SUBMISSION

to the

SELECT COMMITTEE of the House of Assembly

of South Australia

on

THE PORT AUGUSTA POWER STATIONS

Contents

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1 Introduction

This submission relates to clause (e), *"any other relevant matters"*, on the list of things to be considered by the Select Committee on the Port Augusta Power Stations. The relevant matter is *climate change* and the place of wind and solar energy technologies in the battle to reduce Australian and global emissions as required by physical climate change emission budget constraints.

The 2009 paper: *The Copenhagen Diagnosis*[1][1] gives long term sustainable limits for greenhouse gas emissions and work by NASA climate scientists led by James Hansen details more immediate requirements[2][2].

2 Climate, oil and energy

For the past 20 years, there has been a competitive cacophony about the urgency of climate change by Governments and environmentalists around the world — but very little action. The emission reductions supposedly generated by the 1997 Kyoto protocol have in fact been measurably less than the increase in imports of emission intensive products by countries in the first world from countries in the third world[3]. Many countries have simply out-sourced their emissions. This comprehensive failure has accelerated the urgency of substantive action.

During virtually all of these two decades, the French have been generating electricity using nuclear reactors at a CO_2 emission rate of about 80 grams per kWh, compared to the global average of over 500. Australia has a worst-in-class level of about 850 grams CO_2 per kWh[4]. The French completely transformed and grew their electricity generation infrastructure over a two decade period in the 1970s and 80s. The spur was oil prices rather than climate change, but the lesson remains. A fast affordable move to low carbon electricity is possible. The French did it. The Swiss did it. The Swedes did it. It isn't the total solution to our climate problems, but it would be a bloody good start.

In contrast, it's been 12 years since the Germans introduced a feed in tariff to reward rich Germans for electricity generated by putting solar panels on their roofs. We copied them. During this period the German Government has incurred a 100 billion Euro debt to be paid over the next 20 years to those same rich Germans for a miserable 19 TWh/yr (terawatt hours per year) of day-time only electricity (about 3.3% of its total). And after all this expense and a forest of wind farms they are still generating 450 grams of CO_2 per kWh as a result of one the biggest white elephant projects in the history of cool technologies being promoted well beyond their tiny niche of applicability.

To admit the French are right about anything is clearly something everybody in general, and the Germans in particular, would like to avoid, but we really need to get over this, to give them credit and move on.

The French didn't panic when a nuclear melt-down at Three Mile Island in 1979 resulted in no

[1] `http://www.copenhagendiagnosis.com/`

[2] Publicly available here: `http://arxiv.org/abs/0804.1126`

deaths. After all the people who didn't die weren't French and the reactor wasn't French either. The French also didn't panic in 1986 when a steam explosion in Ukraine at Chernobyl blew the top off a reactor without a containment building and killed less people than many a drunken Australian Easter holiday road toll. Again — not French.

In the 1980s, the French added 216 TWh/yr of nuclear electricity to the 100 or so they built in the 1970s. By the time of the formation of the United Nations Framework Convention on Climate Change in 1992, their carbon dioxide cost per kilo-watt hour of electricity was down to about 100 grams and hit 80 soon after. Meanwhile the Germans and most of the rest of us just continued to bugger up the climate big time.

Had we followed the French and gone nuclear in a big way, as they did in Switzerland and Sweden, the world would be very different. It is ironic that sincere concern for the planet has often gone hand in hand with innumeracy, irrationality and frequently both. The 2010 floods in Pakistan displaced 20 million people; cyclone Nargis in 2008 killed 140,000; These are the kinds of events which environmental and Green anti-nuclear activism has made more likely in the future because of ill-informed fear-mongering. Had we all gone nuclear and decarbonised our electricity, we'd still have work to do, but the urgency would be considerably reduced and some of the key technologies would be cheaper and better.

The anti-nuclear movement has cost us all a couple of decades . . . and counting.

Let me say one last thing about Chernobyl before moving on. The accident at Chernobyl was a horrid industrial accident which taught engineers valuable lessons and nobody builds reactors like that anymore. The radioactive plume from the accident increased natural radiation levels in large areas of what are now Russia, Ukraine and Belarus and they have been eating plenty of food with higher than normal radiation levels in those three countries for 25 years. And the result? . . . almost nothing. During this 25 years the three countries have had about 14 million cases of cancer[3] with about 6,000 likely due to Iodine-131 emitted in the first days of the accident[5]. It was a predicted problem and avoided elsewhere, but the Soviets stuffed up. Nevertheless, these extra cancers were treatable thyroid cancers with just a couple of dozen deaths.

It may seem to flippant to dismiss "just a couple of dozen deaths" and 6,000 cases of thyroid cancer. Not so. If these three countries had had Australian age standardised per-capita cancer rates during the past 25 years, they'd have had something in the order of 20 million cancers ... not 6,000 but 6 *million* extra cancers!

Australian's are flippant about much bigger causes of cancer and other diseases than tiny amounts of radiation. They are happy to eat BBQ'd meat, get pissed, get fat, get unfit, feed themselves and their children bacon and eggs, sausages and steak. And they still smoke cigarettes. All of these are far more potent as causes of cancer than small amounts of extra radiation in food or soil. Australians are flippant about causes of vast oceans of cancer and terrified of things that don't even cause detectable ripples. Anti-nuclear campaigners are conveniently ignorant of comparative risks so it's easy for them to tell cancer horror stories to the general public because the general public has no idea about comparative risks.

It is far worse than flippant to risk the destabilisation of the unusually benign climate of the

[3]Rough estimate based on *Globocan* data.

past 10,000 years because of a few dozen deaths. That's nutter stuff. When anti-nuclear elder "states person" Helen Caldicott told people at a press conference in Canada just a week after the deathless Fukushima melt-downs in 2011 that they should stop eating Turkish apricots because the whole of Turkey was contaminated by the Chernobyl plume, she showed exactly what a nutter she was and is[4]. Turkey has half the age standardised rate of cancer of Australia[6]. What has all that contamination done in Turkey? Nothing. Bring on those apricots!

Happily, a growing number of environmentalists have realised they have been deluded by anti-nuclear fear mongering and are now pro-nuclear. Once you start checking information issued by the likes of Caldicott, the result should be inevitable[5]. Most of us just find it hard to believe that a person can tell so many untruths with such sincerity and even harder to admit our own gullibility. It took me months to finally "come out" as pro-nuclear after I realised what a crock of rubbish I'd believed for so long. Even more unfortunately, while some environmentalists have woken up, it's looking like we will have to wait for the rest to die.

3 What to do at Port Augusta

So what are we to do at Port Augusta? And every where else in Australia?

A report, **Zero Carbon Options** from Ben Heard of *ThinkClimate Consulting* and James Pang of *Pang and Brown* tells us we can install a Canadian nuclear plant for about $4 billion dollars, or follow the German lead and install a combination of wind and solar for about $8 billion. Of course, the former risks a deathless nuclear meltdown if Port Augusta is ever hit by a 15 metre Tsunami, and the latter risks continuing to bugger up the climate because we will have $4 billion less to deal with the remaining emission problems we still need to deal with.

At this point it is imperative to point out that while the reactor being considered in this report is Canadian, it isn't French Canadian.

At this point you could just go and read the aforementioned report. The rest of this document will just present a few more details about the comparative history of the nuclear growth in response to the 1970s oil crises compared with the wind and solar response to climate change of the past decade.

4 The 1970s oil crisis and nuclear expansion

The oil crisis of 1973 provided an example of just how incredibly fast an energy infrastructure can be rebuilt if you have the skills and the will.

The response to a rapid 5 fold increase in oil prices was that many countries rapidly rolled out substantial amounts of nuclear electricity capacity. Figure 1, using International Energy Agency data[6] illustrates the rates at which some small, medium and large countries added

[4] `http://www.youtube.com/watch?v=SV7Rn06j_cY`
[5] `http://www.monbiot.com/2011/04/04/correspondence-with-helen-caldicott/`
[6] `http://www.iea.org` — See Appendix A.

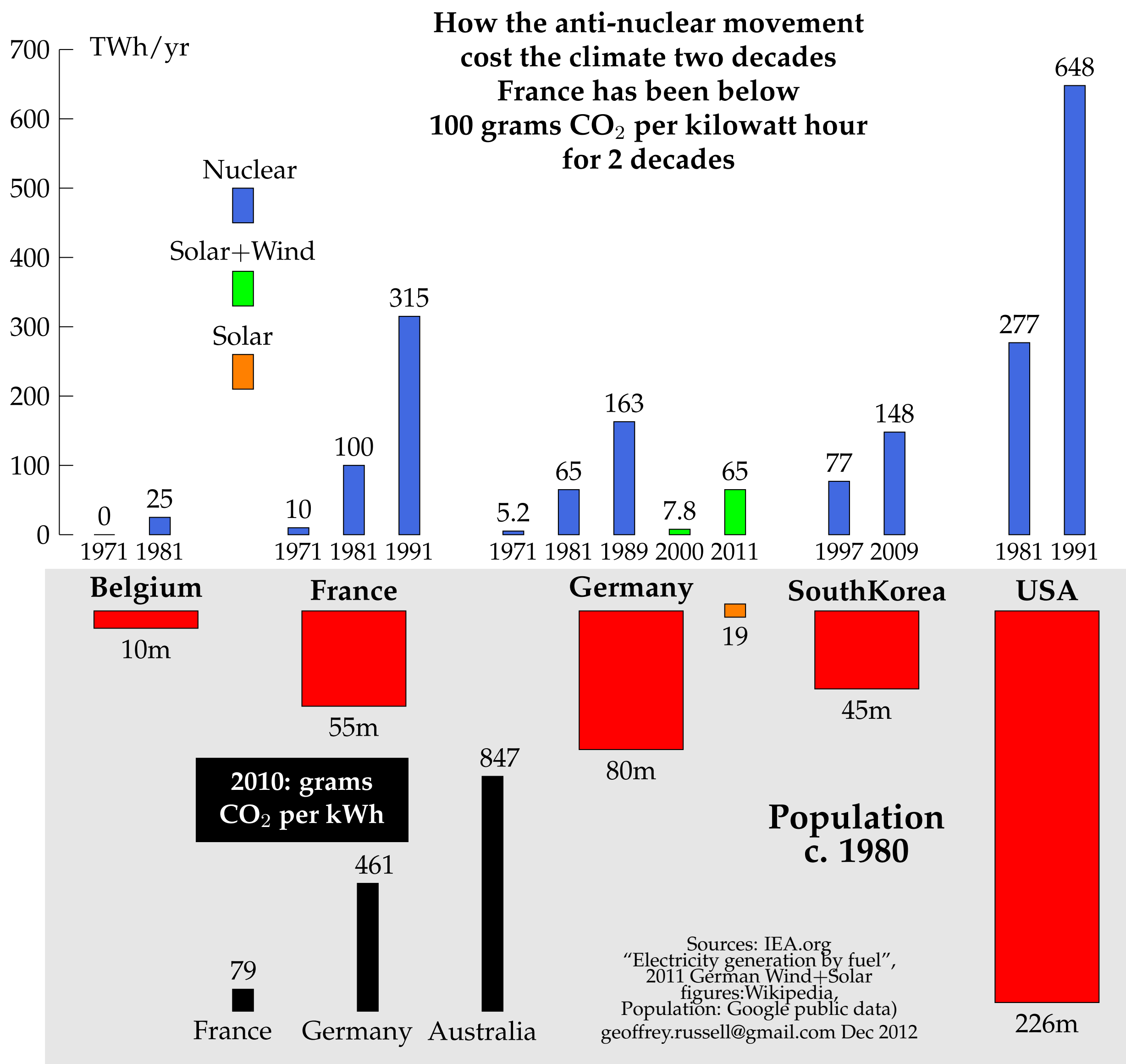


Figure 1: Comparative Growth of Nuclear and Renewable Energy

nuclear power during this period.

Many countries had small nuclear research programs at the beginning of the 1970s, but by 1981 most had expanded these and were generating substantial amounts of electricity using nuclear reactors with a phase out of oil combustion for electricity. For example, Belgium, as shown in the Figure, despite a population below 10 million in 1975, added 25 TWh/yr in just seven years. They aren't shown on the figure, but Switzerland and Sweden did much the same, adding nuclear to their predominantly hydro electricity systems. To put the Belgium figure into context we can compare it to the German solar build. Between 2000, when it began its solar feed in tariff policy, and 2011, Germany, with 80 million people, added just 19 TWh/yr of solar photovoltaic electricity The per capita rate of the Belgium nuclear roll out is about 10 times faster than the German solar roll out. But what about the German wind roll out? The Belgium nuclear roll out was 3 times faster than the combined wind + solar German roll out. Keep in mind that there was nothing new about solar photovoltaic technology in the year 2000. More than 10 years previously, in 1989, Australian Professor Martin Green of the University of NSW predicted that solar photovoltaic cells could replace coal in 10 to 15 years[7]. Indeed solar photovoltaic power plants were a dismally ineffective part of the oil crisis response and quickly abandoned. Debris from these plants still pollutes some desert areas in the US.

After the initial startup phase in response to the oil crisis, additional nuclear growth during the 80s was huge. The figure shows France, with a population of just 50 million people in 1980, adding 215 TWh/yr of electricity in a decade. This is about 6 times faster than the recent decade's combined German wind + solar growth. Germany's nuclear growth during the 80s was well behind that of France but still almost double its combined wind and solar growth since 2000. It also looks highly unlikely that solar and wind growth will accelerate as nuclear growth did in its second decade. More on this below.

Figure 1 contains just a sample of countries, but it is fair to say that during that 1970s oil crisis, every country who tried to roll out significant amounts of nuclear power succeeded.

In contrast, it has been 15 years since the Kyoto protocol was signed and during that period *no* country has achieved anything like the oil-crisis nuclear growth using non-hydro renewable energy technologies like wind and solar.

Germany, with over 80 million people, is often held up as a model of renewable energy deployment, and it certainly has the best record in growth of wind and solar electricity technologies. But between the signing of Kyoto in 1997 and 2011, it has added just 19 TWh/yr of solar photovoltaic electricity and another 46 TWh/yr of wind power. I've already mentioned the staggering cost, and poorer Germans are paying the price with high electricity bills and hundreds of thousands of disconnections annually[8].

South Korea, with a population of 45 million when the Kyoto protocol was signed, has since added 71 TWh/yr of nuclear electricity. She has recently begun work with the United Arab Emirates and will have 4x1400 mega watt nuclear reactors up and running by 2020 generating some 44 TWh/yr for the next 60 years at a capital cost of 20 billion dollars with another 20

[7] http://www.abc.net.au/catalyst/stories/3228140.htm

[8] http://www.spiegel.de/international/germany/germany-s-nuclear-phase-out-brings-unexpected-costs-html

billion in running costs[9]. Compare this 40 billion dollars for 44 TWh/yr for 60 years with Germany's 100 billion Euros for 19 TWh/yr Solar PV for about 25 years ... after which you have to build everything all over again.

If Australia is to take climate change seriously and make steep reductions in our climate forcings[10], then it is clear that it must consider nuclear options. The *ThinkClimate Consulting* and *Brown and Pang* report gives a concrete example of how a nuclear option might work at Port Augusta and should be considered by the committee. The report can be downloaded from the *Decarbonise SA* website[11].

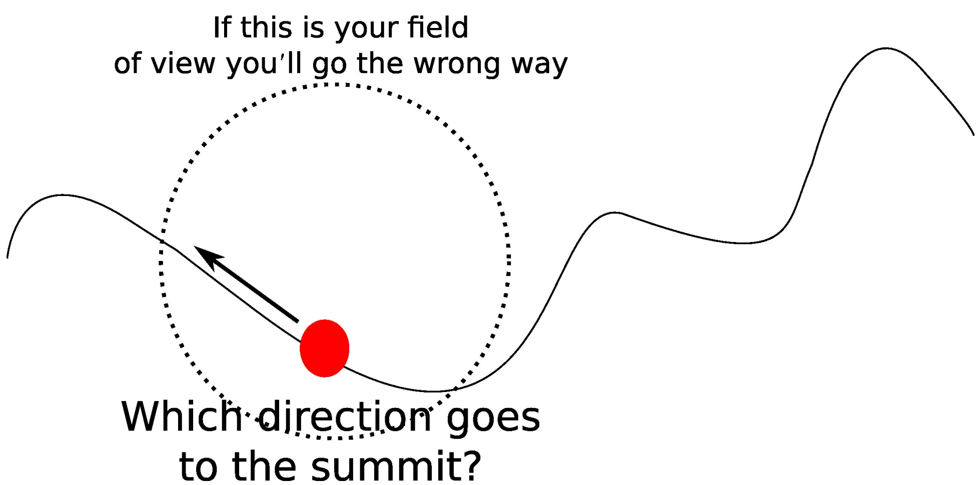
5 Climate change responses and mountain climbing

I now want to turn to more general issues which relate to our response to climate change. Because the climate science tells us that our response has to be much bigger than just electricity.

What would it do to Australia's emissions profile if we added 3 kw of solar panels to all 7.6 million Australian households? Not that this is even possible. Think of high density areas like Lane Cove in Sydney's North Shore with its dense cluster of multi-story units. Even so, such a move would clean up just 3% of Australia's energy consumption. That's all.

In Australia, household electricity is about 25% of all electricity use and electricity use is about 25% of all energy use. So household electricity is a quarter of a quarter ... i.e., 1/16 ... of the energy component of our impact on the climate. And universal 3 kw panels would only deal with about half of that. The knee jerk feeling that installing solar panels is a positive response to climate change is short sighted and ill-informed. Such actions might bring incremental improvement but at great cost and they wouldn't get us to where we need to get.

To understand why incremental improvements don't necessarily lead to the desired reductions we need to make, you need to think about climbing mountains.



[9] http://www.world-nuclear.org/info/UAE_nuclear_power_inf123.html

[10] A *forcing* is anything which has a climate impact, not just greenhouse gases. For example land clearing changes how much sunlight is reflected back to space, so it is a forcing.

[11] http://decarbonisesa.com

Will incremental ascents always get you to the main peak? The figure makes it obvious. If you head to the left, you go up. Great. But you end up going in a direction that doesn't lead you to the summit and it might not get you high enough to achieve what you need. Going right looks all wrong because you go down. We'll give details of real world example shortly with the totally useless switch by the British to natural gas.

The situation is the same when fighting climate change by setting emission reduction targets or a tax on carbon. It's assuming that all upward paths get you to the summit. They may not.

Industrial problem solvers in industries as diverse as bus scheduling or oil refinery planning deal daily with these problems. They use vast computing power and sophisticated mathematics to find pathways to solutions using either techniques proven to be optimal or, when this isn't possible, by surveying as much of the solution landscape as possible. The little picture I've drawn is in two dimensions. In industrial and scientific applications, there may be thousands of dimensions to a problem. This means there are many more ways to head off in a wrong direction.

Think about what can go wrong (and has been going wrong!) with the current short sighted response to tackling climate change:

- You can head into a dead end. This is one of the three problems with using natural gas (which is just methane ... CH_4) to generate electricity.
  - The UK has gradually substituted gas for coal over the past 20 years and its CO_2 per kWh of electricity has fallen slowly from 672 grams to 470 grams. But we'll see later that the real target that needs to be met is well under 100. All that capital invested in gas is dead end investment. It has been wasted, gas is just another fossil fuel which can never feature in any long term sustainable energy system. They'll have to throw out that massive wasted investment and start all over again.

    In comparison, modern nuclear plants have a 60 year design life, and we know they meet long term sustainable goals for emission levels.
  - The second reason is even worse. CH_4 burns cleaner than coal but extracting gas inevitably leads to leakages. Because CH_4 is such a powerful greenhouse gas, even small amounts of leakage can easily offset the gains due to the cleaner burning[7].
  - Last but not least. Burning coal produces sulphates which have a cooling impact on the planet. They are a serious pollution problem but they have a short term cooling impact which partly offsets some of the extra CO_2 emissions[7, 8].

  The bottom line is that gas actually makes things worse, it just substitutes things that aren't easily measured and accounted for in agreements like Kyoto for things which are. Gas is a dangerous dead end.
- You can run out of money. This is the German solar photovoltaic feed in tariff problem. As of 2011, 100 billion Euros has cleaned up just 3.3% of German electricity.
- A similar but slightly different problem to running out of money is that you can run out of rich people.

Currently there is a global glut of solar panels which has been pushing down prices and sending solar panel companies bankrupt[12]. How can you have a global glut with solar panels producing so little electricity?

Our Productivity Commission estimated that the Germans are paying $891 for each tonne of CO_2 that solar panels reduce[13]. This is bizarre. The solar panel strategy in effect, relies on there being enough rich people who want to feel like they are doing "the right thing" or enough gullible Governments willing to subsidise it. The solar panel strategy globally is simply running out of rich people.

- You can run out of alternative energy sites. This is part of the problem with wind power. It gets progressively harder to find good sites and a profit oriented company doesn't want to build in less than optimal positions. The Germans have been busily building wind farms in the north of Germany, because it's nice and windy there, but there's no way to get that energy to the industrial heart land in the south. They need a massive grid upgrade. Suddenly cheap wind power isn't so cheap anymore. This ends up as a run-out-of-money problem again.

- You can simply blow the cumulative emissions budget. Climate scientists have got a pretty good handle on how much CO_2 you can add to the atmosphere in total. With CO_2 unlike other climate gases, it doesn't much matter *when* you add it[9]. Most of it stays aloft for hundreds of years. So what matters isn't when you emit CO_2, but the cumulative emissions over the next 100 years of so. It's fine to increase emissions for a decade if you can plunge to zero at the end of it. For example, the Chinese are looking to build 400 huge nuclear reactors. That's a lot of emissions from cement production, but it gets them to a very good place. In parallel, they are looking at mass produced small modular reactors (SMR). We, in contrast, don't have either a plan A or a plan B, let alone parallel plans. We just hope that a carbon tax will guide the inscrutable mechanism of the market to produce a solution and bumble along with emission targets. Our backup "plan" is to buy dodgy credits if we don't meet our dodgy targets.

  The carbon credit system is designed to complement shortsighted emission target thinking[14]. It allows for example, a developing country to build a supercritical coal plant and get carbon credits because these plants are a slight improvement over other coal plants. This allows a dirty coal plant in Australia to offset some of its emissions by buying credits from the country with the new supercritical plant. Bingo. You have two coal plants pumping out CO_2 and most of this CO_2 is additional because the developing country had nothing to start with.

- The obsession with targets obscures the fundamental need in in developing countries for far more energy. They aren't interested in targets because their current deprivations still look pretty serious compared to climate risks. They need technologies which simultaneously solve both problems. Currently some 3 billion of the planet's population still cook with wood, or some other biomass like cattle dung. The smoke from this cooking

[12] http://www.nytimes.com/2012/10/05/business/global/glut-of-solar-panels-is-a-new-test-for-china.html

[13] http://www.pc.gov.au/projects/study/carbon-prices/report

[14] http://thinkprogress.org/climate/2012/09/19/865471/in-the-crazy-world-of-carbon-finance-coal-no

kills about 3.5 million people annually, including around a million children per year with pneumonia or acute lower respiratory tract infections[15].

So while about 200,000 children die annually in India because of wood or dung smoke, Greenpeace in India is trying to stop the building of a massive nuclear complex at Jaitapur which would save many thousands of lives because Greenpeace think nuclear power is dangerous. Hell, there might be another meltdown and nobody would die. In the two weeks that the world's global media jackals waited to get pictures of 3 minor radiation burns at Fukushima, some 38,000 children died from infections caused by wood smoke.

But I guess they don't matter because they were carbon neutral deaths and not those scary radiation kind.

- Lastly, you can run out of time. We are busily trying one "promising" new beaut cool technology after another only to have them all fail for different reasons while we shy away from a technology which we know works. We are rapidly running out of time.

6 The bigger picture

An effective response to climate change isn't just about energy. It's important when considering Port Augusta to see whatever action is taken as part of a total response to climate change. We can't simply invest huge sums of money at one or a few power plants and think that this is enough. It isn't.

There are a couple of ways to view what is required for an effective response to climate change. In the following two short sections, we first present the broad requirements as determined by climate scientists and secondly quantify the per person greenhouse gas emissions budget that this implies.

6.1 Getting back our recent climate

James Hansen's NASA team has established[2] that there are three things necessary to return the climate to its unusual and relatively stable state. The last 10,000 years really is unusual in the climate record and may be the key to the development of crop farming[10], the critical feature needed to support large stable populations. It's not quite clear if we are partly or wholly responsible for this stability[11], or that we have merely exploited a lucky run to develop our civilisation. Certainly, our species and forerunners did nothing for at least a couple of hundred thousand years despite having ample mental and physical capacity. But the climate of the past 10,000 years has been special and to preserve it in roughly its current form we need to do three things:

1. Rebuild the energy infrastructure with close to carbon neutral methods. This is the *EnergyRebuild* requirement. This is a natural focus in the context of decisions about Port Augusta. But there is more we must do.

[15]From the recently released Global Burden of Disease study. Lancet 2012; 380: 222460

2. Roll back 200 years of deforestation to draw down additional carbon. This is the *Reforestation* requirement.
3. Slash non-carbon-dioxide contributions to climate change. This includes methane, black carbon and nitrous oxide and can be called the *MethaneReduction* requirement on the understanding that it embodies a little more than simply methane.

None of these measures *on their own will* be sufficient to bring atmospheric CO_2 back down to 350 ppm (parts per million) by 2150. The last measure is particularly important because it can change climate forcings quickly[12]. It's methane reductions that might just help stop us from crossing climate tipping points from which there is no return[13].

But these measures will not be without substantial cost and disruption. Reforestation and methane reduction will require rural restructuring which cannot be done humanely without adequate compensation. Australia has 70 million sheep now compared to 170 million in 1990. This is a major part of how we have been able to meet our Kyoto commitments. But reductions in cattle are also essential. The *Zero Carbon Britain 2030*[16] report is making similar calls for similar reasons with plans for a 90% drop in the British beef herd and an 80% drop in the dairy herd.

Plans for Port Augusta must be seen in the light of a total climate change response plan and we must not think that all our problems will vanish simply with an energy rebuild.

6.2 Per person emissions

The Copenhagen Diagnosis documents tell us that the sustainable level of annual $CO_2^{\mathbf{eq}}$ (carbon dioxide equivalent) emissions per person for the estimated 2050 global population of some 9 billion people is about one tonne each.

Australia's current level of per person $CO_2^{\mathbf{eq}}$ emissions is about 25 tonnes.

Australia's current greenhouse gas emissions are about 550 million tonnes $CO_2^{\mathbf{eq}}$ per annum, with about 200 million of those coming from electricity generation. Clearly then, replacing *all* our electricity generation with clean sources would still leave us with 15 tonnes of GHG emissions per person. There are clearly many more sources of emissions than electricity. Some of these relate to energy and others to agriculture.

Australia's livestock generate about 3 million tonnes of methane per annum which is considered, under Kyoto rules, to be equivalent to 75 million tonnes of CO_2. So even if we reduced all energy emissions to zero, our livestock emissions would still put us at 3 times the global average sustainable level.

Is it even possible to get to 1 tonne per person?

Given that about 2/3 of our beef is exported, we could stop exporting that and get close to that one tonne level, but this would still leave no room at all for any other emissions.

Globally also, meat consumption is a major problem. A 2010 paper[14] showed that FAO pro-

[16] `http://zerocarbonbritain.com`

jections of meat consumption growth globally would see greenhouse gas emissions due to meat production occupying 71% of that one tonne per person CO_2^{eq} budget by 2050. If you spend 700 kilograms of your 1000 kilo limit on meat, then there isn't much room for everything else.

At the current French rate of 90 grams of CO_2 per kWh of electricity then we can use about 11,000 kWh per person per year for one tonne of CO_2. The current Australian per capita electricity use is just under this. This isn't household use, but total electricity use divided by the population.

Australian electricity use accounts for about a quarter of the energy we use and 95% of that energy comes from fossil fuels. So "simply" replacing current electrical energy with clean electricity won't come even close to meeting the one tonne target, not in Australia and not anywhere. But with enough electricity, we can use it to replace most other forms of energy. We can make synthetic aircraft fuel, we can make hydrogen for fuel cells. But we need plenty.

So the one tonne budget will be tough. To achieve it we will need to produce electricity for about half the CO_2 yield of the French. This is possible, the Swiss and the Swedes both manage this with a mix of hydro and nuclear, while the French still have some dirty fuels in their system. We also *must* slash meat consumption and meet *all* our other energy needs, such as petroleum, with electricity or other clean fuel technologies.

Unfortunately, there's one last complication which highlights why the methane reduction plank is absolutely essential, along with reforestation in Hansen's 3-pronged strategy. The complication is that the concept CO_2^{eq} ... *carbon dioxide equivalent*, is poorly named. The factors used by the Kyoto protocol to convert CH_4 to CO_2^{eq} understate the climate impact of methane during the 20 years after its release by a factor of about four[15]. So the impact on the climate of the 3 million tonnes of Australian livestock methane isn't 3 tonnes per capita, it's more like about 12.

The good news is the relationship of the livestock population to the *Land Use* plank of the climate problem. Australians only live on a couple of million hectares of our 770 million hectare land mass. We have cleared about 100 million hectares since white arrival and crop about 25 million. So we have 10s of millions of hectares cleared for sheep and cattle that will reforest and soak up CO_2 if we remove the livestock. It's similar globally.[17]. We have plenty that will reforest if we don't use it to grow 12 million tonnes of feed for livestock. So slashing livestock populations simultaneously tackles two of Hansens's three planks.

7 Concluding remarks

As you can see, the one tonne long term global greenhouse emission budget will be really tough and we can't afford to stuff around with expensive feel good technologies. We don't just need to replace Port Augusta with a clean electricity source, we need to either double its output so that we can charge electric vehicles and/or make hydrogen for fuel cells.

Nuclear power is currently illegal in Australia. This is incompatible with an effective response to climate change. Many countries, particularly Belgium, France, the US, Switzerland, and

[17] http://bravenewclimate.com/2010/01/05/boverty-blues-p1/

South Korea have shown us that low emission electricity can be obtained quickly with nuclear power. Germany has demonstrated that even the biggest economic powerhouse in Europe can't roll out renewables quickly, let alone affordably.

To resist nuclear because you are worried about safety issues is like standing on a railway track before and oncoming train and not jumping out of the way because you may sprain an ankle. I've included an appendix discussing the stress and fatalities caused by anti-nuclear hysteria at Fukushima. The only issue I haven't dealt with is nuclear waste. Again this is irrelevant and trivial compared to climate related risks. The nuclear industry has had a solution to the so-called waste problem for decades. The solution is to use the waste as fuel in what are called fast reactors.

The second appendix is some IEA graphs presenting the data used to build Figure 1 at the beginning of this submission. They will repay careful examination.

I urge you to read the *Decarbonise SA* and *Pang and Brown* report and take the necessary steps with the Federal Government to make nuclear power legal. I urge you to show leadership and consider the United Arab Emirates path to fast tracking nuclear development so that Australia is no longer a luddite climate vandalising basket case.

Geoff Russell
December 2012

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Appendices

A Fukushima fear mongering turns fatal

It is unfortunate that any recommendation for nuclear power in Australia needs to deal with decades of nuclear fear mongering. Not only has the anti-nuclear movement delayed effective action on climate change, recent events in Japan have shown exactly how deadly and destructive such fear mongering can be.

In March 2011, Japan was hit by a quake and tsunami which killed some 19,000 people. The seismic events killed along an extensive area of the north eastern coast of Japan. There were a few places along this coast where people didn't die . . . the nuclear power plants. All but three of the 1,000 or so workers at the 4 plants housing 10 reactors on the day of the tsunami owe their lives to the simple fact that they were working in plants designed to cope with a sizable tsunami. Had these people been working as coastal roof top solar panel installers, or any other kind of coastal business, many would be dead. But the tsunamis exceeded design specifications and swamped backup generators and the end result was a deathless triple meltdown. So after saving lives by generating clean electricity for decades and saving more lives on the day of the tsunami, the reactor failures and subsequent events were portrayed as a disaster. The media staked out hospitals overflowing with victims of the actual disaster to eventually take pictures of three reactor workers with mild radiation burns in images that went global.

As the reactor failures unfolded the anti-nuclear movement went to work calculating the number of cancers that the Fukushima radiation would cause over their lifetime to those involved. A paper was subsequently published[16]. Did anybody think to do this calculation when a toxic and carcinogenic plume blossomed over Adelaide with the huge Wingfield fuel fire in March 2012, or when the Chiba oil refinery burned for 12 days after the quake and tsunami in Japan? How did the paper calculating the cancers due to Fukushima radiation control for those due to the Chiba smoke? It didn't and nobody bothered in Adelaide, because nobody ever bothers to calculate refinery fire cancers.

The method used in this paper by physicists Ten Hoeve and Mark Jacobson is explicitly warned against as invalid by international radiation experts. Here's an illustration of the method using alcohol instead of radiation. Alcohol causes cancer. True enough. Let's suppose that if 1000 people drink a glass of wine a day then eventually 10 will get cancer due to that wine. I just made those numbers up, they are to illustrate the method and are intended to be simple to work with rather than accurate, but it is definitely true that alcohol causes cancer and the Cancer Council says there is no safe level so the situation is analogous to the situation with radiation. So how many people will get cancer if a million people drink 1/1000 of a glass per day? The anti-nuclear logic used by Hoeve and Jacobson estimates 10,000 cancers. The population is consuming 1000 times the alcohol that produced 10 cancers, therefore there will be 10,000 cancers. That's the logic behind the study and the anti-nuclear people have been pulling this rubbish ever since Linus Pauling made it famous.

Radiation experts advise explicitly against the method of calculation used in the study[17]:

"Collective effective dose is not intended as a tool for epidemiological risk assessment, and it is inappropriate to use it in risk projections. The aggregation of very low individual doses over extended time periods is inappropriate, and in particular, the calculation of the number of cancer deaths based on collective effective doses from trivial individual doses should be avoided."

This is why the study appeared in an energy and environment journal and not a specialist radiological, medical or epidemiology journal. So the conclusions are ill-founded, but let's consider them anyway.

The study's best estimate is that *without any evacuation* the Fukushima radiation would have caused between 24 and 1800 cancers with the best estimate being 180. This is over the whole of Japan. Given current cancer rates, Japan will have about 10 million cancers over the next 30 years ... plus 180. But of course cancer rates aren't constant. They change according to lifestyle choices, pollution levels and so on. For example, Japan used to have what can what can reasonably be called background levels of bowel cancer. These are the low rates found around the world in populations living on mainly plant based diets. The rates in men and women were similar and resulted in about 20,000 bowel cancers per year in the Japan of the early 1970s. With the Westernisation of the Japanese diet, the number of new cases of bowel cancer rose over a couple of decades to more than 101,000 annually[18], with the small increase in population accounting for perhaps 3,000 of these. Of all the changes to the diet, the only ones with a causal connection to bowel cancer were the increases in red and processed meat[19]. Obesity can also cause bowel cancer, but the Japanese rate of just 3.2 percent is one of the lowest in the world.

Over the next 30 years, Japan will have about $78,000 \times 30 = 2.3$ million extra bowel cancers due to dietary change and, if you trust anti-nuclear logic, about 180 due to Fukushima radiation.

The Hoeve Jacobson study is rather like some Hollywood films. The special effects are brilliant and the technical excellence is remarkable, but nothing can save a fundamentally silly plot-line.

But such was the fear mongering panic after the reactor failures that an extended evacuation was decided upon. According to Hoeve and Jacobson, the panic and haste of the evacuation killed some 600 people. It is amazing how much expertise they expend on estimating their figure of 180 cancers and how little they spend on checking the 600 figure on evacuation deaths. It's a news report, it must be right. Nevertheless, Hoeve and Jacobson plough on, assume the figure is accurate and apply their considerable skills to estimate the cancers saved by the evacuation at about 22% of the cancers. This is a savings of about 40 cancers over the next few decades.

So if we take the results at face value, then the result of anti-nuclear hysteria at Fukushima has been to kill some 600 people to prevent 40 cancers.

The Fukushima reactors saved lives on the day of the tsunami and have been preventing all manner of diseases for decades. The panic whipped up by the anti-nuclear movement completed the devastation began by the tsunami and prompted an unnecessary evacuation that killed people. The evacuation also killed many animals. These were frequently left to starve, often locked in pens or let loose on deserted streets.

But it doesn't stop there. On top of the deaths and stress induced by the anti-nuclear hysteria of the evacuation, the Japanese are wasting billions of dollars and considerable scarce resources dealing with a miniscule problem while hundreds of thousands languish in evacuation centres with much, much bigger problems than the odd mSv (milli Sievert) of radiation. The environmental destruction of decontamination is also considerable. Forests are being felled and precious top soil removed[18] to "decontaminate" areas whose raised radiation levels are lower than normal radiation levels in certain other parts of the world.

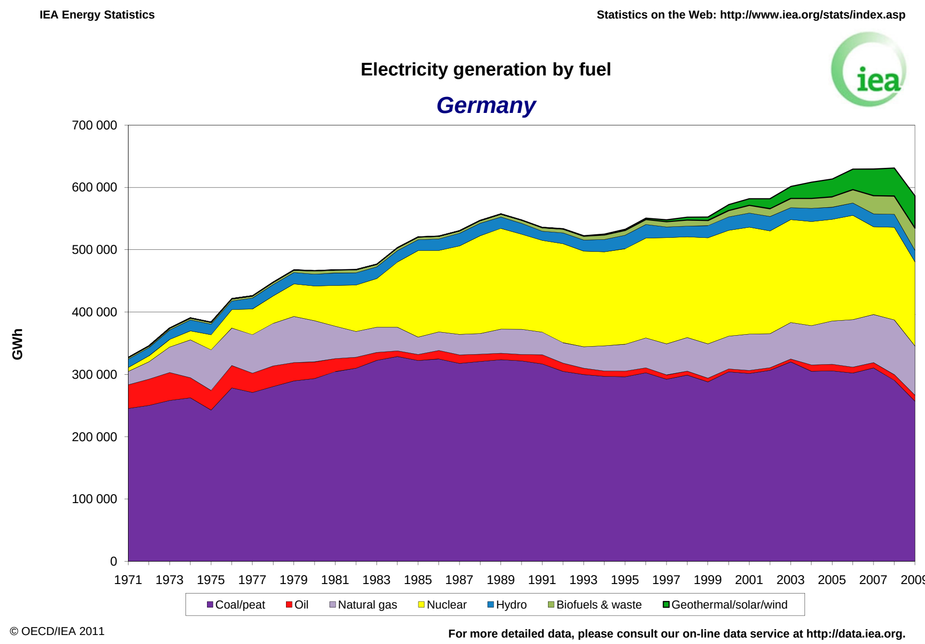
[18]For example:`http://www.jaea.go.jp/fukushima/decon04/english/2-1-4\%20Two_Demonstration_Project.pdf` While there are point sources requiring cleanup around Fukushima, the linked document illustrates the bizarre activities being undertaken. Many areas being "decontaminated" have radiation levels assessed at below 3 μSv (micro Sievert) per hour. If you live 24x7 in an area of 3 μSv per hour, at the end of a year you'd have, at most, 26 mSv, about as much as a full body CT scan. Being inside a house or vehicle or even on a bicycle reduces your exposure.

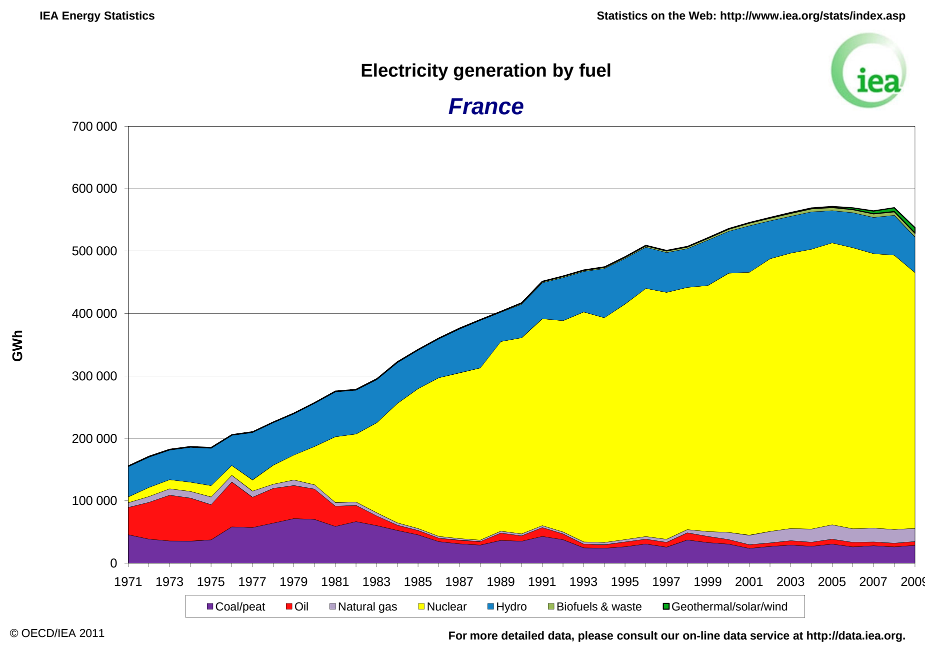
B Electricity generation by fuel

These graphs are from the International Energy Agency and show the breakdown of electricity production by fuel type to 2009. Note that the y-scales differ among the graphs, but that the growth of the yellow *Nuclear* slab within any single graph can be compared with the growth of the *Other* slab representing wind, solar and geothermal. It is useful to compare nuclear growth during the end of the 1970s with renewable growth during the first 9 years of the 2000s.

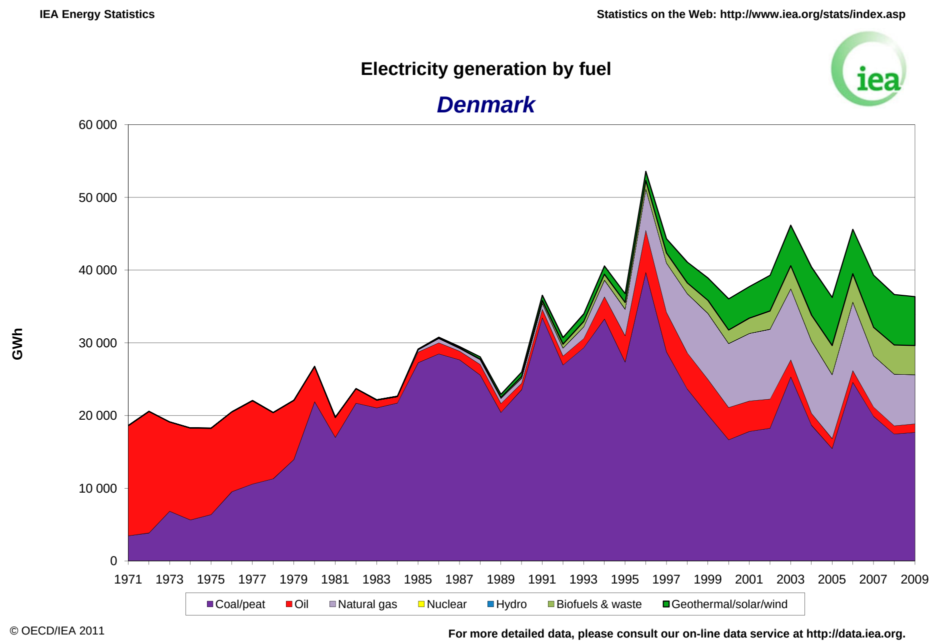
Germany and Denmark are often held up as the leaders of the renewable revolution.

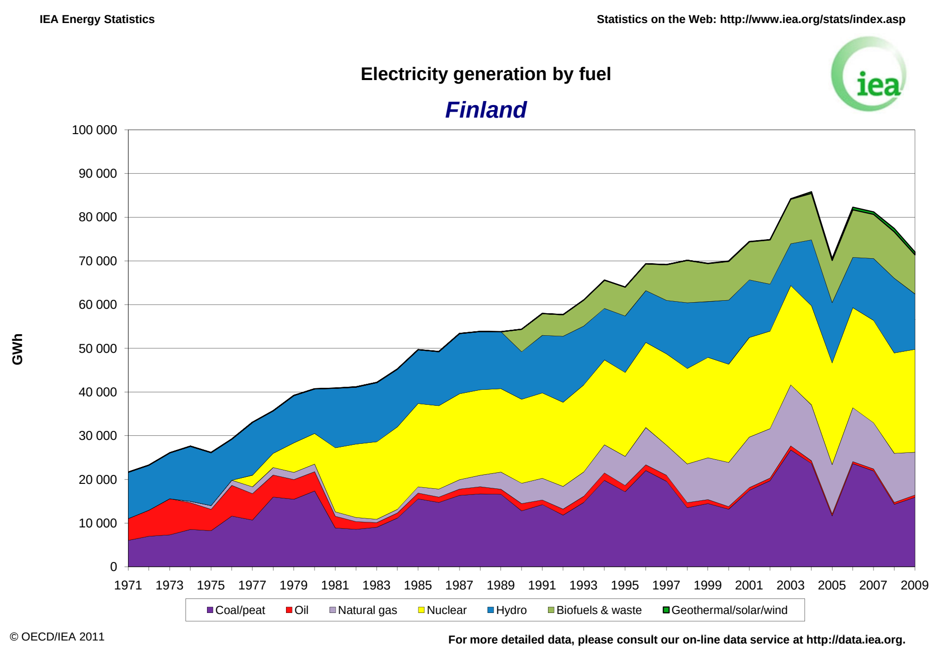
Compare Germany with France:





Or compare Denmark with Finland, both with populations of about 5 million. In the 1970s Denmark opted to replace oil fired electricity with coal and Finland chose nuclear. So in 1990 Denmark was generating 477 grams CO_2 per kWh while Finland was down to 227. All of Denmarks recent efforts have bought it down to about 300. Still well above the Finnish level of the past two decades.



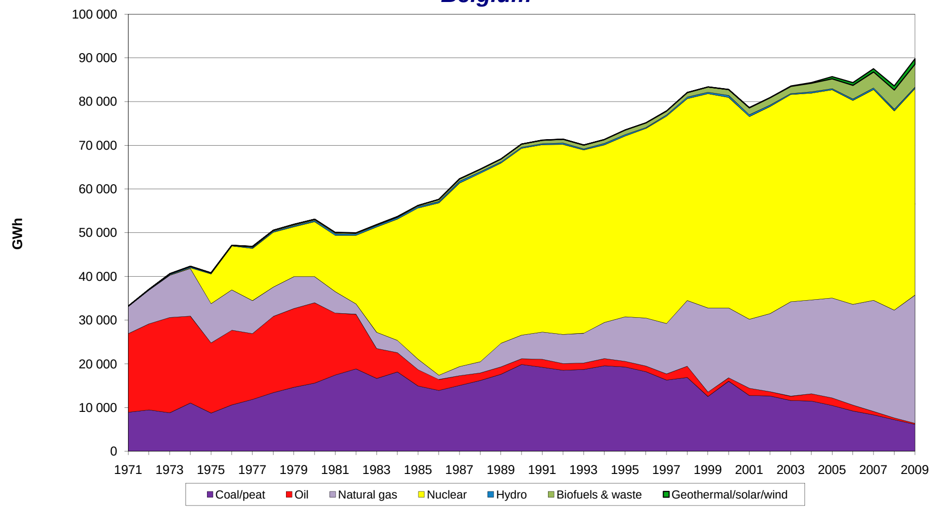


IEA Energy Statistics

Statistics on the Web: http://www.iea.org/stats/index.asp

Electricity generation by fuel

Belgium



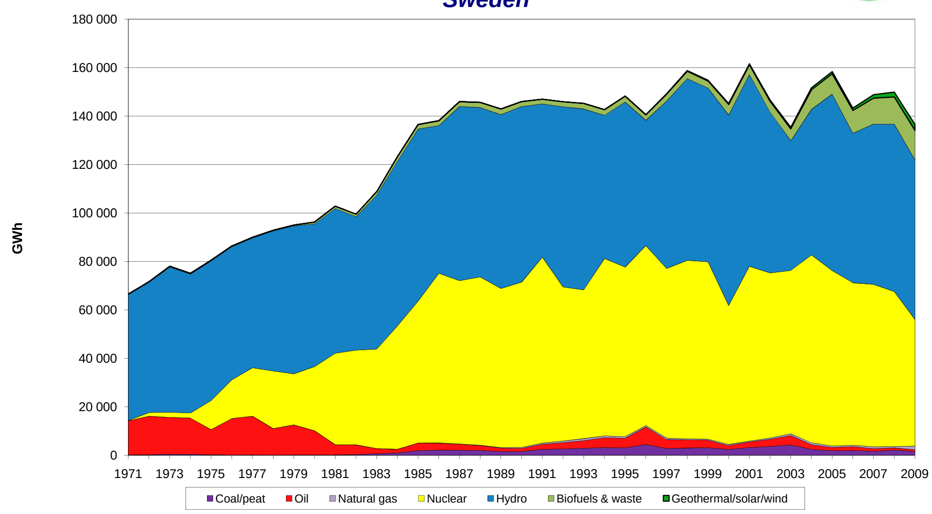
For more detailed data, please consult our on-line data service at http://data.iea.org.

IEA Energy Statistics

Statistics on the Web: http://www.iea.org/stats/index.asp

Electricity generation by fuel

Sweden



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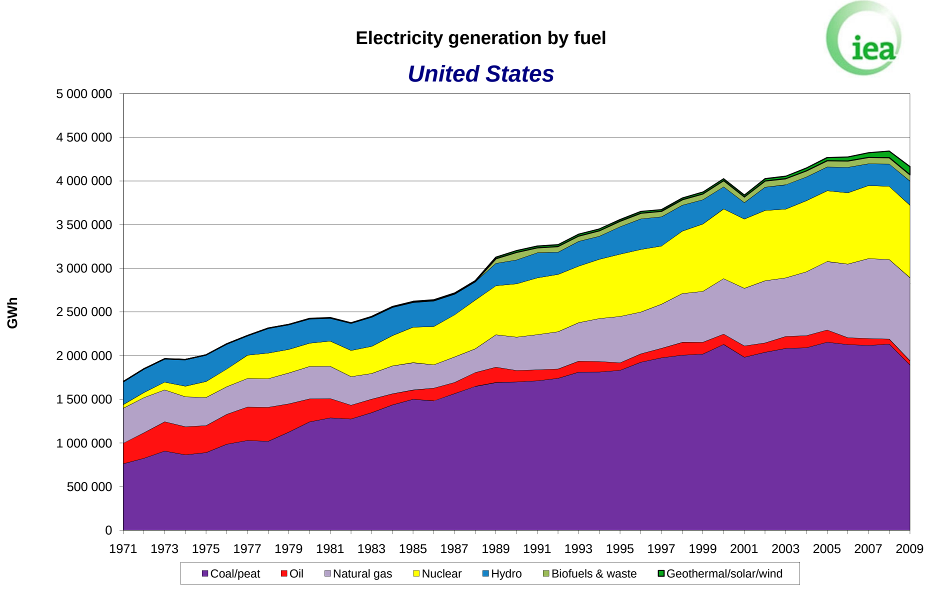

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IEA Energy Statistics
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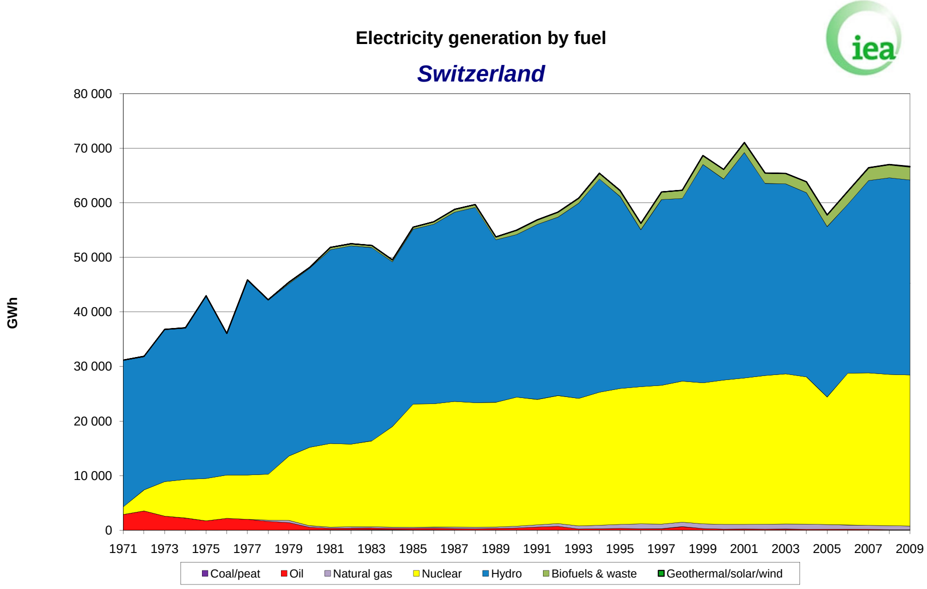

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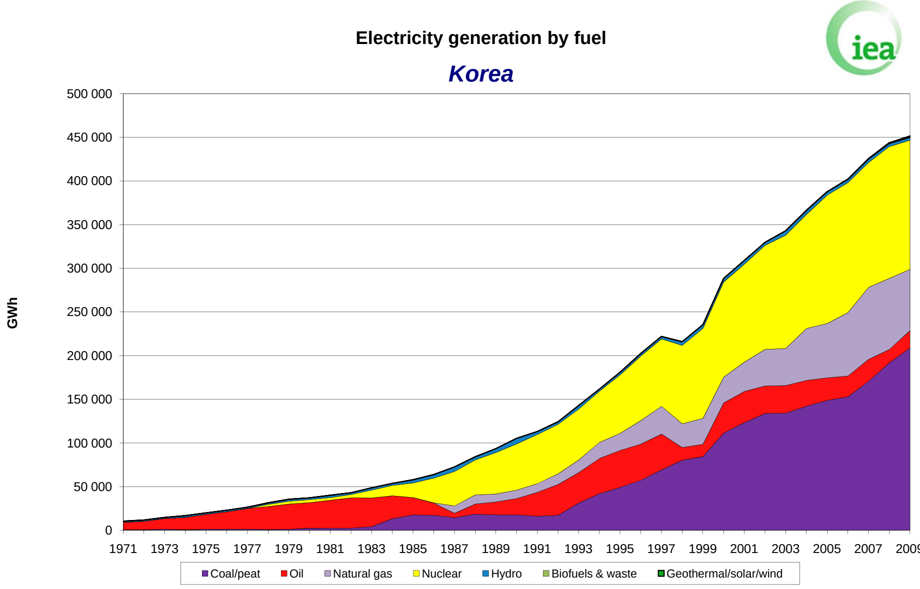

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