million per hour. These deals were hugely profitable for Reliant, which suddenly earned $21.4 million from the transactions. But they also raised prices of natural gas for other buyers by $1.55 per million British thermal units over an eight-month period and boosted the cost of electricity, which natural gas is a key production fuel by $1.5 million during that period.

Reliant was largely involved in what came to be known as the market manipulation of natural gas and effectively bought cheaper gas for resale or export. The company, according to the conclusion of a federal investigation made public Wednesday, was also involved in a broader scheme to manipulate natural gas and electricity markets through a series of transactions designed to influence market prices.

The incident was among several that caused the Federal Energy Regulatory Commission (FERC) to begin investigating Enron and other companies for potential violations of anti-manipulation rules. The FERC investigation was prompted by allegations that Enron and other companies engaged in a scheme to manipulate market prices.

The FERC investigation, which was also spurred by a whistleblower complaint, was focused on whether Enron and other companies had engaged in a scheme to manipulate market prices. The FERC investigators concluded that the company had engaged in a scheme to manipulate market prices and that the company had engaged in a scheme to manipulate market prices.

The FERC investigation also revealed that Enron and other companies had engaged in a scheme to manipulate market prices and that the company had engaged in a scheme to manipulate market prices.
It’s a Crime

Houston firm indicted for role in energy crisis

Reliant Energy is accused of forcing up electricity prices

By Bob Egelko and Mark Martin
CHRONICLE STAFF WRITERS

Reliant Energy Services was indicted Thursday over an alleged plot to artificially boost power prices during the state’s energy crisis, becoming the first company prosecuted for a corporate-wide conspiracy to rip off California consumers.

A federal grand jury in San Francisco indicted Houston-based Reliant and four current and former employees for a June 2000 plan that shut plants and allegedly cost consumers as much as $32 million.

The indictment was welcomed by California officials, who have long blamed misbehavior by power companies for the unprecedented power prices and blackouts that swept the state nearly four years ago. But the same officials also used the indictment to criticize federal energy regulators, who they believe failed to police companies who were allegedly manipulating the state’s energy markets.

“Today’s indictment of Reliant Energy Services for the manipulation of the wholesale electricity market in California is a victory for consumers and one step closer to holding companies accountable for their actions,” said California Public Utilities Commission President Michael Picker.

Enron employee admits his guilt

A former Enron Corp. trader who helped devise the company’s “Cash Shorty” trading scheme pleaded guilty Tuesday to charges that he conspired to manipulate California’s power market during the state’s energy crisis two years ago and also admitted lying to federal agents when first questioned about it last year.

Jeffrey S. Richter, 33, of Houston pleaded guilty to one count of conspiracy to commit wire fraud and one count of making a false statement to a government agent. He has agreed to cooperate with a federal investigation into power companies’ efforts to manipulate the energy markets.

He could get a maximum of five years in prison and a $250,000 fine for each count, although that can be reduced based on his level of culpability and cooperation with the government investigation, according to the plea agreement.

Richter is the second Enron trader to plead guilty to federal charges and agree to cooperate. He was a subordinate of Timothy Enron.

Envisioning the Future

Energy firm agrees to pay $13.8 million

Company drove up prices by withholding power during crisis

By Mark Martin
CHRONICLE SACRAMENTO BUREAU

SACRAMENTO — Adding another piece of evidence to California’s case against energy companies, Houston-based Reliant Energy Resources agreed to forfeit $13.8 million for purposefully shutting down power plants to drive up electricity prices during the state’s energy crisis.

Federal regulators released proof Friday that Reliant worked in the summer of 2000 to withhold energy from the state’s power markets to boost profits.

Transcripts of tape-recorded conversations among Reliant traders and power plant operators reveal frank discussions of market manipulation. “We decided that the prices were too low on the daily market, so we shut down,” one trader said. “Excellent. Excel neat,” noted another.

In a settlement with the Federal Energy Regulatory Commission, Reliant agreed to return $13.8 million to California market participants for its behavior on June 21 and 22, 2000 — a time when electricity prices were first spiking toward the record highs that bankrupted Pacific Gas and Electric Co. and led to blackouts and rate increases.

California consumers are still paying those rates today.

It was unclear Friday to whom Reliant owed the money. The federal energy commission ordered the state’s power market officials to determine that.

The agreement comes amid the state’s final push to convince the commission that greedy energy companies bear much of the blame for the state’s crisis. Lawyers for several state agencies have until Feb. 28 to submit a final report on how companies manipulated state markets.

The commission is expected to decide in March whether the state is entitled to billions of dollars in refunds.

State officials said the Reliant settlement is one more example of corporate misbehavior, which has ranged from memoirs showing how Enron Corp. played unscrupulous trading games to federal judge’s finding that a giant natural gas company withheld gas and helped drive up electricity prices.

“It’s poetic justice. When we first sat down with the generators, their high-priced lawyers insisted that their clients were not culpable for any of our allegations. Now we know,” said state Sen. Joseph Dicano, D-Santa Ana, the chairman of a Senate committee probing the energy crisis.

Another senator criticized the settlement, saying not going far enough. Sen. Debbie Bowen, D-

POWER: Page A21 Col. 5
And Political

- Bush & Co. reward Texas (Enron) & punish California after 2000
Gov. Davis Paid the Piper

Energy crisis pulled plug on Davis, pollster says

Overpriced energy deals that drained the state budget also cost the governor's popularity plenty

Politicians live or die by their defining moment. For George W. Bush, it was Sept. 11. For Gov. Gray Davis, it was the energy crisis of '00 -- and in most voters' eyes, it came up short.

"No question about it," said pollster Mark DiCamillo, who has been tracking Davis for the past five years. "That was the trigger. That's when he crossed the line.

"Look at the numbers," DiCamillo said. "In January of that year, Davis' approval ratings were at 77 percent. Four months later they were under 56 percent. Davis never recovered. In the public's mind, he was fiddling while Rome burned," said UC Berkeley political science Professor Bruce Cain.

"There was a perception that he was slow off the mark in understanding the seriousness of the crisis, and an even deeper suspicion among some Democrats that his ties to the big energy companies kept him from taking them on... for political reasons," Cain said.

"It just brought out all of his negatives -- his adversity to taking risk, his being very slow to make decisions, his need for micromanage everything," said one fellow Democrat who was thrown into the crisis with Davis.

"I remember one Saturday morning. We were all on the hill," said a Democrat who was thrown into the crisis with Davis.

The ups and downs of Gov. Gray Davis

Public opinion of Davis' performance has mirrored that of the economy.

- Nov. 3, 1998: Gray Davis is elected governor of California, winning 56 percent of the vote.
- 1999 and 2000: With the California economy strong, his approval rating stays high.
- April 2001: The state faces a $35 billion budget gap.
- 2001: The bottom drops out of the dot-com economy and the state suffers an energy crisis with rolling blackouts and rate increases.
- Nov. 5, 2002: In his re-election bid, the governor manages to edge out Bill Simon, a little-known Republican.

Note: Results based on 16 statewide telephone Field Pools, the latest conducted July 1-13 among 1,040 registered California voters (sampling error: plus or minus 4.5 percentage points). "No opinion" responses are not displayed.

Why Deregulation Failed in California

- Demand & Supply
  - No investment in new supply during recession
  - Demand shot up fast with boom
  - Hence, shortages developed

- Grid & generation
  - Underinvestment
  - Bottleneck between NorCal and SoCal

- Gaming
  - No long term contracts
  - Generators shut down suspiciously
  - Brokers withheld power in peak demand

- Only the public utilities did well!
IV. Greener Pastures

A. Government

B. Greed & Gaming

C. Gaining Ground?
IDEAS THAT WERE ‘UNINVESTABLE’ NOW GET VC BACKING
By Matt Marshall  San Jose Mercury News 08/15/2004
The idea sparking the latest technology rush is as old as the sun: solar cell energy. After years of shying away from funding solar cell energy start-ups because of high costs, venture capitalists are almost tripping over themselves to sign up the most promising companies, many of them in Silicon Valley.
Silicon Valley Goes Solar

- Lighting up the $1 trillion power market
  - Silicon Valley has changed the world once. Now, thanks to a wave of investment and innovation in solar power, it's on to the next revolution: a massive disruption of the U.S. electricity market.

- Business 2.0 Magazine
  - October 30 2006: 3:01 PM EST
Growth in Solar & Wind in US

It started in California, but we lost the edge
Europe - Center of Windpower
World’s largest solar plant...

- ... in Germany??
- bigger one now in Portugal
Clean China?

- Big advances & emphasis
  - Huge investments, 2X US 2009

- Wind & solar & nukes
  - Experimenting in everything
  - Supporting Chinese companies

- Better grid
  - State Grid Corp. upgrading
Is the Grid Obsolete?

  - Transmission now the biggest cost
  - Most blackouts are from grid failure.
  - No scale economies for powerplants over 1,000 megawatts.
Off the Grid

- Localized production & consumption
  - solar electric
  - solar heating
  - small windmills
What About Conservation?

- National laws & campaigns
  - Japan, Singapore, Germany
  - Japan has reduced energy use by refrigerators by 90% in 10 years

- China has vowed to lower consumption per unit of GDP by 20%
Changing our wanton ways...

- Where’s the impetus?
- High prices
- Leadership
- Social movement

Despite a growing backlash against SUVs, sales of the behemoths are stronger than ever.

CAR WARS
Growing coalition challenges morality of SUVs

By Julian Guthrie
Chronicle Staff Writer

Sue Thiemann, an otherwise mild-mannered Palo Alto resident and Ivy League-trained statistician, has slapped hundreds of faux tickets on Bay Area "mega monsters."

Thieman, who is 48 and married to a clinical psychologist, skips the smaller SUVs, searching instead for Suburbans, which she calls Subhumans, Land Cruisers, derided as Land Bruisers and Excursions, mocked as Extinctions.

"I hate them for environmental reasons. I hate them for safety reasons. Most of all, I hate them for the self-centered, self-absorbed, moral-midget rudeness," Thieman declared.

A mounting SUV backlash reaches from leafy West Coast cul-de-sacs to radical East Coast eco-terror groups, from evangelical asking "What Would Jesus Drive?" to columnists linking trucks with terrorism.

But not everyone is jumping on the same wagon. Despite the criticism, consumers are flocking over truckloads of cash, and SUV sales are stronger than ever.

General Motors sold more than 1.2 million SUVs last year, setting an all-time record. GM's latest addition to the SUV market, the three-ton all-terrain Hummer 2, added nearly $1 billion to the...