Home
Index

The Pros and Cons of Various Methods of Generating Electricity

Home
Index

On this page I look at most common fuels and methods used for generating electricity (and a few novel methods) and give an objective listing of the good and bad points of each.

Created 2004, July 18th, modified 2013/03/25

Electricity generation fuels and methods discussed include: coal, gas, oil, oil shale, biogas, biomass (which includes firewood), conventional nuclear, proposed 'fast' nuclear, wind, solar thermal, solar photovoltaic, bio-voltaic, and hot dry rock.

I want to make this site useful, informative, and correct. If you believe I've missed anything significant, been ambiguous or unfair, or if you think I'm wrong on some point, I'd be very pleased to have your comments. My email address is daveclarkecb@yahoo.com.

Contents

Major sections on this page are...

Diesel and petrol powered generators | Fuel cells

There are cases that are difficult to allocate to a particular one of the above classes.

Home
Top
Index

Methods are listed alphabetically within each group.

This page uses several technical units. Energy units, definitions and conversions are available on an additional page.

Some notes

Carbon dioxide

An advantage of almost any method of power production that does not consume fossil fuels is that it need not result in a net addition of the important greenhouse gas carbon dioxide to the atmosphere.

No level playing field

Economists and politicians often make statements such as "Sustainable methods of power generation cannot yet compete financially on a level playing field with fossil fuel fired power stations". There is no level playing field!

Fossil fuel electricity is only cheaper than the more economically viable of the environmentally friendly options (for example wind power) because the fossil fuel power station operators are allowed to dump their waste (carbon dioxide) into the atmosphere at no cost to themselves. Of course this same waste is the main cause of man-made greenhouse warming and ocean acidification, and these are the greatest environmental threats to the world today.

Nuclear powered electricity would be much cheaper if the power station operators were allowed to dump their radioactive wastes in the sea. The petrochemical industry would make bigger profits if it could dump its wastes in the most convenient place. If fossil fuel electricity generators were made to dispose of their carbon dioxide responsibly, their costs would increase enormously.

The wholesale price of black coal generated electricity is around (Australian) 3 cents per kilowatt-hour ($0.03/kWh = $30/MWh) at present (2008). Estimates of the cost of black coal electricity with disposal of carbon dioxide by geosequestration vary from 6.4 to 13 cents per kWh. (Geosequestration is the deep burial of carbon dioxide.)

Wind farm electricity wholesales for around 7 to 8 cents per kWh (without any subsidies), and one prominent developer of hot dry rock electricity estimates that it will be able to wholesale at 4 cents per kWh. For comparison, domestic electricity users typically pay about 17 cents per kWh at the retail end.

No one has yet demonstrated that carbon geosequestration is viable at any price, and at best, geosequestration is more a land-fill style of disposal than it is an environmentally friendly method.

Home
Top
Index

Comparative costs of power generation

The estimates in the table below are from California Energy Commission (CEC, 2007) and Scientific American (SciAm, March 2009)

Costs are US$/MWh				
Method	**CEC**		**SciAm**	
	Min	**Max**	**Min**	**Max**
Biomass	50	125	-	-
Coal fired	90	600	-	-
Geothermal	65	90	62	76
Hydro	45	65	-	-
Hydro, small scale	90	170	-	-
Nuclear, advanced	70	100	-	-
Solar, Concentrating PV	116	270	-	-
Solar, Parabolic trough	155	300	200	280
Solar, PV	260	600	470	700
Wave	600	1200	-	-
Wind	60	100	61	84

Note that fossil fuel powered stations dump their waste gasses into the atmosphere at no cost to themselves and great cost to the environment; see No level playing field.

Nuclear power is very difficult to cost because, if the figure is to be meaningful, it must cover mining, building the power station, running costs for the full life of the power station, protecting the nuclear material from possible theft by terrorists, decommissioning costs, and costs of disposing of the radioactive wastes and protecting them from disturbance for many years.

In a guest post by Dr Chris Uhlik on Brave New Climate (http://bravenewclimate.com/2011/01/21/ the-cost-of-ending-global-warming-a-calculation/ – No spaces in URL) the cost of building nuclear power stations in 2011 was estimated at US$3.00/Watt, although Uhlik did say that one power station, Shoreham, cost $15/Watt. Note that these prices apparently did not include decommissioning and waste disposal costs. (He also stated that 'Current projects in China are ~$1.70/Watt.')

The capital cost of building wind power in Australia is around $2.00 per installed Watt (wind farms constructed between 2005 and 2011); I have calculated the cost of

generation of wind power in Australia in at least one wind farm at $74/MWh ($0.07/kWh, 2011).

Nuclear fusion

Nuclear fusion is, in a way, the opposite of nuclear fission, the reaction that is currently used in all nuclear power stations. While nuclear fission gets its energy from the breaking apart of very large atomic nuclei, fusion releases energy by making very small nuclei join together.

Unlike nuclear fission, nuclear fusion would produce little radioactive waste. Unfortunately, no-one has ever built a nuclear fusion power station that is anything near profitable, in spite of many billions of dollars being spent on the effort over the last several decades.

War time

In the tables below, notes relating to the advantages and disadvantages of power generating methods in war time are indicated by the words 'war time' in red as in this sentence. Large power stations are major targets for enemy attack in war time. Numerous small power stations, or distributed generators like wind turbines and solar photovoltaic panels, would be more difficult to put out of action. Nuclear power stations would be hugely polluting if bombed; they could produce disasters on a par with Chernobyl.

Links

There is an extensive article on renewable energy in Wikipedia.

Home
Top
Index

Fossil fuel fired large-scale power stations: Table 1

The power stations considered in this section are large operations that usually supply power to a distribution grid. Some may supply power to particular factories.
Electricity generation methods in my page on Home Heating Efficiencies gives more information on the greenhouse gas production levels and efficiency of various electrical generation methods.
The note, No level playing field is relevant to the true comparative cost of fossil fuel and non fossil fuel electricity.

Fuel	Advantages	Disadvantages	Comments
		Not sustainable	

Coal	Low cost Apparently plentiful: we will probably not run out of easily mined coal in the next few decades. It has been believed that the world's coal reserves would last a century or more, but some recent research has indicated that this was optimistic.	Requires around 1.7 million litres of fresh water for each gigawatt-hour of electricity generated. Produces more carbon dioxide (CO_2) per Watt-hour of energy than any other generation method. The methods of mining coal can be very destructive, although responsible coal miners do a remarkably good job of restoring the land after the coal has been mined out. Very large quantities of ash have to be disposed of and a lot of smoke is produced, although in modern power stations most of the latter is separated from the waste gas stream and disposed of with the ash. Coal contains substances such as sulfur, arsenic, selenium, mercury and the radioactive elements uranium, thorium, radium and radon (see USGS). When the coal is mined and burned these substances can be released into the environment. Burned sulfur is one of the main causes of acid rain, but most modern coal-fired power stations remove most of the sulfur oxides from the released gasses. War time – For maximum efficiency coal fired power stations must be big. They therefore present a desirable target for enemy attack.	Coal has an 'unfair' advantage over 'cleaner' forms of power generation in that the power station operators do not have to pay for the damage that they are doing to the atmosphere. See: No level playing field. A coal-fired power station generates a large amount of energy in a relatively small area compared to most renewable methods. However, when all the land required for mining and disposal of ash is taken into account coal does not have any space advantage over several sustainable methods. The misleading term 'clean coal' is sometimes used to refer to coal-fired power stations that efficiently extract substances like sulfur from the coal, either before or after burning. It is impossible to burn coal without producing carbon dioxide, so all coal-fired power stations are dirty in this sense. However, it is possible to dispose of (sequestrate) the carbon dioxide so that it is not released into the atmosphere for a long time. As of the time of writing (Feb. 2006) this has not been done for a commercial scale power station.
Fuel	Advantages	Disadvantages	Comments
Natural gas	Low cost Generators are very compact Produces less CO_2 than oil and much less than coal Requires much less water than coal fired power stations	Not sustainable Produces carbon dioxide. (CO_2), which is an important greenhouse gas. The world's natural gas reserves are limited, but not so limited as oil reserves. Seismic surveys of the sea-bed cause death and injuries to marine species. Leakage of methane to the atmosphere, very difficult to quantify, increases the greenhouse effect.	At the rate we are using natural gas our children will see the price rise so much that it will no longer be economical as a fuel. In a more far sighted world natural gas would be reserved for more valuable uses than burning as fuel. We are consuming our children's heritage. Also see: No level playing field.

Fuel	Advantages	Disadvantages	Comments
Oil	Low cost Generators are very compact. Produces less CO_2 than coal and requires much less water than coal	Not sustainable Produces carbon dioxide (CO_2), which is an important greenhouse gas. Requires a substantial amount of cooling water. The world's oil reserves are limited. Oil spills, especially at sea, cause severe pollution. Some oils contain high levels of sulfur. See the note on sulfur under coal, above. The world's supply of oil is limited; see Peak Oil. Seismic surveys of the sea-bed cause death and injuries to marine species.	At the rate we are using oil our children will see the price rise so much that it will no longer be economical as a fuel. In a more far sighted world oil would be reserved for more valuable uses than burning as fuel. We are consuming our children's heritage. Also see: No level playing field. Shale oil is oil that can be extracted from shale by mining a shale that is saturated with oil, and roasting it at about 500 degrees Celsius to extract the oil. For more detail see Shale oil in 'Notes' on my page Heating Efficiencies and Greenhouse.

Non fossil fuel large-scale power generation methods: Table 2

Home Top Index

The power stations considered in this section are large stand-alone operations that generally supply power to a distribution grid.
Electricity generation methods in my page on Home Heating Efficiencies gives more information on the greenhouse gas production levels and efficiency of various electrical generation methods.
The note, No level playing field is relevant to the true comparative cost of fossil fuel and non fossil fuel electricity.
These power generation methods do not, in themselves, result in a net increase in the amount of carbon dioxide in the atmosphere.

Technology	Advantages	Disadvantages	Comments
Biogas	Uses a renewable fuel. Consumes methane that might otherwise leak into the atmosphere and increase the greenhouse effect, so the waste is converted into a less	Very limited in the quantity of electricity it can produce on the global scale. There is little or no control on	The biogas that I am considering here is that produced from buried organic waste, as in a land-fill rubbish dump, or from sewerage. It is also possible to produce flamable gas from materials such as wood.

	harmful form at the same time and in the same operation; a win-win operation. Biogas can also be used on a small scale, eg. a pig farm.	the rate of gas production, although the gas can, to some extent, be stored and used as required.	It is non-polluting in that it does not produce any net increase in atmospheric carbon dioxide so long as the biological material being used is replaced sustainably.
Technology	Advantages	Disadvantages	Comments
Biomass (including firewood)	Uses a renewable fuel. No net addition of carbon to the atmosphere (the CO2 released into the atmosphere by burning one crop is taken out by growing the next).	A large area of land is required for the production of the fuel (eg. wood lot or cane field) per MW of power generated. Because of the above point, this method can never generate enough power to satisfy a major part of current demands. Burns organic matter that might be better returned to the land for soil improvement.	Biomass includes firewood; see environmental aspects of burning firewood on this site. The sustainability of the production and replacement of the biomass is of critical importance to the ethics of using biomass as a source of energy. My page, Energy Calculator calculates the relative costs of firewood and several other fuels in terms of energy per dollar.
Technology	Advantages	Disadvantages	Comments
Geothermal	Sustainable Relatively low cost for renewable energy, US$0.06 to $0.08/kWh. Non-polluting; little environmental impact since the steam would be released to the atmosphere with or without the power generation.	It can only be developed in selected volcanic areas, so it can never be a major contributor to the world energy supply	I have used 'geothermal' in relation to the capture and use of more-or-less natural steam in volcanic areas; distinct from 'hot dry rock', which is discussed elsewhere.
Technology	Advantages	Disadvantages	Comments
Hot dry rock	Compact; a large amount of electrical power can be produced by a moderately sized station. There are huge volumes of very hot rocks at depths of 5km or so. The resource could not be significantly depleted in decades. In human terms it is close to sustainable. It could provide a large part of	While there have been some trial operations, the technology remains unproven. The costs and technical problems with drilling to great depths in very hot rocks are considerable.	Also see geothermal above A hot dry rock company in Australia: Geodynamics.

	the worlds base-level electricity supply. Non-polluting		
Technology	Advantages	Disadvantages	Comments
Hydro (falling water)	Compact; a large amount of electrical power can be produced by a moderately sized station. Sustainable Once established it is fairly environmentally benign.	The building of dams is usually environmentally destructive – river valleys are important ecosystems; it often requires great changes in many peoples' life styles; river valleys are often fertile and densely populated. Fermenting vegetation in hydro dams releases the greenhouse gas methane to the atmosphere. The water released from a hydro-power station often comes from the bottom of a dam. If so, it is cold and may not suit species native to the region. Water is often released from a hydro-power dam at times that depend on power consumption (or possibly to suit down-stream irrigators). The natural occasional high-flows or floods that the river's ecosystem has adapted to is disrupted.	There is a trend toward modifying dams to produce hydro-power where they were not originally designed for that purpose. This is sometimes called mini-hydro power. There is of course a continuous range of hydro-power stations from multi-megawatt down to a few hundred Watts or even less, see: micro hydro.
Technology	Advantages	Disadvantages	Comments
		Requires substantial amounts of cooling water. It is expensive, especially in capital costs, maintenance costs, and due to the long lead time in planning and construction; see footnote. The equipment needed to produce the fuel for power reactors is the same as is used to produce fisile material for bombs. Large amounts of fossil fuels are used in mining and processing the uranium fuel; with consequent release of	Home Top Index There is a great deal of uninformed emotional fear of nuclear power and nuclear radiation, some is justified, some not. Low levels of radiation are ubiquitous and the preponderance of the scientific literature seems to indicate that they are benificial rather than harmful. There is insufficient U235 (0.7% of natural uranium) to provide a

Conventional nuclear	Compact; a large amount of electrical power can be produced by a moderately sized station. Low fuel costs. Small number of accidents. Normally does not produce any significant atmospheric pollutants. Quantity of waste produced is small.	greenhouse gasses. There is a danger of radiation release, either from the reactors or from the waste. This can be enormously expensive, the Fukushima nuclear disaster has been estimated to cost US$257 billion. While there are few accidents the consequences of some accidents may be very serious. Decommissioning a nuclear power station at the end of its useful life is very difficult and expensive. Safe long-term disposal of nuclear waste is difficult. (It must be kept away from the biosphere for several tens of thousands of years). The lead time in building a nuclear power station is around ten to 15 years. A tempting target for terrorist attack. War time – Nuclear power stations would produce a huge amount of radioactive contamination if bombed.	major part of the current world electrical consumption for a long period. About 99.3% of natural uranium is in the form of U238 which cannot be used as a fuel in a simple nuclear power station. To use 0.7% of the uranium and dump the remainder, as is currently done, is terribly wasteful and, I believe, unethical in regard to future generations; the U235 can be thought of as the match that can be used to set fire to the U238 firewood, we are burning the match and denying the use of the firewood to future generations. (Fast neutron reactors can use the U238, see below.). Is Nuclear Power Globally Scalable?, (by Derek Abbott, School of Electrical and Electronics Engineering, University of Adelaide) provides a convincing argument that nuclear power cannot replace fossil fuels as mankind's main source of energy.
Technology	Advantages	Disadvantages	Comments
'Fast' neutron nuclear	Compact; a large amount of electrical power can be produced by a moderately sized station. Abundant fuel is available from existing stored 'waste' nuclear fuel. Conventional reactors only use about 1% of the potential power in uranium, the Fast reactor system could utilise most of the other 99%. Should not produce any significant atmospheric pollutants.	**The system is not proven on a commercial scale**. Just as expensive as conventional nuclear? See footnote. Requires substantial amounts of cooling water. There is a danger of radiation release. While the system seems to be sound, the consequences of accidents may be catastrophic. Decommissioning a nuclear	Since this system could make use of most of the energy available from uranium, unlike conventional nuclear, in theory a major part of the current world electrical consumption could be generated for a long period. It is claimed that the transuranic elements recovered in the pyroprocessing are "unsuited for weapons"

(combined with pyrometallurgical recycling of fuel)	Quantity of waste produced should be much smaller than for conventional nuclear. Nuclear waste from a fast reactor system will need to be isolated from the biosphere for several hundred years, compared to the tens of thousands for conventional nuclear. Thorium, which is about three times as abundant as uranium, can be used as fuel in a fast neutron reactor.	power station at the end of its useful life is very difficult and expensive. The lead time in building a nuclear power station is around ten years, since this system is 'new' its lead time will be more like fifteen years. A tempting target for terrorist attack. War time – Nuclear power stations would produce a huge amount of radioactive contamination if bombed.	because they include several isotopes of plutonium, not just the plutonium 239 favoured for bomb making, some uranium 238, and fission products. Bad news for uranium miners. If Fast nuclear takes over from conventional then no uranium need be mined for several hundred years; the waste of the old power stations becomes the fuel for the new.

Footnote on nuclear power

It is very difficult to obtain reliable figures on the true monitory cost of nuclear power because of government subsidies.

From New Matilda...

> "Goldberg and Oosterhuis suggest direct public subsidies (for the nuclear power industry) amount to $115 billion and indirect subsidies to $145 billion in the US alone, while annual subsidies in the UK equal US$543 million, and in Germany some US$845 million."

'Fast' neutron nuclear power

The information on the proposed Fast neutron nuclear power combined with pyrometallurgical recycling of fuel was obtained from Scientific American, Dec. 2005. 'Fast' nuclear reactors would use reactions involving fast neutrons rather than moderated neutrons, and probably a low pressure liquid sodium primary coolant rather than the high pressure water that is used in almost all conventional reactors.

Technology	Advantages	Disadvantages	Comments
Solar thermal	Sustainable, non-polluting Heat can be stored and used to generate electricity when the sun is not shining. This gives solar thermal an advantage over wind which can only generate electricity when the wind is blowing.	Solar energy is spread relatively thinly. If a solar thermal generator is to produce much electricity it has to cover a large area. Some forms of solar power require substantial amounts of cooling water. The sun's position in the sky is continually changing so most solar thermal generators have to include expensive machinery to keep them pointed in the right direction. Solar thermal electricity is expensive, US$0.20 to $0.28/kWh.	Solar thermal energy has been most highly developed in the United States South West where clear skies are common. While the technology has great promise it has not yet been proven to be cost-competitive on a large industrial scale. Solar power is most effectively built on flat land. I have written on Australian solar energy at Sun on the Bush.

Technology	Advantages	Disadvantages	Comments
Solar chimney (A type of solar thermal)	Sustainable, non-polluting Requires little water Unlike some other forms of solar energy this can produce electricity at night and for limited periods under clouds due to the heat stored in the 'greenhouse'.	Must cover a very large area While a small (50KW) trial station has run in Spain for some years, the technology has never been proven on a commercial scale. War time – To maximise efficiency solar chimneys must be very tall. They would present conspicuous and desirable targets for enemy attack.	The solar chimney concept uses a large 'greenhouse' to convert solar radiation into warm air. The air is then allowed to rise up a very tall (around 1km to be highly effective) chimney, turning turbines and generating power as it rises. I have written on Australian solar energy at Sun on the Bush.
Technology	Advantages	Disadvantages	Comments
Wave	Sustainable, non-polluting War time – Spread over a large area, and some types completely under water, so they would be difficult to destroy	Not proven on a commercial scale Installation would damage the sea-bed locally	One type (CETO) has been estimated by its designers to be capable of producing electricity at around Aus$80/MWh (US$70/MWh), similar to the cost of wind-power. This type can either produce electricity or desalinated water (at a claimed cost of around Aus$1.50-$2 per kilolitre (US$1.35-$1.80/kL).
Technology	Advantages	Disadvantages	Comments
Wind, large turbines	Sustainable, non-polluting A well proven technology and low-priced for a sustainable energy: US$60 to US$80/MWh at the wind farm. Wind farms can be built by moderately sized local or regional businesses. Requires little water, no cooling water. Reduces the exposure of an economy to fuel price volatility. Very resistant to damage from earthquakes and tsunamis. War time – The scattered	Does not produce power when the wind isn't blowing. If a large proportion of a power system's electricity is wind power then there will be a need for a correspondingly large backup power supply. (See Sustainable Electricity). To generate large amounts of electricity wind turbines must be numerous and spread over large areas. This creates visual and noise annoyance and a significant public opposition has developed, much of which	There are many misconceptions about wind farms. I have notes on problems, alleged problems and objections at Wind Problems. An excellent wind power Internet site is that of the Danish Wind Industry Association. I have written on Australian wind energy at Wind in the Bush.

	layout of turbines in wind farms would make it difficult for enemies to destroy more than a few at any one time. (For more detail see Advantages of wind power.)	is based on the NIMBY (not in my back yard) principle.	

Non fossil fuel small-scale power generation methods: Table 3

Home Top Index

The generators considered in this section are usually small and built to provide power to a homestead or perhaps a village or small factory. If these power supplies are to have a major global impact they will have to be very numerous.

War time – Scattered, numerous, and small power stations would be more difficult for an enemy to put out of action than a few large power stations.

Technology	Advantages	Disadvantages	Comments
Bio-voltaic or bio-electricity	Sustainable Can combine sewerage disposal with power generation. Non-polluting	Unproven on anything other than a laboratory scale	Some bacteria have the ability to produce an electrical potential. These can be fed on something convenient, perhaps sewerage or sugar, and produce electrical power. A little more about bio-electricity can be read at ZDNet, in the news section.
Technology	Advantages	Disadvantages	Comments
Micro hydro	Sustainable Can be used in such a way as to minimise disruption of aquatic life and stream ecosystems. Does not necessarily require damming a stream. Non-polluting	If poorly designed and/or operated, it can have similar disadvantages to large hydro-power, but on a smaller scale.	Home Top Index

Technology	Advantages	Disadvantages	Comments
Solar photovoltaic (Solar electrical panels)	Sustainable It is a well proven technology. Well suited to providing power in home or single building applications. Roof-top installations are well suited to high-consumption urban areas where it has the additional advantage of saving on the cost of building new transmission lines. Peak generation matches peak consumption fairly well.	While the panels are environmentally benign once they are built, the manufacturing process requires large amounts of energy. One less common, expensive, but highly efficient type of solar panel, gallium arsenide, contains toxins that need to be disposed of carefully at the end of the life of the panel. Solar energy is spread relatively thinly. If a photovoltaic generator is to produce much electricity (ie. several megawatts) it has to cover a large area. Does not produce much power when the sun isn't shining. Electricity generated by solar panels is quite expensive, US$0.47 to US$0.70/kWh.	A solar photovoltaic panel must operate for a considerable time before it produces more power than was required in its manufacture. The US National Renewable Energy Labaratory states on its energy payback page that "Paybacks for multicrystalline modules are 4 years for systems using recent technology and 2 years for anticipated technology. For thin-film modules, paybacks are 3 years using recent technology, and just 1 year for anticipated thin-film technology". Can be combined with small-scale wind-generated electricity or with mains power. Alternatively, batteries can be charged when more electricity is being generated than is being consumed. Excess electricity can be sold to the grid in some cases. In the past photovoltaic panels have predominantly been based on silicon. It is possible that in future a larger proportion will use alternatives such as gallium arsenide (GaAs) or copper indium gallium selenide (CIGS). While these elements are much rarer than silicon, they can be used as a thin film; this makes the cost competitive. One wonders if there are pollution implications in their eventual disposal. I have written on Australian solar energy at Sun on the Bush.
Technology	Advantages	Disadvantages	Comments
Wind, small turbines	Sustainable, non-polluting A well proven technology.	Does not produce power when the wind isn't blowing so a back-up electrical supply is also needed. If batteries provide the backup they have the disadvantage of being expensive and needing to be replaced every few years	Units are available to suit single houses or several houses. Small scale wind turbines grade into large scale; turbines are available in a great range of generating capacities. Can usefully be combined with photovoltaic electricity, so that power will be generated when either the wind is blowing or the sun is shining.

Home
Top
Index

Fossil fuel small-scale power generation methods: Table 4

Technology	Advantages	Disadvantages	Comments
Diesel and petrol powered generators	Small. Relatively low cost. The smaller units are easily portable.	Consume fossil fuels – therefore not sustainable. Are net producers of the greenhouse gas carbon dioxide. Produce varying amounts of noise. Some petrol powered units are remarkably well muffled for internal combustion engines.	Petrol engine powered generators are generally small; up to 5 or 10kW. Diesel powered units tend to be larger, heavier, and less portable.
Technology	Advantages	Disadvantages	Comments
Fuel cells	Can be a highly efficient way of converting a fuel to useful energy, 45% or even better; 60% has been claimed	Not yet available at commercially competitive costs At present they (directly or indirectly) consume fossil fuels – therefore they are not sustainable and are net producers of the greenhouse gas carbon dioxide.	If fuel cells were used for powering homes, and the 'waste' heat then used for tasks such as heating water or space heating, the effeciency could be higher again; 85% has been claimed.

Home
Top

Index

Home
Top

Home

On this page...