

Comparing Prices

Best prices are not always the best solution for the climate

Comparing Prices

US Coal-firing power plants are high air-polluters for decades

US coal-firing power plants have to reduce two million tons of SO₂ and Nox/year, says EPA [1]

The total combined sulfur dioxide and nitrogen oxides emission reductions secured from settlements will be about 2 million tons each year once all the required pollution controls have been installed and implemented. Coal-fired power plants are big contributors to air pollution.

Here are some examples:

Westar agrees to install a selective catalytic reduction (SCR) system on one of the three Jeffrey Energy Center coal units by the end of 2014 to reduce harmful emission of nitrogen oxide into the air. To reduce SO₂ a cflue gas desulfurization (FGD) for the control of SO₂ has to be installed to meet the most aggressive SO₂ rates.

Westar Energy owns and operates eight coal-fired units in Kansas at the following locations:

Jeffrey Energy Center, St. Marys. On grid since 1978

Lawrence Energy Center, Lawrence. On grid since 1980

Tecumseh Energy Center, Tecumseh. On grid since 1983

[1] Westar Energy to invest in environmental upgrades, proposed as settlement of litigation. Westar Energy. Jan. 25, 2010.
[http://www.westarenergy.com/corp_com/contentmgt.nsf/resources/2010-1-25/\\$File/2010-1-25.pdf?openelement](http://www.westarenergy.com/corp_com/contentmgt.nsf/resources/2010-1-25/$File/2010-1-25.pdf?openelement)

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EPA News on coal-firing power plants emission [2]

EPA says that investment of Weststar could be \$ 500 millions to reduce 75,000 tons of harmful air pollution from a power plant if the projects will ever become reality.

Sulfur dioxides and nitrogen oxides can be converted to fine particulate matter once in the air. Fine particulates can be breathed in and lodged deep in the lungs, causing a variety of health impacts, including premature death. Other health and environmental impacts from the pollutants addressed in this settlement include the following:

Sulfur Dioxide - High concentrations of SO₂ affect breathing and may aggravate existing respiratory and cardiovascular disease. Sensitive populations include asthmatics, individuals with bronchitis or emphysema, children and the elderly. Sulfur dioxide is also a primary contributor to acid deposition, or acid rain.

Particulate Matter- Short term exposure to particulate matter can aggravate lung disease, cause asthma attacks and acute bronchitis, may increase susceptibility to respiratory infections and has been linked to heart attacks and premature mortality.

Nitrogen Oxides- Nitrogen oxides can cause ground-level ozone, acid rain, particulate matter, global warming, water quality deterioration, and visual impairment. Nitrogen oxides play a major role, with volatile organic chemicals, in the atmospheric reactions that produce ozone. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects such as damage to lung tissue and reduction in lung function.

Mercury emission at coal-fired plants - EPA also tries to implement and explore innovative ways to reduce mercury at coal-fired plants

The United States has reached similar settlements with coal-firing power plants which are told to reduce 2 million tons of sulfur dioxide and nitrogen oxides each year. Coal-fired power plants are big contributors to air pollution.[3]:

[1] Westar Energy to invest in environmental upgrades, proposed as settlement of litigation. Westar Energy. Jan. 25, 2010.

[http://www.westarenergy.com/corp_com/contentmgt.nsf/resources/2010-1-25/\\$File/2010-1-25.pdf?openelement](http://www.westarenergy.com/corp_com/contentmgt.nsf/resources/2010-1-25/$File/2010-1-25.pdf?openelement)

[2] Westar Energy, Inc. Settlement Information Sheet

<http://www.epa.gov/compliance/resources/cases/civil/caa/westarenergy-infosht.html>

[3] Coal-Fired Power Plant Enforcement Initiative. EPA.

<http://www.epa.gov/compliance/resources/cases/civil/caa/coal/index.html>

Comparing Prices

Secretary Chu Announces \$3.18 Billion Investment for Carbon Capture and Sequestration

- \$979 million to support new commercial-scale CCS technologies

"These Federal stimulus dollars for carbon capture and storage will help ensure that West Virginia coal continues to heat and light our homes and businesses for many years to come. Clean coal can be a green, competitive 21st Century fuel

This investment is part of our commitment to advancing carbon capture and storage technologies to the point that widespread, affordable deployment can begin in eight to ten years," said Secretary Chu.

The selections demonstrate technologies that:

- make progress toward a target CO₂ capture efficiency of 90%;
- make progress toward a capture and sequestration goal of less than 10% increase in the cost of electricity for gasification systems and less than 35% for combustion and oxycombustion systems;
- capture and sequester or put to beneficial use an amount of CO₂ emissions in excess of the minimum of 300,000 tons per year required by CCPI.

The Clean Coal Power Initiative Round III was created in 2005 to reduce the time it would take for low-emission coal technologies to be ready for commercial use.

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American Electric Power (AEP) will design, construct and operate a chilled ammonia process that is expected to effectively capture at least 90 percent of the CO₂ (1.5 million metric tons per year) in a 235 megawatt flue gas stream at the existing 1,300 megawatt Appalachian Power Company (APCo) Mountaineer Power Plant near New Haven, WV. The captured CO₂ will be treated, compressed, and then transported by pipeline to proposed injection sites located near the capture facility. During the operation phase, AEP plans to permanently store the entire amount of captured CO₂ in two separate saline formations located approximately 1.5 miles below the surface.

(DOE share: **\$334 million; project duration: 10 years**)

Southern Company Services (SCS) will retrofit a CO₂ capture plant on a 160 megawatt flue gas stream at an existing coal-fired power plant, Alabama Power's Plant Barry, located north of Mobile, AL. The captured CO₂ will be compressed and transported through a pipeline, and up to one million metric tons per year of CO₂ will be sequestered in deep saline formations.

(DOE share: **\$295 million; project duration: 11 years**)

Summit Texas Clean Energy, (LLC) will integrate Siemens gasification and power generating technology with carbon capture technologies to effectively capture 90% of the carbon dioxide (2.7 million metric tons per year) at a 400 megawatt plant to be built near Midland-Odessa, TX. The captured CO₂ will be treated, compressed and then transported by CO₂ pipeline to oilfields in the Permian Basin of West Texas, for use in enhanced oil recovery (EOR) operations.

(DOE share: **\$350 million; project duration: 8 years**)

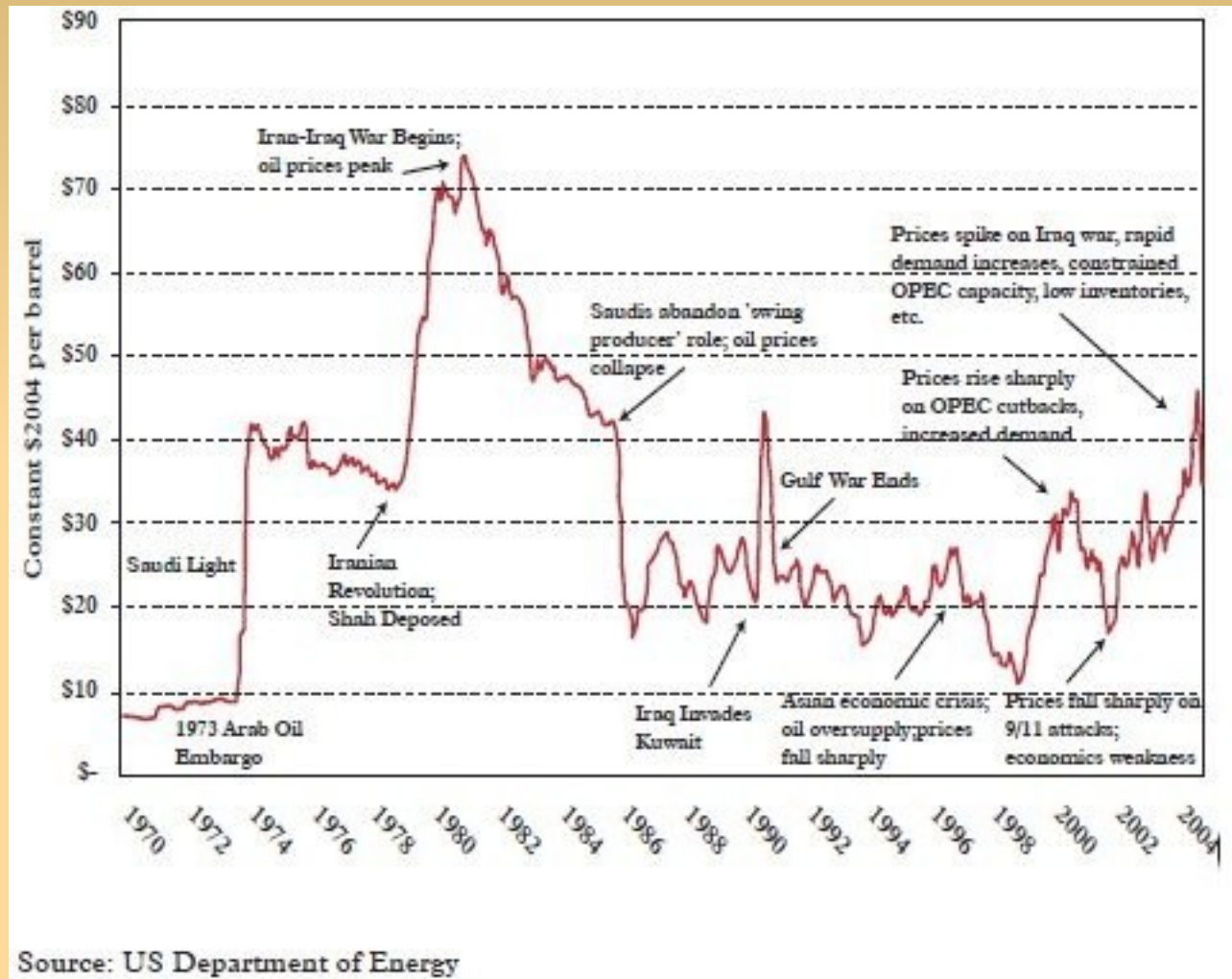
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Real oil prices (i.e. oil prices with inflation netted out) expressed in constant 2005 US dollars. [1]

If there is to be a major reduction in carbon emissions, energy prices, as typified by the price of oil, will have to rise significantly in real terms.

Goldman Sachs controls over 43,000 miles of pipeline and more than 150 oil storage terminals. Morgan Stanley has the capacity to store and hold 20 million barrels. And these firms have the power to direct billions of dollars of their clients' money in oil.

[1] <http://www.publications.parliament.uk/pa/ld200506/ldselect/ldeconaf/12/12i.pdf>



Comparing Prices

The best option must be used, not the cheapest variant of energies.

It is a question who has to pay for this.

Smith Island, NY
- rising sea level



Smith Island, NY
- residents are leaving the island



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Cost/profit analysis

- Advantage of being first in the business.
- It must be evaluated if the costs are higher than the costs of the environmental damage caused if no action is being taken.

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Cost of wind turbines

The cost of the commercial wind turbines varied from \$1 to \$2 million per MW of nameplate capacity installed. The same turbines 2 MW in size cost roughly \$2.8 million installed capacity. These turbines undergo significant economies scale. Smaller farm or residential scale turbines cost less but they are more expensive when per kilowatt of energy producing capacity is applied on the rates.

This would indicate a 10 kilowatt machine might cost roughly around \$48,000. In this manner 100 kilowatts wind turbines would cost roughly \$2,800 to \$4,800 per kilowatt of capacity.

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Cost of nuclear power plants [1]

Westinghouse Advanced PWR reactor AP1000, will cost USD \$1400 per KW for the first reactor and fall to USD \$1000 per KW for subsequent reactors. However the first wave of new plants in the USA are expected to cost over \$3500 per KW of capacity. Additional costs increase the price even more.

The first two General Electric ABWR were commissioned in Japan in 1996 and 1997. These took just over 3 years to construct and were completed on budget. Their construction costs were around \$2000 per KW. Two additional ABWR's being constructed in Taiwan faced unexpected delays and are now at least 2 years behind schedule.

The Chinese Nuclear Power Industry has won contracts to build new plants of their own design at capital costs reported to be \$1500 per KW and \$1300 per KW at sites in South-East and North-East China.

Subsidies for nuclear power plants: The financial industry sees the construction of the new generation of reactors as a risky investment and demands a premium on capital lent for the purpose. The Energy Bill recently passed by the US Congress assumes this risk and provides production credits of 1.8 cents per KW-Hr for the first 3 years of operation. This subsidy is equivalent to what is paid to Wind Power companies and is designed to encourage new nuclear reactor construction in the USA.

If the AP1000 lives up to its promises of \$1000 per KW construction cost and 3 year construction time, it will provide cheaper electricity than any other Fossil Fuel based generating facility, including Australian Coal power, even with no sequestration charges. This promise appears to have been unfulfilled. The cost of the first AP1000 is expected to be over \$3500 per KW.

[1] <http://nuclearinfo.net/Nuclearpower/WebHomeCostOfNuclearPower>

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Operating costs of nuclear power plants [1]

The US Nuclear Power industry has at last lived up to its promise made in in 1970's to produce electricity reliably and cheaply. Since 1987 the cost of producing electricity from has decreased from 3.63 cents per KWHr to 1.68 cents per KWHr in 2004 and plant availability has increased from 67% to over 90%. The operating cost includes a charge of 0.2 cents per KW-Hr to fund the eventual disposal of waste from the reactor and for decommissioning the reactor. The price of Uranium Ore contributes approximately 0.05 cents per KWHr.

Management of Nuclear Plant Operations

It's clear from both the French and US experience that pro-active Industry organisations are vital in obtaining efficient plant utilisation and in minimising running costs. In the US in the late 1980's and early 1990's there was little pooling of knowledge and experience amongst Nuclear Power Operators. This was caused by a combination of industry inexperience, the lack of standardised designs and the fragmentation of the industry. Once again this was in contrast to the French experience where the uniform design and the single state-owned organisation allowed knowledge to be more easily shared.

[1] <http://nuclearinfo.net/Nuclearpower/WebHomeCostOfNuclearPower>

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Waste disposal [1]

In the USA, Nuclear Power operators are charged 0.1 cents per KW-Hr for the disposal of Nuclear Waste. In Sweden this cost is 0.13 US cents per KW-Hr. These Countries have utilized these funds to pursue research into Geologic disposal of waste and both now have mature proposals for the task. In France the cost of waste disposal and decommissioning is estimated to be 10% of the construction cost. So far provisions of 71 billion Euros have been acquired for this from the sale of electricity.

Decommissioning Costs

The US industry average cost for decommissioning a power plant is USD \$300 million. The funds for this activity are accumulated in the operating cost of the plant. The French and Swedish Nuclear Industries expect decommissioning costs to be 10 -15 % of the construction costs and budget this into the price charged for electricity. On the other hand the British decommissioning costs have been projected to be around 1 Billion pounds per reactor. Cleaning up the Hanford Nuclear Weapons reactor is budgeted at 5.6 Billion dollars but may cost 2 to 3 times this much.

[1] <http://nuclearinfo.net/Nuclearpower/WebHomeCostOfNuclearPower>

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