If the Fukushima nuclear reactors were based on thorium instead of uranium, the current nuclear crisis in Japan right now wouldn't be happening.

Thorium is a superior nuclear fuel to uranium in almost every conceivable way, yet we hear almost nothing about it in the contemporary hubbub about nuclear power. If there is such a thing as green nuclear power, thorium is it.

For one, a thorium-powered nuclear reactor can never undergo a meltdown. It just can't. This is because thorium is slightly lighter than uranium and is not fissile – meaning you can pack as much of the stuff together as you want and it won't undergo a runaway chain reaction.

Instead, you need to inject a smidge of energy into a thorium reactor to kick it off. Some designs use uranium or plutonium as a seed. An even safer design uses a particle beam to trigger the reaction. If there's a problem, you switch off the beam, and the reactor cools down of its own accord. The meltdown is averted by simply doing nothing.
That's a fundamental about-face compared to the current uranium reactors, where the normal operating state requires constant intervention to actively prevent a meltdown.

Thorium is also thoroughly useless for making nuclear weapons. That was once seen as a barrier to its adoption for electricity generation because, after all, the nuclear power industry was originally an offshoot of the nuclear weapons industry. Uranium was chosen as the fuel of choice precisely because its by-products, like plutonium-239, that could be made into atomic bombs.

Another consequence of thorium being lighter than uranium is it produces far less of the toxic by-products that constitute a large proportion of the high-level radioactive waste generated by nuclear power plants.

Where a uranium-powered reactor creates tonnes of waste over its lifetime that remain toxic for 10,000 years, a thorium-powered reactor produces a fraction of that waste, and what is produced is only toxic for around 500 years. Clearly, building a facility to last 500 years is a challenging prospect, but it sure beats trying to build one to remain safe for ten millennia.

But wait, there's more.

Thorium doesn't only produce less waste, it can be used to consume existing waste. Stick in some of your old reactor waste by-products, or even unwanted weapons-grade material, and a thorium reactor will burn it up, leaving a far less unsavoury residue.

Thorium itself is also highly abundant, far more so than uranium. In fact, Australia has some of the largest reserves of thorium to be found anywhere in the world. Extracting it from the ground is simplicity itself compared to uranium, and far softer on the environment.

It also doesn't need enrichment; the vast bulk of uranium (around 99.3%) pulled from the

ground is unsuitable for a nuclear reactor, so it needs to be spun in centrifuges to extract the minute amounts of useful fissile uranium-235 material from the relatively idle uranium-238.Thorium, on the other hand, can be used straight out of the ground, meaning it can generate around 40 times more energy per tonne mined compared to uranium.

I could go on.

But, in short, thorium is easy to get at, can generate our much-needed baseload power without the risk of a meltdown, without the weapons proliferation risks of uranium, it produces far less waste, it consumes existing waste, and there are several reactor designs that have already been tested and shown to work.

Now, I'm not going to say that thorium is the only answer to our energy needs. It certainly still has its drawbacks – 500 years is still a long time to stand guard over your garbage – but it could provide that all-important stop-gap between existing dirty coal power and the future sustainable energy technologies, or even the holy grail, nuclear fusion.

India has already built a number of experimental reactors, and is investing heavily in the technology. There's nothing except political will stopping Australia from doing the same. If the technology works, it could come into high demand from around the world, and Australia could doubly do its part in reducing carbon emissions by generating thorium nuclear power at home, and helping spread the technology abroad. We might even make a buck in the process, offsetting the R&D and initial capital costs.

If this country, and others around the world, are going to engage in a debate about nuclear power, we owe it to ourselves to look beyond the relatively primitive 20th century technologies that stir so much ire in the public, and look towards safer, more sophisticated 21st century technologies. Like thorium nuclear power.

abc.net.au By Tim Dean
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