Energy 2009 and Beyond

West Virginia 2008 Energy Summit

Roanoke, WV
December 9 2008

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The Situation

- We produce about 5 million barrels of oil a day
- We import about 10 million barrels a day
- Approximately 21% is imported from Canada, 18% from the Persian Gulf and 9% from Venezuela (as of 9-2008)
- The world has about 1.5 to 3.5 million barrels a day of spare production capacity to cover interruption in a particular location
- China's production exceeded consumption up to 1993. U.S. DOE now helping with CTL.
- In the United States approximately 69% of oil is used for transportation

WE HAVE A PROBLEM

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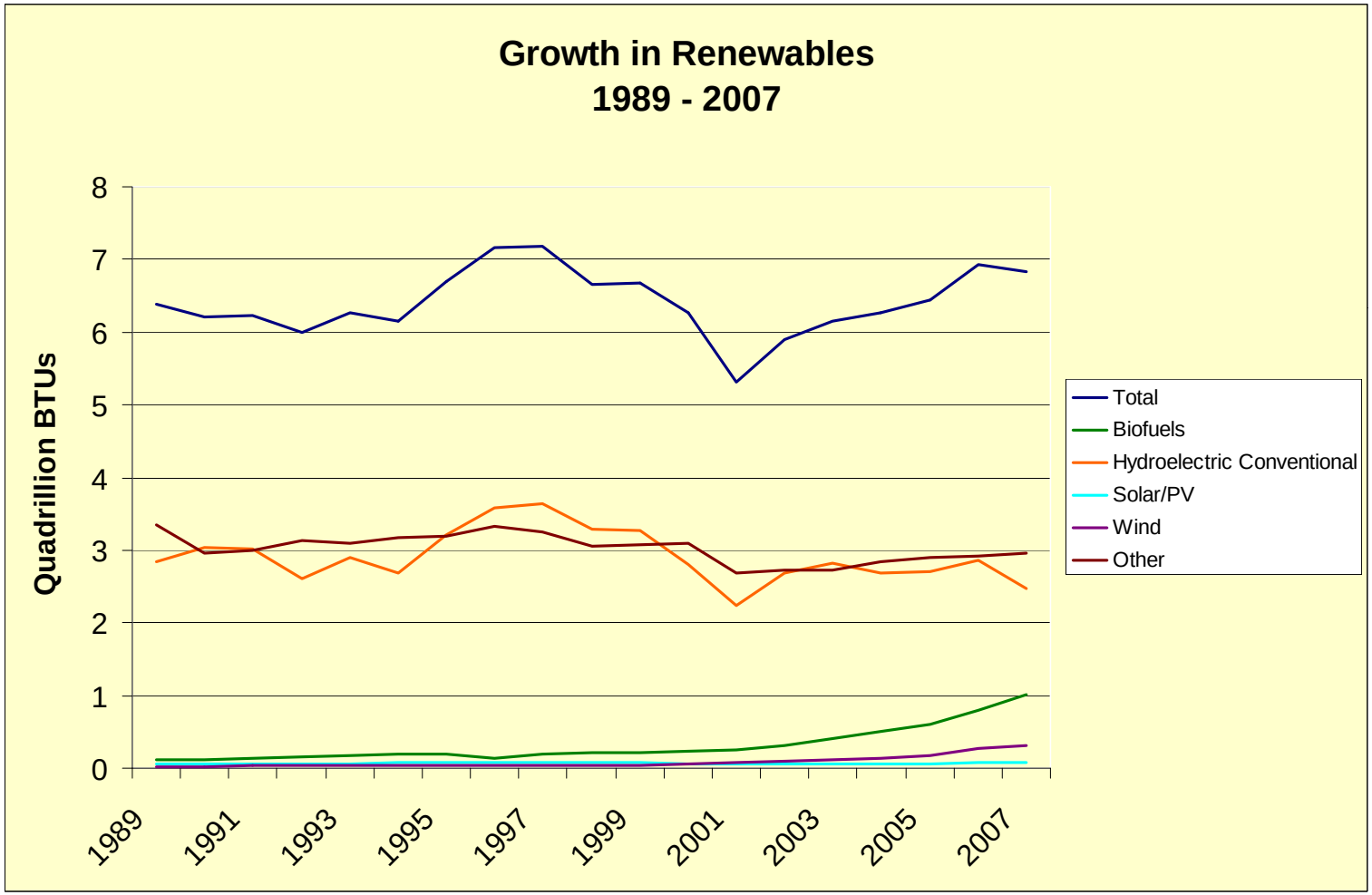
Growth in Renewables



Biofuels include biodiesel derived primarily from soybean oil, and ethanol primarily derived from corn.
Other includes power derived from Geothermal, Waste, Wood and derived fuels

Source: Energy Information Administration (as of July 2008)

Transportation Fuels - Ethanol

- Is it a solution?
- If all corn produced in the US went into ethanol production we would only be able to offset 15% of gasoline consumed
  - Blending with more than 10% ethanol may pose technical problems
- In 2007 about 18% of corn produced domestically went into ethanol production* and this is expected to increase to 30% by 2012**.
- Issues
  - Phase separation
  - Splash blending
  - Eliminates carbon monoxide in winter but may release nitrogen oxide, a component or smog during warmer months
  - Corrosive and a solvent
  - Affinity for moisture
    - Marine issues
  - Not pipeline transport friendly

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** Source: National Corn Growers Association / Renewable Fuels Association*

*** Source: GAO in a Reuters report dated 6-11-07*

Bio-diesel

- Most focus has been on palm oil based bio-diesel
- Palm oil is the most productive oil seed in the world
- Appeared to be a viable offset to crude based diesel
- However, most palm oil is produced in Malaysia and Indonesia
  - Farming plots are created by burning off rain forests which adds 1.4 billion tons of carbon into atmosphere
  - Cultivating the drained swamps releases 600 million tons of carbon
  - These 2 billion tons are equal to 8% of all global fossil fuel emissions

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Coal-to-Liquids (CTL)

- First developed in Germany in 1931.
- Proven technology in use around the world today.
- South Africa has long-relied on coal liquefaction to provide a substantial percentage of its transportation fuels.
- China, India, South Africa, Indonesia and the Philippines all making multi billion dollar investments in coal liquefaction plants, some with U.S. DOE support.
- CTL technologies could provide the U.S. with a key opportunity for diversification of liquid fuel supplies.
- Resulting fuel has a longer storage life than petroleum based fuels.
- Ability to strip out sulfur and CO2.

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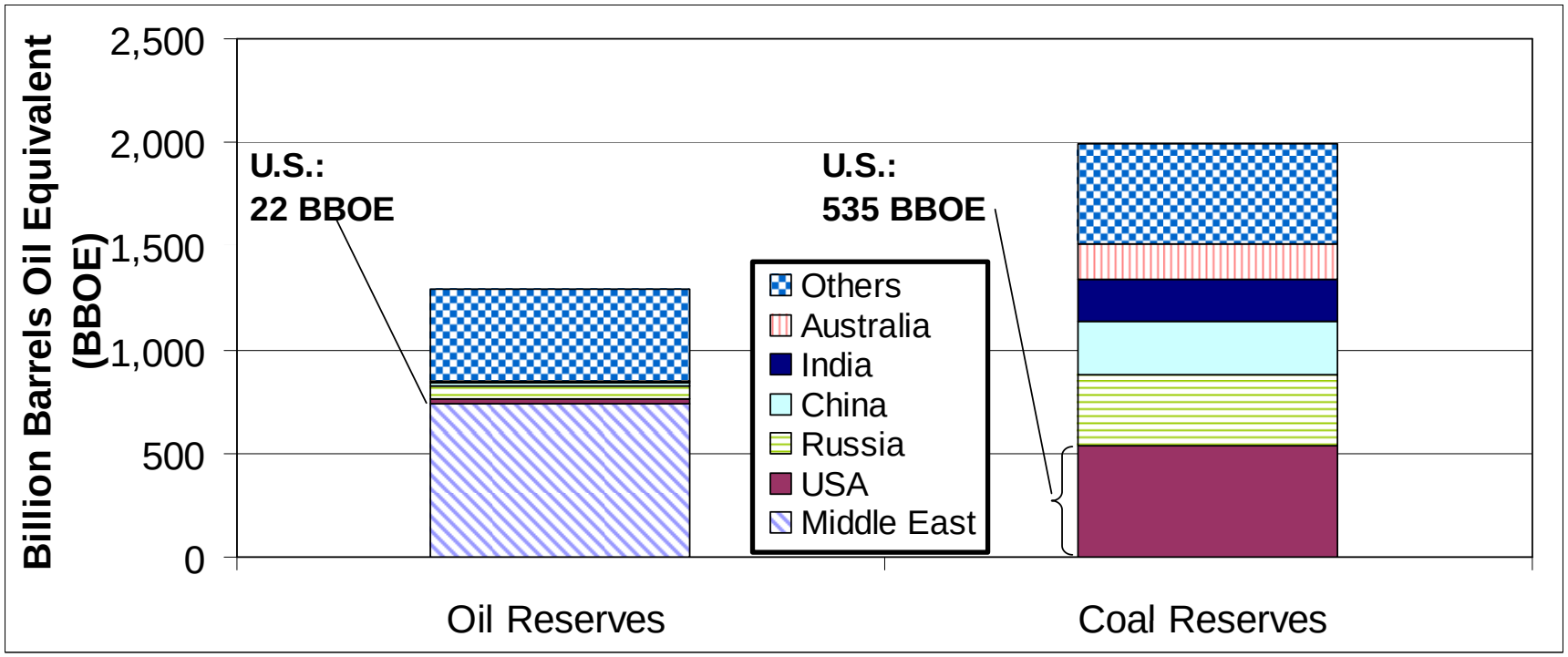
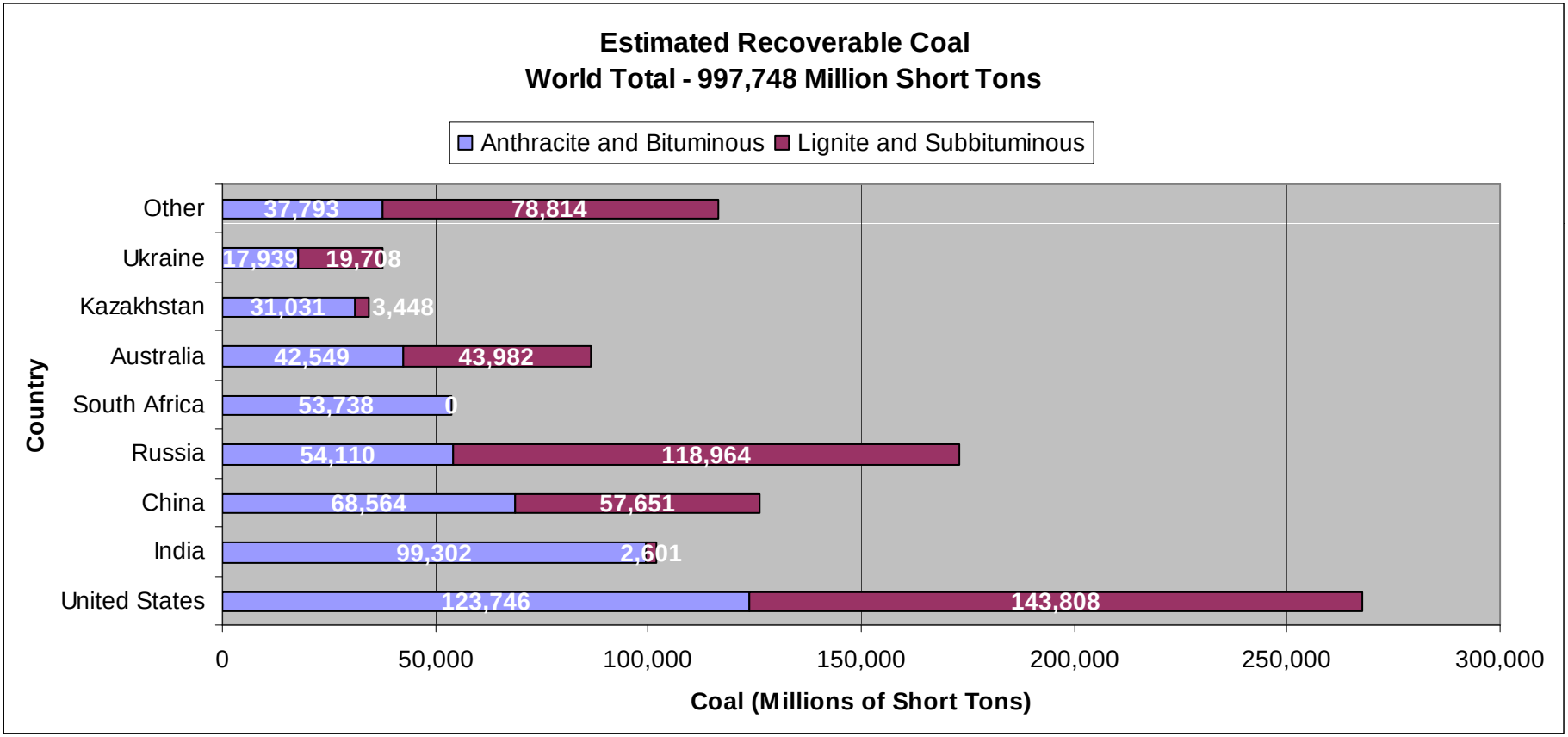
Global Supplies

Comparison of World Oil and Coal Reserves



Source: U. S. Department of Energy

The U.S. Leads in Coal Reserves



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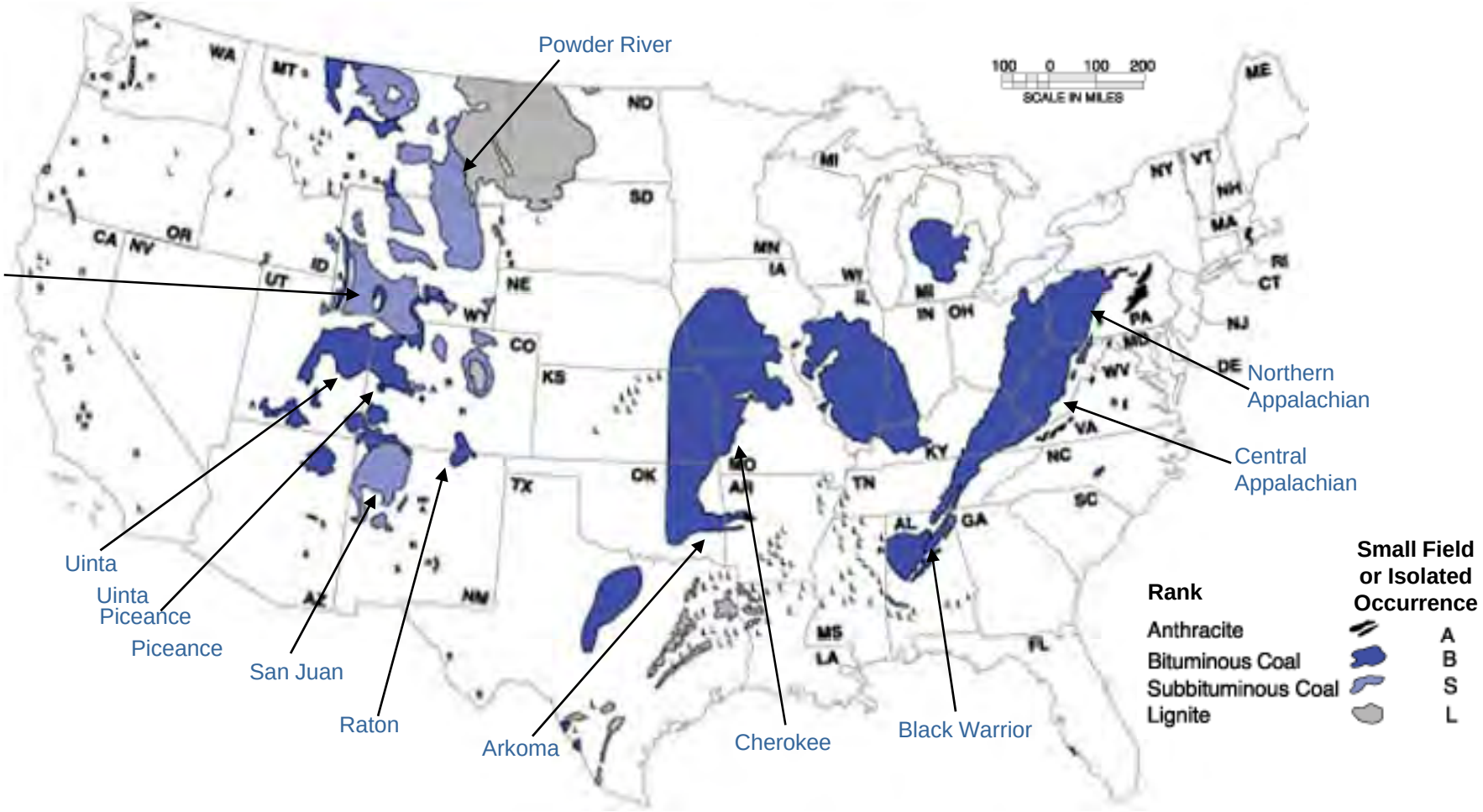
Source: Energy Information Administration (as of June 2007)

Continental U.S. Coal Reserves Distribution



Source: U.S. Department of Energy

CTL Production Potential

- Productive capacity of coal mines, 2007 = 1.34 billion tons.*
- Total coal production, 2007 = 1.15 billion tons.
- U.S. coal mines operated at approximately 86% of capacity in 2007.
- Depending on coal type, a ton of coal yields between 2.5 to 3 barrels of coal liquids.
- If total coal production were dedicated to CTL, U.S. could produce between 7.9 million to 9.5 million barrels of coal liquids per day.
- U.S. crude oil imports, 2007 = 10 million barrels/day

**** Excludes mines producing less than 10,000 short tons which are not required to provide data.***

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Source: Energy Information Administration

Support for CTL From Government

- Coal-derived liquid fuels are considered alternative fuels under the Energy Policy Act of 1992 (EPAct).
- EPAct 2005 : commercialize America's strategic unconventional fuels: Oil shale, tar sands, coal derived liquids, heavy oil, CO2 enhanced recovery and storage.
- Coal-to-Liquids Fuel Promotion Act of 2007 (Senators Bunning and Obama)
  - DOE to administer loan guarantees for CTL plants
  - DOE matching loan program to groups engaged in permitting and planning large-scale CTL plants.
  - Current DOD bases, and current and former DOE facilities for use as commercial CTL plants.
  - Extends the fuel tax credit for CTL products from 2009 until January 1 2020.
  - 50% tax credit for equipment for the separation, delivery and sequestration of CO2 put in place before 2020.
  - Referred to Senate Committee on Energy and Natural Resources
- FutureGen now a cost-shared collaboration between Government and industry to accelerate commercial deployment of near-zero emissions IGCC or other advanced clean coal-based power generation technology with Carbon Capture and Storage.
  - $290 million available for funding through FY09 and $1.01 billion in subsequent years.
- President-elect Obama has stepped carefully when it comes to coal.
  - Wants cleaner air and reduced global warming emissions and will use whatever policy tools necessary to make it uneconomic to site traditional coal facilities and to discourage the use of existing inefficient coal facilities.
  - But also said coal must be a part of our energy future
  - Voted to finance innovative uses for coal (see CTL FPA of 2007 above)

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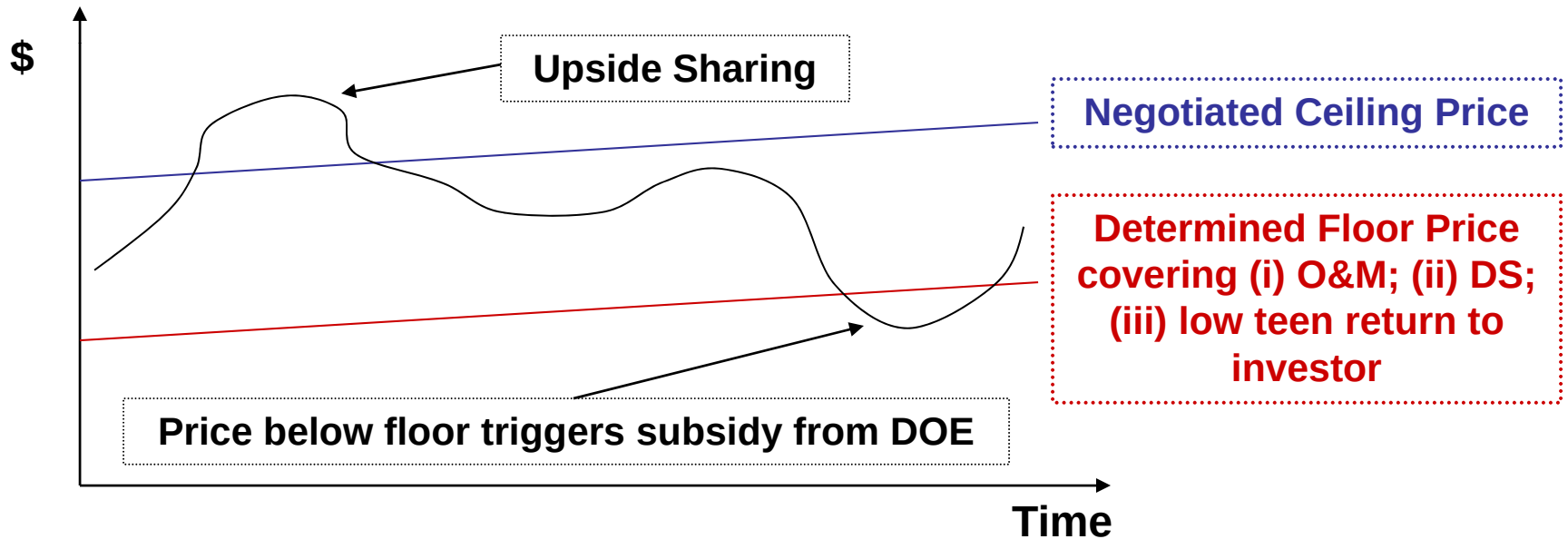
Collar Arrangements

Federal Government Support Warranted



Power Generation: Renewables

- Wind
- Solar
- Hydro

* *Caution: PUCs may become reluctant to support higher cost & less reliable generating technologies once RPS are met and/or in times of severe economic downturn.*

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Wind – Solar – Hydro

WIND	SOLAR	HYDRO
➢ Spatial requirement to match 2007 U.S. nuclear energy output (806 billion kWh) – THE AREA OF WEST VIRGINIA ➢ 1,000 megawatts of electrical capacity require 50,000 acres of wind turbines ➢ Cost per MW of installed capacity ($1.5 mm to $1.7mm) ➢ Load Balancing ➢ Turbine availability / excess capacity = increased cost volatility ➢ Capacity factor = 30%	➢ Spatial requirement to match 2007 U.S. nuclear energy output (806 billion kWh) – THE AREA OF NEW JERSEY ➢ 1,000 megawatts of electrical capacity require 11,000 acres of PV solar cells ➢ Cost per MW of installed capacity ($6 mm for PV technology) ➢ Load Balancing ➢ Capacity factor = 20%	➢ Environmental Issues ➢ Cultural and dislocation issues ➢ Limited site availabilities ➢ Cost per MW of installed capacity ($1.6 mm to $2.3mm)

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Where Does this Leave the U.S.

- Focus on renewables is fine but a realistic energy program also has to consider coal gasification, CTL, and nuclear energy
- US is acting as if it has options, it doesn't
- We need base load capacity
- As base load requirements increase, coal, hydro and nuclear are the main sources that can satisfy the need
  - Coal may be constrained by carbon abatement regimes
  - New hydros will be difficult to build as most resources have already been developed
  - This leaves nuclear as the only viable option with a zero-carbon footprint.
  - This only solves the power generation side of the equation but does nothing to alleviate transportation fuel shortages, forcing reliance on producer countries.
- Long lead time items can be problematic due to competition around the world where countries are moving much faster than we are.

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The Link Between Coal & Nuclear

- We need nuclear energy in order to become energy self-sufficient (Environmental benefit: zero GHG emissions).
- Increased reliance on nuclear energy will allow U.S. to shift coal from a power generation fuel to a transportation fuel (Security & Independence).
  - U.S. can support coal by increasing reliance on nuclear energy
- U.S. is the Saudi Arabia of coal with 300 year coal supply at current usage rates.
- If we accelerate usage rate from 300 to 100 years (enough time to get us to next generation of transportation fuels):
  - Coal used for power generation can now be shifted to transportation fuels (about 4 million barrels a day)
  - If DOE estimate of incremental power from coal goes to nuclear, we go to approximately 5.5 million barrels a day
  - If we shut down 60 – 70 year old coal plants (like New York City's ConEd), we can produce up to 9.9 million barrels a day
  - Brings us closer to energy self-sufficiency

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U.S. Capacity Factors by Fuel Type
2007*

Fuel Type	Average Capacity Factors (%)
Nuclear	91.8
Coal (Steam Turbine)	71.8
Gas (Combined Cycle)	43.3
Gas (Steam Turbine)	16.0
Oil (Steam Turbine)	19.6
Hydro	27.8
Wind	30.4
Solar	19.8

*** Preliminary**

Source: Global Energy Decisions / Energy Information Administration

Updated: 4/08

Funding

- Investors are unlikely to assume any of the risks associated with:
  - new technology
  - potential delays in the regulatory and licensing process
  - construction
- Investors are willing to assume operational and managerial risk once the plant is commercial
- Contractors and vendors have recently offered financial support and pledged to assume a larger share of the completion risks.
- Same support needs to be available to CTL plants.
- Nuclear and coal become relatively easy to finance when long-term offtake agreements are in place.
  - Known technology

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Rationalizing EPC costs

- Given collapse of the securitization market:
  - Significant EPC back logs have made contractors inflate prices.
  - Contractors' tough positions on negotiating bonding and liquidated damages.
  - High material and equipment prices due to hyper construction activities around the globe.
  - Sub prime/soft securitization market may reduce these backlogs resulting in more rational EPC pricing.

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Source: EIA International Energy Outlook 2008 (9/2008)

The End of Coal? Not Yet.

- Duke Energy building clean coal power plant in SW Indiana's coal country.
  - Cost: $2.35 billion
  - Plant will convert coal to a syngas that's been processed to remove pollutants such as mercury and SO2.
  - The syngas is burned in turbines to produce electricity, while heat from the process is tapped to create steam to power steam turbines
  - Duke Energy studying ways to capture some of the 4 million tons of CO2 it would release annually.
- Conventional coal-fired plants under construction:
  - 69 coal-fired power plants under construction or in permitting (representing 45,811 MW of capacity)
  - Represent $85 billion in construction expenditures
  - Includes 20 scrubber installations in the 2009 – 2010 timeframe.
- Scrubber retrofits
  - 102 existing power plants undergoing scrubber retrofits
  - Represent about $4 billion in annual environmental expenditures

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Conclusion

- The United States needs to take action to decrease energy dependence on non-stable countries
- It must develop more energy resources and increase the efficiency of existing processes
- Ethanol and bio-diesel can be part of a temporary fix but we need to move forward with more mainstream capabilities that are available today
  - $40B for ethanol and only $1.4B for coal is unconscionable
- Solar and wind have surged recently, but they and other renewables will peak at approximately 4% of total capacity due to economics and land requirements
- Coal to liquids and nuclear will be part of the energy program in virtually every industrialized nation that has significant coal reserves
- Need to accelerate passage of CTL Fuels Promotion Act of 2007

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AIG, with money to invest, sees nuclear more promising than IGCC technology
By Wayne Barber, SNL Financial

While coal gasification technology might still be years away from commercial usefulness, additional nuclear capacity is the key to keeping up with growing demands for power, a project finance executive with global insurance firm American International Group Inc. believes.

In addition to being among the world's leading insurers of energy projects, AIG has billions of dollars to invest in this capital intensive industry.

Bob Percopo is executive vice president, project finance advisory, at AIG Global Marine and Energy, was a panelist at Infocast's March 18-19 gasification conference in Denver. While he supports development of integrated gasification combined-cycle power technology with carbon capture and storage, Percopo said he considers it an immature technology compared to nuclear power.

"The technology is not there where this makes economic sense right now," Percopo said in an interview March 26. Many analysts believe that carbon capture and sequestration is going to add between 25% and 40% to the capital expenses of a given project, he added.

"You just need to make some more technology breakthroughs to get there," Percopo said of the potential of IGCC and carbon capture.

There are also some infrastructure issues that will have to be addressed: "It's going to cost a fortune to lay pipelines to move that carbon around," he said. More study is also needed on the impact of storing massive amounts of carbon dioxide underground, he added.

AIG, with money to invest, sees nuclear more promising than IGCC technology
By Wayne Barber, SNL Financial (continued)

The U.S. government is devoting many billions of dollars to ethanol research, and Percopo believes the money might be better used on advanced coal and carbon control technology.

Percopo lamented the U.S. Department of Energy's termination of the experimental FutureGen project in Illinois. "That would have been the ideal testing ground for starting to do something with CO2," Percopo said.

Percopo would also like to see more emphasis placed on coal-to-liquids technology to enable U.S. coal reserves to be developed for transportation fuels. This would provide the United States a hedge against so much imported oil, Percopo said.

In theory, the United States could go a long way toward energy independence by gradually shifting from coal power to nuclear power as the chief source of baseload electricity, and then use U.S. coal reserves for transportation fuel, Percopo said. "Current production of coal is about 1.2 billion tons annually," he said. "If total annual production were converted to liquids, it would equal 100% of current imports. Making energy independence is possible for the U.S."

AIG taking a long look at nuclear power options

While IGCC with carbon capture lacks much in the way of a commercial track record, that cannot be said of nuclear power.

The United States has piled up several decades of operating experience with nuclear power. "The bugs are out of the system," Percopo said. "We've got the technology. We have a resistance to using it."

AIG, with money to invest, sees nuclear more promising than IGCC technology
By Wayne Barber, SNL Financial (continued)

AIG will seriously consider funding the costs of a new nuclear power plant provided that key criteria are met. "On financing nukes, we will consider funding 100% of the debt (estimated to be 80% of total cost) of nuclear new builds under certain conditions," Percopo said in an e-mail following a phone interview.

The NRC has already received combined construction and operating license applications for 11 new reactors. If some new reactors do not get built within the next 10 years, Percopo believes it could put a major strain on the energy grid. Many experts think that the entire process, from application to completion of construction, will take about 10 years for a new nuclear reactor, Percopo said.

"Other countries are not talking, they are doing. We are talking," Percopo said. If U.S. developers drag their feet, they could find themselves waiting in line for certain specialty materials needed for construction of nuclear plants, he added. "How far back in the queue are we going to be?“ "Everybody is focusing on wind," but coal and nuclear remain the primary options for baseload generation, Percopo stated.

He cited Nuclear Energy Institute figures that indicate the average nuclear plant of 1,000 MW required 2.3 square miles of space while a wind farm of comparable capacity would occupy 235 square miles.

Renewables, coal and natural gas all have a place in the generation mix, Percopo acknowledged, but renewable energy's role will be limited by land requirements, and development of fossil fuel plants will be limited by carbon constraints.

AIG, with money to invest, sees nuclear more promising than IGCC technology
By Wayne Barber, SNL Financial (continued)

"Nuclear generation's operating costs also give it an advantage," Percopo said. "If the cost of uranium were to double, the production cots of nuclear plants would increase by only 7%. The doubling of the cost of natural gas has increased the per-kWh cost of gas plants by about 70%," Percopo said. "Additionally, uranium is available from stable U.S. allies — most notably Canada and Australia."

Percopo offered a glimmer of hope that the dramatic escalation in power plant prices might eventually subside in coming years. That's because the project backlog held by engineering, procurement and construction companies is beginning to ease due to various factors including coal plant cancellations and a downturn in the market for ethanol facilities.

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U.S. Nuclear Power's Time Has Come – Again. By Bob Percopo

In the U.S. today, there are continual discussions about energy independence, energy security, and ways to slow climate change. But meeting the nation's projected 40% increase in electricity demand by 2030, while reducing overall power plant CO2 emissions, will require much more than talk.

During the 1990s, American utilities increased their gas-fired generating capacity because they believed that gas would always be cheap and plentiful. Neither assumption proved true. At this year's G-8 Summit of the world's economic and military powers, President Bush committed the U.S. to develop a voluntary carbon abatement program, so developing new coal- and gas-fueled plants will be challenging. On one hand, the U.S. is the Saudi Arabia of coal, with more than 250 years of reserves; on the other hand, burning coal releases twice as much CO2 as burning natural gas. Meanwhile, natural gas continues to become more expensive and scarce in America.

Oil and gas imports by industrialized countries have weakened their economies due to the increasing prices of those imports. CO2 abatement will create a greater drain on the West and Japan, since they are the ones preparing to pay for it. Capturing and sequestering CO2 will increase the capital cost of a clean fossil-fueled plant by 25% to 50%. China—about to become the world's largest carbon emitter—has determined that carbon abatement is an issue for wealthy countries, and therefore not its priority. In the U.S., conventional coal plants, which fueled 49% of electricity generation in 2006, produced 2,121 million metric tons of CO2 that year. Natural gas, which fueled 20% of energy generation, produced 1,169 million metric tons. In stark contrast, nuclear generation has no carbon footprint.

U.S. Nuclear Power's Time Has Come – Again. By Bob Percopo (continued)

Land and cost advantages, too

The average nuclear plant of 1,000 MW requires 2.3 square miles of space. According to the Nuclear Energy Institute, a wind farm of comparable capacity, which also produces zero CO2, would occupy an area of 235 square miles.

This article is not meant to denigrate renewables, coal, or natural gas—all have a place in the generation mix. But renewables' role will be limited by land requirements and a shortage of dependable resources and suitable sites. Development of fossil-fueled plants will be limited by carbon caps.

Nuclear generation's operating costs also give it an advantage. If the cost of uranium were to double, the production costs of nuclear plants would increase by only 7%. The doubling of the cost of natural gas has increased the per-kWh cost of gas plants by about 70%. Additionally, uranium is available from stable U.S. allies—most notably Canada and Australia.

U.S. positioned to lose

While the U.S. ponders the economics of building as many as 30 new nuclear plants, China, India, Russia, Brazil, Bulgaria, Romania, and others are planning and executing aggressive nuclear plant construction programs. Unfortunately, the U.S., Western Europe, and Japan are acting as if they have a choice about increasing nuclear power production. The only country with a different attitude is France, the poster child for success in nuclear power on every front—development, O&M, fuel reprocessing, and safety. France gets 80% of its electricity from nuclear reactors.

U.S. Nuclear Power's Time Has Come – Again. By Bob Percopo (continued)

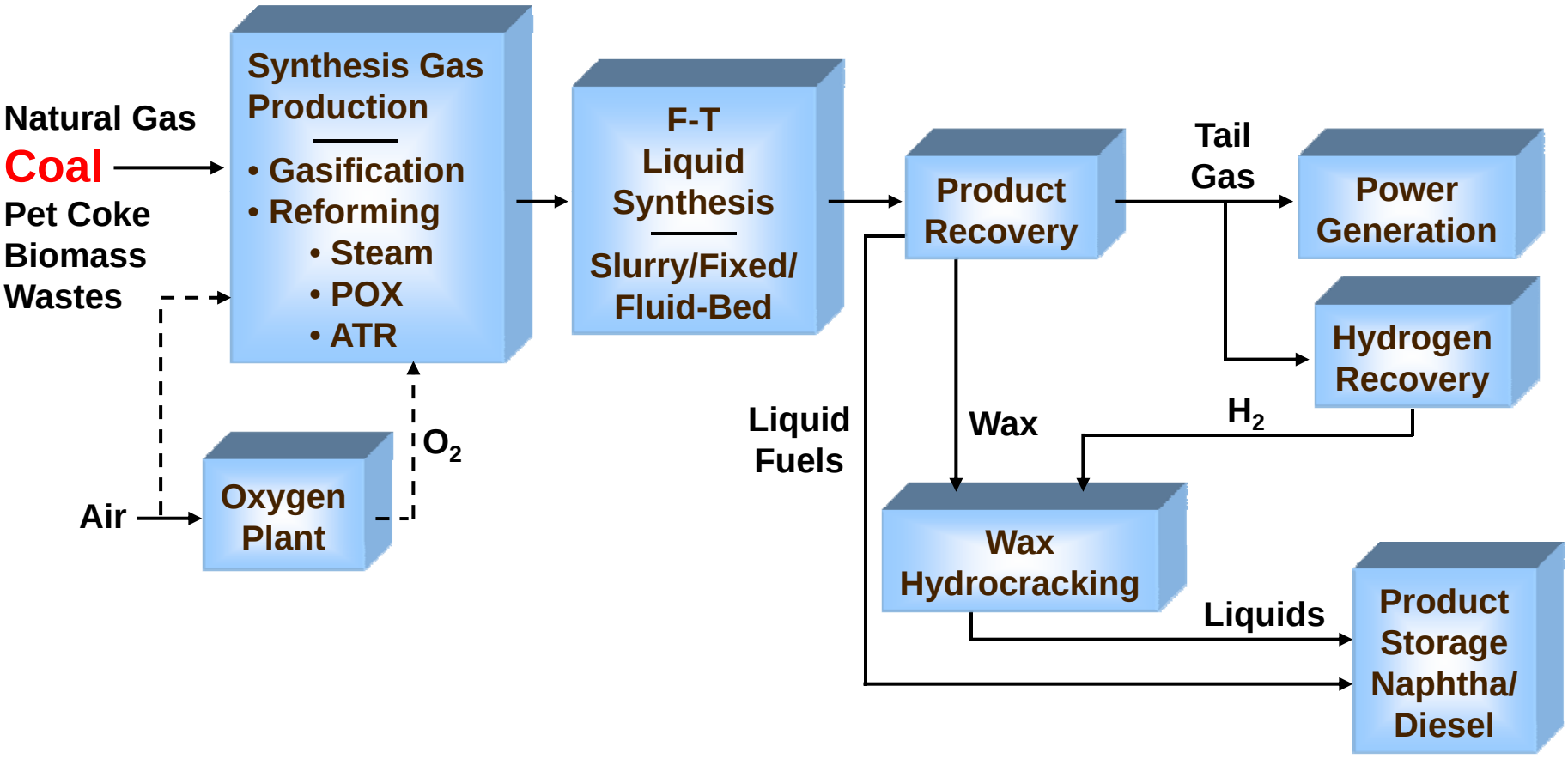
While the G-8 nations endlessly debate the risks of meltdowns, spent-fuel storage, plutonium proliferation, and terrorist attacks on nuclear plants, developing economies are rushing to add more reactors or join the nuclear generation club. If its procrastination continues, the West will paint itself into a corner and suffer the costs of energy dependence and carbon sequestration.

Nuclear power is not an immature technology like integrated gasification combined-cycle generation. Over its 40-year history, nuclear generation has improved its efficiency from 50% to more than 90%. Its two major perceived negatives are safety and the need to manage spent fuels. Safety concerns naturally arose after a partial core meltdown at the Chernobyl plant in 1986. But the Chernobyl unit had virtually no containment. Modern reactors are housed in containment vessels, and many new units are designed to withstand a direct hit from a fully fueled aircraft.

With respect to spent fuels, most Americans believe that somewhere there's an area the size of Texas filled with barrels of oozing radioactive waste. However, all the spent fuel from 40 years of reactor operations in the U.S. would fit in a football field 15 feet deep. If the U.S. were to recycle its nuclear waste, the volume would shrink to that of one end zone 10 feet deep. Compare those numbers to the volume of a single ton of CO2 at sea level (60 feet by 20 feet by 16.3 feet). The average 250-MW coal plant emits 1.7 million metric tons of CO2 every year.

Economics and common sense dictate less debate and more action. Worldwide, there are four reactor manufacturers and only one supplier of specialty steel, and they sell their products on a first-come, first-served basis. Arriving "too late for lunch" will have its consequences for the U.S.

Fischer-Tropsch Process Diagram



Source: U. S. Department of Energy

Nuclear Facts

- America's 104 nuclear power reactors provide emissions-free electricity for one in five homes and businesses.
- The uranium fuel they use is so efficient that just ONE fuel pellet provides as much energy as:
  - 17,000 cubic feet of natural gas
  - 149 gallons of oil
  - 1 ton of coal
- FIVE fuel pellets meet a household's electricity needs for an entire year.

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Questions & Answers

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