Energy Costs and References

Horace Heffner Feb 2006

The following data and references are updates related to

http://www.mtaonline.net/~hheffner/BigPicture.pdf,

especially the data in Table 1, repeated immediately below.

Table 1 - Current energy plant capital cost in $/W

Gas turbine	0.5
Wind	2.0
Solar tower	2.5
Nuclear	6.0

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Gas turbine cost ($0.50/W)

See:

http://www.uaf.edu/energyin/webpage/pages/heat_engines/steam_and_gas_turbines.htm

which shows $0.80/W to $2.00/W "depending on environmental permitting requirements". Also see,

http://www.power-technology.com/projects/tiverton/

which shows a cost of about $0.65/W for a specific plant.

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Wind plant cost ($2.00/W)

See:

http://www.awea.org/pubs/factsheets/EconomicsOfWind-Feb2005.pdf

page 3, which shows typical wind capital cost, including financing, at $1.30/W, well under the $2.00/W used in Table 1. It gets cheaper every year.

Page 2 shows the cost of a 1.65-MW turbine is $0.79/W, but actual power can come in at about 1/3 the nameplate rating, which gives about $2.40/W.

Cost of *windfarm* power is now around $1/W. See:
http://www.windpower.org/en/tour/econ/index.htm

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Solar Tower - also known as Solar Chimney ($2.50/W)

http://www.visionengineer.com/env/solar_flue2.shtml

shows the Midura, Australia project is supposedly going to come in at $395M for a 200MW tower, producing 500 GWh/Yr. That is $1.95/W. However, that is a first of kind project. At 500 GWh/yr, or 57 MW avg, that is a whopping $6.90/W. Though a very high capital cost, it is comparable to nuclear, considering the cost of decommissioning and cost and risk of addressing terrorist threats. The structure has the potential added bonus of providing greenhouse space.

The book *The Solar Chimney, Electricity from the Sun" by Jorg Schlaich, page 40, shows $4.20/W in 1995 cost for a 100 MW plant, after conversion from DM.

See bottom of:

http://www.volker-quaschning.de/articles/fundamentals2/index_e.html

which shows a cost of $2.40/W to $6.00/W depending on size.

Cost of the technology should drop dramatically, if installed worldwide, just like the cost of wind power has. There is the possibility that building solar towers up mountainsides would significantly reduce cost while increasing chimney height, and permit effective use of Bernoulli pressure drop due to wind power as well. Since the solar energy conversion efficiency of the towers is only about 1 percent, there is much room for technological improvement through engineering.

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Future of Solar

“The annual industry growth in 2004 was more than 40 % and over 1,000 megawatts were installed around the world. “ ... “Every time the solar power industry doubled in size, the prices fell by 20 % - and that happens practically every three years!

http://www.bp.com/genericarticle.do?categoryId=9002555&contentId=7006179

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Solar Dish with Sterling Engine

http://www.sciencedaily.com/releases/2004/11/041110163722.htm
http://www.sandia.gov/news-center/news-releases/2004/renew-energy-batt/Stirling.html
http://www.businessweek.com/magazine/content/05_37/b3950067_mz018.htm

Sandia labs model 25 kW at $50,000, or $2.00/W but daytime only. This is thus also close to $6.00/W, but has the major drawback of not producing power 24 hours a day.

Solar dish technology also makes possible home built home heating or hot water heating applications at under $0.50/W:

http://www.harbornet.com/sunflower/

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Nuclear ($6.00/W)

A $6/W figure is higher than can be achieved technically, i.e. without regulation and lawsuits, but reflects todays political realities. It is probably low considering security impact on design and construction and the anticipated high cost of capital soon to follow after general awareness that oil has peaked. It is also notable that nuclear plants are not a solution to *world* energy problems. It is not appropriate technology for many locations.

Construction

"Nuclear power plants that should have cost between $500 million and $1 billion, had their final costs escalate up to 10 times that amount, over the course of construction, thanks to unreasonable regulations by the Nuclear Regulatory Commission, and the stretch-out of schedules over bogus “environmental and safety” concerns. Note that GE and other U.S. firms currently build 1,000 MW and larger nuclear units in Japan, Korea, and Taiwan in 4 to 5 years."

Sample plant construction costs shown are in the range of $2/W to $4/W. See:

http://www.21stcenturysciencetech.com/articles/spring01/nuclear_power.html

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Decommissioning:

"Demolishing the plant and shipping the waste will cost $500 million, more than twice the $231 million the plant cost to build (although that was in 1972, when a dollar bought more concrete than it does today.) The job is 61 percent done and on budget, managers say." ... "Maine Yankee is a single-unit plant, about two-thirds the size of Indian Point 2 or 3 in New York, which suggests the cost of decommissioning a plant the size of Indian Point could well exceed $1 billion...". See:

http://www.mindfully.org/Nucs/Demolition-NPP-Problems14may02.htm
http://www.power-technology.com/projects/maine/

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Solar collection and silicon energy transport and storage:

http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000079095.PDF

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O**ther energy figures (updated to 2004)**

See:

http://www.eia.doe.gov/emeu/aer/

or:

http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf

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Unit Energy Costs

Some older but still meaningful data on unit costs of energy:

From: http://www.awea.org/pubs/factsheets/Cost2001.PDF

Fuel Levelized costs (cents/kWh) (1996)

Coal	4.8-5.5
Gas	3.9-4.4
Hydro	5.1-11.3
Biomass	5.8-11.6
Nuclear	11.1-14.5
Wind (without PTC)	4.0-6.0

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Wind (with PTC) 3.3-5.3