

Obama could kill fossil fuels overnight with a nuclear dash for thorium

If Barack Obama were to marshal America's vast scientific and strategic resources behind a new Manhattan Project, he might reasonably hope to reinvent the global energy landscape and sketch an end to our dependence on fossil fuels within three to five years.

By [Ambrose Evans-Pritchard](http://www.telegraph.co.uk/finance/comment/ambroseevans_pritchard/) (http://www.telegraph.co.uk/finance/comment/ambroseevans_pritchard/), International Business Editor
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We could then stop arguing about wind mills, deepwater drilling, IPCC hockey sticks, or strategic reliance on the Kremlin. History will move on fast.

Muddling on with the status quo is not a grown-up policy. The International Energy Agency says the world must invest \$26 trillion (£16.7 trillion) over the next 20 years to avert an energy shock. The scramble for scarce fuel is already leading to friction between China, India, and the West.



Dr Rubbia says a tonne of the silvery metal produces as much energy as 200 tonnes of uranium, or 3,500,000 tonnes of coal

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There is no certain bet in nuclear physics but work by Nobel laureate Carlo Rubbia at CERN (European Organization for Nuclear Research) on the use of thorium as a cheap, clean and safe alternative to uranium in reactors may be the magic bullet we have all been hoping for, though we have barely begun to crack the potential of solar power.

Dr Rubbia says a tonne of the silvery metal – named after the Norse god of thunder, who also gave us Thor's day or Thursday – produces as much energy as 200 tonnes of uranium, or 3,500,000 tonnes of coal. A mere fistful would light

London for a week.

Thorium eats its own hazardous waste. It can even scavenge the plutonium left by uranium reactors, acting as an eco-cleaner. "It's the Big One," said Kirk Sorensen, a former NASA rocket engineer and now chief nuclear technologist at Teledyne Brown Engineering.

"Once you start looking more closely, it blows your mind away. You can run civilisation on thorium for hundreds of thousands of years, and it's essentially free. You don't have to deal with uranium cartels," he said.

Thorium is so common that miners treat it as a nuisance, a radioactive by-product if they try to dig up rare earth metals. The US and Australia are full of the stuff. So are the granite rocks of Cornwall. You do not need much: all is potentially usable as fuel, compared to just 0.7pc for uranium.

After the Manhattan Project, US physicists in the late 1940s were tempted by thorium for use in civil reactors. It has a higher neutron yield per neutron absorbed. It does not require isotope separation, a big cost saving. But by then America needed the plutonium residue from uranium to build bombs.

"They were really going after the weapons," said Professor Egil Lillestol, a world authority on the thorium fuel-cycle at CERN. "It is almost impossible make nuclear weapons out of thorium because it is too difficult to handle. It wouldn't be worth trying." It emits too many high gamma rays.

You might have thought that thorium reactors were the answer to every dream but when CERN went to the European Commission for development funds in 1999-2000, they were rebuffed.

Brussels turned to its technical experts, who happened to be French because the French dominate the EU's nuclear industry. "They didn't want competition because they had made a huge investment in the old technology," he said.

Another decade was lost. It was a sad triumph of vested interests over scientific progress. "We have very little time to waste because the world is running out of fossil fuels. Renewables can't replace them. Nuclear fusion is not going work for a century, if ever," he said.

The Norwegian group Aker Solutions has bought Dr Rubbia's patent for the thorium fuel-cycle, and is working on his design for a proton accelerator at its UK operation.

Victoria Ashley, the project manager, said it could lead to a network of pint-sized 600MW reactors that are lodged underground, can supply small grids, and do not require a safety citadel. It will take £2bn to build the first one, and Aker needs £100mn for the next test phase.

The UK has shown little appetite for what it regards as a "huge paradigm shift to a new technology". Too much work and sunk cost has already gone into the next generation of reactors, which have another 60 years of life.

So Aker is looking for tie-ups with the US, Russia, or China. The Indians have their own projects - none yet built - dating from days when they switched to thorium because their weapons programme prompted a uranium ban.

America should have fewer inhibitions than Europe in creating a leapfrog technology. The US allowed its nuclear industry to stagnate after Three Mile Island in 1979.

Anti-nuclear neorosis is at last ebbing. The White House has approved \$8bn in loan guarantees for new reactors, yet America has been strangely passive. Where is the superb confidence that put a man on the moon?

A few US pioneers are exploring a truly radical shift to a liquid fuel based on molten-fluoride salts, an idea once pursued by US physicist Alvin Weinberg at Oak Ridge National Lab in Tennessee in the 1960s. The original documents were retrieved by Mr Sorensen.

Moving away from solid fuel may overcome some of thorium's "idiosyncracies". "You have to use the right machine. You don't use diesel in a petrol car: you build a diesel engine," said Mr Sorensen.

Thorium-fluoride reactors can operate at atmospheric temperature. "The plants would be much smaller and less expensive. You wouldn't need those huge containment domes because there's no pressurized water in the reactor. It's close-fitting," he said.

Nuclear power could become routine and unthreatening. But first there is the barrier of establishment prejudice.

When Hungarian scientists led by Leo Szilard tried to alert Washington in late 1939 that the Nazis were working on an atomic bomb, they were brushed off with disbelief. Albert Einstein interceded through the Belgian queen mother, eventually getting a personal envoy into the Oval Office.

Roosevelt initially fobbed him off. He listened more closely at a second meeting over breakfast the next day, then made up his mind within minutes. "This needs action," he told his military aide. It was the birth of the Manhattan Project. As a result, the US had an atomic weapon early enough to deter Stalin from going too far in Europe.

The global energy crunch needs equal "action". If it works, Manhattan II could restore American optimism and strategic leadership at a stroke: if not, it is a boost for US science and surely a more fruitful way to pull the US out of perma-slump than scattershot stimulus.

Even better, team up with China and do it together, for all our sakes.

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Anybody know what has happened to the pebble bed nuclear reactor program?

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The obvious problem, and the reason we are unlikely to ever see this come to fruition, is that it will be devastating to the insiders.

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Greg Buls (<http://www.facebook.com/people/Greg-Buls/100000217143153>)

49 minutes ago

Good thing we have lots of uranium. Let's use that while we're developing Thorium, in case Obama can't get it done in 3-5 years. Evidently he's already on board with Thorium - or something. Clearly he's hoping something will fall into our lap to produce the energy for a population slated to grow from 310 million to 450 million by 2050.

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The article ignores the development of the Integral Fast Reactor (IFR), which can use depleted uranium for fuel as well as nuclear "waste" and weapons material. We have enough out of the ground already to power the entire planet—even with just this source alone—for a millennium, without mining or enriching another speck of uranium. Not only that, but the USA already has a commercial-scale reactor of this kind designed and sitting on the shelf at General Electric. It is by far the most ready-to-build of all the new reactor designs, including thorium reactors as described here, which still require substantial R&D. So while thorium can provide vast amounts of energy, if we build IFRs we wouldn't really need it. The only thing holding us up is politics, not technology. IFRs (and thorium reactors, if we decide to develop them) can most certainly bring the fossil fuel era to an end and provide essentially unlimited clean energy—and a vastly improved standard of living—to everyone on the planet.

What are we waiting for?

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skinnydog

58 minutes ago

Tom - Read your book. Thanks for writing it.

IFRs are awesome, and they can burn more spent fuel rod material than an LFTR. But isn't there a downside to them, in that they are cooled by liquid sodium, which reacts violently with the oxygen and water vapor in the air? Hence, wouldn't thorium reactors be safer in case of a breach? And wouldn't LFTRs be smaller and cheaper to build, in that they don't need a protective containment shell like IFRs?

Also, isn't it expensive to undergo the elaborate fuel processing work needed to fabricate spent fuel rods and the cores from dismantled bombs into suitable fuel for IFRs?

I'd appreciate your thoughts on these issues. But the rivalry reminds me of VHS and Beta. (Beta was better, but VHS was more easily marketed, as I recall.)

Perhaps we could use both types of reactors, rather than pick one over the other. They both seem like a Godsend (and that's coming from an Agnostic!)

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davepowell

Today 09:52 PM

Here is a comprehensive rebuffal of the case for Thorium which should bring some balance to this article.

Thorium Fuel: No Panacea for Nuclear Power

<http://www.ieer.org/fctsheet/thorium2009factshe...>

(<http://www.ieer.org/fctsheet/thorium2009factsheet.pdf>)

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Philip Kelley (<http://twitter.com/philipkelley>)

33 minutes ago

This article seems awfully concerned with the inhalation of the materials involved—who's huffing radioactive materials anyway? Also the PSR's agenda bias against any and all nuclear programs is obvious.

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This report would get a lot of strenuous push back from a horde of nuclear physicists, because it makes a lot of sense until you start thinking about it.

For one thing, it says that "in principle "a bomb could be made with U-233 (what Thorium turns into inside of a reactor) "if worker safety was of no concern..."

Right. AND if you ALSO had a couple thousand people lined up to take the place of your assemblers, who would be dropping like flies every other minute from the U-233's gamma radiation.

Or, alternatively, if you built a multi-billion dollar "hot room" in your terrorist cave, complete with robot arms, to build the dang bomb in comfort and safety. But wait, why not just build a plutonium bomb, with material that you can handle with rubber gloves and a respirator? Just asking...

In principle, you could cobble together a Cadillac from a fleet of Yugos. And in principle, Saddam could have used a balsa wood drone to spray the east coast of the U.S. with nerve gas.

We went to war over "in principle." Let's not forego a chance at saving the planet with abundant carbon-free energy over the same specious reasoning.

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j griffin

Today 09:24 PM

Gosh! AEP is very industrious today . Four (4) new reports/articles - and all on the same day - Phew!

This one and

- 2) Japan renews QE as recovery falters
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stephensaines (<http://my.telegraph.co.uk/members/stephensaines>)

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gregf:

Very good post.

The article is very misleading. Where I support it is in using abundant fuel in new ways, but the most promising new reactor designs (actually fifty years old) are the Pebble Bed Modular, and Uranium (in various isotopes) still remains the fuel of choice.

It is no coincidence that the Indians have not pursued their earlier Thorium reactors, and the South Africans and Chinese are pursuing the Pebble Bed ones.

Anyone who thinks that the Thorium cycle is somehow safer than the various Uranium ones (the varying isotopes determine different cycles) is naive at best, a liar at worst.

Thorium is problematic in various ways, but still very useful. It's just that Uranium handled in the right manner remains preferable.

The 'inertia against change' is in reactor design, not the choice of fuel.

In some ways, Plutonium is even safer to handle than Uranium and Thorium! Context is everything when making such claims, and Hyphen-Pritchard likes to shock with his statements.

Interview a few more scientists, Mr Pritchard, and *quote them exactly with reference*!

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graeme_

graeme_b

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you have to leave at least one character i.e. a "." or a "-" , or simply a full stop.

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apdavidson

Today 06:38 PM

The best source of energy cost data is here: <http://www.pbworld.co.uk/index.php?doc=528>

(<http://www.pbworld.co.uk/index.php?doc=528>)

Offshore wind costs about two to three times nuclear electricity [5-10 p/kWhr]. In the absence of hydro you also need lots of open cycle gas turbines to give very fast power up after winter gales pass. These need to be diesel fuelled because you can't pass gas through pipes fast enough. They cost 30-40 p/kWhr at 5% duty cycle..

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Today 06:59 PM

1. onshore wind is much cheaper than offshore wind

2. the nuclear costs rarely, if ever, factor in the full cost of building the reactor, enrichment, subsidies and decommissioning

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"onshore wind is much cheaper than offshore wind"

During last December's Icebox Britain the windfarms of the country contributed almost NOTHING to our urgent energy needs.

There was little or no wind.

It's not for nothing that during Medieval Times, if your ancestors had a choice of water power or wind power they ALWAYS chose water power - it's more reliable.

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graeme_b (http://my.telegraph.co.uk/members/graeme_b)

Today 08:05 PM

Yes, hydroelectric is pretty much always a better option than wind, but at some point you run out of suitable sites. Tidal power may also turn out to be very worthwhile for the UK. What I was trying to

say is that people should keep an open mind about all the options until they know the facts, and that there should be a level playing field in terms of subsidies.

PS. here is a sample of your cheap rhetorical trick, used to make the opposite argument:

In March 2010, China's hydroelectric power was crippled by a severe drought that had plagued southwest China since August 2009, causing a painful shortage of water in the region. Hydroelectric power did almost nothing to contribute to China's urgent energy needs.

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So essentially we have for decades been conned across the world into inefficient Uranium based nuclear power so that Plutonium for weapons could be produced - ignoring the quite incredible Thorium energy potential all along?

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I find it slightly irritating that people seem to 'know' that wind power is pointless, but nuclear is not. Both are viable ways of generating power - it comes down to cost, which will always depend on energy return on energy invested (EROEI) unless the government throws money down the toilet in misguided subsidies. If you want to know which is better, work out how many barrels of oil equivalent it takes to build/fuel/decommission nuclear versus wind for the number of kWh you get out over the lifetime of the facility. I made a back of an envelope stab at it a while ago and I can remember that conventional nuclear was even more rubbish than wind. Besides, why the hell do you think people built windmills for all those years before we even knew about electricity? they're not useless, they're just not as cheap as burning some stuff that came squirting out of a hole in the ground. I keep hearing the same tired old argument about 'wind is unreliable' as well (probably pedaled by the nuclear industry in an effort to win the zero sum competition for subsidy money), but it can be combined with backup gas for example, saving you some gas. Like I say, depends on the price of alternatives, but for now, if you think oil will stay above \$60/barrel, it is undoubtedly worth putting up turbines in the most suitable locations. Other renewable resources are also worth exploiting where feasible and reasonably economic.

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Flacksteen

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Did your back of the envelope calculations take into account the cost of the back up gas generators (and the infrastructure to support them) when wind power is insufficient or unavailable?

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Today 07:09 PM

no, but are you implying they are massively more expensive than just generating using gas in the first place? perhaps backup load is a more elegant solution - i.e. customers that pay a very low tariff to only draw power when there is a surge (work that can be done any time - like milling flour for instance). pumped storage would also be an option. or fairly high utilization of the gas most of the time, and turning gas capacity *off* when there is a wind power surge. surely a fairly thrifty engineering solution can be found?

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DOES THORIUM PRODUCE MORE HEAT THAN LIGHT?

The debate here has not proved very illuminating.

It has generated a lot of hot air, maybe a little steam but so far not enough to power a kettle.

Chelyabinsk

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