# Nuclear Energy – Australia Energy Futures

In the first episode of ABC Radio National Science Show series *Energy Futures*, Carl Smith examines the state of play in Australia regarding nuclear energy.

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This program is provided to assist students completing an assignment on energy resources for the STELR Renewable Energy module.

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## Transcript

**Carl Smith:** You're listening to 'Energy Futures' on *The Science Show*, I'm Carl Smith.

Nuclear power: it's the first alternative resource we'll be exploring. Australia has about one-third of the world's uranium, but we're the only G20 country not generating nuclear power. Some say we should at least be exploring it as an option.

**Ken Baldwin:** The use of nuclear power to generate electricity is going to be carbon free. This is an option that has been chosen by nations around the world, and increasingly this is being adopted. It has of course the capability to produce power in large amounts. We're talking here a Gigawatt or two-Gigawatt or larger power stations. You can dispatch electricity from a nuclear power station as you need it. They certainly have that advantage of being able to supply a significant fraction of our electricity load when we need it.

**Carl Smith:** Professor Ken Baldwin, head of the Energy Change Institute at ANU, a policy-neutral group which looks at a range of energy resources.

**Ken Baldwin:** So what would be needed to have a nuclear industry in Australia is a complete change in our previous history and in our legislated capacity. And the issue there of course is two things. One is that you will need a social licence from the community to develop such a new power source, and secondly we will need a regulatory framework in which to build confidence in the public that we are able to safely handle not only the operation of the nuclear power station but also the storage and also the mining of uranium, but the storage in particular of the waste afterwards. So it’s these two things—social licence and a regulatory framework—that really need a lot of attention in the near future if we are going to have a nuclear industry in this country.

It will involve a process that could take a considerable period of time. You have to be looking at, let's say, five years to build a nuclear power station. Before that you have to establish a regulatory framework, that might take another five years. And then of course you've got to have the social licence from the community in order to go down this track, so that might take an open-ended amount of time, let's say another five years.

So assuming that both political parties wanted to become a nuclear power country in, let's say, 15 years' time, and they made that decision today, and I think it would take a bi-partisan approach to do that, then there would be a long period of discussion, of public consultation. During that time, a regulatory framework would need to be established. And if we are thinking that maybe it will take us, let's say, a minimum of 10 years and maybe perhaps even 15 years in order to build the nuclear power station, then that's the time frame that we have to create a whole new workforce for the nuclear industry. And of course many things can happen during that time. The price of renewables is dropping, solar is dropping much faster than wind. And it could well be that by 15 years' time solar is really in a position to be the leading form of new power generation. If we wait too long then the nuclear option might have gone completely. What we can be doing is many of these things can be done in parallel. While we are thinking about whether to go nuclear, we could have the regulatory mechanisms being set up.

**Carl Smith:** But Australia has already made some progress down the path towards a nuclear industry. In 1958, Australia's first nuclear reactor began operating, it was called HIFAR, and in 2006 it was replaced by a new reactor named OPAL, or the Open Pool Australian Lightwater reactor. It's the closest thing we currently have to a nuclear power station.

After a process of security and screening, taking weeks, I was finally allowed inside the facility at Lucas Heights in southern Sydney.

**David Vittorio:** My name's David Vittorio, I'm the OPAL reactor manager, and here we are essentially at the pool top of the OPAL research reactor. We can look out and see the reactor pool and the service pool. So OPAL is a 20-Megawatt multipurpose research reactor. Operation commenced in 2007. It's a fission type reactor, so the fission process is breaking the atom in two or more pieces. When you break open a nucleus, a few things happen. You produce free neutrons, and also produce heat.

**Carl Smith:** That nuclear heat can be used to generate electricity, and that's what happens in a nuclear power station but at a much larger scale.

**David Vittorio:** OPAL is a multipurpose research reactor. We don't generate electricity from this facility. OPAL fundamentally is a research tool. We produce neutrons that can go out and be used in many applications. Some of the applications I can explain is the production of nuclear medicine. So one of the products we produce is a product called molybdenum-99, which comes from fission reactors. The molybdenum-99, we ship that to over 220 hospitals around Australia every day. The statistics show that one in two Australians will probably have a nuclear medicine procedure from a product that has come out of the OPAL research reactor.

**Carl Smith:** If we wanted to set up a nuclear power industry here in Australia, how translatable are the skills of the people in there, the technology we've developed here inside the reactor, to nuclear power generation?

**David Vittorio:** There is an element that can be translated. I mean, we have created sufficient capabilities to operate a research reactor, through our own training and recruitment programs. So we have proven we can do it for a research reactor. Going to a power reactor industry is just a level of scale-up. It would need support from universities, from organisations such as ANSTO, additional training programs, so I don't think there's a one-size-fits-all approach. Certainly we have the ability to do it, right now maybe not the capability, but with the right level of planning it is certainly translatable into a future nuclear power industry.

**Carl Smith:** What are the impediments to walk down that path though, from where we are standing right now in Australia?

**David Vittorio:** Personnel and training is obviously one, nuclear regulation, so the nuclear regulator would need to grow as well. At the moment we are regulated by ARPANSA, who are very good at regulating a research reactor, but it's a next step to go to a power reactor. I guess it's probably more of what the public policyholders decide when it comes to the scale of the nuclear power industry. ANSTO is in a position to advise policyholders, advise the public, but we are not the decision-makers.

**Carl Smith:** A big concern for nuclear power is safety. There are plenty of risks; technical or human errors could lead to radiation leaks or meltdown, and reactors could become a target for terrorism.

But Ken Baldwin from the Energy Change Institute says those risks can be managed.

**Ken Baldwin:** There is a hiatus, if you like, in the deployment of nuclear around the world as a result of the Fukushima incident, and it may take some time for that to work its way through, for people to realise that there will be no tsunamis in the northern German plains, and that there will be improved nuclear power stations built in the future that look nothing like the 1960s power stations that we saw in Japan. So once all that process works through, I think we will see a return to the construction of nuclear power stations. And indeed, in a lot of other countries in the Middle East, in China, Asia, other developing regions, that there is going to be an increase in nuclear power anyway, irrespective of what is happening in countries like Europe.

**Carl Smith:** How tried and tested is the fission process using uranium now? I guess I'm driving towards the question of safety though.

**Ken Baldwin:** What we've seen is that the nuclear industry by and large has been extremely safe over many, many years. Clearly there are three incidents that stick in people's minds, one is Three Mile Island where there really was no significant risk outside the power station, no one was injured, no one was killed. There was Chernobyl where there was a catastrophic fire in a reactor as a result of human error and mismanagement that resulted in the deaths of many people. But then more recently of course we've had the accident at Fukushima where around 20,000 people died in a tsunami and no one was killed and no one is likely to die as a result of the nuclear accident that happened in the generating station there.

So, to put that in perspective, if you look at industries like coal mining where, for example, hundreds of people die around the world each year, nuclear is looking very safe as an alternative. What we should be looking at is the type of nuclear power station that we could build right now. No one is going to build a Fukushima 1960s-type power station in Australia. No one is going to build an old-style Russian Chernobyl-style power station in Australia. What they would build is one of the new power stations, and indeed if they go to the next generation power stations what we will see are power stations that have inherent safety mechanisms that are unaffected by external events. So if the electricity went off and there was nothing to operate the nuclear reactor, it would simply shut itself down, with no meltdown, with no risk of exposure, with no fire. And so in the future if Australian were to have a nuclear power industry it would be building nuclear power stations with a much higher safety record and much less reliance on human intervention, because, let's face it, human mismanagement has been primarily the cause of many of these accidents in the past.

**Carl Smith:** Back at OPAL, our next stop was the control room.

The uranium used in the research reactor isn't enriched to weapons-grade levels. But there are still strict safety mechanisms in place.

Where we are right now, we are probably 10 or 20 metres away from the core itself. You can actually see all of this, you can get really close to it, and yet there is no danger of radiation where we are.

**David Vittorio:** That's exactly right. The radiation we are receiving where we are now—as you said, some 10 or 20 metres from the reactor pool—is the same as you would receive sitting on the beach somewhere. So it's a normal office environment, it's our workplace. I'd prefer to be on a beach, but from a radiation point of view there’s no difference.

**Carl Smith:** Throughout the tour of the reactor I was escorted by a team of people, including Nadia Levine, a general manager of ANSTO.

How well protected is the building and its surrounds from radiation leaks?

**Nadia Levine:** It's a great question because I think it's one of the first questions that people ask. We are afraid of things that we can't see, and although you can't see radiation you can detect radiation. So with that knowledge we can use that to ensure that the radiation is where it needs to be, doing what it needs to be doing, and take any necessary precautions as we use radiation to enrich our lives, so to speak.

**Carl Smith:** How strong is this, how immense is the security at this site?

**Nadia Levine:** This one ranks at the top of the food chain, which is incredible for Australia because it is one of the world's newest reactors, which means it has the latest technology possible, which of course includes all of the engineered safety features and the many layers that you are referring to. We've taken it to the limits of our imagination to ensure that the systems that we have in place and the things that we've thought about protect us beyond what it is that we actually need. But it gives us that flex room, if you like.

**Carl Smith:** But expanding a nuclear industry would also mean more radioactive waste. And storing our current waste is very much an unresolved issue.

**Nadia Levine:** Through 50 years of the production of nuclear medicine and neutrons for scientific research, Australia has produced a by-product. And as part of enjoying the benefits of those nuclear technologies we have a responsibility to take care of those by-products. Australia doesn't produce high level waste, so we've got low level waste, which are the sorts of things like gloves, it's like a laboratory environment, you'd be gowning up, mouth masks and plastic gloves and so on, so that's all low level waste. And then you get intermediate level waste which of course is the equipment, the steel work, the stairs, some concrete, all the sorts of things that would be associated, and that's got to go somewhere. We don't have capacity in Australia to reprocess those by-products. So those are sent to countries that do have those facilities, in this case it's France. And there is an international agreement for that by-product to be dealt with, and then it's got to come back to its country of origin, if you like, for storage while it decays down to next to nothing. So that's intermediate-level waste, as it's called.

And at the moment there is a national waste depository process underway, which means that there will be a central facility for all of Australia's nuclear related waste to be stored in one particular place. Because at the moment you've got waste that is being stored in hospital basements, for example, around the country, as a result of being generated from nuclear medicine procedures. And international best practice is that you take care of that at all in one space and you responsibly manage that. I think that's something that the community understands.

**Peter Towell:** The biggest issue at the moment is the waste repository, and that is even an issue to ANSTO itself. Because of the governing charter over the site, they are not supposed to be storing waste there. And we can't seem to find anywhere else in Australia that wants to take it. And that's one of the big issues that I and some of my constituents do have, is that everybody is happy to access the services and take the medicines and all the things that benefit them, but nobody is prepared to share the responsibility of it and perhaps store some waste in their state. And unfortunately it always gets dumped back in good old Lucas Heights.

**Carl Smith:** That's Peter Towell, he's a local councillor for the Sutherland Shire and, like many of his constituents, he lives very close to OPAL.

Those living in the area are the first Australians to experience what it's like living near a nuclear reactor.

**Peter Towell:** As you have seen, I can actually see the new reactor from my front balcony and my lounge room, for that matter.

**Carl Smith:** We are sitting out on that front balcony now, just looking out across to the reactor. It was literally like a 10-minute drive here, and as the eagle flies it's probably much, much shorter actually.

**Peter Towell:** Yes, it is. I'm not sure of the kilometres, but I do know that when I bought my block of land that there was a safety package came with the land title that we all had to make ourselves au fait with so that we could either evacuate or hide in the place or take our iodine tablets or whatever that was needed. You are not allowed to grow vegetables and things commercially within five kilometres I think, and they warn you against growing your own vegetables within that distance. So there's an exclusion zone.

**Carl Smith:** How long have you lived here for? When did you move in?

**Peter Towell:** Early '90s, about '91, '92 I think, I can't remember the exact date.

**Carl Smith:** Have you ever really thought about it, noticed it? Does it cross your mind day to day?

**Peter Towell:** From time to time it does. One of the things I think that gets me mostly is when you see an accident and the traffic goes into gridlock and you think, well, if there was an incident at the nuclear reactor, how would we get people out? But then I know that I have had advice, whether it's the right advice or not I'm not sure, but you are supposed to stay indoors and close all your windows and stuff, but I don't know how effective that would be. I think the majority of people would want to get out of the place.

So from time to time we think about it. Not every day. It's a thing that we've learned to live with. Initially it was a thing of doubt, but as a young couple looking for a block of land it seems to be the right price and the right place. The safety mechanisms were in place, as they said, so we decided to move in the area.

I'm not entirely sure that everybody has an issue with it. There are some that do in the past with HIFAR, the old HIFAR reactor there were a few issues. But on the whole I think the majority of people just live with it and just know that it's there and they are happy to go about their life really not thinking about it much at all.

**Carl Smith:** You're listening to 'Energy Futures' on *The Science Show*, and we're exploring Australia's energy alternatives beyond fossil fuels. I'm Carl Smith.

We've been looking into Australia's potential to generate nuclear power, but what about the cost? Ken Baldwin from the Energy Change Institute:

**Ken Baldwin:** Presently if you were going to build a new power station of any description, wind is by far the cheapest, and this is followed by a number of other technologies. Solar will probably come into the mix, maybe by 2020. Nuclear energy may well be in the mix not very long after that.

**Carl Smith:** He sat on the steering committee for an Australian government report called the Australian Energy Technology Assessment. The goal was to calculate an overall cost per unit of energy for 40 different power generation options in Australia. The calculation incorporated everything from the costs of setting up technology, to ongoing costs, and to the lifetime of infrastructure.

The report puts wind as one of the frontrunners over coming years. Looking well ahead, solar photovoltaic is predicted to emerge as the cheapest method. And nuclear sits somewhere in the middle of the pack.

It looks like wind will come out as one of the first winners and then perhaps solar after that. Is that how you read it as well?

**Ken Baldwin:** Yes, I think that's probably right. I think it's highly dependent also on the price of fossil fuels as to what happens in the next decade or maybe two decades. There is this intermediate period where we are transitioning away from fossil fuel usage, and gas is an attractive alternative to doing that because its fossil fuel content releases less CO2 into the atmosphere for every fixed amount of energy that it generates. So that is a useful transitioning mechanism. But as we know, the price of gas is in a state of flux. Australia is now exporting gas onto the international market, so we are actually getting tied in to the market price internationally. And this market price could easily go up, which would make it more expensive here, and indeed what we've seen is gas power stations being pulled off-line for exactly this type of reason. However, it could also go down, and there are a number of reasons why this might be, not the least of which is that the United States might start exporting and this could affect the international gas price as well.

**Carl Smith:** So beyond gas then, what are the other energy resources that we have here in Australia that appear to be shoo-ins to emerge over the coming maybe 10, 20, even 30 years?

**Ken Baldwin:** I think Australia is well placed in just about every area you could imagine. We are an energy-rich country. We have enormous reserves of fossil fuels, we have enormous reserves of uranium, 40% of the world's reserves there. And of course our resource in terms of both wind and solar is enormous. We have prospective wave generation capacity as well, and all of this will be played out in the market. So it will be driven by cost, but also it will be driven by government policy.