Brave New Climate

Emission cuts realities for electricity generation – costs and CO2 emissions

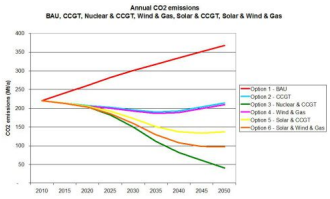
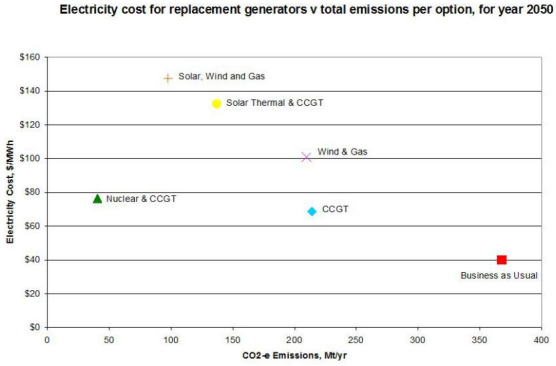


Figure 7: CO_2 emissions per year for the six options

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf7.jpg)"*We must cut our carbon emissions immediately!*"… "*We have to transition rapidly to 100% renewable energy!*"… "*A massive nuclear build out is the only logical course of action!*"… and so on. We get these well-meant but hand-waving arguments all the time, almost always bereft of real-world numbers — especially those with $$ attached. This greatly limits their utility and credibility. Without a practical, pragmatic plan, we aren't going to get anywhere and the people in control of the purse strings will not pay them serious attention.

That's why I'm so happy to present this new, clear-headed analysis by Peter Lang on BraveNewClimate (http://bravenewclimate.com) (which was spawned by in the discussion threads of previous posts on wind (http://bravenewclimate.com/2009/08/08/does-wind-power-reduce-carbon-emissions/) and (http://bravenewclimate.com/2009/08/13/wind-and-carbon-emissions-peter-lang-responds/) solar (http://bravenewclimate.com/2009/08/16/solar-power-realities-supply-demand-storage-and-costs/) power (http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/) — their costs and ability to mitigate carbon emissions). Using Australia as a case study (although the same principles would apply in almost any developed economy that is currently reliant on fossil fuel energy), Peter considers six electricity supply scenarios for the period 2010 to 2050 — a high-carbon business-as-usual projection as a reference, and five low(er) carbon alternatives. In each of the alternatives, coal-fired power stations are retired, and not replaced, such that by the period 2035 — 2040, the last few are closed.



(http://bravenewclimate.files.wordpress.com/2010/01/lang_2010_emissions_cuts_realities_v1a1.pdf)

These analysis are simple, clearly presented and easily understood. Yet they're also realistic in the same way that David Mackay's energy plans (http://www.inference.phy.cam.ac.uk/withouthotair/c27/page_203.shtml) are realistic — they add up (although Mackay was concerned about whether the physics are right, Lang is concerned about whether the $$ and build rates are plausible). They are an apples and apples set of plans, in the sense that they represent reasonable relative comparisons which all aim to achieve the same goal, in different ways. Like any modelling exercise, the uncertainties lie in the quality of the input data and the acceptability of the assumptions made. Peter makes them quite explicit. If you wish to disagree and propose/source your own numbers, fine, but remember that the onus is then on you to justify *your* assumptions.

I'll stop and this point and let you read the analysis. Get yourself a large mug of coffee or a tall glass of wine, and settle in for an interesting read. After that, let the comments fly. I certainly have my own points to make about where I think the analysis is most/least plausible, but that can come a little later…

Emission Cuts Realities – Electricity Generation

Cost and CO2 emissions projections for different electricity generation options for Australia to 2050

By Peter Lang (http://bravenewclimate.com/?s=peter+lang), January 2010

(Download the printable 32-page PDF version here (http://bravenewclimate.files.wordpress.com/2010/01/lang_2010_emissions_cuts_realities_v1a1.pdf), which also includes references and Appendices).

Peter Lang is a retired geologist and engineer with 40 years experience on a wide range of energy projects throughout the world, including managing energy R&D and providing policy advice for government and opposition. His experience includes: coal, oil, gas, hydro, geothermal, nuclear power plants, nuclear waste disposal, and a wide range of energy end use management projects.

Abstract

Five options for cutting CO2 emissions from electricity generation in Australia are compared with a 'Business as Usual' option over the period 2010 to 2050. The six options comprise combinations of coal, gas, nuclear, wind and solar thermal technologies.

The conclusions: The nuclear option reduces CO2 emissions the most, is the only option that can be built quickly enough to make the deep emissions cuts required, and is the least cost of the options that can cut emissions sustainably. Solar thermal and wind power are the highest cost of the options considered. The cost of avoiding emissions is lowest with nuclear and highest with solar and wind power.

Introduction

This paper presents a simple analysis of CO2 emissions, capital expenditure, electricity generation costs and the emissions avoidance cost for six options for supplying Australia's electricity. The results are presented at five year intervals for the period 2010 to 2050.

The purpose of this paper is to address two questions that were raised in discussion of three earlier papers (Lang 2009a, Lang 2009b, Lang 2009c). The papers 'Solar Power Realities' (Lang 2009b), and the Addendum (2009c), looked at the cost of reducing CO2 emissions using solar power. They did this by looking at the limit situation; that is, we replace all our fossil fuel electricity generation 'overnight' with either solar power and energy storage or with nuclear power. The papers concluded that solar power would cost at least 40 times more than nuclear to supply the National Electricity Market (NEM). The estimates were based on current prices for currently available technologies and for the NEM demand in 2007.

The first paper, "Cost and Quantity of Greenhouse Gas Emissions Avoided by Wind Generation" (Lang 2009a), concluded that wind power with back-up by gas generators saves little greenhouse gas emissions and the avoidance cost is high compared with other alternatives.

Discussion of these analyses raised two main questions:

1. The limit situation does not take into account what happens during the transition period. The earliest we could begin commissioning nuclear is about 2020. So, what should we do until then? Does it make sense to build wind power as fast as possible until 2020, at least, so we can cut greenhouse gas emissions as quickly as possible and start as early as possible?

2. The previous papers consider replacement of fossil fuel generators with one technology only rather than with a mix of technologies. This raises the question: would a mix of technologies be better able to meet the demand and at lower cost. Would a mix of solar and wind be lower cost than either alone, and lower cost than nuclear?

To attempt to answer these questions, in a 'ball park' way, I conducted a simple analysis of the cost, and CO2 emissions from six options (six technology mixes) for the period 2010 to 2050. The six options are:

1. Business as Usual (BAU).

2. Combined Cycle Gas Turbine (CCGT).

3. Nuclear and CCGT.

4. Wind and Gas [Gas means a mix of Open Cycle Gas Turbine (OCGT) and Combined Cycle Gas Turbine (CCGT)].

5. Solar Thermal and CCGT

6. Solar Thermal, Wind and Gas.

Throughout the paper 'emissions' refers to 'CO2-e emissions'. More specifically, it refers to CO2-e emissions from electricity sent out from the power station. The figures are not life cycle emissions (see assumption 10, below).

Assumptions

Technology	2010	2015	2020	2025	2030	2035	2040	2045	2050
Black Coal	40	40	40	40	40	40	40	40	40
Brown Coal	40	40	40	40	40	40	40	40	40
USC Black	55	51	50	49	48	48	47	47	46
USC Brown	53	50	50	49	48	48	48	47	47
CCGT	60	57	59	60	62	64	65	67	69
OCGT	97	92	96	97	100	102	104	106	108
Nuclear	101	99	98	96	86	82	80	77	75
Wind	110	107	104	101	98	95	92	89	86
Solar Thermal	233	229	225	220	197	189	184	178	173

(http://bravenewclimate.files.wordpress.com/2010/01/lang_2010_emissions_cuts_realities_v1a.pdf)

Assumptions that apply to all options are described in this section. Assumptions that are specific to an option or to a technology are described under the relevant option in the Methodology section.

1. The total energy supplied is as per the ABARE (2007) projections of electricity supply to 2030, extended linearly to 2050. All options must supply this total energy for each period and all must provide the same quality of power as the Business as Usual case. To achieve this, intermittent renewable energy generators must be backed up by a responsive generator technology.

2. For all except the Business as Usual case, it is assumed that coal fired power stations can be and will be decommissioned at the rate of 1 GW per year for black coal generators and 0.4 GW per year for brown coal generators.

3. The energy deficit caused by decommissioning the coal fired power stations is supplied by replacement generating capacity. Five options for replacement generating capacity are considered. Each option comprises a mix of a few technologies that in combination are capable, theoretically, of providing the energy and the power that would have been provided by the coal power stations. That is, the mixes of replacement technologies must be capable of providing the same power quality, and of supplying it on demand, at all times.

4. The ABARE (2007) projections provide the breakdown of energy supply by nine generation types; four fossil fuel and five renewable energy. The energy supplied by the seven non-coal technologies is the same in all six options [There is one exception to this statement – see Option 3 – Nuclear and CCGT]. The Business as Usual case is as per the ABARE (2007) projections for all nine technologies.

5. The main constraint in the analyses is the assumed decommissioning rate for coal fired power stations and the assumed build rate achievable for the replacement technologies. The build rate assumptions are arguably optimistic. The achievability of the assumed build rates is discussed in a later section.

6. The capital expenditures do not include the cost of replacement of the reserve capacity margin that is needed to cover for scheduled and unscheduled outages because the reserve capacity margin is assumed to be the same for all options.

7. The analyses are intentionally simple so that non-specialists can follow the assumptions and analyses. A more thorough analysis would use sophisticated modelling to optimise the mix of technologies and to calculate the long run marginal cost of electricity sent out. All available technologies would be included in the analyses rather then the simple mixes used in these analyses. Such analyses are complicated and need sophisticated modelling capability. For examples see EPRI (2009a), MIT (2007), MIT (2009), ACIL-Tasman (2009), Frontier Economics (2009), ATSE (2008).

8. Transmission costs are similar for the Business as Usual, CCGT and Nuclear options. So no additional cost is included for transmission for the CCGT and Nuclear options. Extra costs for transmission are included for the Wind and Solar Thermal options.

9. No allowance is made for the lower energy growth rate that energy efficiency improvements will bring. This omission is offset because no allowance is made for the higher growth rate as cleaner electricity replaces gas for heating and replaces oil for land transport (either in electric vehicles or through synthetic fuels such as methanol or hydrogen that use electricity for their production).

10. CO2 emissions from nuclear and the renewable energy technologies are assumed to be zero in operation, consistent with DCC (2009), EPRI (2009b) and Frontier (2009). On a Life Cycle Analysis (LCA) basis the emissions from these technologies are small compared with fossil fuel generation. These are ignored in this simple analysis. [Lightbucket (2009) lists the results from authoritative studies of LCA emissions from electricity generation].

11. No attempt has been made to reconcile CO2 emissions calculated for the Business as Usual option with the emissions projections published by the Department of Climate Change (2009).

12. The ABARE (2007) energy projections are for all Australia's electricity supply, both off-grid and on-grid. However, the analyses here apply the ABARE (2007) figures as if they were for grid connected electricity. This simplification means the potential for emissions reductions and the cost of the options is overstated (perhaps by 10% in early years decreasing over time).

Table 1 lists the CO2-e emissions intensities for sent out electricity in 2010 for the Business as Usual technologies.

Table 1. CO2-e emissions intensities for Business as Usual technologies for sent-out electricity in 2010

Technology	t CO2-e/MWh
Black coal	0.84
Brown coal	1.20
Oil	0.78
Natural gas	0.49
Biomass	0
Biogas	0
Hydroelectricity	0
Solar energy	0
Wind energy	0

Source: see Appendix 1: CO_2 Emissions Intensity

(http://bravenewclimate.files.wordpress.com/2010/01/langecrt1.jpg)Table 2 summarises the assumptions and inputs for the coal and replacement technologies.

Table 2: Assumed input values for the existing black coal and brown coal and for the new replacement technologies; in 2010

		Existing technologies		Replacement technologies				
Variable	Units	Black Coal	Brown Coal	CCGT[3]	OCGT[4]	Nuclear	Wind	Solar Thermal
Emissions Intensity[5]	t CO2-e /MWh	0.84	1.20	0.45	0.70	0.00	0.00	0.00
Emissions Intensity (back-up mode)[6]	t CO2-e /MWh			0.53	0.94			
Economic life[7]	years	40	40	30	30	50	25	25
Availability[8]	%			92%	97%	90%	N/A	N/A
Capacity Factor assumed for converting capacity and energy	%	90%	90%	90%	90%	90%	30%	90%
Capital Cost (2010)[9]	$/MW			$1,368	$985	$5,207	$2,591	$11,046
LRMC[10]	$/MWh	$40	$40	$60	$97	$101	$110	$233
Electricity cost (back-up mode)[11]	$/MWh			$66	$111			
Prescribed rate for decommissioning or commissioning	GW/year	-1.0	-0.4	fill energy deficit	fill energy deficit	1 to 2	1.4	0.5 to 1

[3] CCGT = Combined Cycle Gas Turbine
[4] OCGT = Open Cycle Gas Turbine
[5] Source: Appendix 1 for black coal and brown coal. ACIL-Tasman (2009), Table 41 for CCGT and OCGT, EPRI (2009b), Table 1-6 for Nuclear, Wind and Solar Thermal.
[6] CO2 emissions intensity increased by 17% for CCGT and by 34% for OCGT when backing up for wind power (Hawkins, 2009).
[7] Source: ACIL-Tasman (2009), Table 33 for new coal, CCGT, OCGT and nuclear.
[8] Source: ACIL-Tasman (2009), Table 32
[9] Source: ACIL-Tasman (2009), Table 35 CCGT, OCGT and nuclear; EPRI (2009b), Table 1-10 for wind; NEEDS (2008), Figure 3.7, p 38, for solar thermal in 2010, pus 25% for construction in remote desert locations.
[10] LRMC = Long Run Marginal Cost. Data sources. Refer to Appendix 2.
[11] LRMC increased by 17% for CCGT and by 34% for OCGT when backing up for wind power (Hawkins, 2009).

(http://bravenewclimate.files.wordpress.com/2010/01/langecrt2.jpg)**Methodology**

This section explains how the analyses were done.

Option 1 – Business as Usual (BAU)

The ABARE (2007) projections for electricity supply for the years 2005-06 to 2029-30 were extended to 2050 and converted from petajoules (PJ) to terawatt-hours (TWh). Figure 1 shows the energy projections for the Business as Usual option.

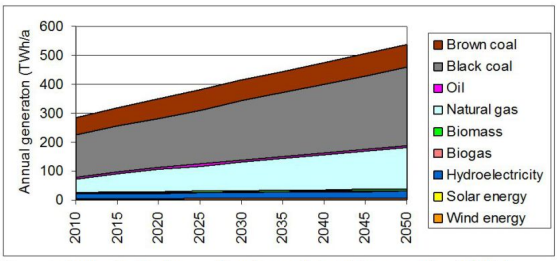


Figure 1: Option 1 – Business as Usual, annual electricity generation (TWh/a). Projections to 2030 from ABARE (2007). The trends from 2020 to 2030 were extended to 2050. The technologies in this chart are the technologies in the ABARE projections. In the charts in the following sections the bottom seven technologies in the chart legend, and the energy they supply, are identical for all options.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf1.jpg)

The CO2 emissions were calculated for the Business as Usual case by multiplying the energy by the CO2 emissions factors. The assumed emissions factors for 2010 are listed in Table 1. Emissions factors for the periods after 2010 were reduced at the rate of 1% per 5 years to account for average efficiency improvements for the existing generators and new generators. The renewable and nuclear technologies are assumed to produce zero emissions (Table 1).

To compare the cost difference between the options we need only compare the cost of the coal with the replacement technologies. All the other technologies are the same for all options.

The capital expenditure for coal in the Business as Usual case comprises two components:

a) the capital expenditure of new coal capacity added to meet the rising demand for electricity; and

b) the capital expenditure of new coal to replace old coal that has reached the end of its economic life. To work with capital expenditure, we must convert the energy figures in the ABARE projections to average power.

The energy (TWh) was converted to average power (GW) using a capacity factor of 90% (refer Table 2). As mentioned previously, this simple analysis ignores the reserve capacity margin needed in the generation system.

The amount of new coal capacity required each year for the Business as Usual case was calculated from the ABARE (2007) projections. The amount of new coal to replace existing coal at the end of its economic life was calculated as 2% of existing capacity per year [Assuming a 40 year economic life, the plants would be replaced at the rate of 2.5% per year if the capacity was constant from year to year. However, the capacity is increasing over time. In any one year we need to

replace only the plants that are 40 years old. If the capacity doubles in 40 years, then we need to replace 1.25% of the total existing capacity in each year. I have assumed 2% as a round figure in between 1.25% and 2.5%.].

The capital cost of new coal capacity for the Business as Usual option was calculated by multiplying the amount of new coal capacity by the unit rate for Ultra Super Critical Black Coal (air cooled) and Ultra Super Critical Brown Coal (air cooled) (refer Table 35, ACIL-Tasman 2009).

All non-BAU options

For all options other than Business as Usual, black coal capacity is decommissioned at the rate of 1 GW per year, and brown coal at the rate of 0.4 GW per year. Decommissioning starts in 2010. All black coal is decommissioned by 2040 and all brown coal by 2035.

The amount of energy these power stations would have generated if not decommissioned is calculated. This is the energy deficit that must be supplied by the replacement generators in all the non Business as Usual options.

The CO2 emissions from the remaining coal capacity are calculated by multiplying the energy generated from black coal and brown coal by the emissions factor for that technology for that year.

The Business as Usual Option comprises projections for nine technologies, – Black Coal, Brown Coal and seven others. The emissions from all the seven non-coal technologies are the same for all options.

The following sections describe the five options considered here for replacing the energy from the decommissioned coal power stations.

Option 2 – Combined Cycle Gas Turbine (CCGT)

CCGT is built to replace the energy deficit resulting from the decommissioning of the coal fired plants. The amount of CCGT capacity required is calculated by multiplying the energy deficit by 90% capacity factor. Figure 2 shows the energy supplied by each technology.

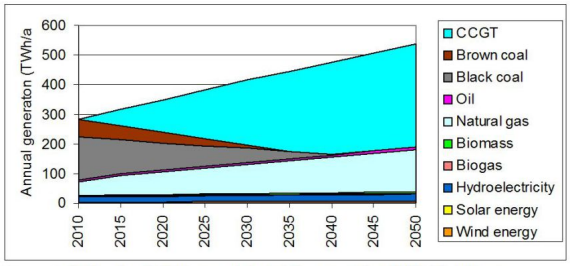


Figure 2: Option 2 – CCGT, annual electricity generation (TWh/a). The seven technologies listed at the bottom of the legend supply the same amount of energy in all options[13]. Black coal and brown coal supply the same energy in all options other than the Business as Usual option. The technologies listed above Brown Coal in the legend are the replacements for the decommissioned coal generators.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf2.jpg)

The CO2 emissions for CCGT are calculated using a CO2 emissions factor of 0.45 t CO2/MWh, decreasing at 1% per five year to reflect increasing generation efficiency.

The CO2 emissions from the remaining coal generators and from the other seven technologies are included in the total for this option.

The capital cost for this option is calculated using the unit rate for new build CCGT (air cooled) given in Table 35, ACIL Tasman (2009), and decreasing at -0.4% pa from 2030 to 2050.

Option 3 – Nuclear and CCGT

For this option, nuclear power is commissioned at the rate of 1 GW per year from 2020 to 2025, then at 1.5 GW per year to 2030, then at 2 GW per year to 2050. The reason for selecting these rates is discussed below in "How achievable are the build rates"

CCGT is commissioned at the rate needed to make up the difference between the energy that the nuclear power can supply and the energy deficit caused by decommissioning the coal power stations. Figure 3 shows how much energy is produced by each technology.

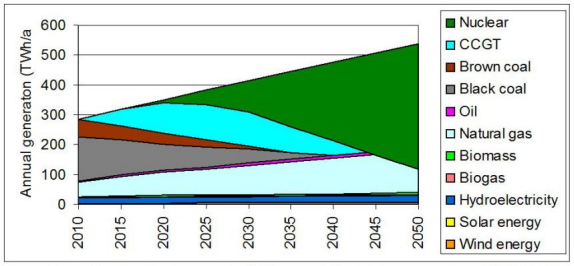


Figure 3: Option 3 – Nuclear and CCGT, annual electricity generation (TWh/a). The seven technologies listed at the bottom of the legend supply the same amount of energy in all six options. Black coal and brown coal supply the same energy in all options except the Business as Usual option. The technologies listed above Brown coal in the legend are the replacement for the decommissioned coal generators.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf3.jpg)

From 2010 to 2019, no nuclear capacity is commissioned so the CCGT capacity is the same as in Option 2 – CCGT. From 2020 to 2025, nuclear is not built fast enough to replace the coal capacity being decommissioned, so CCGT is added to supply the energy deficit. After 2025, nuclear is being built faster than coal is being decommissioned. So, progressively less energy is being required from CCGT. This shows up (in this simple analysis) as a reduction in CCGT capacity. The practical interpretation of this is that the Natural Gas generation capacity would be reduced at this rate. This means that Natural Gas generation capacity would not be replaced at the end of its 30 year economic life. This begins from about 2025.

CO2 emissions for nuclear are assumed to be zero (see 'Assumptions' and Table 1). CO2 emissions for Coal, CCGT and the other technologies are calculated in the same way as for Option 2 – CCGT. As for capacity, the negative emissions shown against CCGT should actually be a reduction in emissions from 'Natural Gas' but for simplicity of calculation they are shown as negative for CCGT.

The capital cost calculations for this option are similar to those for Option 2 – CCGT. The cost of the nuclear capacity is at the unit rate in ACIL-Tasman (2009), Table 35, and decreasing at -0.9% pa from 2030 to 2035 then at -0.6% pa to 2050.

Option 4 – Wind and Gas

For this option, wind power capacity is commissioned at the same rate as the coal fired plants are decommissioned. So when all wind farms are producing full power (a rare event), the wind farms will supply all the energy that the decommissioned coal fired power plants would have supplied. When the wind farms are not producing full power, back-up generation is required to make up for the energy deficit.

Back-up capacity is provided by a combination of Combined Cycle Gas Turbines (CCGT) and Open Cycle Gas Turbines (OCGT). Equal proportions are assumed. A Capacity Credit of 8% is assumed (AER, 2009), so 1 GW of wind power capacity is assumed to be backed up by 0.46 GW of OCGT and 0.46 GW of CCGT [In practice more gas capacity will be built than this calculation indicates. OCGT and CCGT run at lower capacity factors in practice than the 90% used in this analysis for calculating the amount of capacity required]. The proportions, on the basis of capacity, are 1.0:0.46:0.46.

The energy is calculated assuming a capacity factor of 30% for Wind and availability of 90% for OCGT and CCGT. So, on average, 3 GWh of energy is supplied by a combination of Wind, OCGT and CCGT in the proportions 1:1:1. Figure 4 shows how much energy is produced by each technology.

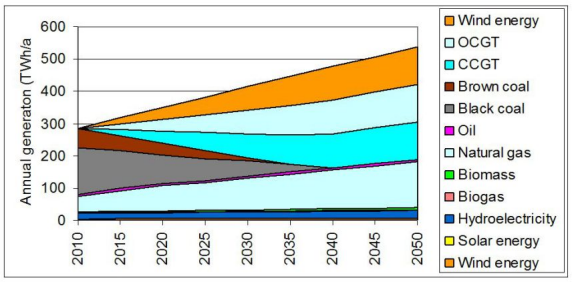


Figure 4: Option 4 – Wind and gas; annual electricity generation (TWh/a). The seven technologies listed at the bottom of the legend supply the same amount of energy in all six options. Black coal and brown coal supply the same energy in all options except the Business as Usual option. The technologies listed above Brown coal in the legend are the replacement for the decommissioned coal generators.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf4.jpg)

CO2 emissions for wind generation are assumed to be zero (refer to 'Assumptions' and Table 1). The CO2 emissions for OCGT are calculated using a CO2 emissions intensity of 0.7 t CO2/MWh, decreasing at 1% per five years to reflect increasing generation efficiency. CO2 emissions for CCGT, Coal and the other technologies are calculated in the same way as for Option 2 – CCGT. The lower efficiency and higher emissions from the gas turbines when operating in back up mode (Lang, 2009a; Hawkins, 2009) are included in this analysis. The CO2 emissions are increased by 34% for OCGT and 17% for CCGT (Hawkins, 2009) when these technologies are operating in back-up mode. The higher emissions rate is applied to the proportion of the energy that is generated when they are assumed to be operating in 'back-up' mode. For simplicity this is assumed to be equal to the proportion of the replacement energy that is generated by Wind. In effect, the increased emissions factor is applied to half the energy generated by the CCGT and OCGT replacement generators.

The capital cost calculations for this option are similar to those for Option 2 – CCGT and Option 3 – Nuclear and CCGT. The capital cost of the wind capacity is $2591/kW (Average of seven wind farms listed as 'under construction' in ABARE (2009). This Australian cost is close to the US cost in EPRI (2009b), Table 7.1, p 7-5, which is US$2350/kW = A$2611/kW) in 2010 and decreasing in future periods at -0.6% pa (Frontier, 2009). The cost of OCGT and CCGT capacity is at the unit rate in ACIL-Tasman (2009), Table 35, increasing at +0.4% pa and +0.5% pa from 2030 to 2050.

As mentioned above, the OCGT and CCGT generators are less efficient when operating in back up mode for wind. These analyses assume that the electricity generation costs are 17% higher for CCGT and 34% higher for OCGT (Hawkins, 2009). However, only half the energy generated by these technologies is considered to be in back-up mode, so electricity cost is increased by 8.5% for CCGT and 17% for OCGT when operating in back-up mode.

Wind power is assumed to have an economic life of 25 years and gas 30 years. Wind and gas capacity installed in 2010 must be replaced in 2035 and 2040 respectively. The capital costs of replacing wind and gas at the end of their economic lives are calculated at the capital cost rate applicable for the year in which the replacement is commissioned.

Wind power requires significant additional capital expenditure for transmission and network management capability. Based on estimated costs for extra transmission capacity incurred because of wind generation in the USA, $1,000/kW of installed wind capacity is included (Gene Preston, pers. comm., 3 Nov 2009). The transmission cost for wind power raises the cost of electricity by an assumed $15/MWh on average (Gene Preston, Dec 2009, pers. comm. and EPRI, 2009a).

Option 5 – Solar Thermal and CCGT

This option is similar to Option 3 – Nuclear & CCGT but with solar thermal instead of nuclear.

The differences are:

1. The build rate of solar thermal capacity in this option (Option 5) is half the build rate of nuclear in Option 3 – Nuclear & CCGT

2. Therefore, the build rate of CCGT is higher in this option than in the Nuclear & CCGT option (to make up the energy difference). This means emissions are higher in the Solar & CCGT option than in the Nuclear & CCGT option.

3. Solar thermal capacity has an assumed life expectancy of 25 years so replacement of solar thermal capacity begins 25 years after the first installation; so replacement begins in 2045.

4. Whereas nuclear would be built near population centres, where work force, infrastructure, suppliers and services are available, this is not the case for solar thermal [The NEEDS (2009) costs are based on constructing the Andasol 1 solar thermal power station in Spain. The cost of constructing widely distributed solar thermal power stations over an area of some 3000 km by 1000 km in Australia's deserts will be higher than the cost of constructing in Spain – where there is well developed infrastructure and larger work force nearer to the sites. To construct the solar thermal power stations in areas throughout central Australia will require large mobile construction camps, fly-in fly-out work force, large concrete batch plants, large supply of water, energy and good roads to each power station. Air fields suitable for fly-in fly-out will be required at say one per 250 MW power station. That means we need to build such air fields at the rate of about two, then three, then four per year.]. Solar thermal needs to be built in areas of high insolation (deserts) and the power stations must be widely distributed to minimise the impacts of widespread cloud cover.

5. Transmission costs are included at the rate of $1,200/kW (derived from estimates in AEMO, 2009).

Solar thermal capacity is commissioned at the rate of 0.5 GW per year from 2020 to 2025, then at 0.75 GW per year to 2030, then at 1 GW per year to 2050. However, from 2040, some of the new build is for replacing existing old capacity. Solar thermal capacity is assumed to have the same capacity factor as nuclear, i.e. 90%. This is based on NEEDS (2008) which forecasts that solar thermal will have this capability by 2020 [There is an alternative to solar thermal with sufficient energy storage for 90% capacity factor. The alternative is solar thermal hybrid. Gas generates power when the sun isn't shining and there is insufficient energy storage. The hybrid options emits much more CO2 than CST alone and the electricity costs are higher (EPRI, 2009a, page 10-20), although this comparison is made at a capacity factor of 34% not 90%. NEEDS argues that the solar thermal with 8000 full load hours energy storage will be available and electricity costs will be less than the hybrid option by 2020. The hybrid option is not included in the options considered here].

CCGT is commissioned at the rate needed to make up the difference between the energy that the solar thermal capacity can provide and the energy deficit caused by decommissioning the coal fired power stations.

From 2010 to 2019, negligible solar thermal is commissioned so CCGT is built at the same rate as in Option 2 – CCGT and Option 3 – Nuclear & CCGT. From 2020 to 2040 CCGT is being added because solar thermal is not being built fast enough to replace the coal capacity being decommissioned. By 2040 all coal capacity has been decommissioned. So, from 2040 less energy is being required from CCGT. This shows up, in this simple analysis, as reduction in CCGT capacity. The practical interpretation of the reduction of CCGT capacity is that the Natural Gas generation capacity would be reduced at this rate. What this means is that the Natural Gas generation would not be replaced at the end of its 30 year economic life. This begins from about 2040. Figure 5 shows how much energy is produced by each technology.

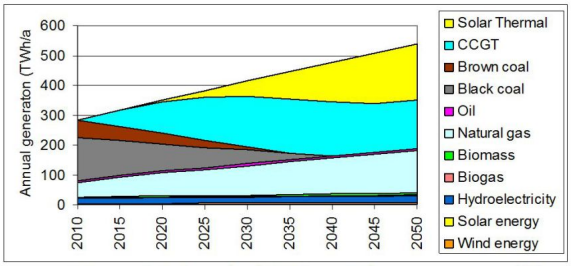


Figure 5: Option 5 – Solar thermal and CCGT annual electricity generation (TWh/a). The seven technologies listed at the bottom of the legend supply the same amount of energy in all six options. Black coal and brown coal supply the same energy in all options except the Business as Usual option. The technologies listed above Brown coal in the legend are the replacement for the decommissioned coal generators.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf5.jpg)

CO2 emissions for solar thermal are assumed to be zero (refer Table 1). CO2 emissions for coal, CCGT and the other technologies are calculated in the same way as for Option 3 – Nuclear and CCGT. The negative emissions shown against CCGT should actually be a reduction in emissions from 'Natural Gas' but for simplicity they are shown as negative against CCGT.

The capital cost calculations for this option are similar to those for Option 3 – Nuclear and CCGT, except that the capital cost of transmission is added and the capital cost of replacing retiring solar thermal capacity is included from 2045. The capital cost of the solar thermal capacity is based on adjusted unit rates from NEEDS (2008), Figure 3.11, Case B [The 'learning rates', and hence the costs, in the NEEDS report seem optimistic (see Appendix 2)]. The rates are adjusted to attempt to make them more consistent with the way the ACIL-Tasman (2009) rates were derived. Two adjustments were made. Firstly, the initial capital cost unit rate is adjusted up by 25% to allow for the greater cost of constructing widely distributed power stations across an area roughly 1000 km by 3000 km of Australia's deserts. Secondly, the learning rate in NEEDS (2008) is replaced with the same rate of cost reduction as for nuclear in Option 3- Nuclear and CCGT.

The capacity factor assumed for solar thermal is the same as for nuclear, coal and gas. This requires that the solar thermal power stations have sufficient energy storage for 24 hour operation and can provide for 8,000 full-load hours per year. Needs (2008) forecast that this capability could be available by 2020. The additional capacity needed to ensure full power generation throughout winter and throughout periods of overcast weather (Lang, 2009b), is not allowed for in this analysis.

As for wind, transmission is a significant cost item for solar thermal. The capital expenditure for transmission for solar thermal is calculated at $1200/kW (based on estimates in AEMO, 2009). Electricity cost includes $15/MWh for transmission.

Option 6 – Solar Thermal, Wind and Gas

For this option, it is assumed that solar thermal is commissioned at the same rate as in Option 5 – Solar Thermal & CCGT. Wind, CCGT and OCGT are commissioned at the same rate as in Option 4 – Wind & Gas. The solar capacity does not reduce the amount of gas capacity needed to back-up for the wind capacity. Gas capacity required to back up for wind does not change but the amount of energy the gas generates does change, with the gas generators working at lower capacity factors.

The energy generated by solar thermal is the same as in Option 5 – Solar Thermal and CCGT. The energy generated by wind is the same as in Option 4 – Wind & Gas. The energy generated by OCGT and CCGT makes up the energy deficit. Figure 6 shows how much energy is produced by each technology.

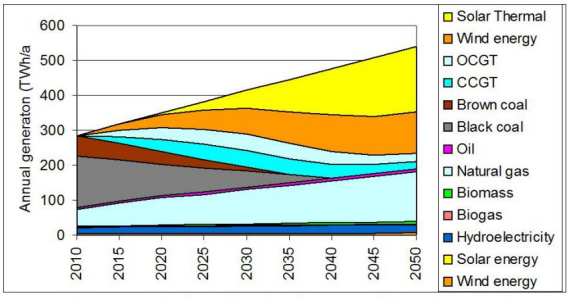


Figure 6: Option 6 – Solar thermal, wind and gas; annual electricity generation (TWh/a). The seven technologies listed at the bottom of the legend supply the same amount of energy in all options. Black coal and brown coal supply the same energy in all options other than the Business as Usual option. The technologies listed above Brown Coal are the replacements for the decommissioned coal generators.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf6.jpg)

CO2 emissions for wind and solar are assumed to be zero in this analysis (see Table 1). CO2 emissions for OCGT, CCGT, coal and the other seven technologies are calculated in the same way as for Option 4 – Wind and Gas.

The capital cost calculations for this option are similar to those for Option 4 – Wind & Gas and Option 5 – Solar Thermal & CCGT. The capital cost of the solar capacity in this option is the same as for Option 5 – Solar Thermal & CCGT. The capital cost of the wind capacity is the same as for Option 4 – Wind & Gas. The capital cost of the gas capacity is less than Option 4 – Wind & Gas because of the contribution from solar thermal; solar thermal provides its share of energy and the gas makes up the deficit. Transmission cost is included at $15/MWh for solar thermal and for wind.

Build rates

The rate of decommissioning coal and commissioning the replacement generating capacity, for each option, is summarised in Table 3. The figures in the shaded cells are prescribed inputs and the unshaded cells are calculated values.

Table 3: Rate of decommissioning and commissioning capacity (GW per 5 years)

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Option 1- Business as Usual									
Black Coal	2.7	2.8	3.5	4.8	5.0	4.7	5.1	5.3	5.5
Brown Coal	1.2	1.1	1.7	1.4	0.9	1.2	1.2	1.2	1.2
Decommissioning									
Black Coal	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	0.0	0.0
Brown Coal	0.0	-2.0	-2.0	-2.0	-2.0	-1.5	0.0	0.0	0.0
Option 2 - CCGT									
CCGT	0.0	7.0	7.0	7.0	7.0	6.5	5.2	9.3	9.3
Option 3 - Nuclear & CCGT									
Nuclear	0.0	0.0	1.0	5.0	7.5	10.0	10.0	10.0	10.0
CCGT	0.0	7.0	6.0	2.0	-0.5	-3.5	-4.8	-7.7	-7.7
Option 4 - Wind & Gas									
Wind	0.0	7.0	7.0	7.0	7.0	6.5	12.2	9.3	9.3
CCGT	0.0	3.2	3.2	3.2	3.2	3.0	2.4	4.3	4.3
OCGT	0.0	3.2	3.2	3.2	3.2	3.0	2.4	4.3	4.3
Option 5 - Solar & CCGT									
Solar Thermal	0.0	0.0	0.5	2.5	3.8	5.0	5.0	5.0	5.0
CCGT	0.0	7.0	6.5	4.5	3.3	1.5	0.2	-2.2	-0.2
Option 6 - Solar & Wind & Gas									
Wind	0.0	7.0	7.0	7.0	7.0	6.5	12.2	9.3	9.3
Solar thermal	0.0	0.0	0.5	2.5	3.8	5.0	5.0	5.0	5.0
CCGT	0.0	3.2	3.2	3.2	3.2	3.0	2.4	4.3	4.3
OCGT	0.0	3.2	3.2	3.2	3.2	3.0	2.4	4.3	4.3

(http://bravenewclimate.files.wordpress.com/2010/01/langecrt3.jpg)Electricity Costs

The cost of electricity, for coal and the replacement technologies, was calculated for each option. The electricity costs were calculated by applying the electricity cost unit rate (see Table 4 and Appendix 2) to the proportion of energy generated by each technology. Appendix 2 explains the sources and derivation of the electricity cost unit rates for use in this analysis.

Table 4: Electricity cost unit rates for the replacement technologies ($/MWh, 2009 $)

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Black Coal (existing)	40	40	40	40	40	40	40	40	40
Brown Coal (existing)	40	40	40	40	40	40	40	40	40
Black Coal (new)	55	51	50	49	48	48	47	47	46
Brown Coal (new)	53	50	50	49	48	48	48	47	47
CCGT	60	57	59	60	62	64	65	67	69
OCGT	97	92	96	97	100	102	104	106	108
Nuclear	101	99	98	96	86	82	80	77	75
Wind	110	107	104	101	98	95	92	89	86
Solar Thermal	233	229	225	220	197	189	184	178	173

(http://bravenewclimate.files.wordpress.com/2010/01/langecrt4.jpg)CO2 Avoidance Cost

The CO2 avoidance cost (the cost to avoid a tonne of CO2 emissions) was calculated for each option. It is the difference in electricity cost between Business as Usual and the respective option divided by the difference in CO2 emission between the Business as Usual and the respective option.

Results

The results of the analyses are summarised in Figures 7 to 12.

Figure 7 compares the total CO2 emissions per year from the six options.

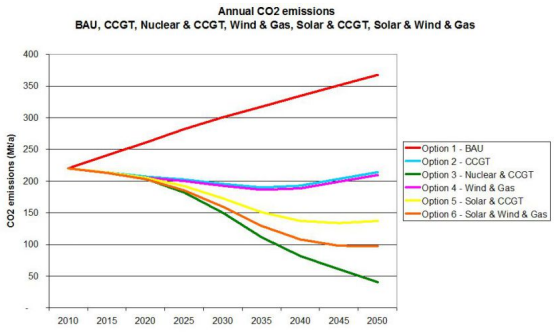


Figure 7: CO_2 emissions per year for the six options

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf7.jpg)

Figure 8 compares the capital expenditure per 5 years for the six options. The capital expenditure is for coal and the replacement technologies only. The capital expenditure for the other seven technologies is the same for all options; these costs are not included in the total capital expenditure figures shown here.

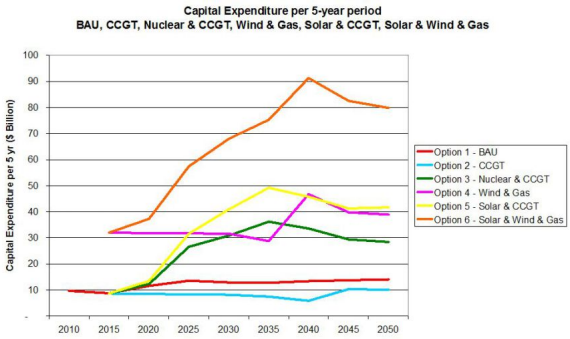


Figure 8: Capital expenditure per 5-years for the six options (Constant 2009 $).

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf8.jpg)

Figure 9 compares the cumulative capital expenditure of the six options.

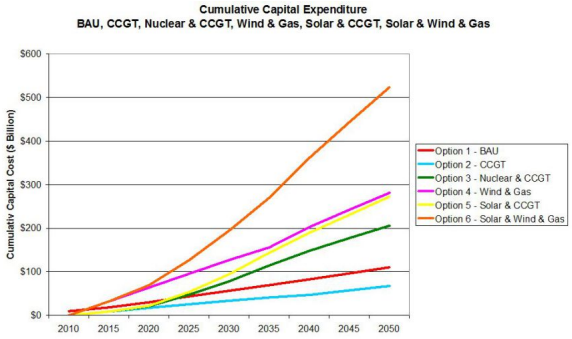


Figure 9: Cumulative capital expenditure for the six options. (Constant 2009 $)

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf9.jpg)

Figure 10 shows the long run marginal cost of electricity for coal and the replacement technologies only. These costs do not include the cost for the seven technologies that are the same in all options.

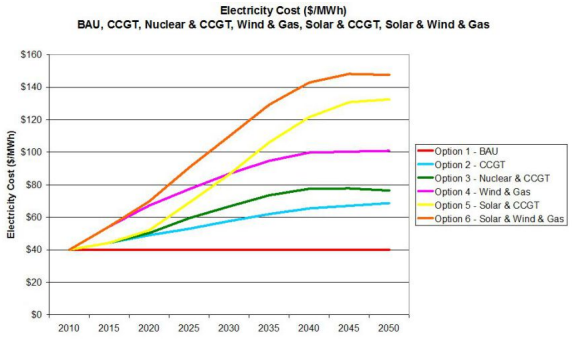


Figure 10: Electricity cost for the six options. ($/MWh sent out, Constant 2009 $)

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf10.jpg)

Figure 11 compares the options on the basis of the CO2 avoidance cost; i.e. the cost to avoid a tonne of CO2.

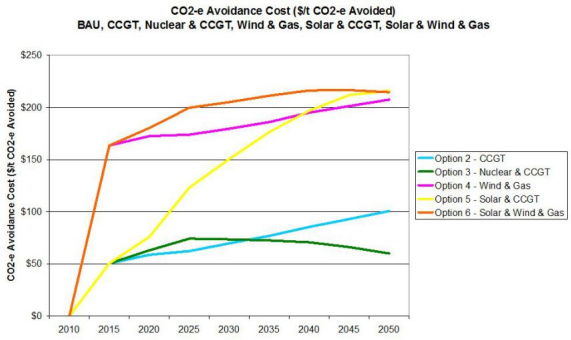


Figure 11: Cost per tonne of CO_2-e avoided (compared with Business as Usual) ($/t CO_2-e Avoided)

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf11.jpg)

Discussion

The following can be interpreted from Figures 7 and 8:

Option 1 – Business as Usual produces the highest CO2 emissions by a large margin. Capital expenditure is fairly consistent at about $10 to $15 billion per 5 years, or about $2 to $3 billion per year.

Option 2 – CCGT has the highest emissions of the replacement options. It has the lowest capital cost of all options (although it has the highest operating cost). The CO2 emissions with this option are only slightly less in 2050 than in 2010. The reason the curve turns up from 2040 is that all coal fired power stations have been decommissioned. Therefore, CCGT is being added but no coal is being removed. So we are adding emissions from the CCGT without cutting any from coal generation.

Option 3 – Nuclear and CCGT has the lowest CO2 emissions from 2020. It has the lowest capital expenditure, except Business as Usual and CCGT, for most of the period from 2010 to 2050. From 2035 the capital expenditure rate decreases.

Option 4 – Wind, with CCGT and OCGT for back-up, produces slightly lower CO2 emissions than the CCGT. However, this is achieved at high cost – about $4 billion to $6 billion per year more than CCGT. The step up in expenditure in 2040 is for replacement of the wind capacity installed in 2015. The emissions increase from 2040 as electricity demand increases and once the coal generators have been decommissioned.

Option 5 – Solar Thermal and CCGT. Solar thermal capacity is built at half the rate of nuclear, and provides half the energy. CCGT must be built faster in the solar option than in the nuclear option to make up the energy deficit. The CO2 emissions from 2010 to 2019 are the same for the three options CCGT, Nuclear & CCGT and Wind & CCGT. From 2020, the CO2 emissions from the solar thermal option are higher than from the nuclear option. By 2050, the CO2 emissions from the solar thermal option are over three times those from the nuclear option, and increasing as electricity demand increases. The capital expenditure for the solar option is substantially higher than for nuclear throughout.

Option 6 – Solar, Wind and Gas is a combination of Options 4 and 5. CO2 emissions are the second lowest from 2020 to 2050. Importantly, this option requires around $5 billion to $6 billion per year higher capital expenditure than nuclear to 2030. From 2030 to 2050 the difference in capital expenditure blows out to over $10 billion per year higher rate of expenditure for this option.

Figure 9 shows the cumulative capital cost and Figure 10 shows the long run marginal cost of electricity (LRMC). The following can be interpreted from these two charts:

CCGT is the lowest cost option throughout the period from 2010 to 2050.

Nuclear & CCGT has the lowest total cost (cumulative capital expenditure) of all options except Business as Usual and CCGT. The electricity cost for the Nuclear & CCGT option peaks in 2045 then starts to decrease as Natural Gas is decommissioned.

The steep rise in capital expenditure and electricity cost for the Wind option and the Solar Thermal and Wind option is because of the high cost of Wind and because Wind is being added at the rate of 1.4 GW per year from 2011, which is three times the rate Wind was commissioned in 2008.

The options with wind and solar thermal produce the highest cost electricity throughout.

The cumulative capital expenditure for the Solar Thermal option is about 30% higher than for nuclear. This is despite the fact that the solar thermal capacity is being built at half the rate of nuclear.

Important to note: The electricity cost for the Solar Thermal, Wind and Gas option is higher than the Solar Thermal and CCGT option. This indicates that combining renewable energy generators does not reduce the cost.

Figure 11 compares the options on the basis of the cost of avoiding a tonne of CO2 emissions. The CCGT option has the lowest avoidance cost to 2035 and then the Nuclear & CCGT option is lowest thereafter. The difference, in 2015, between the options that have Wind in their mix ($163/tCO2-e) and those that do not (50/tCO2-e) is because wind with gas back up is far more expensive but avoids insignificant extra emissions (see Figure 7). In the long run, Nuclear & CCGT is the least cost way to reduce emissions from electricity generation. The options with Wind and Solar are the highest cost way to avoid emissions.

How achievable are the assumed build rates?

The build rate for Business as Usual has been achieved consistently to date, so there can be no doubt that it is achievable.

The build rate for CCGT is about twice the build rate for coal in the Business as Usual case and about 15 times the current build rate for Natural Gas generation plant.

The build rate for wind capacity (1.4 GW per year) is about 3 times the build rate achieved in 2008 (0.48 GW) (GWEC, 2008). For comparison, in 2008 USA installed 8.4 GW and China 6.3 GW (GWEC, 2009). Interestingly, developed countries with larger economies than Australia, installed not much more than Australia, e.g. Canada (0.5 GW). AER (2009), Table 1.4 shows a peak for proposed commissioning of 2.8 GW in 2011. In practice, the build rate for wind will be limited by transmission capacity and the amount of wind power that can be accepted by the grid. The assumed build rate of 1.4 GW per year (500-700 turbines a year based on current turbine sizes) seems achievable in the future.

The rate of commissioning nuclear from 2020 to 2025 is 1 GW per year. That is equivalent to one new reactor per mainland state every 5 years. To put this in perspective, France commissioned its Gen II nuclear power plants at the rate of 3 GW per year for two decades (WNA, 2009). And Japan, China and Korea have been building the new Gen III nuclear power plants in about 4 years. So, it would seem the build rate for nuclear assumed here could be achieved from 2020, if necessary.

The assumed rate of commissioning solar thermal in these analyses, seems highly optimistic. The quantity of steel and concrete required is an indication of the amount of construction effort required. Solar thermal requires about 8 times more concrete and 15 times more steel than nuclear per MW of capacity (Table 5). The build rate for solar thermal, assumed in these analyses, is half the rate of nuclear, so each year we would need to construct solar thermal plants comprising 4 times more concrete and seven times more steel than the nuclear plants. But that's not all. Nuclear would be built relatively close to the population centres, where services, infrastructure and work force is more readily available. Conversely, the solar plants need to be built in the desert regions. They will require four times as much water (for concrete) as nuclear. Water pipe lines will need to be built across the desert to supply the water. Dams will need to be built in the tropical north to store water and desalination plants along the coast elsewhere. To develop and retain a skilled work force to work in such regions will be costly. Work will be for about 9 months of the year to avoid the hottest periods. Based on the quantities of steel and concrete, towns will be required in the desert that accommodate about four times the work force required for constructing a nuclear power station. Fly-in-fly-out airports will need to be built for each town with a capability to move much larger numbers of people than the largest mining operations. Two such towns and airfields must be built per year to achieve the solar thermal build rate. It is hard to imagine how a build rate for solar thermal could be even 1/10th the build rate that could be achieved with nuclear.

The build rate for nuclear would be difficult to achieve. But the build rates for solar thermal would be much more difficult to achieve.

Table 5: Concrete and steel per rated MW

	Concrete	Steel	Source:
Wind Onshore	433	116	ISA (2007), p145
Solar Thermal (7.5 h storage)	1303	415	NEEDS (2008) - Andasol 1, p88
Solar Thermal (18 h storage)	2606	830	rough calculation (x 2)
Nuclear	323	57	ISA (2007), p46

	Ratio to nuclear	
	Concrete	Steel
Wind Onshore (Note 1)	1.3	2.0
Solar Thermal (18 h storage)	8.1	14.6
Nuclear	1.0	1.0

Adapted from Martin Nicholson, pers. comm., (2009)
Note 1: The wind figures must be increased by a factor of 6 to be equivalent to nuclear power per unit of energy. (Capacity factor and economic life: wind: 30%, 25 yr; nuclear: 90%, 50 yr).

(http://bravenewclimate.files.wordpress.com/2010/01/langecrt5.jpg)

Sensitivity to assumptions and inputs

The results are highly sensitive to some of the assumptions and inputs. The most sensitive inputs are the projections of future capital cost, electricity cost, and the development rates for solar thermal. However, the ranking of the options under different inputs, and therefore the conclusions are robust over the ranges tested.

Answers to the questions

This paper set out to address the two questions stated in the Introduction, viz.:

1. Does it make sense to build wind power as fast as possible until 2020, at least, so we can cut greenhouse gas emissions as quickly as possible and start cutting as early as possible?

2. Would a mix of technologies be better able to meet the demand and do so at lower cost? For example, would a mix of solar and wind be lower cost than either alone, and lower cost than nuclear?

Figure 11 provides the answers.

The answer to Question 1 is 'No'. Figure 11 shows the emissions avoidance cost for the options without wind is $50/tCO2-e and for the options with wind is $163/tCO2-e in 2015. In 2020, the ranking is the same but the costs are higher (see Figure 11).

The answer to Question 2 is 'No'. The option with the mix of Solar Thermal and Wind has the highest avoidance cost of all options. It has the highest capital expenditure by far (Figures 8 and 9), and the highest electricity cost (figure 10). Its CO2 emissions are greater than the nuclear option. It has no advantages.

Figure 12 summarises the position in 2050. The figure compares the six options on the basis of the electricity cost of the coal and replacement technologies and the total CO2 emissions per year for each option. Clearly, the Nuclear and CCGT option produces the lowest emissions and the cost penalty is marginally higher than CCGT.

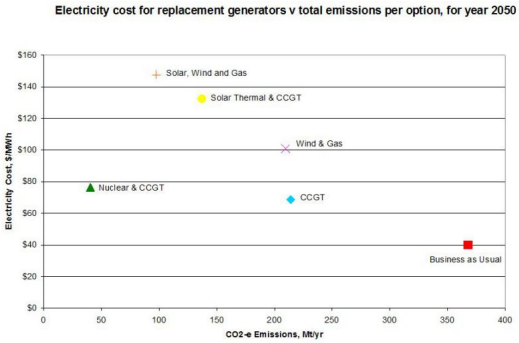


Figure 12: Long run marginal cost of electricity ($/MWh) in 2050 (for the coal and replacement technologies only) versus total emissions (t CO2-e/MWh) from all the technologies in each option.

(http://bravenewclimate.files.wordpress.com/2010/01/langecrf12.jpg)

Conclusions

The Nuclear power option will enable the largest cut in CO2-e emissions from electricity generation.

The Nuclear option is the only option that can be built quickly enough to make the deep cuts required by 2050.

The Nuclear option is the least cost of the options that can cut emissions sustainably.

Wind and solar are the highest cost ways to cut emissions.

A mixture of solar thermal and wind power is the highest cost and has the highest avoidance cost of the options considered. Mixing these technologies does not reduce the cost, it increases the cost.

The results are sensitive to the input assumptions and input data, but the ranking of the options, and therefore the conclusions, are robust to the changes of inputs tested.

For more information on assumptions and calculations, with references to source material, please read the 32-page PDF version (http://bravenewclimate.files.wordpress.com/2010/01/lang_2010_emissions_cuts_realities_v1a1.pdf).

realities&Title=Emission%20cuts%20realities%20for%20electricity%20generation%20-%20costs%20and%20CO2%20emissions) (http://twitter.com/home/?status=Emission%20cuts%20realities%20for%20electricity%20generation%20-%20costs%20and%20CO2%20emissions+%40+http%3A%2F%2Fbravenewclimate.com%2F2010%2F01%2F09%2Femission-cuts-realities)

(http://www.technorati.com/faves?add=http%3A%2F%2Fbravenewclimate.com%2F2010%2F01%2F09%2Femission-cuts-realities)
(http://www.furl.net/storeIt.jsp?u=http%3A%2F%2Fbravenewclimate.com%2F2010%2F01%2F09%2Femission-cuts-realities&t=Emission%20cuts%20realities%20for%20electricity%20generation%20-%20costs%20and%20CO2%20emissions)

342 Comments

Interesting post. I would love to see what happens to these numbers if significant efficiency gains are factored in as this is surely the sensible option (I understand your assumption but feel we can and should reduce overall usage).

Secondly I don't believe the (Gen iii) nuclear option can be built without massive cost blow outs. I would be interested to hear, but doubtful, if there has been a single recent project completed at these costs in a "western democracy". There is just too much politics involved.

posted 9 January 2010 at 7:43 AM by Alastair Breingan

I would love to see what happens to these numbers if significant efficiency gains are factored in as this is surely the sensible option (I understand your assumption but feel we can and should reduce overall usage).

Has history ever recorded an instance where efficiency gains have led to an overall reduction in power consumption? I thought the record indicated the opposite.

Secondly I don't believe the (Gen iii) nuclear option can be built without massive cost blow outs.

The Koreans and Japanese seem to manage it OK. Most cost blowouts in the west seem to be due to a combination of unneccessary regulatory burdens, vexatious law suites and political interference. These are factors which must be managed from the start when we go into the nuclear builds.

posted 9 January 2010 at 8:01 AM by Finrod

This is a really helpful report.

I don't see an accounting for reject heat from nuclear plants mentioned. From where and at what cost will cooling water be obtained for these?

posted 9 January 2010 at 8:32 AM by Doug Bostrom

Whoops, answering my own question, most demand is reasonably close to the ocean so water is easily available…

posted 9 January 2010 at 8:44 AM by Doug Bostrom

Every large project risks cost blowouts, especially if done as “one offs”. This is true for nuclear power and every other type of power source. Even the last coal fired power station built in Queeensland (Stanwell) took 7 years befor it was fully operational and had cost increases. Standardisation is the answer, as the French proved in the 1980s with their nuclear program.

Noting the energy intensities of each source (Table 1) one obvious question is why don’t we phase out brown coal power plants first, then black coal second? Substituting black coal for brown coal drops emissions 30%, which is far less than the 7% to 10% losses for power transmission from NSW to Vic or SA. We would need a high capacity interstate grid link, but that is surely affordable on this scale of cost.

posted 9 January 2010 at 8:55 AM by Scott Elaurant

Great set of conclusions, in particular the last one. This is the 800lbs gorilla in all of these arguments – it really doesn’t matter how you run the numbers, nuclear come out ahead.

posted 9 January 2010 at 10:45 AM by DV82XL

The {Pacfic] Northwest Power and Conservation Council has released its 6th power plan, guidance for Bonneville Power Authority and assistance to the 147 associated utility customers of BPA. By far the lowest cost option determined was energy efficiency, aboiut a quater the cost of Columbia Basin Wind. That in turn is only about 60% of Solar Trough and much less than half the cost of Utility PV. In oder of cost of least to largest:
Energy Efficiency
Geothermal
Combined Cycle
Columbia Basin WInd
Canadian WInd
Advanced Nuclear
Supercritical Coal
Integrated Gassified Coal
Reciprocating Engine
Wood Residue (No Chip)
Montana Wind
Wyoming Wind
Solar options mentioned (but standing well above the crowded middle)

Over the next 20 years, the regional population is expected to grow by up to 28%, requiring (without efficiency gains) an additional 6.7 GW (average, not peak).

posted 9 January 2010 at 11:48 AM by David B. Benson

Addendum: In the NPCC study the cost estimates include
Emission (CO2) cost
Transmission & Losses
System Integration (whatever that is)
Plant costs

Energy Efficiency consists entirely of the plant cost category.

posted 9 January 2010 at 12:03 PM by David B. Benson

David B., do you have a link? Are these LCOE figures? The obvious question (is if these figures were correct), from an economic point of view, is why would anyone be silly enough to build a coal-fired power station?

Scott, one practical reason for not phasing out brown coal first is that it’s cheap to burn when your plant is located on the lignite seam, whereas black coal makes more export $$.

posted 9 January 2010 at 12:33 PM by Barry Brook in reply to David B. Benson

Barry Brook, on January 9th, 2010 at 12.33 — Alas, NPCC just sends me their quarterly newletter and I somethines send in letters regrding the conservation part of the power plan. The seems to be a website:
http://www/nwcouncil.org
which you could try. I don't know what LCOE stands for, but NPCC does their own projections just for the Pacific Northwest, so I suspect everything is modified for the relgional variations from some sort of average. I note that the rankings differ in important respects from ethree's study for California, so these differences must be important.

AFAIK, with the sole exception of a 400 MW coal burner going to be newly constructed in Kansas, the only new construction in the USA (of coal burners) are those already under contract. Indeed, the EPA relicensing provisions (for emissions controls) are already so onerous that many utilities are already planning on shutting down existing coal burners when the license expires, with a few being converted to wood burners. Otherwise, the great majority of the forward planning is to put in CCGTs, maybe using the same steam plant that the coal burner used. There are a handful of NPPs currently awaiting the NRC's slow, slow approval process — not much for such a large country.

What I found particularly interesting is that not even Montana wind is actually cost competative due to transmission costs. Now its a long way from here to eastern Montana, but even further to places further east which might attempt to use that resource.

posted 9 January 2010 at 1:13 PM by David B. Benson

I add that one of the reasons that NPPs come out at such modest costs is that Hanford already has a (old) power reactor, is a highly protcted federal reservation and has considerable (to put it mildly) experience in matters nuclear. In addition, it is well located to feed power into BPA's transmission grid and, I believe, DoE has unused rights to Columbia River water.

posted 9 January 2010 at 1:20 PM by David B. Benson

Hi Peter, this is a very interesting report, you've covered a lot in a relatively short space.

I just wanted to ask how you would take into account the cost of storing the spent nuclear fuel and whether there were any projections on the price of Uranium from 2020+ that could be added to the analysis.

Also, I think this statement may be overly optimistic and is without reference to the current and historical political sentiment towards nuclear in Australia: 'Nuclear would be built near population centres', p. 12.

Last year at a talk I asked Kim Beazley why the Labor Party is against commissioning a study or at least having a debate on nuclear energy in Australia – his reply was energetic and robust (in the negative), to say the least!

Barry, it might be worth putting together a couple of posts on the history of nuclear politics in Australia – with reference to the position of the major parties.

posted 9 January 2010 at 1:32 PM by Daniel

For oil, don't forget to leave out the carbon footprint of the war in Iraq.

posted 9 January 2010 at 2:58 PM by stan

Why is it supposed to be so difficult to mass produce these reactors firing them up at a rate of 2 or 3 Gw a day worldwide in starting in five years or so. The big nukes are little more than a giant hunk of steel and concrete with some stainless tubing – a tiny fraction of what is used on civil construction worldwide.

In 1941 America had a fraction of todays industrial capacity producing 3.7M automobiles compared to 2007 when 10 million vehicles were produced. In 1941 American tank production was almost zero and yet by 1945 we had produced 80000 tanks weighing in at 30 tons each. Auto production was essentially zero 1943 to 1945.

While only part of the solution, a total fossil fuel elimination with the hot tub size factory produced 30 Mwe Hyperion unit weighing in at about 15 tons illustrates the small amount of industrial capacity required. Two units – made almost 100% of steel with a few hundred pounds of enriched uranium weigh about the same as 20 automobiles or a Sherman tank and are lot less complex. Assuming some cogeneraton, 50000 of them would be needed to convert America from fossils to nuclear about the equivalent of a half million vehicles – .5% of American's auto or 10% of the WWII tank annual production per year for 10 years.

There is a lot of unemployed autoworkers and mothballed auto factories just waiting for orders.

posted 9 January 2010 at 4:52 PM by seth

Peter,

A hugely interesting and important post. Congratulations on all the thought and hard work that went into its production. I think you have convincingly demonstrated that any Western government that promises significant emissions reductions relative to 1990 levels by 2050 has no chance without either a large nuclear contribution or the impoverishment of its citizens, notwithstanding efficiency improvements.

However, you were very supportive of Steve Kirsch's quote to the effect that, without alternatives for electric power being cheaper than coal, we're f—ed. I would therefore like to invite you to pursue this point a bit further. Your present post shows nuclear electricity to be nearly double the cost of coal electricity. I accept that one can't necessarily expect new nuclear plants to produce at a lower cost than already built coal plants. What I have been unable to ascertain is how much capital cost one can afford for nuclear so that it can compete against new coal under the two following scenarios: a) without any internalisation of coal's currently externalised non CO2 costs and b) with such internalisation.

You use ACIL-Tasman (2009) to arrive at projected nuclear build cost of Au$ 5207. In your post 41555, you cite a Korean contract price of US$ 3800 and go on to speculate that it might be possible to conceive of the possibility of getting costs down to US$ 2000. Is there a simple, approximate way to translate capital costs into likely electricity costs?

You have also been suggesting that build costs for nuclear are excessively high in part due to a culture in the West of excessive/redundant safety. You have gone so far as to mention safety expenditure was one or more orders of magnitude too high. In your opinion, how much could be saved by opting for extremely safe rather than ridiculously safe?

If you don't think that nuclear can compete with coal on the current unlevel playing field or even were coal's non CO2 emissions costs to be internalised, what level of carbon tax would be necessary to make nuclear competitive (using a range of nuclear build cost assumptions)?

Please don't take any of the above as criticism. I appreciate that it might seem churlish to ask for yet more information immediately following your current magnus opus. However, your contributions are too valuable to put you out to pasture.

posted 10 January 2010 at 1:14 AM by Douglas Wise

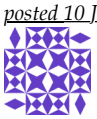
Looking at Appendix 2 in the pdf I don't think the near static unit costs 2020-2050 for black coal, combined and steam cycle gas can be right. The fuel costs must go through the roof in this period due to depletion and overseas demand, not so much on account of weak carbon taxes. While Australia appears to have plenty of coal and gas for now we will be 'leaned on' to supply the rest of the world. However I hesitate to say that gas or coal prices will be say 5X higher in 2040 because their determination is non-linear. Price is determined by supply (affected by depletion and deeper deposits) and demand which is weakened by reduced GDP.

Perhaps an annual fuel price escalation factor is needed. That would be 0% for wind and solar but could be say 2% for coal and nuclear and 5% for gas. Assume labour and other costs have negligible efficiency gains. Sample calculations for a decade's fuel price escalation give 1.02^10 = 1.22 and 1.05^10 = 1.63. That puts long life wind and solar in a slightly better light.

posted 10 January 2010 at 8:19 AM by John Newlands

Douglas Wise, on January 10th, 2010 at 1.14 — The NPCC's 6th power plan estimates that US$40/ton (short ton) of carbon is enough to make NPPs more attractive than coal but not more attractive than CCGTs. That's for here in the Pacific Northwest.

posted 10 January 2010 at 8:50 AM by David B. Benson



John I would question your assumption that wind an annual price escalation factor for wind (or solar for that matter) is 0%. For example :

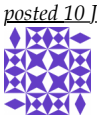
Bolinger, M & Wiser, R (2009) "Wind Power Price Trends in the United States:
Struggling to Remain Competitive in the Face of Strong Growth", Energy Policy 37 pages 1061-1071

I will summarise some of the findings :

This recent research paper demonstrates how rising costs in materials, energy used to manufacture wind turbines and currency weaknesses threaten to hamper future growth of wind energy. Long term historical trends demonstrate that recent cost pressures and rising costs impact on wind energy's competitiveness. The paper details the boom-and-bust cycle that characterized the wind market from 1999 through to 2004, and discusses the uncertainty in the wind marketplace. The volatility and increasing costs of wind turbines are also discussed, as turbine prices have doubled on average since 2002, and in 2008 transaction prices have ranged fro US$900/kW to a high of US$1960/kW. Installed project costs are also rising steadily since 2004, in 2006 they were 35% higher and in 2008 they were 20% higher than 2007. Average project costs in 2008 have increased since the 2001 – 2004 period by 62%. These costs will have to be

recovered through higher sales prices. The project prices would be even higher without access to state and federal incentives, and therefore the real cost of wind generation is much higher. Wind power projects being built from 2008 onwards are expected to continue to rise in cost, with expected costs in 2009 to be up to US$2250/kw. This research suggests that there is great uncertainty in wind power costs and prices, at present the trend is upwards.

posted 10 January 2010 at 9:01 AM by Bryen



ps : Peter, thanks for a great analysis. I'm still reading the paper, but I appreciate the effort that went into such a task. You deserve a medal.

posted 10 January 2010 at 9:05 AM by Bryen

Bryen your point is that wind may not have stable capital costs. Whether or not gas fired generation is faced with stable capital costs eventually fuel costs must escalate. Therefore these kinds of exercises are enormously difficult because of the uncertainty over plant life times, capital costs, fuel costs, carbon taxes and NIMBYism costs. I would point out that wind and solar with 20+ year life times have what I'd call 'low regret'. For example I don't regret spending $20k on PV as opposed to say a new car because it keeps producing albeit with foregone opportunities. PV however won't replace baseload so it can only be a minor component of the mix.

Therefore in some sense if society has spare cash it is better to spend it on scalable low carbon generation than high regret purposes like foreign wars. We should be enormously grateful that the hydro schemes were built early on rather than the money spent on aircraft carriers or whatever.

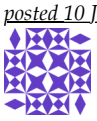
posted 10 January 2010 at 10:31 AM by John Newlands

As the rest of the world follows similar decision paths it does not seem unlikely that deployment of some technologies will become bounded by availability of input resources. Leading up to exhaustion of resources, costs will change as availability becomes tighter.

Lang's writeup as it stands is a compelling argument for nuclear generation but with a population of less than 22,000,000 it is not the place where prices are set for resources needed to build generation systems of any style.

If any revision/extension were done on this work, it would be great to see some discussion on what happens with the costs of various systems under consideration with a view beyond Australia's horizon. The conclusion may remain unchanged but such considerations would improve confidence.

posted 10 January 2010 at 12:45 PM by Doug Bostrom



John,

Firstly, regarding your use of the term "NIMBYism"

I will repeat here what I posted on this thread ->

http://bravenewclimate.com/2009/08/16/solar-power-realities-supply-demand-storage-and-costs/

because this is very important point that unfortunately a lot of people dont seem to understand, and to see you use the term is a shame.

—>

It pains me every time I see this word, because it downplays peoples legitimate concerns and rights. The industry and gov's love it because it is easy to name call, and this is really just all that it is, a schoolyard name calling tactic.

Sustainability also encompasses people, wildlife and the places they live, its not just about technology and numbers.

I recommend this study "Beyond NIMBYism" ->
http://www.sed.manchester.ac.uk/research/beyond_nimbyism/
Project Summary :

"The Energy White Paper (2003) and recently published Energy Review (2006) contain ambitious goals for decarbonising the UK economy, including increasing development of renewable energy technologies (RET) to provide 20% of UK electricity supply by 2020 (it is currently about 5%) and thus facilitate a step change in carbon emissions reduction by 2050.
The significance of issues of public acceptability are being increasingly recognised by policy makers, the research community and other stakeholders as a necessary condition of reaching this 20% goal. However, our current level of understanding of public views and how they might be relevant to the way in which RETs are evolving (including understandings of the public based upon the NIMBY 'Not In My Back Yard' concept), is both limited and restricted, excepting a few case-studies of onshore wind energy development.

In this light, this project, which is part of a major national programme funded by the Government's Economic and Social Research Council, seeks to significantly extend the current research base by examining a range of forms of technology which are expected to figure, to varying degrees, in the UK renewable energy profile – offshore wind, biomass of various forms, small scale HEP, large scale photovoltaics and more speculatively the various ocean technologies currently under development."

Their reports and project summaries are available :

http://www.sed.manchester.ac.uk/research/beyond_nimbyism/deliverables/outputs.htm

http://www.sed.manchester.ac.uk/research/beyond_nimbyism/deliverables/reports.htm

—

My point here is that peoples legitimate concerns are often swept under the rug by this schoolyard name calling tactic, and any text on "ecological sustainability" will rightly point out that people are part of eco-systems too.

The costs incurred by people fighting for their rights and legally objecting to unnecessary & thoughtless industrial scale developments, and therefore the costs incurred by the developer, are something that unfortunately will continue. For an example of recent court costs incurred in an ongoing wind farm case in New Zealand see ->

http://www.windaction.org/news/25042

Summary ->

"Opponents of a planned Central Otago windfarm say their David and Goliath fight with state-owned energy company Meridian has bled them dry. Heavily in debt from their successful Environment Court appeal against Meridian's plans to spend $2 billion building a 176-turbine windfarm on the Lammermoor Range in Central Otago, they now face having to take on deep-pocketed Meridian again."

The opponents court costs are currently at $400,000 and rising. Meridan's tactic is similar to other wind farm developer tactics, which is to keep appealing until the on with the most money wins (i.e. the developer).

You also mentioned that I pointed at capital costs, yes thats true, that paper does only look at capital costs. But a wind or solar farm doesn't run itself.

Wind turbines require ongoing maintenance costs (as well as decommissioning costs), as I have mentioned in other posts on BNC. The paper cited also points out, very importantly I think, that investment in US wind projects are happening mainly for the tax benefits they provide (i.e. production tax credit and accelerated depreciation).

I would like to see also see a paper that covers all the ongoing costs of renewable energy facilities, with comparisons with nuclear and fossil fuels. And that should include the hidden costs to the tax payer of all the scientific pre, during & post construction studies to investigate just what ecological damage is happening as a result of such large scale renewable deployment.

At present these scientific studies are sadly very underfunded, virtually non-existant and this an internationally recognised area of research needed to understand the effects of such large-scale installations. Such a study was also recommended in an Australian context in the NSW Inquiry into Rural Wind Farms.

The homepage of the Inquiry & report to the gov is here ->

http://www.parliament.nsw.gov.au/Prod/parlment/committee.nsf/0/5289EFFDED250AE4CA2575E10007D079

Note the following recommendations on page 103 regarding research :

Recommendation 14
That the Minister for Planning ensure that wind farm developers comply with bird and bat management conditions of consent. A summary of results of bird and bat monitoring, including the number of deaths, should be published annually on the Department of Planning website. Where the results demonstrate non-compliance with the conditions of consent the Minister should apply appropriate penalties or action.

Recommendation 15
That the Minister for Climate Change and the Environment commission an appropriate research project, in partnership with a relevant NSW tertiary institution, into the effects of wind farm operations on native fauna including a monitoring project involving academics and students.

For wildlife issues for example see this 18 page document :

Wind and Wildlife: Key Research Topics, May 2008 (18 pp.)
by the USA's National Wind and Wildlife Collaborative available as a pdf at ->
http://www.nationalwind.org/assets/publications/NWCC_ResearchPriorities.pdf

which is just one of many documents outlining wildlife issues alone.

The notion that "renewable energy is free" is a classic piece of industry spin. Yes, the wind (or the sun) is freely available, the expensive part is harvesting it in a truly ecologically sustainable manner, which at present is not happening.

All the above continue to add to the costs of cutting emissions using large-scale renewables, and these costs & time frames need to be brought out into the open.

A last example regarding build times. The Taralga wind farm development proposed by RES -> http://www.res-australia.com.au/

according to their timeline began in wind resource monitoring began in 2001.
Planning approval was granted in 2007. They then claim construction commences in 2009, this did not happen, and construction still has not started. As far as I am aware the local peoples opposition court case has cost them @ $130,000. We are now in 2010, some 9 years down the track and there is no sign of construction beginning, and this timeline is not unique to Taralga, look at Conroy's Gap for example.

Construction delay's are also not always due to local opposition, steel & turbine prices are highly volatile as stated in the Energy Policy paper and this is something the developers use to delay construction to save money. Note in Peter's paper the amount of concrete & steel required for wind vs nuclear on p21. See my comments on develop & delay as a wind development strategy on this thread ->

http://bravenewclimate.com/2009/08/13/wind-and-carbon-emissions-peter-lang-responds

develop & sell / develop & delay as an industrial scale wind strategy is outlined in :

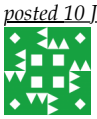
Kann, S (2009) Overcoming barriers to wind project finance in Australia, Energy Policy 37 p3139-3148
This paper is from the Centre for Sustainable Energy Systems @ ANU

posted 10 January 2010 at 12:46 PM by Bryen

Ugh. "with a population of less than 22,000,000 it is "

"It" meaning Australia. Sorry.

posted 10 January 2010 at 12:48 PM by Doug Bostrom



Cryminy Bryen, you might want to start your own blog, if you haven't already.

"Like any modelling exercise, the uncertainties lie in the quality of the input data and the acceptability of the assumptions made." Truer words could hardly be written, Barry. The unknown-unknowns aren't amenable to accurate predictions so you give your best estimate and present your calculations to be dissected by the readers.

Thanks, Peter, for another excellent post.

posted 10 January 2010 at 2:08 PM by DocForesight

As the rest of the world follows similar decision paths it does not seem unlikely that deployment of some technologies will become bounded by availability of input resources. Leading up to exhaustion of resources, costs will change as availability becomes tighter.

My naive first response to this is that seeing as nuclear has a lower resource input per Kw.he generated than just about anything else, its comparative advantage over any renewables mix scenario would be accentuated by input resource shortages. Production bottlenecks, such as the shortage of heavy forging capacity for large pressure vessels may be a short-term difficulty to ramping up output, but that sort of thing can be fixed.

posted 10 January 2010 at 2:31 PM by Finrod

Doc,

Barry has asked me to do some posts, watch this space. Hyper busy at the moment with some wind farm planning realities that have a rather acute time frame it makes uni deadlines seem like a happy memory…

I would suggest people have a good read of the NSW wind farm Inquiry submissions, hearing & report etc in readiness for what I'll be giving to Barry.

http://www.parliament.nsw.gov.au/Prod/parlment/committee.nsf/0/5289EFFDED250AE4CA2575E10007D079

In particular relation to this thread though (staying on topic :) read the Inquiry Committee's comments on GHG emissions reduction.

Alarm bells should be ringing! Read Diesendorf's sub and comments. Again, I hear alarm bells ringing. The Australian gov seems to think we are all "confused" about this issue & will be setting up "Precinct Manager's" to make sure we all get the official gov line. The alarm bells are getting louder…

posted 10 January 2010 at 2:45 PM by Bryen

With reference to Daniel's post of yesterday where he said:

'Last year at a talk I asked Kim Beazley why the Labor Party is against commissioning a study or at least having a debate on nuclear energy in Australia – his reply was energetic and robust (in the negative), to say the least!"

I went to a conference in Brisbane in November where Martin Ferguson (Minister for Resources and Energy) was asked about nuclear power and he was equivocal to say the least. He spun the party line that "nuclear has a place in the world energy mix – but we don't need it in Australia". Which is big shift from "only over my dead body".

The government here is relying on CCS and (to a lesser extent) EGS as the long term solutions with the ability to buy overseas permits to meet their 2020 reduction targets so they see no need for nuclear power today. They will probably need to see both CCS and EGS fail before they will make the right realistic conclusion that they have to build nuclear plants to reach their 60% reduction target by 2050.

On the issue of location for these plants, in Australia it seems to make more sense to locate them were the decommissioned coal plants were. Particularly the Latrobe and Hunter Valley regions. This will be a more acceptable solution politically and those regions have the steam generation operational skills that will still be needed with LWRs plus an existing grid connection point appropriately scaled.

I don't think we need to worry about the leaking radiation polluting the wine although I can imagine the radio talk show banter aleady.

posted 10 January 2010 at 4:53 PM by Martin Nicholson

Another point regarding the question "why don't we remove brown coal first?". In practice, the rate we can remove either black or brown coal ant reasonable cost depends on how old the plants are. Realistically we will be constrained to decommissioning plants that are nearer the end of their lives. Also, if we tried to simply decommission all Victorian plants first and replace them with gas generators while doing nothing in NSW and QLD, it simply wouldn't make sense.

The rates Peter used get rid of all Brown coal before all black coal (2035 versus 2040) and I think he'd argue that rate is probably as good as we can hope for given or current state of knowledge.

posted 10 January 2010 at 5:09 PM by Barry Brook

Victoria is said to have 800 years worth of brown coal. From http://www.eia.doe.gov/cabs/Australia/Full.html I infer that Vic has about 120 Mt of gas with an Mt of gas able to produce about a gigawatt year of electricity I believe. Therefore brown coal will far outlast local gas particularly if as I suspect gas reserves are exaggerated.

I've said before I think it is bad PR to convert a dark satanic mill like Hazelwood to nuclear by switching the steam generator leaving all the other grimy bits in place. A better site would be the Wonthaggi RO desal plant under construction. That confers a clean new site and desalination independent of coal burning, noting the 'offset' wind farm is not yet built. I understand the Feds have offered something like $8bn to TRU Energy to switch to gas fired baseload. That could go towards the cost of a NPP.

posted 10 January 2010 at 10:20 PM by John Newlands

Firstly,

Thank you for mostly supportive comments. I certainly was not expecting this. Perhaps most are still in holiday mood and our Northern Hemisphere contributors are digging themselves out of snow drifts. I'll address a few of the comments initially and may come back to others..

I should mention that I am most interested in the questions and comments that have a bearing on implications of the paper on policy issues – especially with the next round of Parliamentary debate about to begin on our proposed ETS/CPRS.

Alastair Breingan, on January 9th, 2010 at 7.43

The matter of the effect of energy efficency and demand side management was a major issue in ABARE's modelling for the Ecologially Sustainable Development in the early 1990's. At that time, many NGO's and sepcialist consultants were arguing that the demand growth rate should be less that ABARE was using. ABARE said they were happy to run the models with other growth rates. They did so and presented the options. However they and others pointed out that the economists projections based on past experience allow for the unknown unknowns. They pointed out at the time we could never have forseen how internet would reduce the fuel used in courier services but also how electrcity demand would increase due to unforseen new demands. To cut this short, I expect that the improvements in energy efficency will be swamped by the increases as we move to electrification of land transport (or the production of synthetic fuels using electrcity) and other unknown-unknowns.

As Finrof pointed out, most First of a Kind projects suffer cost blow outs. But they decrease as more of the plants are built. The off-shore wind farms are suffering massive blow outs too. The cost of wind farms has doubled in Australia over recent years compared with what the wind advocates were predicting.

Doug Bostrom, on January 9th, 2010 at 8.44

Cooling is included in the capital cost estimates and the price of electricity. Refer to the references by MIT (2009) and EPRI (2009).

Scott Elaurant, on January 9th, 2010 at 8.55 Said:

> " Noting the energy intensities of each source (Table 1) one obvious question is why don't we phase out brown coal power plants first, then black coal second? "

Good question. Barry has answered this and I agree. The least cost option is to shut down the coal fired power stations when they are approaching the end of their economic lives. Also, it seems unlikely that we would shut down power stations in Victoria and not in NSW, Queensland, SA and WA. I simply cannot see that happening.

Daniel, on January 9th, 2010 at 13.32

Daniel, I'll answer your questions in a separate post.

seth, on January 9th, 2010 at 16.52, Good points. You have stated that more clearly than I could.

Douglas Wise, on January 10th, 2010 at 1.14. I'll address this post separately (But I'm inclined to leave my response until next decade – joke alert!).

John Newlands, on January 10th, 2010 at 8.19. Please refer to the ACIL_Tasman report for projected fuel costs. It projects all fuel cost to 2028-29. The projections are sophisticated and certainly as good as we could expect. As I pointed out, I do not have up to date LCOE values for the existing power stations. If anything, I expect these are significantly less than I have stated, perhaps as low as $28/MWh. If so, it means the CO2 Avoidance cost is much higher. The projections of the electricity cost from the replacement coal technologies are a good as we have available. The experience with wind power so far is that itr is far higher cost than was expected by the advocates. The capital cost is twice what was expected and the electrcity cost is far higher too. I'd be much more concerned about the reliability of wind and solar prices than of coal. I'd expect, of all the electrcity cost projections we have, coal is by far the best known and has the least risk (excluding the effects of givernment policy interventions of course). Another point that is not widely appreciated yet is that the expected life of wind turbines is nowhere near what was projected.

John Newlands, on January 10th, 2010 at 10.31
You say:

> "I would point out that wind and solar with 20+ year life times have what I'd call 'low regret'. "

Many would disagree with that statement. Firstly, the life times in practice are proving to be nowhere near 20 years. Secondly, the wind farms are looking to be the "high regrets" option – supplying low value energy at high cost, not cutting CO2 emissions, many environmental problems and negligible benefits,

You implied that you think wind power is a "low carbon option" I am wondering if you've actually digested the paper. Wind with gas back-up saves negligible emisisons compared with gas alone (Figure 7), but costs more than twice as much (Figure 10). The avoidance cost of wind with gas back-up is three to four times higher than nuclear and at least twice as much as gas alone. It seems to be bad policy to mandate renewable energy for electricity generation.

Doug Bostrom, on January 10th, 2010 at 12.45

Doug, I'll come back to this later.

posted 10 January 2010 at 10:49 PM by Peter Lang

Daniel

You asked (2010-01-09 13:32):

> "I just wanted to ask how you would take into account the cost of storing the spent nuclear fuel and whether there were any projections on the price of Uranium from 2020+ that could be added to the analysis. "

This is a really good question. The cost of once-used fuel storage/disposal and of decommissioning is included in the electricity cost projections (see the references quoted in the pdf version of the paper, eg MIT, 2009 and EPRI, 2009).

The quantities of once-used fuel are miniscule compared with the toxic emisisons from the other electricity generation technologies. This photo is of the containers which hold all the once-used fuel from 30 years of production of a nuclear power plant (185 MW, 44 TWh). It has now been decommissioned.
http://www.nukeworker.com/pictures/displayimage-5205-fullsize.html

> "Also, I think this statement may be overly optimistic and is without reference to the current and historical political sentiment towards nuclear in Australia: 'Nuclear would be built near population centres', p. 12. "

I recognise we have a serious problem with perception of nuclear energy in Australia. But if we don't get over it, nuclear will be a high cost option for Australia's electricity generation. We need to get over this perception problem. If nuclear plants have to be built away from the population areas and away from the coast this will be a clear signal that we are not ready to embrace nuclear energy.

The picture here is of Pickering, and eight unit nuclear power station, nicely nestled in the suburbs of Toronto, Canada's largest city.
http://www.world-nuclear.org/ecsgallery/imageDisplay.aspx?id=10584&Page=19
It has been operating for nearly 40 years. There is no fear here. All over the world, once people engage with nuclear energy, the fear and revulsion goes away. They'd much prefer to have nuclear than fossil fuels.

posted 10 January 2010 at 11:05 PM by Peter Lang

Martin Nicholson – I agree, you would think that if constituents are prepared to live near coal fired generators, a nuclear reactor shouldn't cause much of a stir. Of course, the transmission infrastructure is already in place as well.

Last year the Government announced it's $4.5 billion clean energy initiative. Of this the biggest winners were CCS, solar and geothermal. Not one cent has gone into any form of study on nuclear power. Over $200 million has gone towards geothermal – of which companies in Australia are conducting proof of concept on 'hot rock' technology. The first of its kind in the world and obviously, inherently risky because of this. AEMO have also just released their National Transmission Strategy Report, part of which looks at connecting remote renewable energy sources to the grid, such as geothermal.

Bryen – your comment about legitimate (or perceived) concerns being swept under the rug is spot on. I would also add to that comment legitimate political concerns. No politician looking to be reelected would advocate a nuclear policy in Australia today. Unfortunately, no amount of technical or economic analysis will change this.

Howard was in Office for 11 years, Hawke/Keating 13 years before him, and if the polls hold up Labor will be in Office for the next two decades as well! I believe Labor's anti-nuclear position is one of their last ideological differences from the LNP and don't see it changing any time soon.

Rational? Irrelevant.

posted 10 January 2010 at 11:13 PM by Daniel

What are the policy implications of this analysis?

I'd suggest they are:

1. Mandating renewable energy is bad policy

2. If we are serious about cutting GHG emissions, we'd better get serious about implementing nuclear energy as soon as possible.

3. If we want to implement nuclear power we'll need to focus on how to do so at least cost, not with the sorts of high cost regimes imposed in USA and EU.

4. We should not raise the cost of electricity. We must do all we can to bring clean electricity to our industries and residents at a cost no higher than the least cost option.

5. Therefore, ETS/CPRS is exactly the wrong policy.

posted 10 January 2010 at 11:14 PM by Peter Lang

Hi Peter,

Thanks for the follow-up. Along with storage I also see that South Korea store their waste in containers on a hydraulic (moveable) bed (referred to in Switkowski Report) as it is an earthquake prone area! Great bit of ingenuity!

Yeah – I also agree with the problem of nuclear perceptions. It's too easy to play populist politics when referring to any sort of nuclear program. Just thought you might have been a little bit generous with that statement, if nuclear power is realised in Australia, I don't think the reactor(s) will be built near population centres. For the sake of getting nuclear in the door – prob best not to sell it on this point and pay a bit extra in transmission costs.

posted 10 January 2010 at 11:23 PM by Daniel

Doug Bostrom, on January 10th, 2010 at 12.45

Doug, I'll come back to this later.

Great, and looking forward to it. I understand in advance that it"ll stretch prognostication abilities but I think it's an area that needs hard scrutiny.

If (as we hope) the world marches more or less in lock step toward fixing our fossil carbon habit I just have to think we'll see a powerful shockwave of demand for physical resources and capital on a global scale. WWII is the nearest analogy I can think of, if our response is to be usefully rapid.

posted 11 January 2010 at 7:58 AM by Doug Bostrom

Byen,

—
Firstly, regarding your use of the term "NIMBYism….
—

I completely agree. The worst way to tackle a public concern is to call it a "perception" problem. By doing this we would be blaming the people and that immidiately puts them on the defensive and really angers them. This reminds me of the way US govt thinks about the US "pr" problem in the middle east. It is not just a marketing problem – it is a policy issue.

I think concerns raised should be squarely and directly addressed. Afterall nuclear safety concersn are not trivial (anyone here wants to tell us what would have happenned if the planes had hit nuke plants instead ?).

Yes, grave environmental issues exist with coal plants(shale gas, oil drilling etc). Thats why nobody wants a coal plant in their backyard either. Industry has a long record of not cleaning up after an accident. The companies can declare bankruptcy and go away (see Jared's Collapse – chapter on Montana for eg.).

posted 11 January 2010 at 9:16 AM by evnow

Evnow.

You said:

> "The worst way to tackle a public concern is to call it a "perception" problem. By doing this we would be blaming the people and that immidiately puts them on the defensive and really angers them."

Good point. I'll take that on board too.

posted 11 January 2010 at 9:47 AM by Peter Lang

Evnow,

I do haver to take issue with this statement:

"Afterall nuclear safety concersn are not trivial (anyone here wants to tell us what would have happenned if the planes had hit nuke plants instead ?)."

Would you like to tell us what would happen if a plane hit a NPP, preferably a Gen III as that is what we will beuilding in the foreseable future. Please don't just guess and throw up anti-nuclear alarmist propoganda. Do the research. The consequences are well understood, but not by the general public.

posted 11 January 2010 at 9:55 AM by Peter Lang

AP1000 outer containment is designed to shrug off a hit by an airliner.

posted 11 January 2010 at 10:03 AM by David B. Benson

This analysis is excellent!

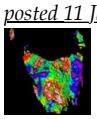
However I have one problem – the assumption about *increasing* energy consumption – are we ever going to get rid off *growth paradigm*? See Dr. Meadows update of Limits to Growth from 1972:

http://www.theoildrum.com/node/6094

just to remind to everybody – we are already in *overshoot*,

best,
Alexander

posted 11 January 2010 at 10:27 AM by Alexander Ač



I'm still to read the paper properly, but have noted there is no mention of geothermal as an option. Is this deliberate? As Daniel has notes, it's still at proof-of-concept stage. Does this mean it's still too early to make any reasonable quantifiable assumptions about it?

posted 11 January 2010 at 11:22 AM by Mark Duffett

Alexander Ač, on January 11th, 2010 at 10.27 — Here in the Pacfic Northwest "energy efficiency" is going to be pushed hard as by far the least expensive option. For example, Portland Oregon has an ambitious plan to reduce eletricity consumption by an amazing 40%!

posted 11 January 2010 at 11:38 AM by David B. Benson

> "Doug Bostrom, on January 10th, 2010 at 12.45 Said:
>
> As the rest of the world follows similar decision paths it does not seem unlikely that deployment of some technologies will become bounded by availability of input resources. Leading up to exhaustion of resources, costs will change as availability becomes tighter.
>
> Lang's writeup as it stands is a compelling argument for nuclear generation but with a population of less than 22,000,000 it is not the place where prices are set for resources needed to build generation systems of any style.
>
> If any revision/extension were done on this work, it would be great to see some discussion on what happens with the costs of various systems under consideration with a view beyond Australia's horizon. The conclusion may remain unchanged but such considerations would improve confidence"

I am getting continually sidetracked so I am not going to be able to put the time I had intended into answering your comment. So here a short reply.

Regarding the industrial capacity to manufacture the heavy components needed for Gen III reactors, I have no doubt that the world's manufacturing capacity will meet the demand shortly after the demand is established. The comment by makes the point clearly.

Regarding resources, I see no shortage of the resources needed. In fact, the resources required for wind and solar are far more than for nuclear. The mining and follow on disturbances are also far greater for renewables than for nuclear Barry presented an entire post on this matter at: http://bravenewclimate.com/2009/10/18/tcase4/ and I have contributed previous posts on this on the BNC web site.

There are limits on fossil fuels that will affect us in the foreseeable future. But other mineral resources are different. As we need more we explore more and find more. The quantity of Uranium in the continental crust is the same as tin and zinc. We are not going to run out of them for a very long time. We simply improve our exploration methods to find new deposits. Fossil fuels are different. They occur only in sedimentary rocks, and only in a very small percentage of sedimentary rocks. And sedimentary rocks comprise a very thin veneer of rocks on the Earths surface. Fossil fuels are limited. Other mineral deposits are not.

My conclusion:

1. Manufacturing capability will meet demand within a few years of the demand being realised

2. There is no shortage of the mineral deposits needed for nuclear energy

3. If there was any shortage of the minerals needed for nuclear energy then it would be a far greater constraint for renewables than it would be for nuclear energy.

> "If any revision/extension were done on this work, it would be great to see some discussion on what happens with the costs of various systems under consideration with a view beyond Australia's horizon. "

I agree with your suggestion. However, I cannot take it on at the moment. The studies referenced such as MIT (2009), EPRI (2009a) and EPRI (2009b) do take projected future fuel costs into account in their analyses. IEA, EIA and NWA all address these issues in various ways. The TCASE3 article also contains references.

posted 11 January 2010 at 11:43 AM by Peter Lang

> "Mark Duffett, on January 11th, 2010 at 11.22 Said:
>
> I'm still to read the paper properly, but have noted there is no mention of geothermal as an option. Is this deliberate? As Daniel has notes, it's still at proof-of-concept stage. Does this mean it's still too early to make any reasonable quantifiable assumptions about it?"

Mark, I had to keep the analysis simple. Six options was all I could manage. Carbon Capture and Storage (for electricity generation) and geothermal (Hot Fractured Rock) are in the early stages of RD&D. There are no commerical plants of either operating anywhere in the world yet.

Also, the paper was a response to questions and suggestions by Neil Howes and Alexei on the Solar Power Realities and the Solar Power Realities – Addendum threads. The questions are stated in the Introduction to the paper.

ACIL-Tasman gives projected electricity prices for both. However, these should be considered to be much less certain than the prices for coal and gas.

posted 11 January 2010 at 11:52 AM by Peter Lang

Peter Lang — When you have a bit of time, might care to look into the Oregon-based Nuscale company's nuclear reactor design. From the brief article about it in The New York Times several weeks ago, it seems to offer some important advantages over other, existing Gen III designs. Might even be less expensive…

posted 11 January 2010 at 11:53 AM by David B. Benson

Peter L re your points 4 and 5 I doubt anything will happen without an administratively imposed carbon price that has few loopholes. In our notional democracy it would be difficult to simply command that most generation is very low carbon. Electricity consumers will question the need for anything but coal and gas even if nuclear was the same price. A CO2 cap or fixed unit price will force change by via the pain of paying increased electricity and fuel bills. If the revenue is reimbursed in the form of efficiency measures then that pain is minimised.

The MRET itself illustrates this. To get to 45,000 Gwh by 2020 I believe we'll need another 20,000 Gwh or more from non-hydro renewables in the next decade, or more than 2 Gw continuous. I don't see it happening simply because government edicts not backed by penalties create little fear.
However directly raising the cost of coal makes everybody sit up and take notice. I suspect that several electricity firms would like to go nuke but can't justify it in the absence of a stiff carbon price.

posted 11 January 2010 at 12:55 PM by John Newlands

David B Benson,

Thank you. I may if I get a chance. However, as you know, since we've been commenting for well over 6 months now on the BNC web site, I try to stick to using figures from the most authoritiative sites. Of course this is not always possible, and when blogging I'll often post information that has recently come to me – sometimes "off the back of a truck". There is a lot of information being published and no one has the time to look at it all, so we have to allow impartial, authoritative organisations to vet the information, compile it and do appropriate comparisons on an equal footing. The MIT and EPRI references cited in the text give an idea of what is involved in doing this. So a study such as you mentioned, and the references you often give on algae farms for example, are of little interest to me.

Thank you for letting me know; it has given me the opportunity to explain why I generally don't get involved in discussing the many fringe renewable energy proposals.

posted 11 January 2010 at 1:02 PM by Peter Lang

David B. Benson, on January 11th, 2010 at 11.38 Said:

Here in the Pacfic Northwest "energy efficiency" is going to be pushed hard as by far the least expensive option. For example, Portland Oregon has an ambitious plan to reduce eletricity consumption by an amazing 40%!

I am a bit sceptical about substantial reductions in electricity unless it is accompanied with substantial reductions in productivity and hence GDP.

Did Portland give any indication of how long they thought it would take to reduce electricity consumption by 40%?

There is a clearly demonstrated close correlation between GDP and energy use (commonly referred to as energy intensity). See
http://www.eia.doe.gov/pub/international/iealf/tablee1p.xls

It does not vary greatly across developed economies and has only improved by 18% in North America over the last 10 years. Clearly the rate of improvement must slow over time not accelerate (we can't get down to zero energy use).

This means it could take Portland 30 years to reduce electricity use by 40% through efficiency measures. If Portland has any plans to grow and prosper it will take even longer.

posted 11 January 2010 at 3:04 PM by Martin Nicholson

"I agree with your suggestion. However, I cannot take it on at the moment."

Thank you for taking the time you did. It's a whole topic in itself, really.

posted 11 January 2010 at 4:26 PM by Doug Bostrom

Once small (250 MWe or less) centrally mass produced floating sea based and land based nuclear reactors become a commercial reality late in the decade, the capital cost of nuclear power is going to fall dramatically during the 2020s and 2030s along with the price of electricity from those sources.

posted 11 January 2010 at 6:37 PM by Marcel F. Williams

Marcel F. Williams

True. Unless we make it impossible to build them through overly restrictive regulations, bureaucracy and shifting risk that should be accpted by the state to the owners and investors. That is the problem we need to address in Australia. And we should not follow the USA or EU precedents..

posted 11 January 2010 at 6:53 PM by Peter Lang

Martin Nicholson, on January 11th, 2010 at 15.04 — I don't know how long the plan is expected to take, but the example of California, with efficiency measures balancing population growth for 30 years now, shows that considerable energy efficiencies are possible in the USA.

posted 12 January 2010 at 8:32 AM by David B. Benson

Ray Kurzweil in a recent interview spoke of the improving efficiency of solar cells:

Interviewer question: Do you see the GNR technologies coming on line to mitigate that kind of a catastrophe?

RK: Absolutely. Those projections are based on linear thinking, as if nothing's going to happen over the next 50 or 100 years. It's ridiculous. For example, we're applying nanotechnology to solar panels. The cost per watt of solar energy is coming down dramatically. As a result, the amount of solar energy is growing exponentially. It's doubling every two years, reliably, for the last 20 years. People ask, "Is there really enough solar energy to meet all of our energy needs?" It's actually 10,000 times more than we need. And yes you lose some with cloud cover and so forth, but we only have to capture one part in 10,000. If you put efficient solar collection panels on a small percentage of the deserts in the world, you would meet 100% of our energy needs. And there's also the same kind of progress being made on energy storage to deal with the intermittency of solar. There are only eight doublings to go before solar meets100% of our energy needs. We're awash in sunlight and these new technologies will enable us to capture that in a clean and renewable fashion. And then, geothermal — you have the potential for incredible amounts of energy.

Global warming — regardless of what you think of the models and whether or not it's been human-caused —it's only been one degree Fahrenheit in the last 100 years. There just isn't a dramatic global warming so far. I think there are lots of reasons we want to move away from fossil fuels, but I would not put greenhouse gasses at the top of the list.

posted 12 January 2010 at 9:10 AM by Chris

David – I never doubted that energy efficiencies were possible but at a cost in GDP per person.

how is the GDP tracking in California compared to the US as a whole?

posted 12 January 2010 at 9:58 AM by Martin Nicholson

John Newlands, on January 11th, 2010 at 12.55 Said:

> "Peter L re your points 4 and 5 I doubt anything will happen without an administratively imposed carbon price that has few loopholes."

John, Thank you for your comment. I think this is an extremely important issue. I want to discuss this some more but I am falling behind in answering comments. So until I can catch up, I hope you might take another look at this thread http://bravenewclimate.com/2010/01/02/investment-we-arent-making/ and especially at my replies to posts by Ewen Laver and David Walters. My posts explain why I believe we must focus on reducing the cost of clean energy so it is competive with coal rather than raise the cost of fossil fuel energy. I intend to say more later, but hope you can look at those replies of mine first.

I hope others who are interested in the policy implications of the "Emission Cuts Realities" paper might also look at http://bravenewclimate.com/2010/01/02/investment-we-arent-making/ thread and my replies to Ewen Laver and David Walters for background to my thoughts on this matter.

posted 12 January 2010 at 11:10 AM by Peter Lang

Martin Nicholson, on January 12th, 2010 at 9.58 — California's GDP is so high that if it were a separate country it would rank in the uppermost few.

Which shows that electricity consumption is not that well correlated with wealth, past some sort of minimum. For some comparisons, try North Carolina versus various states of Europe. And so on.

Probably the main point is that in the USA people have become quite profligate in energy usage and now need to learn to be wealthy more along a European standard. Or even more efficient.

posted 12 January 2010 at 11:36 AM by David B. Benson

Peter, you really are performing a tremendous public service. Thanks for another important contribution.

On policy implications, the important question is how to ensure your analyses feed in to actually setting policy. This looks like the sort of analysis ABARE or a similar body should be doing. Do you have any thoughts on how best to convey your analyses to policy makers, or to have your conclusions confirmed by independent analysis?

Do you think there would be value in preparing your work for publication in a peer reviewed journal? (One of the criticisms I've seen in discussion of your work in other fora is the whinge that it is not 'peer reviewed'. A cheap shot, IMO, which could be rectified by publication, or by independent analysis.)

posted 12 January 2010 at 12:36 PM by John D Morgan

Somehow I missed that levelling up vs. levelling down thread but since the topic is now efficiency here's what I think is a new idea; we could save the first 5 Gw average via efficiency quicker and cheaper than building new renewables. The way to do it could be based on higher carbon prices combined with low pain ways to reduce consumption such as insulation and smart meters. We could also introduce soft rationing with basic allowances for gas and electricity that quickly step up to premium rates. This is the approach water authorities are adopting to soft ration water use.

However I'm not sure aggressive efficiency can co-exist with the ~4% economic growth which some consider a necessary goal. We also need to cover Australia's recent annual population growth of 2%. Meanwhile reserve depletion and overseas demand will raise fossil fuel prices with or without carbon taxes. Therefore we'll have to learn to use less FF sooner or later. What we have now is a worst-of-both-worlds situation in which we kid ourselves a few renewables make a difference while in reality we remain as FF dependent as ever.

posted 12 January 2010 at 1:10 PM by John Newlands

Douglas Wise, on January 10th, 2010 at 1.14 Said:
Peter,

> "A hugely interesting and important post. Congratulations on all the thought and hard work that went into its production. I think you have convincingly demonstrated that any Western government that promises significant emissions reductions relative to 1990 levels by 2050 has no chance without either a large nuclear contribution or the impoverishment of its citizens, notwithstanding efficiency improvements.
>
> However, you were very supportive of Steve Kirsch's quote to the effect that, without alternatives for electric power being cheaper than coal, we're f—ed. I would therefore like to invite you to pursue this point a bit further. Your present post shows nuclear electricity to be nearly double the cost of coal electricity. I accept that one can't necessarily expect new nuclear plants to produce at a lower cost than already built coal plants. What I have been unable to ascertain is how much capital cost one can afford for nuclear so that it can compete against new coal under the two following scenarios: a) without any internalisation of coal's currently externalised non CO2 costs and b) with such internalisation. "

Thank you for the supportive comments. I understand your question and the scenarios a) and b). I'll have to come back to this in a later post. It is an important issue. In the meantime, ExternE project http://www.externe.info/ estimated the externalities costs for the various electricity generation costs. It is a thorough job. How to internalise the cost is the big problem. We have not been successful in 30 years of looking at this. The politics of it is nearly impossible. We can spend another 30 years playing around with it or recognise there is a much easier way – get rid of the impediments that are dramatically raising (perhaps

doubling) the cost of the most realistic, low-emissions alternative – nuclear energy. ACIL Tasman provides projections to 2029 of capital costs and electricity generation costs for coal, gas, coal and gas with CCS, nuclear and geothermal generated electricity in Australia. The projected electrcity costs are for the case with and without $10/tonne CO2-e emissions. The ACIL-Tasman estimated capital costs in AUD in 2010 are as follows: nuclear (the first plant) = $5207; Ultra Super Critical Black Coal (air cooled) = $2451; IGCC = $3705.

> "You use ACIL-Tasman (2009) to arrive at projected nuclear build cost of A$ 5207. In your post 41555, you cite a Korean contract price of US$ 3800 and go on to speculate that it might be possible to conceive of the possibility of getting costs down to US$ 2000. Is there a simple, approximate way to translate capital costs into likely electricity costs? "

Let me clarify those figures first. The ACIL-Tasman figure of A$5207/kW is a theoretical cost for a First of a Kind (FOAK) nuclear power plant in Australia. It is theoretical because the cost is for the year 2009-2010. Once the first one is built (ACIL-Tasman asumes this is in 2025) ACIL-Tasman projects a rapid reduction in the capital costs – to $4263/kW over 4 years. The point to note is that the $5207 is a FOAK cost and ACIL-Tasman projects a sharp reduction as more are built. Now let's consider the cost for the UAE NPPs. The US$3800/kW is wrong and also it needs to be converted to AUD for comparison with all the other figures in the "Emission Cuts Ralities" paper. The cost should be US$3704/kW (US$20 billion / 4 x 1350 MW). This is A$4115. So now we have a competitive bid for FOAK build of four 1350 MW power stations using AP1400 reactors. The comparison is UAE = A$4115 and Australia (projected) A$5207. Both are FOAK.

> "You have also been suggesting that build costs for nuclear are excessively high in part due to a culture in the West of excessive/redundant safety. You have gone so far as to mention safety expenditure was one or more orders of magnitude too high. In your opinion, how much could be saved by opting for extremely safe rather than ridiculously safe? "

Without researching it, here is my guesstimate:

Nuclear is currently (Gen II history) some 10 to 100 times safer than coal. I expect we could have nuclear at 9 to 90 times safer than coal for around 50% reduction in cost. We could build them on the coast (lower cooling costs), near the demand centres (less transmission costs, lower costs for workforce, lower costs for construction, operation and maintenance throughout the plan life), we could accept the investment risks that are best owned by the public (such as public mischief, legal interventions and delays during construction, and sovereign risk), etc.

> "If you don't think that nuclear can compete with coal on the current unlevel playing field or even were coal's non CO2 emissions costs to be internalised, what level of carbon tax would be necessary to make nuclear competitive (using a range of nuclear build cost assumptions)? "

Off the top of my head, A$20 to $40/tonne CO2. But I do not believe a Carbon tax or ETS is the preferred way to proceed. I believe it would be better to address the unlevel playing field.

> "Please don't take any of the above as criticism. I appreciate that it might seem churlish to ask for yet more information immediately following your current magnus opus. However, your contributions are too valuable to put you out to pasture. "

Thank you for your comment. It is very encouraging and the matters you raise have important policy consequences. It is the policy issues that I would like to see discussed more fully on this forum. I do not believe raising the cost of electrcity is the best way to proceed for humanity, for the poor, for future generations, or for the environment.

I am convinced we can have low emissions electricity in Australia at a cost that is competitive with coal and it can be far safer and far less environmentally damaging. Let's have the debate on this forum.

posted 12 January 2010 at 1:43 PM by Peter Lang

John D Morgan,

Thank you for your comment and encouragement. I would really like to submit a paper to a peer reviewed journal. I'd need to do it together with another experienced person, at least for the first one.

I am a bit concerned that the papers I've written so far are more like consultancy reports than the sort of paper that is submitted to peer reviewd journal. However, an email that was forwarded to me this morning encourages me. The email was between colleagues at MIT and said as follows:

> "From another direction, I came across a paper that examines various scenarios about cutting emissions through changing sources of electric power. Although this paper is Australia-specific, it's methodology may be applicable for similar ways of looking at the American energy supply of the future. Conversely, if you disagree with the methodology, I'd be interested in learning your reasons why."

I agree these analyses should be done by ABARE, Treasury, Department of Industry, Productivity Commission, AER and AEMO. But they are not. I've tried to discuss some basic issues with DCC about CO2 emissions intensity from electricity generation.

I don't know how to influence policy. It is very tied up in politics, and the looming election. Being seen to be anti-nuclear is a clear electoral advantage in Australia.

But I would love to work with others to do whatever we can.

posted 12 January 2010 at 1:55 PM by Peter Lang

John,

Could you look through the paper and suggest the assumptions and inputs that you would like to see changed. Please provide a source for the figures. I am sure you'd agree, we would need a set of consistent figures for all technologies and all years in the projection, otherwise the analysis is simply a nonsense of cherry picked bits and pieces.

I note you mention 4% projected GDP growth. I've never seen a figure as high as that for long term growth for Australia. I seriously soubt that eficciency improvements will offset rising demand for electrcity. But I'd be interested to see what information you have on that matter. Certainly, neither ABARE nor Treasury are projecting that.

posted 12 January 2010 at 2:15 PM by Peter Lang

David B. Benson, on January 12th, 2010 at 11.36 Said:

"California's GDP is so high that if it were a separate country it would rank in the uppermost few."

I was really asking about GDP per capita. I did a very quick bit of checking and I know it's a bit anacdotal but sure California is the biggest state by GDP but is only 11th by GDP/capita.

It is actually only 38th by GDP/capita growth. This may or may not be related to energy usage per capita.

posted 12 January 2010 at 2:15 PM by Martin Nicholson

Peter, Barry's your obvious co-author. You're right that this needs to be turned from a consultants report into a research report, but I believe the research content is there to support that. The main thing lacking in current form I think is some review and contextualization within the existing literature.

I'm not sure where you'd publish. Is this an energy paper, a policy paper, or an economics paper? I'm sure there are suitable journals though. The only reservation I have about publication is hitting a vexatious reviewer. How would you like to have Mark Jacobson as your anonymous referee?

posted 12 January 2010 at 3:32 PM by John D Morgan

John,

Thank you. I agree about the potential for a vexacious reviewer. The wind paper on this web site was sent to the Premiers of NSW, Victoria, SA and ACT, and to the Minsiters for Environment, Energy and Industry in each state and the Federal Government. Most politicians gave polite do-nothing responses or advised me it was not their responsibility and they had sent it to another Minister. I received two genuine responses. One suggested I get it peer reviewed and suggested the organisation where Mark Diesendorf works.

The Federal Government charged ASIC with conducting an enquiry into "misleading claims about GHG emissions".

I also sent it to the "Energy News", but they are in league with the renewable energy research scientists. After much delay they told me it is not the sort of thing they want to publish.

I don't have a lot of energy to put into this sort of nonsense. That is why I need to work with someone else who can cut through. I agree it needs to be properly submitted and properly peer reviewed. But I see an enormous amount of work ahead. I'm just typing want is going on in my mind on this.

posted 12 January 2010 at 3:57 PM by Peter Lang

Chris, Kurzweil has a faith in magic. (The "Singularity"? Please ..) Just because he calls his magic "nanotechnology" in this instance does not embed it in physical reality. When he talks about "linear thinking", that's just content free rhetoric. When he talks about being "only" eight doublings away from solar panels providing all necessary energy, he's making the same error of judgement as investment analysts who believe the economy can grow exponentially forever, or people who think Moore's Law applies to any technology.

Douglas Hofstadter said of Kurzweil (and another author), "It's as if you took a lot of very good food and some dog excrement and blended it all up so that you can't possibly figure out what's good or bad. It's an intimate mixture of rubbish and good ideas, and it's very hard to disentangle the two, because these are smart people; they're not stupid." After listening to a talk from Kurweil recently I'd have to agree – he's off with the fairies.

posted 12 January 2010 at 4:01 PM by John D Morgan

Generally speaking, although the reviewers are anonymous, they'd be chosen by a commissioning editor for their competence in assessing key parts of the paper — so I imagine someone with engineering expertise in Peter's area or surveying would be chosen.

A hostile reviewer can't *simply* be hostile. They have to offer reasoning and if the reasoning is bogus or frivolous it embarrasses the commissioning editor more than anyone else.

posted 12 January 2010 at 5:36 PM by Ewen Laver

Correct Ewen, and generally, the authors are given a chance to provide a rejoinder, especially if not all reviewers are dissenting. It's part and parcel of the peer review process that I've experienced (suffered through) more than 150 times over the last 10 or so years :)

posted 12 January 2010 at 5:39 PM by Barry Brook in reply to Ewen Laver

Peter, I had a chat on how to get some policy traction on nuclear over Christmas with my father, who's a veteran of many environmental campaigns (and now a nukie). He met one of Goss's ministers (QLD Premier in the 90s) who described how Cabinet would consider environmental issues (and others). It went something like,

Environment minister raises agenda item.
Goss to Forestry minister: "You had any letters on this?" "No."
Goss to Resources minister: "You?" "No."
Goss: "OK. Next item .."

You've got to write to them (which you've done), and not just the single responsible minister.

This is similar to Obama's response to someone advocating some cause I don't recall: "Show me the movement". We've got to show them the movement. Which means there has to *be* a movement. I don't know what the next step is, but it needs to be political.

posted 12 January 2010 at 10:29 PM by John D Morgan

Peter,

I'd second the suggestions to try and get this out to a larger audience somehow, whether or not that's in the peer-reviewed literature.

It's a great analysis but I'm very aware of how 'nuclear friendly' this blog has become (this is not a criticism, btw)- which does mean that your paper won't get validation from surviving more 'hostile' reviews. I wish I had the time and the engineering/economics background to critique it properly, but apart from anything else I'm just as likely to add to the BNC 'echo chamber effect', having been largely won round to the prevailing POV by your (and Barry's) previous posts.

Only thing I was really struck by was the assumption of steadily rising electricity demand. I haven't looked at your original source but presumably this has much to do with Australia's population growth? I'd be interested to know how generalisable this is to other countries, and also the effect that picking the 'low hanging fruit' of efficiency measures might have (whether it might cancel out the effect of any increased demand due to electrifying transport etc).

You've put a huge amount of work into the paper and (I hope no offence to the other commenters here)– it really deserves a different audience.

posted 13 January 2010 at 12:19 AM by geodoc

re #42554 Peter Lang (Jan 12th)

Many thanks for your response to my previous comments. I would like to summarise the presumptions I have made as a consequence of what you have written and then make a few further observations:

Presumptions

1) You suggest that Australian nuclear electricity could initially be produced at a price some 88% greater than the current cost of electricity from coal.
2) The cost of constructing a FOAK nuclear plant can be projected to be 18% more than than the equivalent cost 4 years down the road.
3) The 18% reduction will still leave nuclear uncompetitive in straight economic terms.
4) A more favourable regulatory regime for nuclear could halve the cost of construction without having a significant adverse effect on safety.
5) Under the scenario outlined in 4), nuclear electricity would be no more costly and, possibly, cheaper than coal electricity.
6) Your opinion is that carbon emissions should neither be capped nor taxed.

Observations

1) I was talking to an asset rich cash poor large scale farmer in the UK yesterday who had just been visited by a senior Bank of England civil servant who was examining the health of the agricultural sector. The farmer was bemoaning the fact that the privilege of being allowed to grow wheat and rape for the nation had resulted in his having had a trading loss of £250000 for the year. The civil servant told him to be of good cheer. It has been dawning on the UK government that farmers should grow food rather than be park keepers now that our City Traders are no longer able to sustain us in the manner they saw fit, having first taken their bonuses. He stressed that it was being increasingly realised that both food and energy security were important and had been, in the recent past, neglected. The farmer, therefore, could expect more incentives to produce his wheat in the future. The civil servant continued the discussion by giving his views on Copenhagen. It was his opinion that anyone who thought that politicians from 160 nations could agree a deal on emissions reductions were living in cloud cuckoo land. He was open minded over climate change but absolutely certain in his own mind that the nations of the world would never agree (or certainly not all adhere to) any restrictions that threatenened their economic growth.
2) The day before yesterday, I had dinner with a friend who is the CE of a mining company operating in the Third World. His company has thousands of hectares of concessions and, having done its exploratory bits, is seeking large amounts of capital to rip up the countryside to extract smallish concentrations of that massively important and valuable mineral (for jewellery), gold. I asked him about power . He replied that they were intending to build a coal fired power plant. He was surprised to learn that nuclear batteries existed (perhaps they don't to the extent that they can't be bought off the peg and perhaps they wouldn't be affordable anyway) but thought they sounded a good idea. He had just read Ian Plimer's book and was so impressed that he gave it to his daughter in law for Christmas. She had responded with the gift to him of the full IPCC Report. Unfortunately, it was too heavy for him to take on his imminent flight to his concession.
3) The UK government has just approved a massive offshore wind development (enough for 5 million homes no less!). This has coincided with a very cold period during which the wind has had the temerity not to blow. (In theory, we should be getting 5% of our energy from wind but, because of its absent mindedness, we have only obtained 0.2%.) Meanwhile, the Norwegian gas pipeline which supplies us sprung a leak (noone mentioned the methane) and we had little gas stored. Several industrial users were closed down, enabling the rest of us to sit in our shirtsleaves watching television because the roads were blocked with snow, schools closed and we'were clean out of grit (and gumption).

Conclusions

The examples above, gleaned by coincidence over the last 48 hours, are strongly supportive of the views held by Steve Kirsch and Peter Lang, namely that the only hope we have of saving ourselves from climate catastrophe is to produce energy in quantity from a carbon free source at a price equal to or cheaper than that which can be produced from coal. At present, that has almost certainly to be from nuclear fission but carbon free alternatives should not be barred, regardless of their likely greater costs.

However, it occurs to me that even a level price would not guarantee a successful outcome without some degree of coercion. Without it, some companies or nations would still consider extending the longevity of existing coal plants, extracting oil from shale and tar sands or using coal to liquid technology for transport fuels.

I think it may therefore still be necessary to map out fairly stringent and verifyable emissions reduction targets. One would not necessarily expect that all nations would sign up to them. However, this is where the coercion would be required. Non signatories or non performing signatory states should be subject to trade restraints/embargoes/tariffs. This might be a very naive and unworkable idea. Even if workable, it would require a huge amount of effort and expertise to come up with the necessary level of detail that would be required for successful implementation.

It would be interesting to hear comments from others on alternative conclusions or suggestions.

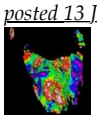
posted 13 January 2010 at 2:26 AM by Douglas Wise

Peter Lang, on January 12th, 2010 at 15.57 — What you have is certainlyt worth the effort of obtaining peer-reviewed publication in a suitable energy policy related journal. If both you and Barry Brook are willing to jointly publish, then fine.

It is not important that even the reviewers agree with your conclusions; just that the methods and sources are sound. Someone reaching a different conclusion could then publish a rebuttal. However, within the limitations you set yourself (reasonable ones IMO) I believe you are one of the few to set out a clear path to a less CO2 intese future.

Gopher It, as is said around here.

posted 13 January 2010 at 7:04 AM by David B. Benson



Peter, I'd consider finding an economist co-author, and publishing in an economics journal (I'm pretty sure there are several operating at the interface between economics and energy). My impression is that this route is the most likely to get these conclusions on the radar of the policy-making domain, where they need to be.

posted 13 January 2010 at 8:50 AM by Mark Duffett

Martin Nicholson, on January 12th, 2010 at 14.15 — I checked
http://en.wikipedia.org/wiki/List_of_U.S._states_by_GDP_per_capita_(nominal)
in which the combined influences of US goverment and NYC explain all but #4, #7 (energy extracvtion, nobody actually makes much money in at least

Wyoming) and the surprises of #9 and #10, both of which are northerly and so the cost of living is higher than in #11, California.

So I'll use this as a further indication that once some minimal level of energy is available, factors othr than energy are more important in wealth generation.

posted 13 January 2010 at 9:11 AM by David B. Benson

Thank you all for the support and encouragement. Barry and I are progressing on preparing the paper for submission for publication as a peer reviewed paper. Barry will be the senior author for many good reasons. I am completely in agreement with that. I don't have the contacts, nor the skill set, nor the perserverance/patience to take the lead role through what is ahead. Thank you to Barry, John D Morgan, Ewen Laver, geodoc. Douglas Wise, David B Benson. Mark Buffet for your encouragement. It now in train.

posted 13 January 2010 at 9:22 AM by Peter Lang

Geodoc

You commented:

> "Only thing I was really struck by was the assumption of steadily rising electricity demand. I haven't looked at your original source but presumably this has much to do with Australia's population growth? I'd be interested to know how generalisable this is to other countries, and also the effect that picking the 'low hanging fruit' of efficiency measures might have (whether it might cancel out the effect of any increased demand due to electrifying transport etc)."

I'd like to ask Martin Nicholson to address this question. he is mor up to date on this than I am.

In the meantime, I'll just comment that I am not aware of any authoritative projections that show a decrease in electricity consumption, anywhere. Some authoritative sources you may want to look up on this are:

IEA, EIA, ABARE, Treasury.

Here is a link to Treasury: http://www.treasury.gov.au/lowpollutionfuture/report/html/03_Chapter3.asp. You can get to the other chapters from here.

I'd also add that we've been through the optimisitc beliefs in what can realistically be achieved with efficiency improvements before. I expect a very small part of wehat is being advocated can really be achieved economically.

posted 13 January 2010 at 9:33 AM by Peter Lang

Douglas Wise. Another great post. Very interesting your two experiences in the past 24 hours and their implications for policy. I agree with almost all you say.

I am open minded on the matter of eventually having to have an ETS on carbon emissions. But I am not in a hurry to implement it. Once implemented it can never be undone (property rights are involved). So we'd better be sure it is the best policy to achieve our objectives before we proceed down the ETS path. I doubt we can ever trade, internationally, a commodity (carbon emissions) that is unmeasureable. It is unmeasureable at all levels: the individual, the business and the country. This will mean there will be massive cheating and fraud at all levels. The bureaucracy, police forces etc neecessary to adminisdter and police it will be a great cost to society. I believe the ETS is unworkable and will be an inmittigated disaster.

I do agree with implementing any workable means to internalise the external costs of energy consumption.

I hope others will discuss David Wise's excellent article.

David. I did not answer some of your previous comments very well. I intend to return to them.

posted 13 January 2010 at 9:59 AM by Peter Lang

Peter, that is fantastic. If the paper that results incorporated your earlier pieces as both the limit positions, and the current one as the approach to the limits, then that would be a landmark publication.

Well done on your decision to publish.

posted 13 January 2010 at 10:00 AM by John D Morgan

Peter,

I would strongly encourage you to submit to the journal Energy Policy. Particularly as the current NSW Renewable Energy Precincts (ghetto's is a better word for precinct) target is 45,000GWh by 2020.

See -> http://www.environment.nsw.gov.au/climatechange/windprecincts.htm

Note NSW gov have called the web page "wind precincts" as is the email addy, which gives you an idea of what "renewable" means i.e. wind.

Now correct me if my figures are off here, but based on an annual figure of 4000MWh (capacity factor of 22.8% from current Life Cycle Analysis papers) for a 2MW turbine. In terms of the number of 2MW turbines in NSW that will mean :

45,000,000MWh / 4000MWh = 11,250 turbines.

Now have a look at the map ->

which of course omits :

ACT (funny that…)
&
Sydney region all the way west to just past Katoomba and all of the coast from a little north of Ulladulla all the way up to Tweed Heads (the coast is the best area of wind resource in NSW)

Yep, thats right, who is going to suffer the worst consequences, the rural minority and the ecosystems/wildlife of NSW.

*** Oh and of course anyone in NSW who pays an electricity bill & taxes because this will cost them a fortune! ***

How many nuclear power stations would you estimate could cover that?

I would like to remind everyone reading that those 11,250 wind turbines will absolutely require at least a 90% gas fired power station installation as backup. Has the NSW government read what the Australian Energy Regulator (AER) say's in the State of the Energy Market Report 2009, p65 ??

"wind capacity depends on the weather and cannot be relied on to generate at specified times."

The issues such as intermittency/variability/non-reliability of wind, use of gas for back up, and start up times for coal are clearly stated extensively throughout the AER's State of the Energy Market Report 2009 as shown by the following short selection of brief quotes :

Page 38 :

"Gas is likely to play an important role under climate change policies in complementing intermittent renewable electricity generation. Wind generation — the likely primary renewable technology to 2020 — has intermittent output and must be backed up by other generation. Open cycle gas plants can respond quickly when there is insufficient wind generation, but any new plant is likely to operate at relatively low capacity factors. There will also be an increased need for gas transmission and storage to provide gas at short notice."

Page 50 :

"The fuels that can be used to generate electricity each have distinct characteristics. Coal fired generation, for example, has a long start up time (8 – 48 hours), while hydroelectric generation can start almost instantly."

Page 55 :

"The extent of new and proposed investment in intermittent generation (mainly wind) has raised concerns about system security and reliability."

Page 102:

"The three largest private energy retailers — Origin Energy, AGL Energy and TRUenergy — are moving towards portfolios more balanced between generation and retail assets. In 2007 AGL Energy acquired the 1260 MW Torrens Island power station in South Australia from TRUenergy, in exchange for the Hallett power station (150 MW) and a cash sum. Origin Energy is quickly expanding its generation portfolio, commissioning the Uranquinty power station (650 MW) and expanding its Quarantine plant (130 MW) in 2008 – 09. It has also committed to a further 1250 MW of gas fired generation in Queensland and Victoria. All three businesses also have ownership interests in Australian wind farms."

I recommend everyone have a good read of the SEM 2009 report :

http://www.aer.gov.au/content/index.phtml/itemId/732297

Its a free to download PDF, and a real eye opening and educational exercise.

Given that it is becoming more and more apparent that wind may end up contributing to increasing GHG emissions through the thrashing of these gas power stations, what would be the estimated increase in emissions should such large scale wind energy ghettos get built?

The wind/gas alliance are rubbing their hands with glee at the prospect of the market price cap being raised further this year to $12,500/MWh & a green light from government planning. So when their "noise generators" (wind farms) are installed, ensuring even more & higher spot price peaks in the market, what can we expect as our % electricity bill increase from this situation?

posted 13 January 2010 at 10:05 AM by Bryen

Martin Nicholson, on January 12th, 2010 at 14.15 — To follow up on the disconnect between wealth production and energy consumption, note from http://old.swivel.com/data_columns/spreadsheet/3987533
that Tennessee is second ranked in electricy per capita at about 27.8 units, but from the earlier link, is ranked 37 in GDP per capita, while California is dead last (51st) in electricity per capita at about 7.0 units but is ranked 11 in GDP per capita.

posted 13 January 2010 at 11:22 AM by David B. Benson

Thanks David for this additional info. Why do you think that California ranks so low on GDP/capita growth? See my previous post on this topic yesterday.

posted 13 January 2010 at 11:38 AM by Martin Nicholson

David Wise

I did not complete my answer to one of the questions in your post of January 10th, 2010 at 1.14.

You said:

> "You use ACIL-Tasman (2009) to arrive at projected nuclear build cost of A$ 5207. In your post 41555, you cite a Korean contract price of US$ 3800 and go on to speculate that it might be possible to conceive of the possibility of getting costs down to US$ 2000. Is there a simple, approximate way to translate capital costs into likely electricity costs? "

The last sentence of my answer said:

> "So now we have a competitive bid for FOAK build of four 1350 MW power stations using AP1400 reactors. The comparison is UAE = A$4115 and Australia (projected) A$5207. Both are FOAK"

I want to say more here. The the capital cost of the first NPP in Australia should be less than A$4115 for the same design as being built in UAE.by Korean contractors if all other factors are equal. The reasons it should be lower cost in Australia than in UAE are:

For UAE all the designs and documentation must be translated from Korean to English and then to Arabic, whereas in Australia the conversion is to English
Australia has a higher proportion of it workforce educated to the level neded to construct and manage the NPP
Australia has higher standards of safety accepted by and ingrained in the workforce

The capital cost of the succeding NPP's can be expected to decrease. As you pointed out ACIL-Tasman projects a roughly 18% reduction in the first four years following the completion of the first NPP. Would a 30% reduction in 10 years be realistic? If so, capital cost would be down to around $2881; i.e.capital cost for nuclear at about 33% above the ACIL Tasman projected A$2201 for Ultra Super Critical Black Coal (air cololed) in 2028-29. The operating costs of nuclear are much less than coal, so is nuclear competitive with coal at this capital cost? More below.

You said:

> "You have also been suggesting that build costs for nuclear are excessively high in part due to a culture in the West of excessive/redundant safety. You have gone so far as to mention safety expenditure was one or more orders of magnitude too high. In your opinion, how much could be saved by opting for extremely safe rather than ridiculously safe? "

I answered:

> "Without researching it, here is my guesstimate:
> Nuclear is currently (Gen II history) some 10 to 100 times safer than coal. I expect we could have nuclear at 9 to 90 times safer than coal for around 50% reduction in cost. We could build them on the coast (lower cooling costs), near the demand centres (less transmission costs, lower costs for workforce, lower costs for construction, operation and maintenance throughout the plan life), we could accept the investment risks that are best owned by the public (such as public mischief, legal interventions and delays during construction, and sovereign risk), etc. "

I also need to point out that I don't believe what I am advocating will result in a reduction in safety. Gen III'a are much safer than the Gen II's which are already some 10 to 100 times safer than nuclear (see the second figure here: http://bravenewclimate.com/2009/08/13/wind-and-carbon-emissions-peter-lang-responds/). So I expect safety will continue to improve, just as it does in the aircraft industry. We are not talking about a reduction in safety. We are are talking about a massive reduction in regulation, reporting, bureaucracy, administration – resulting in a reduction in cost. And remember that implementing nuclear in

Australia would see an improvement in safety, health and environmental outcomes of around 10 to 100 times compared with coal. Those arguing that we should not proceed with nuclear for safety reasons are saying they would prefer to stick with coal which is much less safe. The argument is nonsense in my opinion.

You said:

> "If you don't think that nuclear can compete with coal on the current unlevel playing field or even were coal's non CO2 emissions costs to be internalised, what level of carbon tax would be necessary to make nuclear competitive (using a range of nuclear build cost assumptions)? "

I replied:

> "Off the top of my head, A$20 to $40/tonne CO2. But I do not believe a Carbon tax or ETS is the preferred way to proceed. I believe it would be better to address the unlevel playing field"

However, it doesn't matter what price we put on carbon, there will be no nuclear in Australia unless it has bipartisan support in the Federal and all state parliaments and general support from the public. Without this, it will be impossible to implement it. So the question as to what carbon price will make nuclear competitive with coal is cannot be answered. It depends on the public and political support and even with that it will depend to a great extent on the regulatorey regime imposed. The capital cost figures quoted above are based on USA and EU type regulatory regimes. If we can avoid adopting them, we can have far lower costs.

I have one more question to respond to. You asked: "Is there a simple, approximate way to translate capital costs into likely electricity costs?" I'll get back to you.

posted 13 January 2010 at 11:58 AM by Peter Lang

Martin Nicholson, on January 13th, 2010 at 11.38 — I not an economist, so can only guess. But maybe because they are already richer than Midas and would rather have more play time?

posted 13 January 2010 at 12:25 PM by David B. Benson

Peter @ 14.15 on 12/1 the diagrams on the pdf show about 275 Twh/a of electrical generation in 2010 and about 550 twh/a in 2050. I divide those by 8.76 to get continuous equivalent gigawatts of about 31 in 2010 and 63 Gw in 2050. That is generation growth of 0.8 Gw per year in arithmetic sequence. A hell of a lot is going to happen by 2050
-some of us will be dead
– crude oil production will be negligible
– transport will be electrified and synfuelled
– remaining gas and coal will be at world prices, heavily carbon taxed
– desalination and airconditioning will be needed to survive
– world population could be 30% higher
Therefore it's hard to even feel certain that growth can still physically happen for all that period. The 4% growth expectation is default target neoclassical economists use to ensure full employment. Counter to that you have steady state theorists like Herman Daly who say 0% economic growth is inevitable. However I don't have a compelling rebuttal to the assumptions in the pdf, just hunches. I think others would also agree that we should assume coal and gas fuel costs must rise quite strongly 2010-2050. The reasons are a combination of depletion, booming overseas demand and carbon taxes panic driven up by rapid climate change. Whether that and the other factors are growth killers I can't say.

BTW I completely agree that offsets are a copout and a recipe for fraud. I suggest severely curtailing their use in the ETS, which I suspect will be even more watered down by mid year.

posted 13 January 2010 at 12:52 PM by John Newlands

Joh Newlands,

First, I don't know where you get your 4% GDP growtht for Australia from. I've never seen anything like that (except for short periods). I am looking at the Treasury and ABARE forecasts. Can you point to where they are saying that 4% GDP growth is their central assumption for Australia?

Secondly, regarding coal and gas price rpojection, I suggest you look at ACIL-Tasman to understand what they have done as a foirst step. You can also look at MIT, EPRI and others. I am not persuaded there is any value in making changes to the inputs unless I have a complete set of projections that have been prepared on a consistent basis for all the technologies and applied to Australia. The costs are real costs (i.e. constant dollars). The expectation is that gas prices will rise but coal prices will continue to fall.

Thirdly, I'd suggest no ETS yet. Not until the main players have decided, and legislated, what they are going to do.

posted 13 January 2010 at 1:19 PM by Peter Lang

What economists seem to think on the growth vs unemployment tradeoff is linked here
http://ideas.repec.org/p/oxf/wpaper/062.html
That is Treasury types want 4% annual increase in inflation adjusted GDP but they are pleased to get 1-3% because of all the inhibiting factors.

On black coal firstly I suggest that exports will determine the long term price since from memory domestic consumption is about 90 Mtpa while exports are around 260 Mt. I think the spot price for thermal coal ex Newcastle is about $80/t. This is a stretch but I think it was more like $40/t circa 2000. China's imports increased 12 fold from 2008-2009 and Melbourne's NIEIR believes China will run short of coal by 2015. Their annual consumption is around 2.5 Gt. Several independent reseachers (Energy Watch Group, Aleklett, Rutledge) predict a global coal production peak around 2030.

Brown and poor quality black coal in Latrobe Valley, Leigh Ck and Collie (70 Mtpa combined ?) is probably more stable in price since the power stations are minemouth or have inhouse supply and no exports. I believe the price of black coal to Australian power stations could conceivably double within a decade through Chinese demand alone. I assume that neither Australia nor China has any serious intention of reducing emissions. On the one hand you have ACIL Tasman saying stable coal prices and on the other you have NIEIR suggesting unstable.

posted 13 January 2010 at 1:59 PM by John Newlands

John,

I'd suggest you understand what ACIL-Tasman is projecting. They are conmtracted by AEMO to do the work, and also by DCC for much of the work on energy and CO2 emisisons projections. I'd trust them over what you are quoting. You should get an understanding of waht they've done as a first step. By the way, they ABARE have been doing this work for Australia for 20+ years.

posted 13 January 2010 at 2:20 PM by Peter Lang

John,

I'd just repeat, I am not willing to play arounfd with the numbers without a complete set of replacement figures, prepared on a consistent basis. Do you have such?

posted 13 January 2010 at 2:23 PM by Peter Lang

John Newlands,

Your argument about increasing fuel costs further supports a point I've been making on this and previous threads. If we allow a level playing field, with consistent regulations for all generators, then the investors will make their decisions based on their assessments of future costs. However, while some options are excluded (nuclear) and others are mandated and heavily subsidised (wind and solar), it is impossible to have the least cost option. This reinforces my belief that we should allow nuclear to be an option and we should stop mandating and subsidising renewable energy production. Furthermore, we should have a level playing field for all the electricity generation technologies.

posted 13 January 2010 at 2:31 PM by Peter Lang

A shorter version of the NIEIR position is here
http://www.energybulletin.net/node/51097
They don't speculate on future coal prices but suggest there will be international tensions. I think that's likely eg if China wants coal exports stepped up but the Great Barrier Reef is undergoing heat stress.

posted 13 January 2010 at 5:13 PM by John Newlands

Douglas Wise,

You asked:

> "If you don't think that nuclear can compete with coal on the current unlevel playing field or even were coal's non CO2 emissions costs to be internalised, what level of carbon tax would be necessary to make nuclear competitive (using a range of nuclear build cost assumptions)? "

EPRI (2009) Page 10-21 (section 10 slide 21) http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405 shows that nuclear at US$84/MWh is competitive with Pulverised Coal with a carbon cost of US$22/tonne CO2. For this analysis they used a capital cost of US4860/kW in 2015 (see page 6-6 for the input assumptions. For pulverised coal, the capital cost assumed is US$2650 (in 2010), and LCOE is US$66/MWh>

posted 13 January 2010 at 7:05 PM by Peter Lang

John Newlands,

I accept that coal prices for export coal will increase and the price of coal for power stations may also. However, the best figures I have are the ACIL-Tasman figures. I don't know if you have looked but they have done the projections for each power stations and summarised by region. These are detailed bottom up figures. They would be well aware of NIEIR and other work on this and would take it into consideration along with all the other information available. ACIL-Tasman was selected to do this modelling exercise by AEMO supposedly because they were considered to be the most competent to do the work. I agree there are probably hundreds of researchers at different levels all with different approaches, assumptions, input data, perspectives and agendas. ACIL-Tasman is the best information available for the purpose.

If the price of coal does rise, it makes nuclear more competitive.

We can all speculate on international tensions. However, improving energy security and reducing the cost of energy for all peoples on the planet should be a major assistance to reducing such tensions.

posted 13 January 2010 at 8:11 PM by Peter Lang

Is California really a good example of energy efficiency, or is the California economy rapidly falling apart? Considering the recent collapse of the California housing market, and the state government's financial problems, falling apart is not that improbable.

posted 14 January 2010 at 1:26 AM by Charles Barton

Peter Lang

Thank you for your further replies. I am delighted that you and Barry are planning to publish in a refereed journal.

Thought experiment: Suppose nuclear power were to have all political, bureaucratic and legal obstacles removed globally and be ready for roll out from 2015 (Gen IV from 2030) and suppose that it were to produce power at a price that could only be matched by coal. What would be the answers to the following questions?
1) Would enlightened self interest alone be sufficient to ensure that the technology was adopted fast enough to produce the needed emissions reductions (say 80% by 2050)?
2) If not, what is the best form of coercion needed to ensure such emissions reductions and what is the likelihood of such coercion having the required effect globally?
3) If carbon free energy were no longer limiting by 2050, would population growth continue beyond its projected level of 10 billion and, if so, would anyone consider this desirable?
4) Should population start falling from 2050, what economic model can best be adopted to manage the decline with its associated diminishing workforces and ageing populations?
5) Classical economic theory apparently requires continuing economic growth for capitalism to survive in a democratic society. Is it possible for economic growth to continue sustainably in a world with a declining population but plenty of energy and the potential to recycle?
6) Is it not the current case that economic growth demands that purchasers buy goods that they neither need nor particularly want?

posted 14 January 2010 at 1:31 AM by Douglas Wise

Charles Barton, on January 14th, 2010 at 1.26 — The statistics I used are from several years ago. California is experiencing on of its (many) downs just now, but they are doing so with energy efficiency already in place.

posted 14 January 2010 at 8:15 AM by David B. Benson

Douglas Wise,

Thought experiment: Suppose nuclear power were to have all political, bureaucratic and legal obstacles removed globally and be ready for roll out from 2015 (Gen IV from 2030) and suppose that it were to produce power at a price that could only be matched by coal. What would be the answers to the following questions?

I like yout thought experiment. I'll play, but this initial response will be from opinions 'off the top of my head'.

> "1) Would enlightened self interest alone be sufficient to ensure that the technology was adopted fast enough to produce the needed emissions reductions (say 80% by 2050)? "

No. It must be least cost to achieve that. I believe nuclear would be the least cost option by far there was a genuine level playing field for all electricity generation technologies. That is the issue we need to address. If coal was being introduced after nuclear had been around for a while, who would accept coal generators in their back yard, or for that matter, in their country, or on their planet? I'd suggest the next "thought experiment" you propose should be challenge the BNC contributors to take a clean sheet of paper and consider what would be a genuine level playing field for electricity generators.

> "2) If not, what is the best form of coercion needed to ensure such emissions reductions and what is the likelihood of such coercion having the required effect globally? "

a) The word 'globally is the real sticking point. There are stacks of possibilites but I really don't believe any are workable. (for example, we could have trade barriers for those who do not have acceptable carbon intensities ($/GDP), etc. Australia would be one of the most heavily penalised. We could have an international ETS, based on consumpton not production, and managed by WTO as part of the intenrational trade agreements. There is zero chance of getting anything like that established in the forseeable future). And I wonder, aren't we simply going aboit this the wrong way. Why not just get a level playing field. The problem goes away. Anything that tries to solve the problem you are asking about while continuing to maintain a ten to 1 disparity in safety between nuclear and coal and mandates and subsidises rediculous generation technologies like solar and wind, is just nonsense.

b) Within a country, internalise the externalities to the extent possible. This may be done partly by regulation and partly by taxes or emissions trading schemes. Regulations can be on polution, land area disturbed, royalties for fossil fules extracted, increased costs for remedial action. These should be collected from electrcity revenue just as the cost of decommissiong and used fule management is collected by governemts to pay for these at the end of a nuclear power stations life.

> "3) If carbon free energy were no longer limiting by 2050, would population growth continue beyond its projected level of 10 billion and, if so, would anyone consider this desirable? "

No. Low cost energy will reduce not increase population growth. As peoples emergy from poverty the population growth rate decreases. If we want to reduce the woelds peak polulation the best thing we can do is get low cost clean energy to the poorest people on the planet as fast as possible.

> "4) Should population start falling from 2050, what economic model can best be adopted to manage the decline with its associated diminishing workforces and ageing populations? "

Outside my area of expertise. Long way off. Perhaps we can get a piano in every house and family and friends gather and enjoy the interation instead of having to go to work for our interaction with people. People were pretty happy doing that before we got so involved with going shopping to buy 'embodied emissions' and 'land fill'.

> "5) Classical economic theory apparently requires continuing economic growth for capitalism to survive in a democratic society. Is it possible for economic growth to continue sustainably in a world with a declining population but plenty of energy and the potential to recycle? "

Yes

> "6) Is it not the current case that economic growth demands that purchasers buy goods that they neither need nor particularly want? "

Not sure. Some froiends argue that we can move to a more service based economy instead of a products based economy. He once jokingly and exaggeratedly said something to the effect that he can foresee a time where we sit in a tub of amniotic fluid with sensors attached that make us feel permanently happy.

Douglas. Good thought provoking "Thought experiment". Apologies for frivolity. I hope I am not the only one to make a fool of myself here

Hope you will take up my suggestion for your next "thought experiment". What would be a genuine level playing field for electricity generators.

posted 14 January 2010 at 11:44 AM by Peter Lang

Peter Lang, on January 14th, 2010 at 11.44 wrote "what would be a genuine level playing field for electricity generators"?

Easy in principle: internalize all externalities, via royalties, taxes and even regulations. Impossible in practice: nobody knows all the externalities and of those known, how to price them. For example, what is the "true cost" of emitting a tonne of CO2?

For some emissions such as sulfates and NOx, it seems the US EPA attempts to set some sort of maximum allowable emissions from point sources. [I don't know the details.] So possibly the same approach could be taken for carbon dioxide emissions?

If so, then the closed carbon cycle of algae farm + CCGT becomes quite attractive, since there would be no CO2 emissions at all! [Of course, this still needs to be demonstrated as cost effective, but with some sort of constraint on, or heavy price for, CO2 emissions it surely is.]

posted 14 January 2010 at 12:12 PM by David B. Benson

Further dabbling with coal tonnages leads me to conclude that since Rudd has been PM Australian coal has contributed around 2 billion tonnes of CO2 to the atmosphere. A conservative derivation is
2.4 tCO2/t coal X 2 years X (65 br + 85 bl + 250 ex) = 1920 Mt

Quite remarkable given his election promise to take decisive action on climate change.

posted 14 January 2010 at 12:32 PM by John Newlands

"What would be a genuine level playing field for electricity generators"? "

Here are a few preliminary thoughts:

1. Remove all mandatory requirements (eg the Mandatory Renewable Energy Targets)

2. Remove all subsidies from production (subsidies fro RD&D are good)

3. Remove all favourable tax incentives and other hidden incentives.

4. Ensure that regulations applying to a generator are the same for all types of generators. Set up a system to allow generators to challenge anything that is impeding a level playing field.

5. Emissions and polution regulations must be the same for all industries and should be based on safety and healthe effects on an equal basis.

posted 14 January 2010 at 1:02 PM by Peter Lang

Peter Lang, on January 14th, 2010 at 13.02 — Good! I would add

Clean Up Your Mess.

Not only at the end of useful generator life but also for whatever mineral extraction is employed, at any stage.

posted 15 January 2010 at 11:22 AM by David B. Benson

John B. Benson,

I agree with your additions.

I also want to clarify for those who think I am arguing to "level down" safety (e.g. Ewen Laver from our discussion on an earlier thread), the IAEA regulations must apply to all nuclear facilities in all countries (the regulations apply to all industries using ionising radiaton including medical, food, industrial and research. Australia complies with internationally accepted regulations and accepted practices for the gas industry, for dam design, construction and maintenance, and for most other industrial activities. We must do the same for nuclear energy. But that does not mean we need to have our own enormous bureaucracy (like the US Nuclear Rejection Commission) who's existance, some believe, depends on making things as difficult as possible for the nuclear power industry. We can be lean, follow the IAEA's guidelines and requirements (just as other small countries do) and have nuclear energy at far lower cost than the US and EU precedents. If we don't do this, we can always stick with coal! The choice is that simple.

These three options may help to clarify my point:

1. New Coal generation ($50/MWh with 1x deaths/MWh)

2. Nuclear ($100/MWh with 0.1x to 0.01x deaths/MWh)

3. Nuclear ($50/MWh with 0.5x to 0.05x deaths/MWh)

Figures are fictious for illustration purposes only.

posted 15 January 2010 at 12:55 PM by Peter Lang

In terms of "regulation" the wind industry is currently at what I would call "the wild west frontier stage". See the recent NSW Inquiry Report :

"The Committee has noted that guidelines for wind farm developments are currently being prepared at the Federal and State level. The Draft National Wind Farm Development Guidelines intend to provide a nationally consistent set of methods for addressing wind farm concerns, however, the Committee notes that they will only be effective if states such as NSW choose to require wind farm developers and operators to comply with them. The guidelines also state that 'other government policy' should be followed as required. This presents as an issue for NSW as there is currently lack of 'other government policy'. The Committee believes that the development of NSW Planning and Assessment Guidelines for Wind Farms presents an opportunity to vastly improve current policy, however, if the guidelines do not address issues such as DCPs being ignored in assessment of Part 3A development applications, the perception that the Department of Planning disregards local concerns may remain."

That is a very short extract regarding planning reg's and legislation, more of which is contained in the inquiry report. Notice the use of the words "Draft" & "Guidelines", and most developers take the word "guidelines" to mean non-legally binding wishes that can and are completely ignored.

I find it interesting that two different technologies have completely opposite amounts of regulation : wind has pretty much none and is demonstrably NOT environmentally benign. Nuclear on the other hand seems to be wrapped up tighter than a baby in cling film.

Is it me or this a double standard?

posted 15 January 2010 at 1:20 PM by Bryen

Re Peter Lang. Level playing field for electricity generators. Jan 14th.

I am more or less in agreement. Your point 1 – the removal of mandatory requirements is sensible. I suppose an alternative – and possibly one that might be more politically achieveable – would be to make nuclear an "honorary" renewable.

In an ideal world, I wouldn't quibble with any of your other points nor that added by David Benson. However, I have certain misgivings:

1) the French have the cheapest electricity in Europe but, possibly in consequence, they use more of it. The Americans have cheaper motor fuel and, possibly in consequence, their vehicles have poorer fuel economy. I am therefore doubtful that a totally market driven approach to energy will bring down emissions fast enough.

2) There remains the problem that any nation or group of nations that takes strong action to reduce emissions is likely to put its own manufacturers at a competitive disadvantage and end up exporting emissions and importing manufactured goods from elsewhere. This brings me back to the need for coercion in the form of import tariffs.

I totally agree that, as soon as nuclear electricity becomes cheaper than coal electricity, everything will become simpler but this will take time. In the meantime, we will need to explore improvements in energy efficiency and these are most likely to be driven by increased energy prices.

3) I am not sure that nuclear power will be rolled out quickly enough if private NPP manufacturers are left to their own devices. It would seem that we may need "a war footing" approach which will require governments to play very active roles in the process, not only in providing the level playing field you want, but in encouraging funding by private investors. You might argue that this would involve "picking winners" rather that letting them emerge. However, with the odds heavily stacked on the chosen technology working, our dire situation may justify such an approach. I am attracted to the idea of making it attractive for pension funds, which are looking for long term rather than short term returns, to invest in nuclear power. I would also consider it might be an interesting idea to offer those on very high incomes the choice between paying more tax or investing, tax free, in nuclear power (sort of like punishing bankers by taxing them or allowing them to have huge bonuses so long as they are deferred).

You will, no doubt, gather that I have neither technical expertise on the subject that I'm corresponding about nor, necessarily, a great grasp of economics. However, others might like to shred my ideas which are presented only as debating points.

posted 15 January 2010 at 10:07 PM by Douglas Wise

Douglas Wise,

I am also not an economist and I also hope that some others will comment on uyour post.

I understand your aim but I have great difficulty with the proposed solution. I've seen an enormous amount of picking winners and the Mandatory Renewable Energy Targets is the most blatantly obvious. What an idiotic policy that is.

I think us asking governments to raise the price of energy is just about as idiotic (other than what ever needs to be doe to include internalise externalities).

The reason I say it is bad policy to raise the price of energy is because the very large proportion of people living in the developing and under-developed countries are going to go through the transition that China and India are going through now. It will definitely happen. It will either happen using coal or nuclear. The best thing the West can do to help cut GHG emissions is to lower the cost of clean energy relative to fossil fuel energy so that when these countries transiotn they use nuclear instead of coal.

Raising the price of fossil fule energy in Australia, EU, USA doesn't achieve that. What is need is the focus on reducing the price of nuclear by half, not in increasing the cost of fossil fuels (other than including the externalities).

We keep focusing most of our research effort and funding and incentives on renewable energy. There is no hope of that going anywhere. We should turn all that effort into getting the cost of nuclear down asap. Most of the research is needed in the social engineering rather than the technical engineering. We need to work out how to completely turn over the opposition to nuclear and get it demanded.

I don't believe raising the price of energy is the right way to go about this problem. As long as governments continue to play with wind and solar instead of getting out and explaining why we must go nuclear there wil be no serious progress. The ETS is for several purposes: collect more revenue for spendthrift governments to waste, provide a new source of revenue for banks, traders, gas companies, renewable energy businesses and researchers, and more jobs for the bureaucracy. There are plenty of winners. But overall we lose.

posted 15 January 2010 at 10:47 PM by Peter Lang

Peter Lang

Thanks for your response. Obviously, we are not in agreement but I am in no way claiming that my stance is better than yours.

Some of your conclusions appear to be predicated upon your view that "a very large [proportion of people living in the developing and under-developed countries are going to go through the transition that China and India are going through now. It will definitely happen."

This may be a noble aspiration but I am by no means convinced that it will definitely happen. It is, in my view, as likely that some developed nations with high population densities and which rely on imports for their food and energy requirements(e.g. UK) may descend into poverty

As an aside, I would predict that, should such a descent occur, fertility rates would decline rather than increase. You suggest that the converse, namely an increase in living standards, will lead to population reduction. I believe this only starts to happen when populations with increasing wealth become so driven to acquire more material possessions that their only chance of meeting these aspirations is by "reducing their biological fitness" and having less children. This might explain why first generation immigrants to the developed world initially outbreed the indigenous population. In other words, it is the perception of poverty rather than the acquisition of wealth that is likely to cause populations to decline. This leads me to the conclusion that, without Chinese style coercion or tax penalties on large families, it is unlikely that population growth will become negative until a large (and globally dangerous) lag time, particularly when or if welfare is doled out to non aspirational people.

To revert to the main theme, I would argue that your approach does little or nothing to enhance efficiency of energy use. Of course, you may not deem this necessary if one is using affordable fossil fuel free energy. My counter to this would be the time factor.

In fact, it is the time factor that leads me to wonder if it is really sufficient to aim for a level playing field. Progress would surely be quicker with a playing field tipped in favour of non fossil fuel energy. If you don't like picking winners, don't discriminate between nuclear, renewables and CCS coal. However, it is obvious to me that your winning pick would be nuclear and you have also been, in large part, responsible for making it mine.

You don't want energy to be made more expensive for the "people". Tax and dividend, as advocated by Dr Hansen, would overcome this by returning the dividend to the people but have the advantage of encouraging efficiency and accelerating the drive towards non carbon energy.

I cannot decide how this could be effected in one segment of the globe only without taxing imports from non participating areas. At a push, one might consider going easy on tariffs for exports from poorer nations provided they agreed to breed less fast or burn less forest (I would distinguish this from ETS-type offsets of which I don't approve.) One might also consider a levy from the developed nations to finance nuclear power in the hot wet tropics, part of which would be mandated for accelerated mineral weathering to lower atmospheric CO2 levels if such was deemed necessary by climate scientists and if it was regarded as economically sensible.

posted 16 January 2010 at 1:04 AM by Douglas Wise

PHEW!!
What a marathon that was. Congratulations to all contributors and especially to you Peter Lang for a great analysis of the various energy options. It has reaffirmed with strong back up statistics what Colin Keay summarized in his booklet, Nuclear Energy Gigawatts. I'm glad that you and Barry will publish it. I appreciate that we in Australia must have this debate about nuclear power but would just add that surely most/all of the nuclear countries [33 currently, and increasing to 53 within a few years] have already had this debate. And the've all concluded that nuclear power is the best, most cost effective,safest,cleanest power source which will guarantee them energy security and without emissions. That's why energy authorities around the world are saying things like "Any country serious about climate change will be serious about including nuclear power in their future energy mix." It seems to me that we all need to get out there and spread the word to all of our politicians and to the people. Have any of you pro nukes, like me written to your local paper and exposed the people to the truth about nuclear power? I've been trying that for ten years, with some success. We just have to keep doing it. And keep at the pollies especially. I think Abbott is ready for a discussion. I've contacted him offering to speak to his people. Rudd didn't want to know me when I offered tp speak to the ALP [I vote for them and have been a candidate on 5 occasions]. Let's not keep all of this information to ourselves. Get out there and tell the masses.When they know the facts they'll change their minds except for the likes of Jim Green who will never be persuaded by fact or reason. Sorry for that little tirade!!

Evnow If a plane hit a nuclear plant it would bounce off in bits and the plant would probably continue to operate. Ask James Lovelock

Douglas Wise
I loved your stories and your agreement with Steve Kirsch and Peter Lang that our only hope of salvation from catastrophic climate change is for the world to have a very large dose of nuclear power. If we could get it to 35% of total world electricity by 2030, we could probably manage to reach our targets without the crippling ETS that we all seem to be facing.

To everyone again, thanks for a great effort. I really enjoyed the discussion. Special thanks to you again Peter. Excellent work.

posted 16 January 2010 at 9:37 AM by Terry Krieg

When they know the facts they'll change their minds except for the likes of Jim Green who will never be persuaded by fact or reason.

I suspect that Jim Green is motivatd by darker considerations than ideological blindness. He's too intelligent not to recognise the truth he publically denies. Indeed, the arguments he makes require a thorough knowledge of the issues and an understanding of their implications.He *knows* that nuclear power has all the virtues claimed by its supporters, and that the anti-nuclear case is false. Given his points of argument, he cannot not know. He knows, and persists in his anti-nuclear campaigning.

posted 16 January 2010 at 9:51 AM by Finrod

To back up what Finrod wrote above I offer this quotation by Princeton philosopher Harry Frankfurt:

"It is impossible for someone to lie unless he thinks he knows the truth. A person who lies is thereby responding to the truth, and he is to that extent respectful of it. When an honest man speaks, he says only what he believes to be true; and for the liar, it is correspondingly indispensable that he considers his statements to be false. "

posted 16 January 2010 at 10:08 AM by DV82XL

As for lowering the cost of NPPs, it seems the goal is to be able to build for less than US$2/W as that seems to be about the price for CCGTs. Someone may care to look into Nuscale's modular approach as it appears that much of the construction can be done in a factory rather than in the field.

posted 16 January 2010 at 10:53 AM by David B. Benson

To Peter Lang (and anyone else who would care to comment)
When you say we need a level playing field, but RD&D should be subsidized, doesn't this create a slight contradiction?
Now the contradiction may not be relevant here (or I may just be wrong) but nuclear power (and as far as I can see most technological development) has been developed by the state at state expense.
Again it might not be relevant, but saying something should be developed by the state up to the point that it can just be handed over to the private enterprise so they can profit from it, which is what it sounds like you are saying, is a concept that bothers me.
Should I be bothered or am I just worried about nothing?

posted 16 January 2010 at 11:27 AM by Lawrence

David B Benson,

You say:

> "As for lowering the cost of NPPs, it seems the goal is to be able to build for less than US$2/W as that seems to be about the price for CCGTs. "

No. That is a misunderstanding. Most of the cost of electricity from a CCGT is the cost of the fuel (natural gas). For nuclear, most of the cost is the repayment of capital and interest on the debt. Coal is between.

So roughly, the capital costs that would give equal cost electrcity might be something like nuclear $3/W, coal $2/W, CCGT $1/W. (conceptual figures only).

posted 16 January 2010 at 11:55 AM by Peter Lang

Lawrence, on January 16th, 2010 at 11.27 — At least in the USA, utilities are required to provide power at the least possible cost. That means they have (almost) no funds available for D, much less R&D. So the DoE steps in to provide some funding to be matched by potential vendors of generating equiment, coal, gas and (especially) nuclear. [Maybe also solar and wind, I don't know, but none for geothermal.]

Eventually a technology becomes so mature that it makes little sense to do further R&D; that is DoE's position with regards to geothermal.

In any case, some sort of review panels need to be set up to assess which technologies should receive some taxpayer funded support. I would prefer the funds came from utility customers rather than taxpayers, but that's not how it works these days.

posted 16 January 2010 at 11:55 AM by David B. Benson

@Lawrence:

Some technologies can be developed to the point of commercial viability for practical large-scale electrical generating capacity (be it baseload, peak or whatever), and some cannot. Would you then request eternal subsidies for an inadequate technology just because an adequate one recieved some timely facilitation at its birth?

posted 16 January 2010 at 12:02 PM by Finrod

Peter Lang, on January 16th, 2010 at 11.55 — Thank you for teh clarification.

posted 16 January 2010 at 12:10 PM by David B. Benson

Lawrence You ask:

> "When you say we need a level playing field, but RD&D should be subsidized, doesn't this create a slight contradiction?"

Yes, I agree. I included that cavet because I often get accused of not allowing for any state RD&D (such as is being sppent on renewables). We've spent a lot on RD&D on renewable energy and a whole host of other energy end use efficiency and other measures over the past 20 years. I am not saying we should stop spending state funds on RD&D. What I am saying is that it has been misdirected by ideological beliefs. We need to stop picking winners. We need to stop allowing ideology and politics to misdirect how the research funding is used. Funding should be based on a fair assessment of likely return on investment and risk.

Yes, nuclear was directed by the state at great expense. But the expense per MWh of electricity generated is far less than we have spent on renewables.

> "Again it might not be relevant, but saying something should be developed by the state up to the point that it can just be handed over to the private enterprise so they can profit from it, which is what it sounds like you are saying, is a concept that bothers me.
> Should I be bothered or am I just worried about nothing?"

I agree with this concern given the way it stated here. I guess the alternative is that the state should not fund any directed research on anything. On that basis the only research the state would fund would be pure research (like astronomy, etc). If we took this to the extreme, there would be no state research on Health or other directed research that is clearly in the best interests of humanity. I'm exaggerating to make the point that there is a middle ground. I think we need to compare how we have directed enormous amount of our research effort to renewable energy for 20 years fo near zero return. And at the same time have banned almost any work on nuclear. There is almost no funding for it and virtually no nuclear engineering facilities in any of our higher education organisatrions.

I am not opposed to state owned electricity industry, but I am far from convinced that it will provide lower cost electricity over the long term than private ownership. For a parallel, we've had to move to private ownership of freeways, with tolls, because the state cannot get the finances together to build them. If we can't get the public funds to build freeways how can we hope to find the capital to build and maintain the electricity supply industry properly? With public ownership the problem of poor management goes above the electricty industry up to the bureaucrats in the overarching department and then up to the Minister, the politicians and those who set the polical party's policy. I am not convinced that public ownereship of electricity is better than private ownereship with appropriate regulation (as light as practicable).

posted 16 January 2010 at 12:21 PM by Peter Lang

Douglas Wise,

Thank you for another thought-provoking post. As you mention, we do agree on much but disagree on the optimum level of state regulation and what I call "picking winners".

Overnight it occurred to me two examples of 'picking winners' that demonstrates how powerful we are at doing it and yet how bad our picks can be. One example is "picking a loser" and the other is "preventing a winner".

1. Picking a loser – Renewable energy

2. Preventing a winner – Nuclear energy

We've been preventing nuclear from replacing coal for 40 years (since the early 1970's when the anti-nuclear groups became successful at shutting down and slowing construction of nuclear power stations. We've weighed nuclear down with excess regulatory baggage.

Conversely, renewables has had a dream run.

You say:

> "In fact, it is the time factor that leads me to wonder if it is really sufficient to aim for a level playing field. Progress would surely be quicker with a playing field tipped in favour of non fossil fuel energy. "

I agree that time is a major consideration. But let's think what we could achieve in Australia if we really wanted to. Let's consider two scenarios:

1. Both major political parties in all states and territories endorse nuclear power as an option for Australia, and both agree to pass laws to clear the way ahead. BUT, the major political parties argue over who will make it safer and who's electorate it wont be in.

2. As for option 1, both major political parties in all states and territories endorse nuclear power as an option for Australia, and both agree to pass laws to clear the way ahead. But, in this case, they don't spar over safety and sighting, they spar over who can set up the best regime to implement clean energy at least cost quickest.

What a difference that would make to how quickly we can get low emission, low cost electricity in Australia.

Surely, we could start at a capital cost well below the price of US$3.7/W that has been awarded to a Korean consortium for the four 1.35GW units in UAE. Surely a bid for the same in Australia should be much less given the following:

1. Korea will have had experience with building the UAE reactors by the time they get to bid for the Australian plants, so Korea would be well down the learning curve by then. Say $3/W to $3.5/W (in 2010 $). Other consortium will be hungry to get a look in too. There will be competition from Japan, USA, France, Russia, China.

2. We have a larger proportion of our workforce suitably educated and able to handle the building on NPP's than UAE does. Much of the cost of the Korean bid would be to cover for this problem, I expect.

3. We have excellent universities and education facilities near to where I want the NPP's to be built, so the new nuclear engineering facilities can work hand in glove with the NPP's so both the universities and the power station benefit.

I cannot accept that Australia cannot have its first NPP commissioned by 2020, and at a capital cost in the $3/W to $3.2/W range if we could get our act together. It really is up to the politicians to act and to lead the community. And it is up to us (the Australian public) to convince them to do so.

posted 16 January 2010 at 1:16 PM by Peter Lang

Ok, I'm slightly amazed to have received the feedback I got.
I'm not particularly smart, just slightly bothered by my logic circuits is all. The ends justifies the means and all that, provided it's humane.
My feeling is that I'm learning about all the weirdness that's going on, and I just wish it wasn't going on, and we could just implement the most sustainable and most useful power producing systems possible. Right now, it's the IFR or LFTR (I simply can't figure out which) ASAP. If we have to go through GenIII(+) to get there then fine.
My point may well have been academic, I'm simply not smart enough to know.
So please ignore what follows if you would rather.

David Benson said
"At least in the USA, utilities are required to provide power at the least possible cost. That means they have (almost) no funds available for D, much less R&D." etc
And how is this sustainable?

Finrod said
"Would you then request eternal subsidies for an inadequate technology just because an adequate one recieved some timely facilitation at its birth?"
No, and I'm pretty sure you mistake my nuclear orientation. I'm all for it.

Peter Lang said
"I am not saying we should stop spending state funds on RD&D. What I am saying is that it has been misdirected by ideological beliefs. We need to stop picking winners."
And Einstein said something like you can tell the right theory because it is so nice it kindof picks itself. Which requires an observer, who is nevertheless subjective, who then puts the theory down on paper, and presents it to others.

Someone has to pick the winners. Before you can pick the winners, someone has to to a lot of different research. Someone has to pay for that.

If it's necessary to do it this way i.e. the state does all the research, then you hand off the winners to private enterprise, well ok. But gosh, that's quite an amazing schism in the middle isn't it.

It's probably not a relevant point I'm making, to the point that we just have to move to (more) sustainable energy production. For what it's worth, nuclear power is my pick (I'm sorry William Schreiber), and I can't figure out if it should be the IFR or the LFTR (although my low-IQ guess is that the LFTR is a better technology).

All I've done is wonder about whether what seems to me as Peter Lang's market orientation is completely logical.

In any case, I certainly hope everyone here – perhaps even Jim Green! – will opt for that which really works, and provides the energy we need to create a sustainable future. I'm sure the majority of you know how to get there better than I do.

posted 16 January 2010 at 1:38 PM by Lawrence

Lawrence,

I am not quite as strongly pro free market as I am aruing here. But there are several people who are a long wa to the state ownership end of the spectrcum, and many of my points are sort of aimed at offsetting their perspective. I wrote up on another post that the introduction of nuclear in Australia may have to be managed by a state owned organisation – somewhat like a modern version of the Snowy Mountains Scheme.

posted 16 January 2010 at 1:57 PM by Peter Lang

Finrod said
"Would you then request eternal subsidies for an inadequate technology just because an adequate one recieved some timely facilitation at its birth?"
No, and I'm pretty sure you mistake my nuclear orientation. I'm all for it.

My apologies if I've offended. I wasn't sure where you were coming from there.

I'm sure there are various financing models for nuclear power development and implimentation which will work more or less effectively.

My own philosophical position is generally free-enterprise libertarian, but of practical neccessity I think we need to recognise that the energy production and distribution system and associated environmental and economic issues are matters of existential importance for modern civilisation. A case can certainly be made for government oversight, including facilitating R&D and supporting FOAK projects.

posted 16 January 2010 at 2:04 PM by Finrod

Of course my previous post is not that discernable from me saying that I pick nuclear as a winner….

posted 16 January 2010 at 2:15 PM by Lawrence

Yah, it becomes an intellectual exercise – for where have we seen "free-enterprise libertarian" actually in place enough to judge if it could work – or any other model other than what we've all been living with for quite a while – which is some-kind-of-liberal-democratic-capitalist-etc model.
I really don't know what works best, I mostly only hope, against the odds, to get out of this life situation alive.

posted 16 January 2010 at 2:21 PM by Lawrence

Oh I think in my low-IQ way I get it Peter, Godel was right – nothing really works.
I'm just a bit uncomfortable about it all given what seems to me a big contradiction living somewhere in the middle.
But the fossil fuels are a bad solution, so lets move to the only thing with more energy density, for which practicable solutions have been worked out, as soon as may be. And let's hope that it's as affordable as I think it should be, and not infact necessarily subject to economic constraints that prevent us from getting there.
I believe my job depends upon it.

posted 16 January 2010 at 2:29 PM by Lawrence

Douglas Wise,

You say

> "It is, in my view, as likely that some developed nations with high population densities and which rely on imports for their food and energy requirements(e.g. UK) may descend into poverty. "

Maybe, but such countries are insignificant in the scheme of things (joke alert!). More seriously, the population of rich countries that might decline into poverty, as you suggest here, will be miniscule compared with the populations of Asia, Africa and South America that will emerge from relative poverty. So, to me this argument is messing in the weeds while avoiding the main problem. By the way, as my aside, the reason that UK is slipping down is because of its "government involved in everything" policies. The mandating of wind power and long term wind down of its nuclear power, until recently are just two examples. If we want politicians and bureaucrats to run everything (as Russia tried) we'll get what is happening in the UK.

> "As an aside, I would predict that, should such a descent occur, fertility rates would decline rather than increase. You suggest that the converse, namely an increase in living standards, will lead to population reduction. I believe this only starts to happen when populations with increasing wealth become so driven to acquire more material possessions that their only chance of meeting these aspirations is by "reducing their biological fitness" and having less children."

I believe high population growth rate is a result of poverty and low opulation growth rate is a result of having options for a more fullfilling life. People in the developed countries want 'life balance'. They want to be able to study and persue a career in prefernce to simply feeding the kids, washing, and gathering cow dung to cook and heat. I think this chart supports my argument very well. Notice that the higher the electrcity consumptions per person the lower is the fertility rate. You can change the variable on the axes and change between log and linear scales. Also press play to see the change over time. Notice how countries move from top right towards the bottom left. This shows that as we use more electrcity the fertility rate declines.

http://graphs.gapminder.org/world/#$majorMode=chart$is;shi=t;ly=2003;lb=f;il=t;fs=11;al=30;stl=t;st=t;nsl=t;se=t$wst;tts=C$ts;sp=6;ti=2005$zpv;v=0$inc_x;r

If the long link to the actual chart doesn't work for you, then go to http://www.gapminder.org, and select the following:

Y-axis: Children per womanfertility rate, 'log' scale
X axis: Electrcity consumption, per person (select: Energy/Consumption per person/Electricity consumption, per person). Select 'log' scale.

posted 16 January 2010 at 4:55 PM by Peter Lang

Lawrence, on January 16th, 2010 at 13.38 asks "how is this sustainable?" I don't know that it is, but the economists convinced all the utility regulatory commisions to break power into three separate companies in each region:
(1) power generation
(2) transmission
(3) distribution
with at least (1) in a cost-competative marketpalce. So the power producers have no incentive to contribute $$ to shared R&D. To the extent that the equipement suppliers do not commit to continuing R&D, currently DoE picks up some of the tab.

I find this all far from idea, but there it is.

Sustainable, to me, implies almost no resource extraction. While natgas is in plentiful supply, coal is less so. Please read David Rutledge's article about the comeing Peak Coal on TheOilDrum.

posted 17 January 2010 at 7:00 AM by David B. Benson

David B. Benson, on January 17th, 2010 at 7.00
http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-43033

Oh believe me I've spent some time on TOD. And I know who Dave Rutledge is. It's clear that Richard Heinberg's phrase Peak Everything is a good nutshell description of living on a finite planet.
Everything winds down in time – I think I read that James Lovelock thinks Gaia will only work for another 500 million years because the sun is heating up and it will in that time produce more heat than the current (and presumably any conceivable) biota can moderate.
All I know about all this is we should be implementing the LFTR/IFR ASAP. There's even a current thread on talk-polywell about using the LFTR
http://www.talk-polywell.org/bb/viewtopic.php?t=1397&sid=968e31c214fa5e21b92ff40f4ca61817
and those guys are generally not fond of any competition.
My question, probably a distraction from the practical need to just get on with it, was an overall one about how the arguments this way and that don't seem consistent to me when they appeal to some overall schema like a level playing field. But I'm perhaps practical enough to know that, inconsistent philosophies aside, we gotta put in place something that can give us what fossil fuels have given us i.e. a huge energy advantage, without the downside that it's going to run out or destroy the planet any time soon, and clearly it's nuclear.

posted 17 January 2010 at 10:58 AM by Lawrence

Lawrence, on January 17th, 2010 at 10.58 — Perhaps it is unavoidably inconsistent, in part because people are affected, one way or another, by large engineering projects such as power production sites.

I fear that starting right away it will be 15+ years before there are LFTRs. So in the nonce, try CCGTs equipped with algae ponds for a closed carbon electrical power source; except for the fairly large land requirement, ought to work in some locations and Australia probably has those.

I don't think of this scheme as more than a fractional player, say 20–25%, but very nice if it works. Be helpful if someone would do a small demonstration project to finish working out the operational details.

posted 17 January 2010 at 11:53 AM by David B. Benson

David B. Benson, on January 17th, 2010 at 11.53

Yeah, algae.
I don't remember what I read or where, but the numbers appear to add up to something like $50-100/gallon for algae biofuel.
Certainly, like everything else, let's do demo's of things. If you can convince TPTB to do it. A company called Valcent tried to make a go of it and went, basically, out of business, at least in El Paso wrt their algae research.
Anyway, if you're asking me to consider anything that requires a lot of IQ to absorb, you're asking the wrong guy. I can only absorb the most obvious stuff, and it's only obvious to me that there is some hold up involving Wall St and the US Govt that prevents the USA from getting on with being truly productive, and one of the lead components of that is that the USA has developed planet saving technology in the form of advanced nuclear power technology that is not being implemented anything like as fast as it should be.

posted 17 January 2010 at 12:08 PM by Lawrence

Lawrence, on January 17th, 2010 at 12.08 — The idea is convert algae in biogas and maybe refine into biomethane; appears much less expensive that making even biodiesel. I think the costs compare approximately with the costs of natgas, but a pilot project is required to be certain.

posted 17 January 2010 at 12:14 PM by David B. Benson

re David B. Benson, on January 17th, 2010 at 12.14
Does this proposal connect to that proposal at all?
http://www.theoildrum.com/story/2006/11/27/0432/3533

posted 17 January 2010 at 3:48 PM by Lawrence

Peter Lang. Jan 16th.

Your views on human fertility rates follow the demographic transition theory and are certainly fairly mainstream. However, this theory is not without its critics. Might I refer you to the work of Virginia Aberhnethy (plenty of info available on google)?

I find no fault in your criticism of the UK's current Government. However, I cannot agree with your suggestion that nations likely to nosedive with respect to economic well being are insignificant in number relative to those that will prosper.

posted 17 January 2010 at 8:20 PM by Douglas Wise

Douglas Wise,

I've just realised I didn't reply to your last comment.

I have not read the theories. I've followed the UN projections and some of the UN Human Development Index stats from time to time. The opinion I expressed above is based on what I've gleaned from those and especially my interpretation of the charts we can all plot on Gapminder (I gave a link above to a chart I made for the purpose of the discussion; it charts fertility rates versus electricity consumption per capita. You can slide the scale at the bottom of the chart or

press 'Play' to cycle through time and see how fertility rates have declined as people have consumed more electricity). To me these stats are so clear that any theory that does not fit with these stats is false. I agree these are historical figures so there is room for discussion as to what the future may hold. I also agree that correlation is not proof ocf cause.

You say:

> " I cannot agree with your suggestion that nations likely to nosedive with respect to economic well being are insignificant in number relative to those that will prosper."

Firstly I don't accept that the nations are likely to nosedive as you suggest. However, if some do, what I meant was that the total population of such nations is small compared with the population of the nations that will emerge from poverty. What I actually said was:

the population of rich countries that might decline into poverty, as you suggest here, will be miniscule compared with the populations of Asia, Africa and South America that will emerge from relative poverty.

posted 20 January 2010 at 8:37 PM by Peter Lang

Peter

Thanks for your response. I mentioned Virginia Abernethy but realised that I had previously mistyped her name. I think the effect of increased prosperity may well eventually lead to a drop in human fertility but indirectly and not before the advertising industry and other influences have sold the relevant population on the joys of materialism and the need to "keep up with the Jones". There thus may be much more of a time delay than you envisage and the effect may depend on competition for for the type of tat that many of us acquire but which the greens tell us we should forego.

Economics remain something of a mystery to me but it strikes me that you are remarkably sanguine about the prospects of net increases in living standards, given the economic recession, approaching peak oil and the necessity to reduce CO2 emissions. I really hope you are right but I think that even you would consider that any improvement will depend on rapid rollout of nuclear power. So far, only Asian states seem to be exhibiting the necessary levels of urgency.

posted 21 January 2010 at 5:07 AM by Douglas Wise

Douglas Wise,

In a previous post you commented that you use history to guide your thinking. If you do, then surely you would be persuaded that man has improved his standard of living, health, etc since the days of the cave dwellers. And this improvement has been virtually continuous and gone hand in hand with his ability to harnessing energy.

Also, throughout history there have been the doom and gloom merchants. There is always a new theory as to why these trends that have been established for 10,000 years are suddenly going to stop.

I see history as telling me that we are going to continue to improve our lot, the poor will improve their lot faster than the rich, the gap will close, we will manage the problems that face us and do it well.

Spending a bit of time on GapMinder will show very convincing evidence for what I've said above. It's well woorth looking at the demonstration by Hans Rosberg too. Supplement these UN statistics with a look at energy use per capita, and per GDP, life expectancy etc. over a long time and you will be even more convinced. I have a chart that shows per capita energy consumption over the past 10,000 years. And charts showing how nations go through a beta curve of rising energy intensity and then decreasing. All nations do this and nations are at a differenct position on the curve. The industrialised and wealthy nations are progressing down from the peak energy intensity. Developing nations are on the up slope.

Regarding nuclear energy you say:

> " … any improvement will depend on rapid rollout of nuclear power. So far, only Asian states seem to be exhibiting the necessary levels of urgency."

If we get serious about GHG emissions we can roll out nuclear. If we really believed we needed to we could commission one nuclear plant in each mainland state per year. That is 5 GW per year. At that rate we'd have sufficient capacity to power the NEM's 2007 demand in 6 years.

What would be the cost. If we were really wanted to, we could build nuclear plants for a price that would produce electricity cheaper than coal. If we say the settled down cost in today's dollars is $2.5/W, then the capital expenditure would be $12.5 billion per year spread across five states.

What do we need to do? Get on with it !!

We need strong political leadership. The facts are clear. But there is political advantage in running anti-nuclear campaigns to win elections. If our leaders really thought GHG's were a problem, there'd be no question about whethjer or not we need to get on with nuclear power as quickly as possible. There'd be no nonsense about "do you want one in your back yard?", their'd be no argument that nuclear is far safer and environmentally benign than coal. Instead, the argument would be between the major political parties as to which has the better policies to implement nuclear fastests and at least cost for the long term.

posted 21 January 2010 at 11:35 AM by Peter Lang

Peter Lang: 21st Jan

I don't really disagree with you from the broad brush point of view.

I agree with your first paragraph. It is likely, as I have previously said, that fertility levels will drop with increasing prosperity. It is the proximate cause of the drop that we may disagree over. If Abernethy's hypothesis is correct, one could expect the fall in fertility to kick in half to one generation more slowly than if it were to follow Demographic Transition Theory.

You correctly assert, in your second paragraph, that history has at all times been replete with doom mongers. Most of my friends, who get on with their lives with little or no thought about peak oil, global warming and solutions thereto, would certainly use this argument (that doomers be ignored) and be convinced that technology will solve all the problems of the future. However, without the doomers, there may be no appreciation of an impending problem and thus no ready technofix.

You also argue convincingly that technology could, indeed, come to the rescue, provided that it is nuclear technology and provided that politicians enable it to be deployed soon enough. However, it as at this stage that you start to wobble because you profess little faith in politicians. Does this make you a doom merchant or merely an agnostic?

Peter, I'm really not trying to pick a fight with you and I think your work on relative costings is an extremely valuable way of convincing politicians to do the right thing. I just think that you are somewhat optimistic to think that we can fix global warming and eliminate global poverty all at the same time in a space of less than a century but good luck to you.

posted 21 January 2010 at 8:40 PM by Douglas Wise

Douglas Wise,

I know you are not picking a fight. I find it an interesting disussion and even though it is way outside the scope of this thread, everyone else has departed for more interesting pastures, so I thought no harm to persue the discussion a bit further and learn a lot as I go. I really apprreciate your contribution and stimulation. As I say, this subject is way outside my area of expertise, but very interesting.

You say:

> "I just think that you are somewhat optimistic to think that we can fix global warming and eliminate global poverty all at the same time in a space of less than a century but good luck to you."

I don't mean to say that. We won't completely eliminate poverty, but it will improve over time. I believe we will improve our management of our resources and will manage polution better than we do now. In general, I believe we will continue to improve what we do. I am frustrated with politicians in the short term, but they respond to what the population wants them to do. Over the longer term they do respond as we want them to. I am frustrated about the 40 year delay in nuclear power in the 'west', but the politicians were responding to a strong but, in my opinion, wrong belief about nuclear held by the population.

Regarding pollution, the population at the moment wants it managed as long as the cost to them is not too great. At the moment the population is not persuaded that the ETS/CPRS will have a significant effect on the climate. They are not persuaded that the cost/benefit analysis favours an ETS/CPRS type policy approach.

posted 21 January 2010 at 9:05 PM by Peter Lang
Pingback: Copenhagen – now what? | Song for Jasmine

Lawrence, on January 17th, 2010 at 15.48 — Wasn't aware of it. What I have in mind is simple and self-contained, just to generate electricity via closed carbon loop with a combined cycle gas turbine at one end and the algae farm at the other. Much less ambitious.

posted 22 January 2010 at 8:58 AM by David B. Benson

Douglas Wise, on January 10th, 2010 at 1.14 you said:

> " Is there a simple, approximate way to translate capital costs into likely electricity costs? "

I've back-calculated an expression from the ACIL-Tasman figurees:

Inputs:
Annualised capital, fixed O&M and tax costs (AFC) $/kW/yr)
Short Run Marginal Cost (SMRC) ($/MWh)
Capital cost (CC) ($/kW)
Capacity Factor (CF)
Anualised Fixed Costs / Capital Costs (AFC%) (%)

Expression:

Electricity Costs (EC) ($/MWh) = SRMC + CC * AFC% * 1000 / 8760 / CF

Example 1: Nuclear:

EC = $9.94 + $5207 * 13.1% * 1000 / 8760 / 85% = 101.4 $/MWh

Example 2: Black Coal, Super Critical, Air Cooled:

EC = $12.82 + $2291 * 13.1% * 1000 / 8760 / 85% = 53.0 $/MWh

Example 3: Combined Cycle Gas Turbine, Air Cooled:

EC = $36 + $1398 * 12.4% * 1000 / 8760 / 85% = 59.4 $/MWh

For comparison, ACIL-Tasman's estimated electricity costs ($/MWh) in 2010 for these three examples are: $101.41, $52.97, $59.95.

From the ACIL-Tasman numbersI calculated the AFC% as follows:
coal and nuclear =13.1%;
OCGT = 11.5%;
CCGT (air cooled) = 12.4%;
CCGT (water cooled) = 12.8%.

posted 22 January 2010 at 11:04 AM by Peter Lang
Pingback: Real holes in science « BraveNewClimate

Douglas Wise, on January 10th, 2010 at 1.14 you asked:

> "What I have been unable to ascertain is how much capital cost one can afford for nuclear so that it can compete against new coal under the two following scenarios: a) without any internalisation of coal's currently externalised non CO2 costs and b) with such internalisation. "

Notice in my previous post that ACIL-Tasman calculates a theoretical cost of electricity from nuclear in 2010 as $101.41/MWh. The variable operating cost is $9.94/MWh. This comprises about 10% of the cost of electricity from nuclear. Of this, $4.94/MWh is the fuel cost. So fuel cost comprises about 5% and the other variable operating cost about 5% of the cost of electricity from nuclear.

Since the fixed costs (capital, financing and fixed O&M costs) comprise some 90% of the cost of electricity from nuclear, we must focus on reducing the capital cost if we want to cut the cost of electricity from nuclear.

I believe that the capital cost is elevated because of 40 years of excessive regulation, compliance and bureaucracy. Why are we doing this given that nuclear is already some 10 to 100 times safer and less environmentally damaging than fossil fuel generated electricity? I would like Australians to focus on how we can have electricity from nuclear at a cost similar or less than coal.

I submit the following as evidence that we could have this if we wanted to:

1. Nuclear energy provides low-cost electricity in many other countries. Russia is building new nuclear plants to provide electricity for aluminium smelting for the world market. This is a clear indication that nuclear generated electricity can be amongst the lowest cost electricity in the world. If it were not, they could not produce aluminium at a price they can sell it competitively on the world market.

2. Another example is the United Arab Emirates which has just let contracts for 5,400 MW of nuclear power stations they claim will supply electricity at ¼ the cost of electricity generated by gas. And this is in the centre of the world's oil regions.

What could we achieve in Australia with total political commitment and widespread public support? Let's play with some ball park numbers.

ACIL-Tasman used A$5207/kW for a First of a Kind (FOAK) nuclear plant in Australia in 2010.

A contract for 5400 MW of FOAK nuclear plant has recently been awarded for US$3700/kW (= A$4100/kW). This is for a FOAK plant in UAE in 2010.

I'll assume that an aggressive schedule such that Australia awards its first contract for its first plant in 2015, and by then Korean consortiums has won contracts for other plants elsewhere and have learnt a lot from the construction of the first plants in UAE. Given this and also that all documentation for Australia would be in English rather than Arabic, and Korea's extensive construction experience in Australia already, I'll assume the cost of the first plant in Australia will be contracted at a price 20% below the price for the UAU plants; i.e. $3280/kW

ACIL Tasman assumes 18% reduction in capital cost in the first 4 years after the first plant is commissioned in Australia, and the cost reductions will continue but at a reducing rate. I'll assume 30% reduction in 10 years from commissioning of the first plant.
That is a reduction of $984. Therefore, the cost for first plant = $2296/kW.

Compare this with ACIL Tasman's figure for Black Coal, ultra super critical, air cooled in 2025 of $2218/kW (all costs in constant 2010 $).

Let's compare the cost of electricity from these two options in year 2029.

To calculate the cost of electrcity from Nuclear in 2029, substitute $2296 for $5207 in the expression in my previous post and reduce variable O&M cost by 20% to say $8/MWh (my assumption)

EC = $8 + $2296 * 13.1% * 1000 / 8760 / 85% = $48.33/MWh

Black Coal, Ultra Super Critical, air cooled (ACIL-Tasman, Table 52) = $48.36/MWh

The answer to part a) of your question:

> "What I have been unable to ascertain is how much capital cost one can afford for nuclear so that it can compete against new coal under the two following scenarios: a) without any internalisation of coal's currently externalised non CO2 costs"

is $2296 (constant 2010 $) in year 2029.

posted 22 January 2010 at 8:36 PM by Peter Lang

Peter Lang: 21st Jan, 21.05

I am finding this discussion interesting but agree with you that it is somewhat off topic.

The reason I dragged in the subject of population growth was concern over so-called overshoot and its deleterious effects upon species other than our own. Without a supply of affordable energy to replace fossil fuels, I would guess that we are already in overshoot mode. I fully accept your thesis that renewables are not the solution in the short/medium term. With a much smaller global population (perhaps 2 billion) they might be but, even then, a nuclear solution would still probably be superior.

If you accept the premise above, I will next pose several possible scenarios:

1) We go with renewables and reject nuclear. We continue to use fossil fuels but with diminishing short term benefits as ERoEIs slump. Well placed richer nations maintain their populations reasonably well in the medium term but massive population crashes occur throughout much of the globe. Clearly, this is an ugly scenario but, nevertheless, it may or may not be the worst. This would depend upon whether the population crash was sufficiently great enough and/or timely enough to prevent runaway global warming in the longer term.
2) We rush to nuclear and attempt to make it globally available, so greatly reducing the chances of runaway climate change. This could have two possible consequences:
a) Benign. GDP/capita would rise and, simultaneously, global population numbers would fall.
b) Adverse. Global population would continue to increase and GDP/capita would stagnate or fall. In the medium term, other bottlenecks to sustainability would become manifest and lead to a massive human die off. This could be worse than scenario 1 because the die off would be delayed and involve more people by which time even more damage would have been done to other species and the environment.

Clearly, this is very over-simplified but I think it makes the case that, while rapid deployment of nuclear energy almost certainly has the potential to provide the most benign outcome, it can't automatically be assumed that this potential will be realised. Meanwhile, it is totally politically incorrect even to discuss the true implications and possible benefits of scenario1 despite the fact that it is the preferred position of many greens from the first world. In effect, the populations of wealthy states would be deciding to save themselves and their progeny at the expense of those less fortunate. This might be sensible and logical but it is not something that these greens appear willing to admit to.

posted 22 January 2010 at 10:13 PM by Douglas Wise

Douglas Wise,

I'll think about your questions and get back to yo.

In the meantime, I hope you might have time to look at the two posts I made today. These are more immediately important/urgent I believe. They answer two questions from one of your post of 10 January. I believe they are relevant to the energy and emissions policies soon to be debated in the Australian parliament. My reasi=on for wanting to debate this as much as possible is to try get the Australian population involved in discussing the policy options and the pros and cons in this election year. This is the year when we can have the greatest effect on what Australia's policy will be for the next three years.

posted 22 January 2010 at 11:40 PM by Peter Lang

Peter Lang: Jan 22nd 11.04 and 20.36

Your two posts were very illuminating and useful. Thank you very much for doing the calculations.

While I had realised that the variable operating costs for nuclear represented but a small proportion of total nuclear electricity costs, I had not appreciated that they were as low as 24% for coal. I assume, therefore, that the cost of the fuel in your coal fired plant example contributes no more than about 20% to the cost of the electricity emanating from it.

Unless I have failed to grasp something obvious or made an elementary mistake, I would conclude the following:
a) CCS coal is not necessarily such a daft idea as I had supposed from an economic perspective even though there will remain technical difficulties.
b) Nuclear fuel costs $4.94/MWh. Coal costs around $10.5/MWh. This differential of just over 2 is much less than I would have expected. I understand that uranium enrichment methods have been improved recently by a factor of 20. Does the $4.94 figure relate to fuel produced by the old or new method and, if the former, by how much would you expect the $4.94 to be reduced?

I am not for one moment suggesting that point b) is of any huge consequence relative to the capital cost issue for nuclear but I do think point a) deserves to be taken seriously (unless I have cocked up which is quite possible).

posted 23 January 2010 at 12:57 AM by Douglas Wise

Peter Lang

Thought you might be interested in these if you haven't already seen them:

http://www.utilityweek.co.uk/features/europe/accurately-comparing-the-costs.php

www,carboncommentary.com/2009/10/22/776

posted 23 January 2010 at 2:31 AM by Douglas Wise

Douglas Wise,

Yes, I agree, I think the cost of fuel for coal generators is a higher proportion of the total cost of electricity than these figures suggest. I also think the cost of fuel for nuclear is much lower than the ACIL-Tasman figures. I would need to look back at the EPRI and MIT reports to check the proportions (I include the references below in case you want to follow through on this). I do think the ACIL-Tasman figures are high for nuclear, as the recently awarded UAE contract demonstrates. I understand why reports on nuclear costs in Australia tend to be conservative. Partly because to say otherwise is embarassing for governments and all the special interests, and partly because if the politics stay as they are now, there is no chance of nuclear being implemented at a lower cost.

Regarding CCS, I do think it is a daft idea. Technically, I don't believe there is anyway in the world we can sequester about 3 times the mass and 4 times the volume of carbon we mine and burn in our power stations. Secondly, the risks are far higher than from nuclear. Thirdly, even ACIL-Tasman's very pro-coal report says the capital cost of CCS is around that of nuclear. On top of that you have much higher O&M costs. I believe CCS is mainly on the table in Australia to give us time to back out of coal and to keep the unions happy for as long as possible.

Regarding comparitive costs of energy technologies, this reference explains what is involved in getting an apples to apples comparison:
http://pandora.nla.gov.au/pan/66043/20061201-0000/www.dpmc.gov.au/umpner/docs/commissioned/EPRI_report.pdf

For up to date cost projections of various technologies and clear short description of what is involved in getting an apples to apples comparison of costs:
http://my.epri.com/portal/server.pt?Product_id=000000000001019539

This is even better but more detailed:
MIT (2009). The future of nuclear power.
http://web.mit.edu/nuclearpower/

And the equivalent for coal:
MIT (2007). The future of Coal.
http://web.mit.edu/coal/

This is EPRI's recent analysis, but based on 2008 costs, of what USA could achieve to reduce GHG emissions from electricity generation (and plug in electric vehicles):
EPRI (2009a), The power to reduce CO2 emissions: The full portfolio – 2009.
http://my.epri.com/portal/server.pt?Product_id=000000000001020389

posted 23 January 2010 at 9:39 AM by Peter Lang

Peter Lang, on January 23rd, 2010 at 9.39 — I opine that sequestering carbon dioxide in formations containing ultramafic componenets will be quite safe; the minerals weather to carbonates and under the proper conditions fast enough.

In Papua New Guinea alone there is more than enough peridotite to sequester all the excess CO2 already emitted and then to continue to do so for longer than fossil fuels can possibly last. [That will hardly get one started and that is but one near-surficial ultramafic formation.]

Costs? Well once one has the (nearly) pure CO2 transported to the sequestration site, this is similar to other drilling operations. Around US$10 per tonne of CO2 ought to do it for operations on land. The only local effects will be a certain swelling up of the land, eventually largely offset by isotacy.

posted 23 January 2010 at 9:52 AM by David B. Benson

David B Benson,

I would say this idea is less feasible than even algae farms.

posted 23 January 2010 at 10:11 AM by Peter Lang

David B Benson,

I sent my last comment before I considered it properly. My feeling about CCS is that we will have a number of Demonstration plants around the world for a decade or two and we will sequester some CO2. However, I expect the rate fo development of the technology will be siimilar to any other technology. It will take decades and in some two decades from now it will be a similar contributor to electrcity generation as solar thermal, geothermal, and wind power – i.e. down in the noise as far as making any significant contribution but making heaps of fuss and always "just around the corner".

By the way want ti the effectivity porosity, hydraulic conductivity, and fracture surface area of the peridoties. What percentage of the land surface is covered by peridotites, or are you thinking of drilling into the Earth's mantle?

Also, the major risk of CCS is the piping of the CO2.

posted 23 January 2010 at 10:24 AM by Peter Lang

Peter Lang, on January 23rd, 2010 at 10.24 — The big problem, of course, is separating the CO2 from the rest of the exhaust gases. It is possible that oxy-fuel schemes may prove economic, I dunno.

But the geology is straightforward in those locations with near-surficial ultramafic rock. Other locations near you include New Caledonia and two sites in northern West Australia. The total percentage of land with near-surficial ultramafic rock is quite small, but vastly more than ever required. Here is the starter paper, after two popularizations about it:
http://www.popularmechanics.com/science/earth/4292181.html
http://www.technologyreview.com/energy/21629/?a=f
http://www.pnas.org/content/105/45/17295

As for piping CO2, it is currently being done in a few locations, one for a quite considerable distance. There are no problems at all; after all CO2 isn't reactive unlike natgas in pipelines.

posted 23 January 2010 at 11:52 AM by David B. Benson

You say CO2 is unreactive. That is not the problem. The problem is that it twice the density of air at atmospheric pressure. When a pipe ruptures, as they do, CO2 expands and flows as a heavy than air fluid. It fflows down low lying areas (valleys) displaces the air and suffocates all animal life. People think nuclear is dangerous, but they haven't started to consider the dangers of piping CO2 from power stations to sequestration sites. There is not a chance in hades of CCS getting much beyond the RD&D stage, for many reasons, in my humble opionion. Some of the reasons are: safety, cost, energy consumed, volume to be sequestered. Regarding my previous questions and your responses, N/A ratio is zero. (numbers/adjectives). Adjectives are not an answer to my questions.

posted 23 January 2010 at 12:22 PM by Peter Lang

Peter Lang, on January 23rd, 2010 at 12.22 — Well, for many years CO2 has been piped from southwestern Colorado (from a natural source) to West Texas for injection into oil wells. The Norwegians have an even more ambitious project going. So far, at least, your concerns do not appear to be justified.

There is one demonstration project going injecting CO2 into deep saline formations; the geochemistry is not as favorable as ultramafic rock, but the formation is adjacent to the coal burner under test. Another company at least states that they are going to inject CO2 (from a coal burner) into undersea basalt off the east coast of the USA. The location is not the same, but here is the idea:
http://www.pnas.org/content/105/29/9920.full.pdf+html

Regarding your previous questions, the article in PNAS provides all the numbers that I have.

posted 23 January 2010 at 1:06 PM by David B. Benson

David B Benson,

I am across what you've posted here and in the previous posts. Pipes operate notrmally most of the time and occasional rupture, with or without huma assistance. You are totally missiing the point on this and on the other questions I asked.

There are thousands of bright ideas being promoted all the time. Almost all will never become commercial. And those that do eventually become commercial will take decades to get there. There i no point in discussing all these 'possibilities' you refer me to if you have no realistically derived costs for them – and that doesn't mean costs derived by the researchers who are promoting their idea!

As I said: "I would say the idea that sequestering CO2 in ultramific rocks can have a mjor impact on CO2 emissions is even less feasible than algae farms"

posted 23 January 2010 at 1:29 PM by Peter Lang

Peter Lang: 23rd Jan 9.35

Peter,

Thanks for your response and links. I'm relieved that you agree with my comments pertaining to relative nuclear and coal fuel costs.

I have one or two comments arising from MIT (2009) Future of Nuclear Power document.
a) They base their costings on a 40 year nuclear plant life which seems to be ultra conservative.
b) They go out of their way to recommend once through fuel cycles and advise against closed cycles on grounds of cost and safety. Admittedly, they qualify this by referring to the "next few decades" but this seems quite a long time in the current context.

Point b) seems to be very bad news for advocates of 4th Generation Nuclear. Have any of them addressed or attacked this recommendation of the MIT study which, otherwise, is relatively pro nuclear?

posted 23 January 2010 at 8:47 PM by Douglas Wise

Douglas Wise,

I intend to have a closer look at the relative cost of capital, fixed O&M, variable O&M, fuel, risk premiums in finance costs and the other paramaters for coal and nuclear.

I hope others who know more than I do about Gen IV will answer your question about when we can expect it to be commercially viable and the likely costs.

The 40 year life is conservative but it is the figure that has been used for decades in the major analyses, so I can see that for MIT to change it would create a discussion and argument that would divert attention from the main message. But I agree, it would be good if MIT could provide the LCOE for both 40-year and 60-year life expectancy.

posted 23 January 2010 at 11:51 PM by Peter Lang

A recent poll in the USA found that support for wind dwindles when costs are considered :

Press release from :

http://www.umassd.edu/seppce/policyanalysis/docs/ng_pressrelease.pdf

full report at :

http://www.umassd.edu/seppce/policyanalysis/docs/ng_poll.pdf

Story at :

http://www.windaction.org/news/25245

Briefly from the press release :

"Results to these questions show that respondents are price sensitive; the higher the increase in their bill, the less likely they are to support the Cape Wind project. For example, while 42 percent of respondents are less likely to support the Cape Wind project if their bill increased by $50 per year, this percentage increases to 67 percent at the $100 increase per year threshold and to 78 percent at the $150 increase per year threshold.

Finally, in terms of wind power, electric rates and support for political candidates, respondents report they are more likely to vote for a candidate who endorses policies that cut their electric bill (43% much more likely) in comparison to candidates who support wind power projects (26% much more likely)."

posted 24 January 2010 at 8:42 AM by Bryen

Peter Lang, on January 23rd, 2010 at 13.29 — I am at a loss: what does "I am across what you've posted here and in the previous posts" mean?

posted 24 January 2010 at 9:48 AM by David B. Benson

David B Benson, I don't want to get diverted into a discusion about geosequestration in ultra-maffic rocks (or any type of rocks). I think I have far more understanding of the geotechnical issues involved than you would appreciate, but it is, in my opinion, another one of these, what I would call, pie-in-the-sky ideas (like piping hydrogen from the Sun). They attract research grants, as solar power has for 55 years and geothermal HDR has for 40 years (HFR in Australia), and algae farms and all these are a diversion from addressing the rational solution. They are time and effort wasters. They are a distraction. They are diverting our research resources and diverting public and political focus from applying the real solutions.

So I would like to focus our attention on the options for electricity generation that are known viable solutions to our problems, and then focus on what we can do to facilitate their implementation, facilitate public understanding, and help to find a way to solve the genuine issues – COST !!!!

posted 24 January 2010 at 12:06 PM by Peter Lang

"piping hydrogen from the Sun"

I love it! That one's definitely going in the quiver.

posted 24 January 2010 at 12:15 PM by DV82XL

Finrod, on January 9th, 2010 at 8.01 you said:

> "Most cost blowouts in the west seem to be due to a combination of unnecessary regulatory burdens, vexatious law suites and political interference. These are factors which must be managed from the start when we go into the nuclear builds."

I agree and add:

I notice the MIT 2009 update of its 2003 report "The future of nuclear power" (Table 1) http://web.mit.edu/nuclearpower/pdf/nuclearpower-update2009.pdf calculates the Levelised Cost of Electricity (LCOE) from nuclear is 8.4 c/kWh for their base case and 6.6 c/kWh if the cost of capital for nuclear was the same as the cost of capital for coal and gas generators. The difference in the cost of capital is the risk premium that investors demand for nuclear compared with coal and gas. The investors demand this premium because they assess that public attitudes to coal and gas are less likely to mean they lose their investment than is the case for an investment in nuclear. These figures imply that the risk premium the US investors are putting on nuclear is 27%. That is the amount by which we could reduce the cost of nuclear power if the public perception would change such that the risk of adverse government policies sometime in the future is the same for nuclear as for coal and gas.

I notice that the Australian government recently stated it would accept all the risk for leakage of CO2 in Carbon Capture and Storage. Is this the sort of unequal treatment we need if we want to move to cleaner and safer electricity generation? Shouldn't the government also announce it will carry the public risks of nuclear power to at least and equivalent extent as is being offered for Carbon Capture and Storage?

Any ideas on this?

How can we get this discussion going in the media?

posted 24 January 2010 at 12:43 PM by Peter Lang

Peter Lang, on January 24th, 2010 at 12.06 — You were the one to bring up CCS and without any justification for your position. The subsequent exchanges on this rather imperfect medium (1) did not challenge my cost estimate nor its potential feasibility and (2) quickly diverted to fears about CO2 pipeline leaks, again without any rational risk analysis. So I greatly fear you do not appear, in these few writings, as either as knowledgeable nor using rational argumentation.

Your opinion is of course your own, but R&D work on CCS is going forward in at least the US and in Germany; it seems that some think it may prove to be cost-effective as well as safe. Of course, it isn't available for deployment now (and indeed may never be). However, various interests want it attempted, so as it is not obviously worse than other means of offsetting or reducing CO2 emissions, I am sure that R&D will continue.

If successful, as IPCC AR4 MG3 report points out, then using wood burners (or algae burners) as opposed to fossil fuel burners would provide carbon-negative energy, a good thing. For, as well you know, just direct dollar cost is not the only issue.

Peace,
David

posted 24 January 2010 at 12:49 PM by David B. Benson

David B Benson,

Fair points that I brought up CCS. I am sorry I did so. I don't remember the context, but emphaise I think this is not where we should be placing our effort.

posted 24 January 2010 at 1:05 PM by Peter Lang

Peter Lang, on January 24th, 2010 at 13.05 — If by "our" you mean Australians, then while it is far from my place to agree, I do so anyway.

As an outsider who visited some parts of NSW and Queensland in the previous century, I strongly encourage your efforts to encourage NPPs as part of your solution. If in 15-20 years CCS is found feasible, then it'll work for the CCGTs in your proposal (assuming that advanced nuclear hasn't undercut their LCOE and so those are in fact never built).

posted 24 January 2010 at 1:16 PM by David B. Benson

David B Benson,

I agree but put a caveat on this statement:

> "If in 15-20 years CCS is found feasible"

The caveat is: as long as it isnt found feasbile by filling the Great Artesian Basin with CO2, thereby sequestering a few years of CO2 from our power stations and rendering the Great Artesian Basin useless as a source of water for ever.

And don't believe the hype when the politicians say neve never never. The Great Artesian Basin is by far the best place to sequester CO2. Just watch and listen to the pressures, politics and manouvering that will be applied over time to sequester CO2 in this the easiest of all aquifers to pump CO2 into.

And don't worry, I have no financial interest in the Great Artesian Basin nor do I live on it. But I do appreciate its historic value and it future value as a water source for much of inland Queensland, NSW and South Australia.

posted 24 January 2010 at 1:50 PM by Peter Lang

Peter Lang, on January 24th, 2010 at 13.50 — That seems a quite horrid thought!

posted 24 January 2010 at 1:55 PM by David B. Benson

Douglas Wise, on January 10th, 2010 at 1.14 you said

> "You have also been suggesting that build costs for nuclear are excessively high in part due to a culture in the West of excessive/redundant safety. ….. In your opinion, how much could be saved by opting for extremely safe rather than ridiculously safe? "

The 2009 update of the 2003 MIT report "The future of nuclear power" shows that the risk premium demanded by investors in nuclear power raises the cost of electricity by 27% (8.4 c/kWh versus 6.6 c/kWh; 6.6 c/kWh would be the price if the cost of capital was the same for nucear and coal power stations). http://web.mit.edu/nuclearpower/pdf/nuclearpower-update2009.pdf , Table 1.

(I see why no one responded to this point in my previous post; I made a mistake and quoted the 2003 instead of the 2009 c/kWh figures, but gave the the 2009 % increase of 27%. But no one wanted to embarrass me.)

So, this suggests we can cut the cost of electrcity by around 27% once the investors become convinced that the investment is just as safe or safer than coal and gas from an investment perspective. That requires bipartisan support by the main political parties, both federal and state and removal of all the impediments that penalise nuclear power relative to coal, gas and renewables.

Putting my recent previous posts together, I can see the potential to cut the cost of nuclear as follows (in constant, 2010 A$):

1. $4100/kW – Start cost, based on the contract awarded for 5400 MW of FOAK AP1000 in UAE

2. 27% reduction in risk premium demanded by investors ($2,993/kW)

3. 20% reduction for a contract awarded in about 2015 for the first AP1000's to be constructed in Australia, for commissioning in 2020 ($2,394/kW)

4. 18% reduction in capital cost over the next 4 years (as per ACIL Tasman capital cost reduction for learning in Australia), commissioning 2024 ($1,963/kW)

5. 30% reduction from 2020 to 2030 (extending the learning curve from 4 years to 10 years), commissioning 2030 ($1,676/kW)

I realise this is optimistic. However, I am hoping to generate discussion that will help to focus our efforst on where the effort is required – i.e. in reducing the risk premium for investors.

With nuclear some 10 to 100 times safer than coal generation, our political leaders should be able to accomplish this for the benefit of all.

posted 24 January 2010 at 9:48 PM by Peter Lang

Peter Lang: Jan 24th 20.10

Be careful. If you carry on, we'll get electricity too cheap to meter! To be more serious, the 27% figure is very interesting. I agree, too, that FOAK costs will always be higher than bedded down costs provided that supply constraints can be avoided (laws of supply and demand). I would also accept that factory built modular plants ought to bring down costs over one off versions.

For my own amusement, I calculated electricity costs, using your earlier formula, keeping variable costs constant but varying build costs according to your post above. I also assumed that fixed costs would remain at 13.1% of build costs which is presumably spurious:

Build cost $ 5207/KW . Electricity cost $101.4/MWh
$ 4100 $ 82.1
$ 2993 $ 62.6
$ 2394 $ 52.1
$ 1963 $ 44.5
$ 1676 $ 39.4

Obviously, we'll get much more realistic figures after you have finished your examination of the detailed breakdowns you proposed in post 43739 (Jan 23rd).

I thought that you may be somewhat OTT with respect to CCS. You are happy to use the MIT nuclear study in support of your position. However, the equivalent MIT coal study was not nearly as dismissive of CCS as you are and claimed that CCS coal would be competitive with non CCS coal at a CO2 price of $30/tonne. Given the forseeable lives of existing coal plants and the possibility of retrofitting, might there not be circumstances where it would be cheaper to allow the existing plants to survive but switch to CCS coal than to close them prematurely? I suppose it might depend upon whether governments felt obliged to compensate the coal industry in the event of enforcing a total shutdown. Some might find it expedient to allow clean CCS coal plants to continue for a finite time while, themselves, subsidising the extra CCS costs in lieu of compensation for immediate enforced closures.

None of the above indicates that I am arguing against going full bore for nuclear. Rather, I am thinking about the most economically possible interim arrangements. You want a level playing field for emissions-free electricity. Let CCS coal, CCS gas, renewables and nuclear compete on equal terms. We both think nuclear should easily come out on top in the long run. In the short term, I'm only sure that renewables are a dead end.

posted 25 January 2010 at 1:32 AM by Douglas Wise

Douglas Wise,

I agree with you warning:

> "Be careful. If you carry on, we'll get electricity too cheap to meter!"

I am just trying to promote a discussion here on what I think we need to work on, which is: How can we implement clean electricity in Australia at least cost while also ensuring it is safer than what we have now and more environmentally benighn than what we have now.

I am just trying to get the discussion going. There are people who contribute to this web site that know far more about the costs, and the excessive regulatory and buraucratic burden on nuclear power costs, than I do. I urge contributors to engage on a discussion of costs and what can be done.

posted 25 January 2010 at 8:43 AM by Peter Lang

Douglas Wise,

On CCS, yes I do expect there will be some CCS. There will be enormous amounts of government funding spent on subsidising CCS and a whole raft of "renewable-fuel" technologies. So yes there will be some CCS.

As a geotechnical engineer who has seen a lot of rock from underground, done a lot of hydraulic testing of rock at considerable depth, and pushed a lot of water and tracers over long distances and in many different types of rock, I expect that the researchers pushing CCS are working from computer models and have very little real world experience. I simply do not believe it will be technically feasible for the developed countries to sequester a significant proportion of their CO2 emissions, let alone China, India or Africa as it develops. To me CC will be another huge drain on our resources that could be put to better use. I think an impartial cost/benefit analysis would show this. My bias is that MIT leans to be pro-coal and slightly anti-nuclear. I believe they, EPRI, CSIRO and others are overly optimistic on CCS.

By the way, ACIL-Tasman gives the capital cost and electricity cost for both nuclear and coal with CCS. I'll list them below separated by ";" so you can copy them into Excel and pars them into columns.

;;2010;2020;2029
Nuclear;Capital;5,207;4,959;4,263
Nuclear (if wanted);Capital;4,100;2,394;1,676
USC CCS BLACK (AC);Capital;3,922;3,358;3,103
Nuclear;LCOE;101;98;87
Nuclear (if wanted);LCOE;82;63;39
USC CCS BLACK (AC);LCOE;83;72;67

Legend:
Capital = Capital Cost
LCOE = levelised Cost of Electricity
Nuclear (if wanted) = estimated costs if the unequal imposts on nuclear removed. The estimated electricity costs are from Douglas's calculation reported in comment above (25 Jan at 01:32 am).

posted 25 January 2010 at 10:10 AM by Peter Lang

I wondered what had happened to the proposal to store CO2 in depleted gas wells in the Cooper Basin. A year ago the oil company Santos publicised it on its website, now it seems they are more into sponsoring bicycle races. The archived proposal is here
http://www.santos.com/library/Santos_Moomba_Carbon_Storage.pdf
It seems preposterous to me to build 1000km pipelines from east coast coal stations yet I think this year might see something even more bizarre. I strongly suspect that a new gas fired power station will figure in the Olympic Dam expansion. That is, burn expensive and carbon emitting fossil fuels to assist part of the nuclear industry. If that prediction proves right it's extraordinary the lengths politicians will go to to avoid nuclear power on home soil.

David B there is an open cut mine near home which aimed to extract platinum group elements from serpentine type or ultramafic rocks. Cracks in the rocks have thin veins of carbonate but I see no way that they could capture millions of tonnes of CO2 every year.

posted 25 January 2010 at 11:01 AM by John Newlands

> "As a geotechnical engineer who has seen a lot of rock from underground, done a lot of hydraulic testing of rock at considerable depth, and pushed a lot of water and tracers over long distances and in many different types of rock"

This is why I'd be very interested in your opinion of HDR (i.e. artificial, operating at depths of several km) geothermal systems, and in particular their likely longevity.

posted 25 January 2010 at 11:05 AM by Mark Duffett

John Newlands, on January 25th, 2010 at 11.01 — There is a big difference between serpentine and ultramafic rock; the latter weathers into the former by a slightly exothermic reaction with CO2. (Maybe you knew that, but other readers here might not have.)

Anyway, even basalt (some types), not even ultramafic, is considered good enough to consume millions of tonnes of CO2 per year via in situ weatherization. The links are above and in geologist's usual reckonings, the amounts of CO2 are hardly worth mentioning; I have yet to see a serious objection

once there is a (nearly) pure stream of CO2.

That last is the hard part, IMO.

posted 25 January 2010 at 11:12 AM by David B. Benson

It is not necessary for CCS to be practical, or even implemented beyond a few test sites. The role of CCS is to provide the illusion that something can and is being done to address the CO2 generated by burning fossil-fuels. It is greenwash, like wind is greenwash, and it will never amount to anything else, because if CCS were ever mandated by regulation, it would drive the price of using these fuels right through the roof, and everyone knows it.

It's a show, nothing more, nothing less and that's all it ever will be.

posted 25 January 2010 at 11:43 AM by DV82XL

DV82XL, on January 25th, 2010 at 11.43 — Yes, the issue in setting and enforcing a price on CO2 emissions. At a high enough price burning coal stops being economic; utilities will move to other generation methods. The goal is to have everybody require CO2 emissiions costs that are that high.

That said, once that high it is possible that CCS becomes economic. It is not obvious, but it is certainly not just greenwash.

posted 25 January 2010 at 11:50 AM by David B. Benson

David, that's the scientist in you talking, and as far as it goes, I'm sure you right, and can supply numbers to support it.

But I see things from a more Machiavellian perspective, and consequently I see only that the fossil-fuel industry will dangle CCS in front of us as the reason we can continue to burn carbon. At the same time they will be dragging their heels over implementation, by constantly assuring everyone that they are working as hard as they can, and holding up development projects as proof.

This sill assumes that CCS won't suffer from other political pressure concerning its safety, (justified or not) something which it is very vulnerable to.

But it will never become cheaper than nuclear.

posted 25 January 2010 at 12:03 PM by DV82XL

DV82XL, on January 25th, 2010 at 12.03 — Well, use the political process to implement CO2 emissions costs; that'll hurry the coal guys along!

As for the relative pricing of variouys generation methods, that changes over time. Worse, it is becoming increasingly clear to me that simple economic cost, as usually measured, is not the only factor to deciding which power production methods and facilities to license.

So once again, back to politics I fear.

posted 25 January 2010 at 12:26 PM by David B. Benson

DV82XL, on January 25th, 2010 at 12.03 — I need to add that the 6th NPCC power plan for my region placed advanced nuclear as slightly more expensive than CCGTs and slightly less than coal burners, when a substantial CO2 emissions cost was factored in.

By far the least espensive was energy conservation measures.

posted 25 January 2010 at 12:29 PM by David B. Benson

"Worse, it is becoming increasingly clear to me that simple economic cost, as usually measured, is not the only factor to deciding which power production methods and facilities to license."

No kidding!

One of my biggest complaints with the current pronuclear movement is that it doesn't pay enough attention to the politics, and when it does, it is in the most naïve way. I'm appalled at how often I get some riff on the idea that if we could just sit down with [*insert leader*] and *explain* it to him/her, they would surely support nuclear energy. Of course that's an oversimplification, but unfortunately not by much.

The antinuclear side, on the other hand, are seasoned political operators, which is why they are still ahead in the battle. Yet despite the fact that they are beating us up on every corner of the street, I get very little positive feedback when I bring the subject up, and say we have to stop worrying about being technically correct, and start playing the game properly.

posted 25 January 2010 at 12:46 PM by DV82XL

Consider this a quantum of positive feedback :)

posted 25 January 2010 at 12:59 PM by John D Morgan

DV82XL

Sadly, it has ever been thus. It';s the easiest thing to assume that this or that industrial or energy system was chosen because it was the best at the time, but a careful look back shows that while questions such as efficiency and effectiveness were relevant they were often not decisive. Politics and culture have always played a part in what gets adopted, deferred and passed over.

That's certainly true of nuclear power. Once or twice each year, when I raise the subject someone asks how people in countries that use nuclear power can tell it from coal fired power — as if you could put a Geiger counter up at the socket in the wall and find out. More common still is the idea that nuclear power plants can detonate in a huge mushroom cloud like Hiroshima or Nagasaki, and that a meltdown will *melt the containment area* and slip its way insidiously into the water table and contaminate our drinking water for 50,000 years and that we will see instances of deformed and mutant children skyrocket.

It also seems somehow as if because Chernobyl was a disaster that honouring them requires a never again clause. Building a nuclear power plant for some is the equivalent of spitting on the victims of Chernobyl or Hiroshima, in much the same way as condemning the holocaust and solidarising with its victims means opposing modern anti-semitism. For some, opposing nuclear power is that kind of masthead moral shibboleth rather than something to be analysed for contemporary relevance.

So it's little wonder that those of us who favour a rational discussion are up against it. What? You want a radioactive Australia? Not bothered by nuclear weapons? You're Ok with deformed babies? What the hell is wrong with you?

Throw in populist hatred of big business, ideas about naturalness and you have a pretty compelling bunch of reasons for anti-nuclear people to set aside their differences and work to block it. Even the aesthetics of the plant make them look like malignant growths on the landscape.

That's why I really think we need as much as possible to get people focused on the numbers. Make the debate be about what works best. Point out that what works best is also what will make it possible to protect the environment from human encroachment and protect those forests and rivers sooner, and more widely than the ostensibly cleaner alternatives. Point out that LFTRs and IFRs can *subtract* from waste which we don't otherwise quite know what to do with and that smaller amounts of visible and contained hazmat is preferable to larger widely dispersed quantities of hazmat which is the alternative.

There will always be some people who aren't amenable to reason (dropped into John Quiggin's blog yesterday and you should have read some the wailing and gnashing of teeth on nuclear power when a couple of posters tried to talk numbers) , but if we can get the debate to be about measurable things rather than aesthetic and visceral things, our chances of securing good policy go way up.

posted 25 January 2010 at 1:27 PM by Ewen Laver

Ewen Laver

A large part of the resistance to prosecuting a political campaign, is that because most of us came to believe in nuclear power through reason, we tend as a group, to be rational people. So we look at the problem of convincing others of nuclear power's superiority as rationalists. But really is kind of like the old saying that when all you have is a hammer, every problem is a nail. We have to bring in other tools to work this issue, and raw logic can only be one of them.

You say if we can get the debate to be about measurable things rather than aesthetic and visceral things, our chances of securing good policy go way up. Perhaps if we only needed to influence a small group of powerful people, but we live in much more political complex countries, and it is never that simple. Basically unless you can mobilize a large enough group of voters, or have pockets deep enough to buy the necessary politicians, all the economic arguments we might bring to the table will be next to useless.

The way you are suggesting would work great if we all had governments like Singapore, but Australia, Canada, and the U.S. are very different playing fields with very different groud rules. For us something as basic as flipping on the light switch is the end result of a series of political decisions that begin at the voting booth and make their way through the vast dark spaces of politics, bureaucracy, and commerce.

The fact is we need a more visceral approach to get the population behind us, because the only real threat we can raise is the threat of having the incumbent politicians voted out. Its is the only weapon that will counter money which is the other thing we are facing.

We have a war on two fronts. On one side are the Antinuclear forces that have various agendas that don't allow for nuclear energy. They have a religion. Their religion tells them that only renewable energy is "good" and all other energy is "bad." Never mind that their definitions of good and bad are only in their minds. They use fear to drive their cause into the body public, with little concern for the truth. Plausibility alone is the only 'proof' they require to construct a mythology of atomic horror, and to serve it up as absolute truth.

On the other side we have fossil-fuel industry that is using their right to employ money-amplified free speech to persuade the world that we cannot possibly be changing the world's climate and that continued use of their products are mankind's wisest course of action. They have hijacked wind and solar, and yes CCS, to create a green façade behind which they can continue their hegemony.

Against this a purely rational set of arguments falls flat.

We need high profile support from celebrities, we need grassroots organizations on the ground in the community, and we have to start fighting dirty, because these are the things they are doing to us. Yet I have actually heard from pronuclear supporters that believe that much could be accomplished with a letter writing campaign *à la* Amnesty International.

Nuclear power has survived, and its public stature has grown of late, almost in spite of itself. But as it does, it is again going to become a target, and if we are not prepared to fight they way our opponents are going to, we will be pushed back into the hinterlands for another thirty years.

posted 25 January 2010 at 3:03 PM by DV82XL

Great contributions from all.

DV82XL, Ewen Laver, as you say, gaining public acceptance is essential. It is an essential precursor to getting nuclear at a competitive price.

As Steve Kirsch said here http://bravenewclimate.com/2010/01/02/investment-we-arent-making/ :

> "If you want to get emissions reductions, you must make the alternatives for electric power generation cheaper than coal. It's that simple. If you don't do that, you lose. "

posted 25 January 2010 at 11:04 PM by Peter Lang

"Ok with deformed babies?"

Burn coal!

That'll bring 'em on…

posted 26 January 2010 at 9:36 AM by David B. Benson

I am not quite as despondent about the public support for nuclear power. The politicians in Europe, and even the US, are starting to realise that the only way we will stabilise at 450 ppm in a few decades is by using more nuclear. They have had enough experts in their collective ears to hear the clarion call. They would not do this if the voters were dead set against it or if they believed it was inherently a bad idea.

Australia stands alone in the G20 by refusing to seriously consider nuclear. This may be the voters in Australia but I suspect it has more to do with protecting the valuable coal industry. Australia has many reasons for seeing CCS be successful. The challenge here is to persuade the government to take out an insurance policy in case CCS fails to deliver. It will probably take at least a decade to build the first nuclear plant once the announcement is made. Valuable time is being lost.

A parallel approach like we see in the UK and the US makes more sense. Hedge the bets between CCS and nuclear. The government is prepared to invest in EGS which is probably an even more problematic solution than CCS so why not nuclear planning?

posted 26 January 2010 at 4:31 PM by Martin Nicholson

1. Establish an organisation like a modern version of the Snowy Mountains Authority, to implement nuclear power in Australia to provide electricity at a price less than coal generated electricity

2. Set up nuclear research facilities in at least one university in every mainland state

3. Major part of the research to be into the social engineering aspects

4. No CPRS

5. No Carbon Tax

6. Remove the ban on everything to do with nuclear energy, uranium mining and the nuclear fuel cycle

7. Remove all Mandatory Renewable Energy Targets – they are a total waste of money and have zero effect on emissions.

posted 26 January 2010 at 7:32 PM by Peter Lang

The CPRS is exactly the wrong policy, for Australia, and for the world.

The CPRS will make no difference whatsoever to global temperatures.

It will raise the cost of electricity which is exactly the opposite of what we should be doing.

To help people out of poverty, throughout the world, they need electricity.

(see this chart of UN statistics charting life expectancy versus per capita electricity consumption.
http://graphs.gapminder.org/world/#$majorMode=chart$is;shi=t;ly=2003;lb=f;il=t;fs=11;al=30;stl=t;st=t;nsl=t;se=t$wst;tts=C$ts;sp=6;ti=2005$zpv;v=0$inc_x;r
Click on 'Play' to see how the chart changes over time. Then change the left axis to see the comparison of electricity consumption with any of the other UN statistics such as health, education, fertility rate, poverty, etc).

To get electricity to the poorest people as fast as possible we need to help the world to lower, not raise, the cost of electricity.

CPRS and ETS are designed to raise the cost of electricity.

Instead, we should be doing all we can to lower the cost of clean alternatives to fossil fuel generated electricity.

The only economically viable clean electricity generation technology is nuclear energy.

We should do all we can to lower the cost of nuclear energy in the developed nations – including Australia. Then it can be applied in the developing nations.

Nuclear is some 10 to 100 times safer than coal generated electricity and far more environmentally benign. http://bravenewclimate.com/2009/08/13/wind-and-carbon-emissions-peter-lang-responds/
So, why aren't our political leaders explaining this to the population? Don't they know the facts?

There are other reasons apart from lifting people out of poverty and giving them a better life. Low-cost, clean electricity will reduce emissions more quickly than high cost electricity, because electricity will more rapidly displace gas for heating and oil for land transport. The choice is a slow transition to clean electricity or a much more rapid transition to clean electricity with the added benefit of a faster transition to a clean energy for heating and land transport (clean electricity). Oil fueled land transport will be displaced over decades by a combination of electric vehicles and vehicles running on synthetic fuels produced using clean electricity.

Summary:

Some policy implications of the paper: "Emission Cuts Realities – Electricity Generation" (Lang, 2010)

1. Mandating renewable energy is bad policy

2. If we are serious about cutting GHG emissions, we'd better get serious about implementing nuclear energy as soon as possible

3. If we want to implement nuclear power we'll need to focus on how to do so at least cost, not with the sorts of high cost regimes imposed in USA and EU

4. We should not raise the cost of electricity. We must do all we can to bring clean electricity to our industries and residents at a cost no higher than the least cost option

5. Therefore, ETS/CPRS is exactly the wrong policy.

References:

Lang,P. 2010. Emission Cuts Realities – Electricity Generation.
http://bravenewclimate.com/2010/01/09/emission-cuts-realities/

please click on the pdf version if reading the paper in detail. The pdf version includes the footnotes, references and appendices.

Lang, P. 2009. Wind and Carbon Emissions – Peter Lang responds
http://bravenewclimate.com/2009/08/13/wind-and-carbon-emissions-peter-lang-responds/

posted 27 January 2010 at 8:05 PM by Peter Lang

Peter Lang: 27th Jan. 20.10

Peter, I am worried that your strongly worded opinions on the political and economic policies that would best lead to a carbon free energy future may detract from the well researched facts and conclusions that you elaborated in your post at the top of this thread.

I am sure that the strong wording is primarily to provoke discussion and, as a layman, I am happy to discuss. So here goes:
1) In your summary, I agree entirely with your points 1-3, but not with the last two.
2) At present, you have calculated that nuclear electricity is far and away the cheapest form of carbon free electricity. Notwithstanding, for many (and often unnecessary) reasons, it still can't currently compete with electricity fom coal. Over the course of a few decades (possibly sooner), one can reasonably expect that it will be competitive with coal from newly built plants, but probably not with coal when the coal plants still have life in them but have had their capital costs written off. There are grounds even to suppose that nuclear baseload electricity may ,eventually, be significantly cheaper than coal electricity. Having accepted all that, I can't see why nuclear roll out wouldn't be quicker with the aid of a push from, say, a carbon tax.
3) Your prescription appears to do nothing to encourage energy efficiency. You might argue that energy efficiency wouldn't be nearly so important if all energy were carbon free. However, in the real world, it won't be for decades.
4) You suggest that a carbon tax (or exchange trading) will slow transition to electrical transport and heating. I can't see why this should be so, but I am possibly being thick. I am assuming that petroleum products would be subject to a carbon tax in the same way as coal and gas. On what assumptions was your suggestion made? (In fact, for domestic heating, heat pumps are already competitive with oil and gas boilers.)
5) On another thread, you reasonably point out the difficulties of some nations and not others taxing carbon. I acknowledge the problem but have mentioned before that it might be soluble by use of trade embargoes or tariffs. However, there are equally going to be problems if some nations take your view and commit to nuclear while others don't. Because of high up front costs, nations not adopting the technology will have short term competitive advantage. Longer term, this will undoubtedly reverse but, by then, it could be too late for all of us. How would you propose solving this dilemma?
6) You suggest that higher cost energy will delay the development of poorer nations which, in turn, will result in their populations continuing to breed unsustainably. I really don't think that this need be the case with, for example, a tax and dividend scheme. What have you got against it?

It seems we both want plentiful, clean and affordable energy and both agree that nuclear fission represents the only plausible hope of achieving the aim. We differ as to how the objective is to be achieved in the most efficient and expeditious manner.

posted 28 January 2010 at 12:04 AM by Douglas Wise
Pingback: Tom Blees in Australia « BraveNewClimate

"CPRS and ETS …" — Sorry, what do these mean?

posted 28 January 2010 at 11:57 AM by David B. Benson

> "“CPRS and ETS …” — Sorry, what do these mean?"

a) *Carbon pollution reduction scheme*;
b) *emissions trading scheme*

a) = the legal title given to Australia's ETS knocked back in the senate in December 2009

posted 28 January 2010 at 12:23 PM by Ewen Laver

Ewen Laver, on January 28th, 2010 at 12.23 — Thank you for the prompt reply.

posted 28 January 2010 at 12:29 PM by David B. Benson

Douglas Wise,

Thank you for your reply. I agree with your first comment. I thought about whether or not to post it for the very reason you make. But I decided to anyway. And yes, I wanted to try to get some discussion going on the policy implications of the "Emission Cuts Realities …" paper, given that our Parliament is scheduled to debate Carbon Pollution Reduction Scheme Bill next week.

> "1) In your summary, I agree entirely with your points 1-3, but not with the last two. "

Great. That's 60%, so I got a I pass (or is that a Credit?)

> "2) At present, you have calculated that nuclear electricity is far and away the cheapest form of carbon free electricity. Notwithstanding, for many (and often unnecessary) reasons, it still can't currently compete with electricity fom coal. Over the course of a few decades (possibly sooner), one can reasonably expect that it will be competitive with coal from newly built plants, but probably not with coal when the coal plants still have life in them but have had their capital costs written off. There are grounds even to suppose that nuclear baseload electricity may ,eventually, be significantly cheaper than coal electricity. Having accepted all that, I can't see why nuclear roll out wouldn't be quicker with the aid of a push from, say, a carbon tax. "

You say nuclear "cannot currently compete with coal". I disagree. It cannot compete when it is banned and when there are so many unequal constraints and regulations on it but not on its competitors. I say we can build nuclear commencing in 2015 for commissioning in 2020 at a proice competitive with new coal. But we need to remove the unequal imposts. I would also impose phased in emissions regulation on all generators. And I would have a "Cash for Clunkers" policy as mentioned in an earlier post on BNC. I'll put my ideas on all this in a separate post.

> "3) Your prescription appears to do nothing to encourage energy efficiency. You might argue that energy efficiency wouldn't be nearly so important if all energy were carbon free. However, in the real world, it won't be for decades. "

I agree. I didn't cover that. Although a price on carbon will have an effect on efficiency, there are so many other problems the ETS will introduce that I think the efficency benefit will be lost in the noise, while sending Australian industires off shore, making us poorer, and having no net envireonmental benefit for the planet. If all countries raise the cost of electricity, humanity will be worse off not better off (for the reasons I outlined http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-44149). And if only Australia and a few other countries implement an ETS, then we lose out for no net environmental gain.

> "4) You suggest that a carbon tax (or exchange trading) will slow transition to electrical transport and heating. I can't see why this should be so, …. I am assuming that petroleum products would be subject to a carbon tax in the same way as coal and gas. "

My underlying assumption is that the cost of gas for heating, oil for transport and electricity will all increase. So there will be no greater incentive than now to move from oil and gas to electricity. If electricity is kept low cost it will displace oil and gas faster. A price on carbon will raise the cost of electricity faster than oil and gas (I am guessing; I haven't checked this).

> "5) On another thread, you reasonably point out the difficulties of some nations and not others taxing carbon. I acknowledge the problem but have mentioned before that it might be soluble by use of trade embargoes or tariffs"

Trade embargoes and tarrifs lead to trade wars. Everyone loses. It leads to conflict and, in the past, to world wars. That is a completely wrong approach. We need to move to free trade as quickly as possible for the benefit of all humanity. If the EU wants to continue to resist free trade (as it has been doing for the 40 odd years the GATT negotiations have been going on – remember the French farmers and their tractors blocking the roads if they don't get their way about every 5 or so), the rest of the world shoud embargo the EU, IMHO :)

> "5) cont. However, there are equally going to be problems if some nations take your view and commit to nuclear while others don't. Because of high up front costs, nations not adopting the technology will have short term competitive advantage. Longer term, this will undoubtedly reverse but, by then, it could be too late for all of us. How would you propose solving this dilemma? "

This problem doesn't exist if we implement nuclear at a price competitive with coal from the start. I accept that new nuclear cannot compete with old coal. But is can compete with new coal if we remove all the impediments. And we are going to phase out the old coal by regulating emissions of all generators. And we'll buy some back. And the public will have to pay for the additional costs of FAOK for the first 5 or so power stations.

> "6) You suggest that higher cost energy will delay the development of poorer nations which, in turn, will result in their populations continuing to breed unsustainably. I really don't think that this need be the case with, for example, a tax and dividend scheme. What have you got against it? "

I haven't looked at it closely and don't really know anything about it. I didn't look at it closely because it isn't one of the options being discussed for Australia. There has been some limited discussion of a consumption based ETS as opposed to the production based ETS. But it is totally impractical to implement. We'd need a finance and accounting system just as sophisticated as our money system. I can't contribute anything to the discussion of the tax and dividend scheme. However, I would add that if government is involved, I'll take a lot of convincing :)

posted 28 January 2010 at 4:48 PM by Peter Lang

Peter Lang: Jan 28th 16.48

I suppose our different slants on appropriate policy depend, in part, on the length of the transition period to clean energy that we have to work with. I strongly suspect that your route is the longer one and that it might get us to our destination too late to do any good. I am simply not knowledgeable enough to calculate how much time we really have but I am frustrated that matters are moving more slowly than I would wish.

I do agree that all developed nations need to embrace nuclear power as a priority and facilitate developing nations to do similarly. If one had to pick one policy, this would do more good than any other. However, in my view, it may still be insufficient, in itself, without some sort of regulatory push. I think it is possible to detect some evidence of political encouragement for nuclear by an increasing number of nations. Notwithstanding, the real enthusiasm of many seems currently to be directed towards the deployment of wind power, encouraged by extremely damaging subsidies. You have done far more than most to demonstrate that this approach is foolhardy. The sooner such subsidies are removed the better since they are guaranteed for the lifetimes of those windfarms already built and their removal would stop further construction of wind farms in its tracks and thus make more money available for functioning alternatives.

You say that nuclear could, in theory, compete now but immediately go on to say "nuclear cannot compete……when there are so many unequal constraints and regulations on it but not on its competitors." But ,currently, there are and it will take longer than either of us would wish to level things off (I've avoided saying up or down in view of your discussion with Ewen Laver).

You have somewhat puzzled me by your call for "phased emissions regulation on all generators". Are you thinking of non-CO2 emissions or all? Would the regulations apply to vehicle users and those burning oil or gas for domestic heating or just to electricity generators? Would the emissions be capped or taxed in your proposed regulations?

You guess that "a price on carbon will raise the cost of electricity faster than oil and gas". I'm not sure this is necessarily the case. I have read, for example, that an electric vehicle emits less CO2 than an equivalent petrol one even when one factors in the coal power station's emissions created by making the electricity to power the said car. I have already mentioned that electrical heat pumps produce less CO2 per unit of heat than oil or gas boilers, again having factored in the coal power plant's emission contribution. In any event, regardless of carbon taxes, one might expect that oil and gas prices would increase faster in the future than electricity prices for purely supply and demand reasons. To sum up, I remain unconvinced that you have made the case that a price on carbnon would delay the transition to more efficient transport or domestic heating.

Although you acknowledge that your proposals would do little to encourage efficiency, you somewhat cynically go on to suggest that any ETS scheme would be so inefficient and bureaucatic as to swallow up most of the efficiency gains anyway. I can assure you that my opinion of bureaucrats almost certainly matches your own. It is why , as a gut instinct, I find tax and dividend much more appealing – in its simplest form, the entire tax raised would be distributed equally to each adult member of the population of the government raising the tax. The average citizen would thus be no worse off for paying the tax but each would be personally incentivised to use energy more efficiently.

You are a passionate believer in free trade. I used to be. You suggest trade embargoes/tariffs are bad and can lead to conflict. Let's take this a bit further. The cost of vehicle fuel in the UK is much higher than in, for example, the States. There is also a climate change levy paid on all fossil fuel derived energy. There are consequences of this disparity. UK manufacturers are placed at a competitive disadvantage because of higher costs. UK drivers drive smaller, more fuel efficient vehicles, reducing CO2 emissions in consequence. Meanwhile, many UK manufacturers move production to China or India, dropping UK emissions further but increasing Asian emissions. In consequence, there will be rising UK unemployment, a shrinking tax base but a citizenry that expects its government to provide generous welfare provisions. This has all the necessary ingredients for the end of democracy and some might legitimately suggest that it was the consequence of the growth of insufficiently regulated multinational companies and a blind faith in the virtues of free trade. I am not saying that this is my own view because I remain ambivalent. One could argue that, as UK citizens get poorer , even more people in developing countries are getting richer and that this is, overall, a good thing – not for me or my genes though.

Let's now put that issue to one side and consider a carbon tax and dividend programme that, say, was adopted by Europe, the Americas and Oceania but not by China or India. We leave free trade in place but the developing nations reduce emissions much more slowly than the rest of the world deems necessary, thereby enriching themselves with their exports and impoverishing everyone else until they can no longer continue to import but have few, if any, viable surviving industries. You accept that a carbon tax, unlevelly applied, would disadvantage those applying it but can't accept the balancing need for trade tariffs/embargoes because of your adherence to free trade. I think, in fact, that the Chinese and Indians are far too intelligent not to appreciate the threats to themselves of climate change and would quickly become carbon taxers themselves or willingly comply with tariffs until such time as it took them to transition to carbon free energy. At present, they are sensibly trying to get ahead of the game before the rules change.

I support a tax on carbon (preferably with a returned dividend) because I think it will encourage efficiency and speed the transition from carbon-based energy. Actually, I think it would also drive home the compelling argument for the need for nuclear power more quickly. Your route would be fine if we had until 2100 to sort matters out. I don't think we have this time. I accept your misgivings over an unequally applied carbon tax but don't think they need be insurmountable.

posted 28 January 2010 at 11:03 PM by Douglas Wise

Hi Douglas Wise,

My apolgies for not replying today. I will tomorrow. We are poles apart on our position on globalisation, trade barriers and protectionism and role of governemtns. In short, I'd say, the reason GB and Europe are sinking economically is too much socialism. If you want socialism, and want to protect your self from competition, those policies will drive these nations into the poor house. You can't have socialism and be wealthy. I'd also point out that globalisations, freeing up trade (there is a long way to go with this yet) and market economies are bring health, eduation and closing the gap between rich and poor. If you don't agree, spend some time with the GapMinder charts. And even look at Hans Rosling's demonstrations on the GapMinder web site.

posted 29 January 2010 at 10:34 PM by Peter Lang
Pingback: Alternative to the CPRS (cap-and-trade) « BraveNewClimate

Great comments everyone. Since 2005, I've been making speeches on why Australia should go nuclear. I go so far as to suggest to groups that they invite me to put the case. Most reply positively. As a result I've reached about 2000 people including the Royal Geographical Society SA [usual meeting 30 members my meeting 130-standing room onl], Engineers Australia [SA], the Commonwealth Club, Adelaide Rotary [standing ovation from 120 present] AdelaideRoyal United Services Institute and several other Rotary, Probus, Apex clubs etc. I've even got into a couple of schools to speak to the ones we really do have to convince. There is a lot of support for a nuclear Australia out there. Take it from me. Have written countless letter to editors [quite a few have been printed but by no means enough], politicians and others. Had one printed today in which I bagged the misguided SA government because of its insistence in building more and more part time power wind farms. We just have to get out to the people and stop just discussing the issue amongst ourselves. Have YOU had a go yet?

posted 1 February 2010 at 6:42 PM by Terry Krieg

I just noticed the comment by Stephen Gloor at the end of this article. Some here who followed the earlier discussion on BNC threads might be interested.

http://theenergycollective.com/TheEnergyCollective/56159

posted 4 April 2010 at 8:59 AM by Peter Lang

Neil Howes, on 5 May 2010 at 9.00 Said:
http://bravenewclimate.com/2010/04/28/a-gassy-vision-2/#comment-62849

> "[I] am working on a scenario of all NEM coal-fired power being replaced by 16GW av wind, 6GW av CSP(12GW peak capacity, with 24h storage), 1.5GWav hydro and approx 1.5GW av OCGT(present 4GW capacity) , using your figures for present NEM demand. I am using the data from the 18 wind farms in operation at present(1600MW capacity, scaled x29) to calculate pumped storage requirements and load shedding losses (wind output above 80% capacity during low demand periods). Adding more OCGT capacity doesn't really help, as the critical requirement is to be able to store excess wind during low demand periods. OCGT capacity would be used mainly to assist hydro in balancing daily peak and seasonal variations in solar and wind. This would require about 16GW of additional pumped storage (>1200GWh over a 5 day period), a little more than double the capacity of the Tantangara/Blowering project you detailed. A 1.5GW HVDC link to WA would reduce pumped hydro peak pumping capacity by 1.5GW but require a larger total storage capacity (which is available). "

I have been looking at this comment more carefully and have the following comments:

Based on the 2007 NEM demand, we need 25GW average power, 33GW peak and 18GW baseload. The peak occurs at about 6:30 to 7pm in July (winter; about 2 hours after sunset and 3 to 4 hours after SCP can generate directly from the sun).

Peak Power considerations:

I understand the scenario you are analysing has 32GW peak generation capacity (comprised of: "CSP 12GW peak capacity, with 24h storage", 16GW pumped-hydro and 4GW OCGT).

Can we rely on the 12GW of CSP from storage after sundown and after say 5 days of overcast weather?

Can the 16GW of pumped hydro generate the peak power required for say 5 or 10 days in a row if there has been insufficient wind power for pumping during those days?

Storage considerations:

If the Tantangara-Blowering pumped-hydro scheme was recharged using reliable baseload power, such as coal or nuclear, then about 40GWh of energy would be stored each night, and used the next day. However, with wind power, we may need sufficient storage to last for weeks at a time, with insufficient wind power to recharge. So, much more storage would be required and probably a larger pumping capacity to make best use of the wind power when it is available.

If we want to use Tantangara Reservoir for more than some 40GWh storage (5 hours at 8GW), I expect there will be issues with replacing the intended purpose of this reservoir and also with the limits on the rate of drawdown.

> "A 1.5GW HVDC link to WA would reduce pumped hydro peak pumping capacity by 1.5GW but require a larger total storage capacity"

Does this mean that you assume that WA can provide a guaranteed 1.5GW of power at the time of the eastern states' peak demand (which is after sundown in both eastern and western states in winter)?

My rough calculation of the cost of the generating assets is about $270 billion. We'd need to increase this by some $60 billion for transmission for solar and wind (even without the link to WA). Total = $330 billion.

For comparison, the rough cost to meet the same requirements with nuclear and pumped hydro is about $120 billion. The nuclear option would have far greater reliability, lower emissions and require about 1/10th as much mining, processing, manufacturing, construction and transport between each step. It seems to me the nuclear option would be cheaper and more sustainable.

posted 6 May 2010 at 4:36 PM by Peter Lang

There has been a discussion about nuclear and solar power on John Quiggan's blog web site. He has now stopped any more discussion on nuclear. There is a criticism about the "Solar Power Realities" paper. I've replied, but it may get deleted because it was posted after John Quiggin said "no more comments'. So I'll post it here for others to see. My two responses are in reply to this comment: http://johnquiggin.com/index.php/archives/2010/05/06/nuclear-power-the-last-post/comment-page-9/#comment-262567

Following is my first reply:

BilB,

I will get to addressing your specific comments below. First, a general remark. I expected some sort of nonsense like you've written. You haven't understood and haven't bothered to read the papers on the CSP costs and the mix of technologies. Basically you have not understood. More on that later

Importantly, you have reneged on your undertaking. You undertook to provide the basis of your estimate of $180 billion for solar to provide our demand. You have not done so. That figure is totally ridiculous. My motivation is I am concerned about what is going on with misleading the population about the prospects for renewable energy to provide our energy needs. By continually focusing on and fiddling with renewable energy we are avoiding making the decisions that can have a real effect. You and the other renewable energy proponents are convincing people, who are not capable of checking what they are being told, that renewable energy is a viable alternative. You are deceiving people. You either don't understand, or you do understand and are being intentionally deceptive.

Now I'll respond to your points.

> "For starters you whole premise of NEM's 2007 is not relevant to solar origin energy. Solar energy has a different peak at the middle of the day. "

Wrong! The renewable energy proponents claim solar thermal can provide our energy needs. It cannot. Our energy needs are what is shown by the demand curve. CST hast to be able to provide power when ever it is demanded. CST cannot. Not at any cost!! You now say the demand is wrong and you want to change it. That is avoidance. What this paper is about is demonstrating that CST cannot supply electricity to meet the demand. Not even close. The paper clearly demonstrates that.

> "The Queanbeyan Solar farm from which you draw your information on solar yields is a rigidly mounted photovoltaic array"

. That is true. It is irrelevant. If it was a tracking array it would produce about 20% to 30% more power (theoretically), but make little difference on the worst days in winter. Furthermore, tracking PV is more expensive per unit of output. The site is described in the cited references. However, this is irrelevant. We are not chasing 10%, 20%, 50% differences in cost. Solar power is 2000% to 4000% more expensive. Given this, the difference in cost between CST and PV is a 'down in the weeds issue. Anyone who is numerate understands the difference between 20%, 50% and 2000%. But all you points you raised are dealt with by people who are knowledgeable in the comments on the BNC site.

> "The essays linked reference to storage solutions contains zero information on eutectic salt heat energy storage, and contains no performance information or any basis upon which costing conclusions can be drawn. "

Wrong! Look at the cited references. Look at NEEDS for example, which is an authoritative study, unlike the modelling study you are relying on.

> "The essay argument that a renewable system would need to provide storage for a 90 day continuous non solar period is ridiculous on so many levels, "

You've misunderstood or are trying to mislead, again. The amount of generation capacity needed depends on how much storage you have. There is a trade off between storage capacity and generating capacity. That is why the paper you are relying on has MS1 to MS4, where MS4 is one day of storage based on average annual capacity factor. The key problem with the study you are relying on, and what the 'Solar Power Realities" paper, and the addendum, point out is that we should not use the average annual capacity factor. We have to use the worst case capacity factor. This is because the demand for electricity does not go away on the worst days in winter. We have to be able to generate to meet all the demand during those days. Papers like the one you are relying on completely ignore this problem. That is part of the reason you have underestimated the cost.

> "The essay makes no mention of other renewable energy sources other than hydro electricity which is included only as an energy storage medium. "

The paper was one in a series. You did not read the others I linked to, nor did you look at the cited references. In short, you have misunderstood or are intentionally misrepresenting the papers; the papers clearly point out how far from being viable are renewable energy generators, including a mix of technologies.

> "The essay contains no industry or market based qualified costing information from which costing conclusions can be assessed. "

There is no commercial costing data available on CST. CST is not commercial yet. That is why the study you point to is a modelling exercise. The costs used for the PV are low, not high. But this is irrelevant, because the cost of solar power is too high by 2000%, not 20% or 50%.

> "This is a sloppy, unprofessional piece of work and the conclusions drawn from it are 100% unsupportable. "

I expected something like that, given your previous dismissals before you'd read anything and given you have a business interest in CST and probably have your snout in the public funding trough as well.

posted 14 May 2010 at 12:21 PM by Peter Lang

My second reply to http://johnquiggin.com/index.php/archives/2010/05/06/nuclear-power-the-last-post/comment-page-9/#comment-262567 (and also relating to the preceding discussion)

> "Bilb clearly has no intention of following through on his undertaking to provide the basis of his cost estimate of $180 billion for CST, so I'll address some questions to Bilb which may highlight for others just how ridiculous is his estimate of $180 billion to supply our power with CST.
> .
> 1. How much did you allow for the over-build needed to provide power through winter, and specifically through extended periods of overcast weather in winter?
>
> 2. How much did you allow for transmission?
>
> 3. How much did you allow for construction in the Australian desert?
>
> For those interested, regarding construction of CST consider the following:
>
> 1. CST needs to be built in our desert regions to maximise insolation. They need to be widely distributed to maximise the generating capacity during long periods of widespread cloud cover, and dust storms. Let's assume for now we need 200 of 250MW CST plants to provide our 2007 demand. These would need to be widely distributed over an area of desert about 1000km by 3000km, e.g. between Alice Springs and Broome.
>
> 2. CST requires about 8 times as much concrete and 15 times as much steel as a nuclear power plant. So a 250MW CST requires about twice as much concrete and 4 times as much steel as a 1000MW nuclear plant.
>
> 3. That translates to about 2 to 4 times as many workers, and at least twice as much fresh water (for concrete) during construction.
>
> 4. We'd need towns and a 'fly-in fly-out' airport for each construction. The town would need to accommodate some twice the number of people required to build a nuclear plant. We need to build about 200 of these towns and 'fly-in fly-out' airports over 40 years, or about 5 per year. These are far bigger than anything the mining industry builds, and we'd need to build five new ones per year.
>
> 5. We need fresh water at each power station – about twice as much as needed for an NPP. Where do we get it? We'd need desalination plants along the west coast, dams in the north and pipes laid out across the desert.
>
> 6. Certainly we can argue about details, and I am sure BilB will pick some out to argue about. But if we think of the big picture, and recognise the overall scale of what is being proposed by the CST advocates, we can begin to realise how absolutely ridiculous this whole concept is.
>
> Without including the costs for the items above, the paper BilB is relying on estimates the cost of CST is about $16,000/kW in 2010. That is about 4 times the cost of a new, 'first of a kind' nuclear power plant (ref. the recently awarded contract for the first nuclear power plant in the UAE at about $$4,100/kW).
>
> Regarding the CST advocates' cost estimates, as reflected in the paper Bilb is relying on, they are gross underestimates as has been demonstrated by the past 20 years of gross exaggerations by the solar power advocates. David Mills for example has been saying for the past 20 years "solar thermal can provide baseload power now and at a competitive price. If the government would just give us some more funds we could demonstrate it".
>
> The 'learning curves' are ridiculous. NEEDS was based on the same learning curves in their 2007 report. They projected the cost of solar thermal would drop by about 30% by 2010. In fact, EPRI estimates the CST costs have increased by about 30% over that time.
>
> Importantly, the most optimistic projections (by the CST advocates) is that this technology might be achievable between 2020 and 2030. For example, the paper Bilb is relying on states, on page 6: "The comparison shows that CSP can become fully competitive between 2020 and 2030, and can later contribute significantly to stabilize global electricity costs." In other words, some time in the way-off, never-never, CST may be economic to do something, perhaps!!
>
> BilB is trying to promote his own business interests, He should not be believed. I suggest reading the four papers yourself, then asking questions on the BNC web site. I and others will answer, and if an error is found, I will be pleased to correct it and reissue the paper(s)."

posted 14 May 2010 at 12:24 PM by Peter Lang

At the moment it seems to be displayed there …

Thanks for your efforts Peter. It's good that this stuff is on the record.

posted 14 May 2010 at 12:29 PM by Fran Barlow

Fran,

You did well too. We may have got some points through to a few lerkers, even if not to the stridently anti-nukes.

posted 14 May 2010 at 1:07 PM by Peter Lang

Whyalla Solar Thermal plant

http://www.abc.net.au/news/stories/2010/05/13/2898697.htm

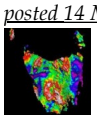
This article says the plant will be 40MW and cost $230 million. The article also says it will reduce GHG emissions by 60,000t/a. If the conversion factor is 1.0 t CO2-e/MWh, then the plant produces 60,000MWh/year. In that case, the average annual capacity factor is 17%. That would suggest the energy storage component is insignificant. I'd like to know the MWh of energy per year rather then the tonnes of CO2. I'd also like to know what is the Capacity factor on the worst day of the year, because that is what we need to design for if we have only one day of energy storage.

posted 14 May 2010 at 1:33 PM by Peter Lang

I thought the Whyalla solar plant works on high temperature dissociation of ammonia which generates heat when recombined. If they don't have some form of storage it's no better than a coal plant saying it is 'capture ready' i.e. a stalling exercise.

Whyalla has a long way to go before it can call itself clean and green. Ships regularly call in to OneSteel laden with coking coal from Newcastle. Strangely a coke oven by-product is ammonia not sure where it goes. Santos has or had a NG to propane separation plant next to where BHP wants to build the controversial desal.

posted 14 May 2010 at 1:51 PM by John Newlands



$180,000 million? Over at *Crikey*, a correspondent pointed to the Zero Carbon Australia 2020 project, which purports to lay out a plan for Australia to be 100% renewable by 2020 (seriously!). Their bottom line is $367,000 million for a 60/40 mix of CST and wind, or over double the CST-only scenario outlined above, and purports to take transmission into account.

Even if this is realistic (which I still doubt), I'd love to see how many reactors we could build for $367,000,000,000.

posted 14 May 2010 at 2:45 PM by Mark Duffett

I hope so Peter.

The anti-nuke crowd there are simply hysterical.

In one way I feel kind of bad. Although I never got to the place they are in, even at my most sceptical, for a long time I harboured much of the underlying sentiment they vent. In a way that they can't currently grasp, I really do empathise with them.

They see me as some sort of Jedi-mindtrick spinmeister running nuclear propaganda, because I know exactly where they are coming from and where they are going. So I copped enormous abuse there. One of them even referred to you as if you were one of my staff. You have to laugh.

It really is sad that it has got to this. I really did try to keep the discussion focused on the substantive matters but they were determined it would be a flame war — (nuking the discussion? ;-) a tactic designed to force JQ to close the thread, which he ultimately did.

Wouldn't it be nice if we could simply line up all the options, draw up a ledger and pick the best from that without bringing up irrelevant emotional nonsense?

This is energy policy — not sports.

posted 14 May 2010 at 2:49 PM by Fran Barlow

367 billion bloody dollars!!?

Well, at least their economic analysis is probably plausible.
But it obviously does not make the slightest bit of sense, unless you start with an anti-nuclear-energy dogma.

posted 14 May 2010 at 3:17 PM by Luke Weston

Fran,

I feel for what you went through on that thread. All I can say is: chin up, dust off, and take on some more anti-nukes elsewhere. I reckon you did a really great job. If that thread ends now, without more anti-nuke comments, then I am pretty pleased with the outcome. I hope some may go away and think about those last few posts.

posted 14 May 2010 at 3:19 PM by Peter Lang

Luke, $367 billion for an all renewables system to provide all our electrcity is not even close to plausable. Have a look at my recent comments here: http://johnquiggin.com/index.php/archives/2010/05/06/nuclear-power-the-last-post/comment-page-6/#comment-262326 and in the comments up thread at: http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-65305. Also look at Figure 9 this thread's lead article, (but note that the capital costs of solar in this paper do not allow for the overbuild required).

posted 14 May 2010 at 3:30 PM by Peter Lang

Peter, great stuff, I admire your ability to deliver patient comprehensive replies.

Fran, I followed a lot of that thread, and you're an absolute trooper.

I hazard a guess that BilB may be a screen name for Scott Bilby, one of the Beyond Zero Emmissions campaigners and web jockeys. But I do not know this.

posted 14 May 2010 at 4:14 PM by John Morgan

peter: you state a cost for csp as $16,000/kw (BIIB's reference), indicating that it leaves out some costs "above."

I thought some of your "above" might have been included in the 16,000 figure so could you say precisely what that figure excludes?

and great work. that quiggan site is pretty toxic.

posted 14 May 2010 at 10:14 PM by gregory meyerson

I notice that John Quiggin has deleted my last two posts but Bilb's criticisms remain. BilB's criticism is here: http://johnquiggin.com/index.php/archives/2010/05/06/nuclear-power-the-last-post/comment-page-9/#comment-262567

The responses I had posted, but now deleted, are pasted up thread at #65305 and #65306.

posted 14 May 2010 at 10:32 PM by Peter Lang

Gregory,

The A$16,000 is a conversion from EUR read from Figure 7 here: http://www.solarthermalworld.org/files/global%20potential%20csp.pdf?download

This figure does include some cost for transmission (for Europe and USA) but the costs would be considerably more in Australia. The figure does not include the overbuild required to allow full availability for on demand power throughout the year. Also, the figure does not include the much higher cost of building the plants throughout the Australian desert.

If anyone picks up that I am wrong on any of this, please let me know.

posted 14 May 2010 at 10:47 PM by Peter Lang

Alright, I am not going to spend much time on this as I have a huge work load.

The quick test for orders of magnitude is to take known performance, in this case we will use the 20 year average for segs viii at harpers lake, and divide it into Australia's total electricity consumption, for this exercise 220 billion kwhr per annum.

This yields 1571 segs viii 80 meg equivalents to generate Australia's total electricity requirement.

So that is 80 times 1571 divided by 1000 to give gigawatts at 126. In the absense of price information for segs viii I will use the European figure of 1.7 billion for a standard single solar multiple hybride with some storage. this yields a 214 billion dollar price tag for total energy delivery. Now your going to launch into the capacity argument, but recognise that this model includes gas burning backup so there is no additional solar multiple. This simple calculation included 3 times as many turbine houses as are required. However the cost of these is balanced against the cost of the storage for each the fields used as solar multiples.

There is no logic available to turn that 214 billion dollars in to 4200 billion.

Using the SolarPaces document 30 times 6 giving 180 billion, there is corellation of order of magnitude at 1.035 .

posted 16 May 2010 at 1:12 PM by BilB

BilB, – Do you really think anyone here is so stupid that they will buy into something like that?

I've seen better mathematical reasoning from numerologists than what you are trying to float here.

You are just embarrassing yourself now, and it's getting painful to watch.

posted 16 May 2010 at 1:21 PM by DV82XL

Now your going to launch into the capacity argument, but recognise that this model includes gas burning backup so there is no additional solar multiple.

So here we haave it. when presssured, this model 'renewables' advocate has no cchoice but to admit that his preferred system is useless without fossil fuel backup, and is therefore nothing more than an excuse to continue burning those fossil fuels. The whole scheme is a natgas greenwashing exercise cynically marketed as a low carbon option when the opposite is the case.

posted 16 May 2010 at 1:24 PM by Finrod

That is a predictable response from you, dv8, can't be bothered to think about anything that might challenge your prejudices, so just lash out. Deny, deny, deny. You've got to be a lawyer.

No, Finrod, gas is the safety backstop exactly as it is for, Nuclear. What I have demonstrated takes no account for wind wave geothermal PV field or PV distributed. CSP is the perfect companion for wind and other renewables as its inbuilt storage allows for rapid reaction to demand fluctuations. And the SolarPaces system as described specifically nominated dry cooling towers. The total system offers the capacity factor with surplus.

posted 16 May 2010 at 1:48 PM by BilB

No, Finrod, gas is the safety backstop exactly as it is for, Nuclear. What I have demonstrated takes no account for wind wave geothermal PV field or PV distributed. CSP is the perfect companion for wind and other renewables as its inbuilt storage allows for rapid reaction to demand fluctuations.

You have stated that home battery storage isn't an issue because homes will have grid access, and you've stated that 'renewables' storage isn't an issue because the grid will have gas backup, and now you're saying that the gas isn't an issue because you'll have 'renewables' storage backup. Where are you going to try to hide next?

posted 16 May 2010 at 1:57 PM by Finrod

BilB – it's a predictable response from me, because it is a typical set of assertions by you – completely devoid of logical content. Your calculations don't make any sense, and and your assumptions are utterly shallow and indefensible.

You stupid little wannabe, do you think I haven't done the calculations? How do you think I came around to supporting nuclear energy? Most of us here would love the idea of powering our homes and cars on solar panels on the roof, and seeing our industries run on windmills and biogas. Unfortunately it is not to be, and we know it **BECAUSE** we have done the math *AND* we have the education to do it properly.

You are a nobody without any qualifications, trying to blow smoke up everyone's butts, and Fin and I and the rest here see straight through you.

posted 16 May 2010 at 2:12 PM by DV82XL

BilB,

You still have not provided the basis of your estimate, which you undertook to do. I am waiting for you to do so. Then I can lead you through, step by step, why it is a gross underestimate.

The first thing you will need to understand is that if we want a total solar system (which is what you started off saying), we must have sufficient storage to get through the winter, and especially the extended periods of overcast conditions. You'll need to provide figures for the worst case scenario, because that is what we need to design for.

What is the lowest capacity factor for 1 day, 3 days, 5 days, 10 days?

How will you generate the power to meet demand on those days?

If you are now saying that you will use gas to generate through those periods, then we'll need a lot of gas generating capacity. The only saving is on fuel. We'll need the capital cost for the full solar capacity and the full gas capacity.

But the gas capacity will be far more expensive if located at the solar plants than if it is located near the demand centres. We've now moved from needing towns during construction for each solar power station to needing permanent towns at each solar power station. These are needed for the crews to maintain and operate the hybrid power stations. Not only that, we need the gas pipelines to each power station. And the pipes have to be sized to carry the full gas flow for the gas turbines when running at full power. But they will only be used 5% of the time. So the cost per MWh of electricity generated will be very high. Not only do we need pipelines laid across the desert, sized for full power generation, we also need pump stations along the pipelines. So, to build and operate your proposed system, we need:

1. Dams and desalination plants along the coast, up to 2000 km from the power stations

2. Pipelines running from the dams and desalination plants to the power stations. The pipes must be capable of carrying twice the amount of water to each 250MW CST power station as would be needed for the construction of a 1000MW nuclear plant.

3. Pump stations at intervals along the pipelines

4. Transmission lines along the pipe lines to power the pumps

5. gas pipes to each CST power station

6. Towns at each 250MW CST power station. Each town will need to accommodate some 2 to 4 times as many workers as are needed to build a 1000MW nuclear power station. These towns will have to be constructed at the rate of about 5 per year

7. A 'fly-in fly-out' airport for each town. These airports will have to be sized to carry a very much higher traffic volume than those we have at the mining sites.

8. I wonder what else is not included in your estimate.

9. Extending this thought a bit (just for fun!!), the only way we could get the workforce needed to achieve what you are proposing is if the 'fly-in fly-out' workers were coming in from China, Korea, Indonesia, etc.

10. So we'd need airports suitable for jumbo jets. We'd need Customs and Immigration facilities at each CST.

11. And jails for the lunatics that got us into this mess.

posted 16 May 2010 at 2:21 PM by Peter Lang

I realise that you are just tugging my chain here, but,
the CSP has storage built into its design that is what the solar multiple is about. In the extreme impossibility that the country is entirely shrouded with cloud, all the wind stops and the seas are becalmed the CSP system has gas available to power the system. Home battery storage is an option not a necessity until the grid shows signs of instability. Anyway.

The reality is that the entire rebuild of the energy industry is not stalled by renewables it is stall by CCS and the determination of the politicians to squeeze every last dollar from coal, at the expence of all else. We are in a holding pattern while "Clean Coal" has its day.

posted 16 May 2010 at 2:30 PM by BilB

Bilb,

Only my last couple of points are 'tugging your chain'. I am dead serious that you have not understood the real costs of what you are proposing.

There are some more cost to add to my previous post.

1. The workforce could only work on the construction for about 9 months a year because of the heat in the desert. So most costs will be raised by a factor of 4/3.

2. Hourly costs for equivalent will be at least double the cost of working on an NPP in the inhabited parts of the country. (Did you know that a train driver's salary is $180,000 per year in the Pilbara?)

posted 16 May 2010 at 2:48 PM by Peter Lang

BilB – Do you have any concept of the mass required to store the sort of heat you would need to make a CSP system able to store its own heat? Do you even know how much energy is needed to make a pound of steam or how many pounds of steam you would need to produce from that system each and every hour to generate 1GWe? There isn't a practical engineered system in the world that can store that much heat for any length of time

Absence of a decent storage technology means you can't really time-shift electricity demand. When more electricity is needed (for example, to run air conditioning during the day in the American Southwest) more power plants have to be running and feeding power to the grid in real time. There's no way to run plants at night and store the generated power for daytime use.

Transmission losses mean our ability to space-shift demand is limited, too, though not as severely. Electricity-intensive industries (the classic example is aluminum smelting) need their own dedicated power plants nearby.

Talk of linking a vast network of these sources of a large distance, fails to take into account transmission scheduling, control and costs.

The combination of these problems also means you cannot, practically speaking, aggregate lots of very small flows of electricity into one big one. It's not just total volume of energy production that matters, but the energy density available to high-volume consumers at a given place at and at a given time.

This may sound like a dry technical points, but it has huge and nasty implications. Solar and wind power are both time-variable and low-density. Lacking good ways to time-shift and aggregate electricity, this means you can't count on them to run factories and hospitals and computer server farms.

And there is no way anyone with any knowledge of how energy markets work will want to arbitrage that might not be there when the end-users are willing to pay a premium for it, which when you stop and think about will be the very times the sun isn't shining and the wind isn't blowing,

posted 16 May 2010 at 2:48 PM by DV82XL

Peter that is a fair approach.

Items 1 to 4 not necessary. Water for town operations but not cooling towers as the SolarPaces system specifically uses dry towers. Some water is required. As pipe lines yes/maybe
Towns yes
Systems are more likely to be in blocks of 4 gig so bigger towns
Airport (country) is no big deal.
And certainly have fun with it, the workers are very much an issue. I know that I don't want to live in the centre. But there are plaenty who do. You have to realise that towns (cities) servicing energy infrastructure are going to be wealthier locations than most country towns. I find that part of it kind of interesting. These could be towns as never before done.
do recognise that we are over congesting our cities in a destructive manner, with the projected population increase a system such as this could well provide new life to parts of the Country. Much of what you have described has to be built anyway. And that is a whole other discussion.

posted 16 May 2010 at 2:50 PM by BilB

> "Water for town operations but not cooling towers as the SolarPaces system specifically uses dry towers. Some water is required. "

The mirrors will need to be pressure washed every 3-5 days, or the build-up of dust and grime will significantly impair their efficiency. Where does this water come from? Also, what effect will the run-off have on the desert ecosystem? How will it effect plant growth around the mirror fields?

posted 16 May 2010 at 2:55 PM by Barry Brook in reply to BilB

Bilb,

> "In the extreme impossibility that the country is entirely shrouded with cloud, all the wind stops and the seas are becalmed …"

You wouldn't have made this remark unless you haven't read, or if you did you didn't understand, this:
http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/

Akso, have you read the article at the top of this thread. It shows that a mix of renewables costs even more. So we cannot hide from the problem by saying" when the sun isn't shining and the wind isn't blowing we'll use wave or tidal power or some other renewable energy dream.

BilB, you should by now be beginning to realise that you've bought into a religious like belief in renewable energy. If you haven't reached that stage, it is understandable. You are in the position of a drug addict that cannot accept what he is being told. He is in denial.

posted 16 May 2010 at 3:02 PM by Peter Lang

Bilb,

> "Items 1 to 4 not necessary. Water for town operations but not cooling towers as the SolarPaces system specifically uses dry towers. Some water is required."

BilB, once again you either haven't read my previous comments to you or you haven't understood them.

The amount of water required during construction of a 250MW CST is defined by the amount of concrete. That means we need about 4 times as much water for a 250MW CST as we would need for a 1000MW nuclear power plant.

Furthermore, if you want to build a 250MW CST in say half the time we'd take to build a 1000MW power plant, then you'd need to double the pipe and pumping capacity – to 8 times that needed for construction of an NPP.

Can you follow this? Let me know if you want me to explain it again. I previously pointed this out to you in point 2 of my comment up thread: 14 May 2010 at 12.24

posted 16 May 2010 at 3:10 PM by Peter Lang

The mirrors will need to be pressure washed every 3-5 days, or the build-up of dust and grime will significantly impair their efficiency. Where does this water come from?

Perhaps we need to start thinking outside the box on this issue, and not be blinkered by our narrow belief systems. Does the fluid used to clean the mirrors need to be water? We could get around this issue by using supercritical CO2. There is a substantial research effort going into CCS technology for new coal plants, so we can expect to soon have an unlimited source of CO2 to work with. All we need to do is mate a CSP park with an appropriately sized CCS coal station. Not only will we have a clean coal station on site, but we'll also have an adequate supply of mirror cleaning fluid which will disperse harmlessly into the environment after flowing downhill a while. And we can use the coal plant to back up the CSP! You see, we just have to think holistically about things.

posted 16 May 2010 at 3:26 PM by Finrod

BilB,

> "do recognise that we are over congesting our cities in a destructive manner, with the projected population increase a system such as this could well provide new life to parts of the Country. Much of what you have described has to be built anyway."

This is total fruit-loop thinking.

Firstly, no one will want to live in the desert unles they are being paid an enormous amount of money to do so. We know that because we have miners flying in and flying out.

Secondly, the cost has to be paid by the electricity consmer. All these items I've mentioned have to be included in the cost of electricity from the CST power stations.

We are discussing the cost of your proposal. I am explaining to you some of the things you have omitted from your cost estimate.

posted 16 May 2010 at 3:41 PM by Peter Lang

I don't have to know, dv8, it is the European energy people who are developing these systems, but I do have an appreciation of what is involved. I was just having a look at it there and I've discovered that they are probably running their Rankine cycle system on a synthetic fluid rather than water. There are a few clues which put together with the fact that water has a specfic latent heat only exceeded by hydrogen in the short list, suggests a measure to reduce cooling tower energy losses.

Peter L

The heat work item is an issue no less so for me in my factory when the temperature hits 48. So I am owrking on solutions for that (periodically). Apart from that there is a mass of automation being developed for huge CSP installations (airconditioned cab territory)

The train driver thing is a maining industry phenomenon. There was a mine in tasmania where the toilet cleaners were getting a similar figure, nefore the mine shut down.

Some years ago I knew that they were achieving 6 hours storage with concrete blocks. Recently this has all changed to eutectic salts.

The Europeans declare that the storage is certain and I am happy to believe that.

I'll go through your other points later on, because they are all very interesting.

posted 16 May 2010 at 4:16 PM by BilB

BilB, on 16 May 2010 at 16.16 Said:

"I don't have to know, dv8, it is the European energy people who are developing these systems, but I do have an appreciation of what is involved. I was just having a look at it there and I've discovered that they are probably running their Rankine cycle system on a synthetic fluid rather than water. ***There are a few clues which put together with the fact that water has a specfic latent heat only exceeded by hydrogen in the short list, suggests a measure to reduce cooling tower energy losses****"*

First you cannot hold a considered opinion, or even have an appreciation of what is involved in these matters if you do not know the basics. This is illustrated by the sentence I bolded – it is utter balderdash demonstrating you haven't the faintest notion of what you are babbling on about.

Second – if it cannot be expressed in numbers, it is conjecture. Go and calculate how big a mass of concrete blocks is needed to store enough heat to make steam for six GWhre, or do the calculation for the mass of sodium sulfate decahydrate. You will see that the sheer size of the storage would be tremendous, and well outside any practical considerations.

"The Europeans declare that the storage is certain and I am happy to believe that."

Well you are stupid enough to, I am sure. But show me a reference to this declaration – I would like to know why, if it is so good, they aren't using it now.

posted 16 May 2010 at 4:48 PM by DV82XL

BilB @ 16 May 2010 at 16.16
http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-66116

You really don't have a clue what you are talking about.

I'm convinced you have never been on a construction site, let alone worked in the desert.

Totally clueless!!

posted 16 May 2010 at 5:00 PM by Peter Lang

Bilb,

> "I'll go through your other points later on, because they are all very interesting."

Don't waste your time providing more narative. It is all total nonsense.

Instead, provide the basis of the cost estimate you said you could provide.

Once you've done that there may be some chance that you can be educated. Although I seriously doubt it.

posted 16 May 2010 at 5:05 PM by Peter Lang

Bilb,

Some of your comments lead me to believe you may have missed this comment: http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-65306

posted 16 May 2010 at 5:30 PM by Peter Lang

As a current lurker … thanks to the people doing the work (Peter in particular). I'm sure there are plenty of nuke agnostics getting the message on the difference between real costings and fairy floss costings.

posted 16 May 2010 at 6:00 PM by Geoff Russell

In my experience with this character, DV8 and Peter Lang, his advocacy is a cultural preference in search of an engineering figleaf.

He likes micro-energy systems because these smell more pluralistic and local — and thus authentic. He likes CSP because he likes the idea of getting energy from the sun "for free" and not giving the money to big companies. Apparently, CSP will be the province of small business, in his world.

Like the people who deny anthropogenic climate change, he knows he has to sound sciencey, but this is pure handwaving to cover his cultural preference.

posted 16 May 2010 at 7:12 PM by Fran Barlow

Peter and DV:

keep hitting BllB with the arguments, but dial back some on "idiot" and "nitwit." [I'm referring to comments on all the threads].

I read the Quiggan site a bit to see how Peter (not to mention Fran) was treated over there and it was my sense that he was treated like he was an idiot (by BllB, and totally unjustifiably), so I get why there would be anger about this.

Most of us know the dynamic well. When I raise informational points about nuclear on some of my green left lists (not all; some are better than others), I'm told to go FUCK MYSELF (with no moderator intervention). and it actually has an effect. I stop posting for a long while or stop responding to anti nuke disinformation.

Dialing back on insults is very hard to do–especially when we think they are well deserved. I myself have a difficult time. I sort of insulted Peter about his views of the housing crisis and I think he stopped replying to my questions for a while (maybe; maybe not).

There are places for insults: it's really a question of where individuals draw the us/them line and we all draw it somewhere. but it seems to me that the renewables/nuclear us/them, though very difficult to overcome, is especially irrational given the commitment of most in this discussion to reducing ghgs, among other things.

another dynamic I have noticed is that some of us have a tendency to be nastier on our home fields so to speak. As if we feel protected and can therefore insult away. We are polite on other people's turf because no one has our back. (not sure this is the case with our DV, whose self confidence is high and who calls em as he sees em.)

at any rate, I hope people realize the value of this discussion, insults and all.

posted 17 May 2010 at 12:15 AM by greg meyerson

Sage advice, Greg.

posted 17 May 2010 at 12:23 AM by Barry Brook in reply to greg meyerson
Pingback: Learning the truth about energy « BraveNewClimate

greg meyerson – Thank-you. You are quite right. I occasionally need to be reminded of Anglophone sensibilities to this type of minor insult, and that they may have a greater impact than I intend on those watching.

I will be more careful, and do not hesitate to remind me at any time I am letting my language get out of hand.

posted 17 May 2010 at 1:06 AM by DV82XL

Greg,

Thank you for the reminder. I agree with all you say.

BTW, I do not remember anything about the 'housing crisis" comments or discussion you mention. Not the slightest recollection, so no need to worry about that.

As DV82XL said:

> "I will be more careful, and do not hesitate to remind me at any time I am letting my language get out of hand."

Please remind me too.

posted 17 May 2010 at 8:36 AM by Peter Lang

Yes Greg, this is indeed a word to the wise. Most of us slip up with this one from time to time — I know I have — it's hard not to when you feel passionate about something and others are insulting you unreasonably, but it is worth recalling that it's the *something you're passionate about* that you ought to be discussing rather than the ethical and intellectual worthiness of other people.

If you can't set out your problems with what others say without speaking uncivilly, you might conclude that you won't do the best possible job of explaining the problems as you see them.

posted 17 May 2010 at 9:26 AM by Fran Barlow

The thing about insults is they generally have the opposite effect to what was intended. People actually become hardened in their beliefs – however wrong they are.

I heard an interesting radio program the other day discussing the results of a study which showed that the less someone knew about a subject the more certain they were that their answers to questions about the subject were right. Students that got one answer right in ten thought they got 5 or more right whereas knowledgeable students often under estimated their results. Just telling the poorer students their answers were wrong didn't improve their performance.

Once the poorer students were properly educated in the subject they could then see that their answers were wrong (to much embarrassment).

Personally I am convinced this is the problem we have in the nuclear power debate. Those that have studied the subject in depth can readily see the benefits. For those that have not, many would rather believe the rhetoric and can see no reason to become educated so will never be persuaded by insults or being told they are wrong for they know they are right!

However there is a large body of people who are not knowledgeable about nuclear power who may be cautious about it but who can be influenced by education. If we can get enough of those onside then the naysayers will become an uninfluential minority (he said hopefully).

posted 17 May 2010 at 9:37 AM by Martin Nicholson

You were listening to a discussion of the well known Dunning-Kruger paradigm Martin.

posted 17 May 2010 at 9:53 AM by Fran Barlow

Thanks Fran. You are correct – I had forgotten what it was called.

posted 17 May 2010 at 10:14 AM by Martin Nicholson

I've just been sent "The Cost of Transmission for Wind Energy"
http://eetd.lbl.gov/EA/EMP/reports/lbnl-1471e.pdf

Exerpt from the Executive Summary:

> "The total range in unit transmission costs for wind implicit in these studies is vast – ranging from $0/kW to over $1,500/kW. The majority of studies, however, have a unit cost of transmission that is below $500/kW, or roughly 25% of the current $2,000/kW cost of building a wind project. The median cost of transmission from all scenarios in our sample is $300/kW, roughly 15% of the cost of building a wind project.1 In terms of cost per megawatt-hour of wind power generation, the aggregate range of transmission costs is from $0/MWh to $79/MWh, with a median of $15/MWh and most studies falling below $25/MWh."

The figure of A$15/MWh I used in the analyses (see lead article for this thread) is a little lower than this study would suggest.

However, the median cost of US$300/kW is a lot lower than the A$1,000/kW I used, and have been using in my analyses for Australia.

I'd make the following comments:

1. This report puts the cost of new wind projects in the USA at US$2,000/kW. In Australia, the cost is about $2,600/kW (according to ABARE). So 15% to 25% of $2,600/kW is $390/kW to $650/kW

2. I notice that the work this group is doing is largely related to renewables so I wonder if this may affect the results.

3. Australia does not have a transmission system that is as well developed as the USA's. I suspect it will cost us more per MW to build the transmissions system to support wind power projects along our southern coastlines.

4. I'll continue to use $1,000/kW as a rough cost for transmission for wind power, given that my calculatins are of scenarios with a very high penetration of wind power.

5. Can anyone provide an authoritative source of transmissions costs for nee wind power projects in Australia for the case where wind is being extended to 20% to 50% capacity penetration?

posted 17 May 2010 at 11:16 AM by Peter Lang

Greg M,

I got annoyed at Peter L because he refused to register that the answer was in the SolarPaces document, repeatedly. I read his piece, he did not read the other. And that was important because he refused to justify, and to date has still failed to justify his calim that CSP would cost 140 billion dollars per gigawatt. The argument has not gone away, I just have work to do to catch after spending far too long on this sort exercise. I think that it is important to get the bottom of it and for Peter Lang to justify his claim. And yes keep hammering away at BilB, I'm up for it, because I clearly have a better grasp of the issues than you guys collectively do. Work.

posted 17 May 2010 at 11:19 AM by BilB

Bilb,

First, you were arroogant and very insulting from the very first post on the John Quiggin thread, and continued. So I responded in kind.

Second you said you could justify your estimate, and then continually reneged on that undertaking.

Third, the full basis of my estimates are laid out in the papers. I have referred you to them repeatedly. You haven't read them yet, despite me reminding you repeatedly. So much of your criticisms and preconceived ideas are because you haven't read them (and didn't read the first one with an intention to try to understand).

Fourth, I did read the paper you are relying on and did include comments on it in the two posts I put on John Quiggin's web site. The tow posts were subsequently deleted, but are posted on this thread (14 May 2010 at 12.21 and 12:24)

Fifth, I have pointed you to those and other comments repeatedly. But you don't seem to read them.

Sixth, I've said repeatedly, that once you provide the basis of your estimate, which you undertook to do, I'll lead you through what is wrong with it.

Seventh, can I suggest you take some time to get up to speed on energy matters. A great place to start would be to go to the "Renewable Limits" tab, at the top of the page, and start reading the linked papers, from the top.

posted 17 May 2010 at 12:01 PM by Peter Lang

BilB,

Can I suggest:

1. read; http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-65305 and http://bravenewclimate.com/2010/01/09/emission-cuts-realities/#comment-65306

2. read: http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/ including the appendix

3. read: the lead article to this thread

4. Fullfil you undertaking to provide the basis of your estimate of $180 billion as the capoital cost of CST to meet the NEM's 2007 demand.

posted 17 May 2010 at 1:21 PM by Peter Lang

Barry Brook

Yes the mirrors do need cleaning (it should be noted that that water does not necessarily go to waste), and the only real argument is the effect of CSP on the desert ecosystem. By all accounts this is small. Keep in mind that the area required is of similar scale to the hunter valley open cut coal mine, and dwarfed by iron ore mining. Australia doesn't seem to care.

Peter Lang

All of your points are unqualified guess work. The biggest single cost in a CSP installation is the turbine house. In an installation using salt for storage the amount of concrete is not of the scale that you have "imagined". One thing about CSP is that it does contaminate its foundations with radioactive seepage as nuclear plants seem to do.

Peter L, feel free to insult away, that is understandable with this highly emotive topic. But most importantly stick to facts and reality. Unlike your comment above where you admit that your costings are inflated 3 fold over reality base on REaL research, which once you had read you decided to stick with your infalted costings on power trasmission.

You do without realising that you shoot the nuclear arguement in foot, simply because the only real chance that Nuclear has of getting a foot hold in Australia is to put it as far away from populations and our very essential mountain range bounded coast line as possible. This obviously requiring the HVDC trunk line as does CSP eventually.

But otherwise you clearly haven't got the foggiest clue as to the costs of building a CSP installation, despite the fact that information is readily available.

What is the mirror area per sq klm
What is the cost of production and installation
How much steel is there really
What is the energy yield per sq klm
What is the cost of the turbine house
What type of turbines are they
What is the cost of storage
How much storage is required
What is meant by a hybride system
What is the ideal field size
What are the limitations for field design
What are the solutions for the field layout limitations
Where are the future efficiency improvements
What is the efficiency scope for those improvements
What is the life of a solar field
What are the operating considerations
How many staff are required
How are operating costs managed
What is the scope for reducing operating costs
In what manner will that be achieved
–
–
–
–

When you can answer all of those questions you will be able to start to make believeable pronouncements on the cost of CSP systems. Until then You are all wind.

posted 18 May 2010 at 9:08 AM by BilB

That should be…does NOT contaminate its foundations..

posted 18 May 2010 at 9:10 AM by BilB

BilB,

How can I respond to this heap of unsubstantiated assertions, intermingled with many insulting comments. You apparently have not read the links I provided (that provide the basis of the estimate for CSP including cost of power block etc). You haven't read or aunderstood any of the links I've provided. You havent understood any of what has been said to you in commentsd by me and others. You believe what you are reading about CSP because it suits your belief.

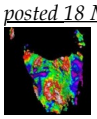
> "Unlike your comment above where you admit that your costings are inflated 3 fold over reality base on REaL research, which once you had read you decided to stick with your infalted costings on power trasmission. "

BilB, that is one study amongst many. Based on all the studies and analyses by specialists within the industry, and the fact they use a rough rule of thumb of $1/W for transmission for wind in the early feasibility investrigation stage, I am sticking with the $1/W rather than this pro-renewables study. If I get better information from within the industry, I'll change, but not based on just one academic report.

You certainly have a lot of emotion tied up in your belief in CSP. If you would provide the basis of estimate for your $180 billion figure, as you undertook to do, then I could begin to lead you through it. It would be interesting to see what figure we end up with. Are you scared to try?

Why have you avoided looking at this? http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/

posted 18 May 2010 at 9:39 AM by Peter Lang



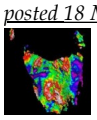
@BilB

> When you can answer all of those questions…
> ""

This is just breathtaking. Who is the CSP advocate here? That would be you, BilB. I'd have thought that casts a fair bit of onus in your direction.

Oh, and when/if you're answering questions, would it kill you to provide a hyperlink or two? Phrases like 'by all accounts', 'seems to' and, most egregiously, 'that information is readily available' don't cut it.

posted 18 May 2010 at 9:42 AM by Mark Duffett



I did like the nice irony of your "you are all wind" line, though. However, on reflection, a brighter spark should have focused on generating some more powerful substantiation to dish out.

posted 18 May 2010 at 9:53 AM by Mark Duffett

Peter L

One thing that I forgot to comment on with the GenII PV, is that because of its special construction it still keeps generating electricity on cloudy days, obvioulsy at a much reduced level. It is also seasonally self compensating. Total energy output drops but electrical output stays much the same. It is a beautiful system, assuming physical tests match the theory.

posted 18 May 2010 at 10:05 AM by BilB

BilB,

All your unqunatified and unsubstantiated assertions are totally meaningless. They are simply assertions. What we need is your basis of cost estimate. That is what the disagreement is about. That is what we need to get into. It is all about the cost. Do you intend to provide it?

posted 18 May 2010 at 10:08 AM by Peter Lang

BilB, this can be quantified as the capacity factor of the system, as an annual average if seasonal compensation is important.

Can you tell us what the (yearly average) capacity factor of a GenII PV system is, relative to available commercial systems?

posted 18 May 2010 at 10:11 AM by John Morgan

Not so Mark,

Peter made a declaration of "overriding" understanding, and then stubstantiated that, not with substance, but his professional standing as an energy R&D manager and advisor to government. He then repeatedly maintained that his paper contained the answers, which by my reading of it bore absolutely no relevence to the claims on CSP. That is why he came in for derision. If he were a politician pulling this stunt he would be torn to shreds by the media. You guys have got to be a whole lot smarter than what is going on here.

The onus is on Perter to prove that "he" is the thing that he declares to be. Iam not seeing it yet, and you would surely have to see that I am doing him a favour.

posted 18 May 2010 at 10:14 AM by BilB

BilB,

You haven't read the papers!!!!! You do not read the comments nor follow the links. You do not have a clue what you are talking about.

Are you going to fulfill your obligation to provide the basis of your estimate of $180 billion as the capital cost of CST to meet the NEM's 2007 demand?

If you don't intend to do so, can you just say so, please. Then we can stop all this nonsense.

posted 18 May 2010 at 10:23 AM by Peter Lang

BilB, why do you care who Peter is? We're not arguing about who you are, that is irrelevant. Simply read his paper and tell him where he is wrong – or which particular assumption(s) you object to, why you object to them, and offer a replacement assumption that can be better justified.

> "Yes the mirrors do need cleaning (it should be noted that that water does not necessarily go to waste), and the only real argument is the effect of CSP on the desert ecosystem. By all accounts this is small. Keep in mind that the area required is of similar scale to the hunter valley open cut coal mine, and dwarfed by iron ore mining."

This has answered nothing, and the comparisons with open cut coal mines and iron ore mines are meaningless, since we are talking here about demand for lots of fresh water in a remote desert. You still don't say where the water is going to come from, or how it would "not go to waste", or where the "by all accounts" is justified when saying the effect on desert ecosystems is small. To date, your statements are vacuous.

posted 18 May 2010 at 10:29 AM by Barry Brook in reply to BilB

The GenII PV is domestic and small business system with extremely compelling economics. I am market testing suitability and so far, very positive. GenII PV is going to create capacity problems for which the solutions are best handled with CSP, but frankly, I don't care how the grid system copes. The dynamic energy management system that will come as standard with the GenII will have the ability to manage a household through extended non solar periods by intelligently controlling system configuration and energy useage.

posted 18 May 2010 at 10:32 AM by BilB

John Morgan,

Just a reminder, the cost estimate is based on the system with capability to provide baseload power (fully dispatchable with required availability factor; eg 90%) throughout the worst case conditions. For example, it must have the required availability throughout 1 day of worst case conditions if it has only 1 day of storage.

posted 18 May 2010 at 10:34 AM by Peter Lang

Barry, Peter made an outlandish claim in another forum, which is similar to "going Public". It is one thing for you guys to develop your arguments and ideas here, it is another to start extending the range of your influence. Before you do that you should really make sure that your arguments stack up properly.

Lots of fresh not necessarily so. I believe that there is a system being developed that recycles all of the cleaning fluid. It works in reverse by spraying at the perimeter and draws the fluid towards the centre in a tornado fashion, but the cleaning cavity is quite thing so the fluid surface residency time is quite high and the tests are also examining integrated repolishing along the lines of "ooze polishing". There is alot of development under way. Much of the Saharan Desertec is coastal where water is less of an issue.

On the desert flora and fauna impacts (not my subject an all), fauna is relatively unimpeded and with better shade fed by insects that are definitely unimpeded, and flora still coexists but in a bonsaied form, as I understand it. Though you would have a far better insight into these issues .

Hopefully a little less vacuous.

posted 18 May 2010 at 10:48 AM by BilB

Since I'm supposed to control myself, I'll only jump in for a moment to point out that all this BilB character is doing now it trying to throw sand in everyone's face so they won't notice he has run out of anything to say that is of any value. He knows he's been cornered, and is fighting now, not to convince anyone here but to try and re-convince himself. He is beaten, and he knows it, he just won't accept it. and is only trying to salve his wounded ego.

Personally, I have wasted enough time on this cretin. I will not comment further.

posted 18 May 2010 at 11:24 AM by DV82XL

Peter you are not listening, My argument is backed up by the SolarPaces published infromation which puts the cost of baseload CSP at 6 billion dollars/euros per gigawatt. That time 30 is 180 billion. Considering that any system, no matter what it is will be built over a 30 time frame, practical experience ained along the way will determine the ultimate configuration of the system. If capacity factors require a 50% larger installed capacity then that would take the cost to 270 billion, not 4200 billion as you have claimed. Your NEM's 2007 argument is a red herring as I have said and all other authorities on the subject of solar energy have said, solar has a different delivery pattern and the peak delivery is in the middle of the day not the middle of the night. Furthermore the advanced metering being installed today has the ability to dynamically alter the off peak (demand) consumption.

However peaks aside the Solar Paces system is designed to deliver near constant power, with the ultimate backup coming from gas firing. I know that does not suit you as it is a total solution, exactly as it was designed to be. In solar multiple systems average gas firing energy amounted to 13% over years of experience. In the solar multiple 4 system that figure is likely to be between 2% and zero annually.

The last time that there was extended cloud cover over the centre was in 1998 when 2 pressure systems channelled moist air from the North West diagonally across Australia to saturate the East, and this held up for 6 weeks straight. That was the last time that Warragamba dam was full to capacity.

So your scenario can occur, but it is very rare, and fully catered for with the Hybride CSP configuration aided by, in future, wind generation and hydro which are powering at full capacity under those circumstances.

posted 18 May 2010 at 11:30 AM by BilB

Go on dv8, let it all out, but stick to substance.

posted 18 May 2010 at 11:37 AM by BilB

You've nailed it DV8 … even at the Quiggin site, BilB's "defence" was to attack me rather than defend his own claims about the efficacy of CSP.

And here, he cites no data at all, offers no links to data he regards as robust in its pertinent detail and covers with "by all accounts".

The onus is surely on him, the proposer of an alternative to the current system to show that it can do the job of the technologies he proposes to retire at an economically acceptable cost.

It is undisputed by him that nuclear power can do this job, as it does so in many countries, though in Australia, it is still politically in the too controversial basket.

This is something with which he simply will not engage because he is emotionally connected with the notion of renewables.

posted 18 May 2010 at 12:02 PM by Fran Barlow

Fran,

There is only one source required here, and that is the source which you supplied, and that is the information made available to you as a result of your direct inquiry Dr Franz Trieb and the European energy organisation which he represents.

You are right I am intellectually connected to solar power solutions, but wrong in that it is an emotional attachment. Just as your collective connection to the nuclear solution is intellectual rather than emotional. Conceptionally the nuclear solution is elegent and compelling, practically it is problematic. But then all systems are problematic. It all comes down to which set of consequences will we live with best.

posted 18 May 2010 at 12:16 PM by BilB

Peter, I understand your point. What I'm getting at here is the GenII PV advantage BilB describes looks like it should appear as an uprated capacity factor. Suppose the CF goes up by 10%. Great! But we're looking for much larger improvements before the decision over which technology to pursue would change.

BilB: you say this system is "seasonally self compensating". What do you mean by this? Do you mean the system automatically reduces its output in response to lower light levels? Perhaps you mean it tracks.

You also state "Total energy output drops but electrical output stays much the same."

This is inherently contradictory. The energy output of the PV system is electrical – you are saying its total energy output drops but its energy output stays the same.

GenII will have the ability to manage a household through extended non solar periods by intelligently controlling system configuration and energy useage.

From this I take it that where you say the seasonal compensation and the output stays the same even though it drops, you mean the energy output *actually* drops and the household or business has to live within the reduced energy budget.

A householder may choose to, but this is the sort of shell game you cannot play with the grid powering society as a whole. But lo,

frankly, I don't care how the grid system copes

Aha. We do, and you should.

posted 18 May 2010 at 12:18 PM by John Morgan

John m, yes it does track. It has other properties that do exist to some degree in regular pv but are not utilised.

Yes, in extended non solar (that does not include winter) if the user is not grid connected then they have to live within the reduced energy budget (and before you leap onto that recognise most people will use this on grid, that is the intention). That is not as hard as it might seem as proper analysis of user needs reveals a very low energy consumption most of the time. Also this requires a significant battery such as a recycled EV battery pack.

I don't care because it will be a long time before it matters, at least 15 years, and considering the energy action intransigence there is little point in configuring strategically for the future now other than to seek out the best options from a personal point of view. This is the area that the GenII PV will be aimed at. This system style has the ability to provide 50% of Australia's electricity. It is in that context that it will provide capacity fluctuations.

6 months ago I was talking PV down. This is a whole different thing.

"and you should"

In the CSP sense I do. Capacity is totally covered in the system as described. There is no knockout blow for CSP there.

posted 18 May 2010 at 1:19 PM by BilB

The more that I think about it Nuclear's best shot is in the centre. This resolves the a number of key barriers. The risk to the coastal fringe and its premium land value and tourism value. In the so doing the insurance feature is minimised. Other items I can't be bothered to think out.

All you have to do to win this battle is reframe your argument in a manner that suits other peoples needs rather than your own.

But don't expect me to not battle against it.

posted 18 May 2010 at 1:29 PM by BilB

BilB, thank you for that explanation. I wholly support individuals acting to reduce their individual greenhouse gas emissions, and for bringing in solutions as soon as they become available.

At the same time, I do not expect voluntary action at the individual level to be much more than a marginal contribution to our greenhouse gas reduction target (of 100%), because too few individuals will be sufficiently motivated to reduce their emissions completely, and fixing the domestic sector does not fix industrial or transport or other sectors. The main game is to get the grid sorted out. So this sort of system, while worthy, is not our solution.

How much does one of these puppies cost, batteries included? Whats its output? What would it cost to generate 50% (say, 12 GW) of our electricity using these systems? Is there another way we could spend that money that would give us more clean power, faster?

These are the questions we are trying to address here, and hopefully come up with a better alternative than assuming nothing will happen for fifteen years.

posted 18 May 2010 at 2:18 PM by John Morgan

What we are designing is a system with a rated electrical output of 10Kw. To achieve that, we have to take in 28 kw of energy and dispose of the other 18. We have a lot of control over what form the other 18kw takes. The other 18 kw is suitable for space heating, airconditioning, and water heating house and pool, as well as for energy storage.

That is as far as I am prepared to go with out describing the system in detail. We are targetting a price of 15 to 20 thousand for the main system. The airconditioning which has not been built for this scale before has an uncertain price at this stage. I am hoping fo 6 thousand. Recycled EV batteries I have no information but there is a Dutch researcher who has done a definitive study on the subject. Probe around.
Assuming that this system works as we believe it will particularly enhanced with the prospect of charging EV's (VW Milano as the standard model) it becomes very compelling. I was just checking my factory electricity bill here. I used 23612 units in a year which cost at the current retail rate of 17 cents is 4700. This system is viable at that pricing level, however if electricity rises to the projected 25 cents then that becomes 7000 dollars and the GenII PV becomes a shoe in. I would install 2. And the airconditioning would be a very welcome bonus.

On that basis it is not inconceivable to propose 6 million units installed over 30 years.

The beauty about this is that it only involves private funds which are covered against avoided electricity expenditure. There is no drain on the public purse, and it measureably reduces the size of the industry restructuring cost, along with its gross turnover. So with the increased population and the shift towards more electricity consumption and the necessary system overcapacity required I think that the industry turnover will remain static in the medium term.

The GenII PV once paid out provides free electricity there after for the owner so when there is an overcapacity those suppliers are going to be the ones who lose. Independent brokers may find a niche by installing flow batteries which can store 20 watt hours per litre with a possible 40 watt hours per litre with other chemistry to soak up surplusses for sale at opportune times. I have not run any numbers to verify if that makes sense.

My output calculation is based on Sydney with 256 days at 7.5 solar hours per day time 10kw per solar hour. We have a lot of design flexibility to ensure that that output can be achieved.

That should give you enough in formation to include as a possible outcome for your "future" modelling.

posted 18 May 2010 at 3:05 PM by BilB

BilB, on 18 May 2010 at 13.19 Said:

> "There is no knockout blow for CSP there."

Yes there is. The knockout blow is that CSWP cannot supply baseload power. There is not a single CSP plant anywhere in the world that can provide baseload power. As the paper that BilB relies on clearly admits (page 6):

> "The comparison shows that CSP can become fully competitive between 2020 and 2030, and can later contribute significantly to stabilize global electricity costs."

In other words, some time in the way-off, never-never, CST may be economic to do something, perhaps!!

posted 18 May 2010 at 4:36 PM by Peter Lang

Your entitled to draw that conclusion Peter, because that is how it is worded. The reality is as I understand it that is that that statement is based very much on orders. When I spoke to Trieb last, several years ago, there was a total of 3 gigawats installed in the world (I think that is how it went) but none of the installations on order were significant enough to achieve the best installation economies. It is about commitment. At the moment there is only minimal commitment for every technology, every where but China.

The Chinese 2 gig installation will be the primary test for full scale CSP.

But having read that much I hope that you took in the full intention of the paper.

posted 18 May 2010 at 4:53 PM by BilB

BilB,

You've misunderstood, again. We are talking about baseload CSP. Do you understand what that means?

posted 18 May 2010 at 5:10 PM by Peter Lang

Peter, I know exactly what baseload means. You do not get baseload without system mass. Hybride CSP with storage delivers baseload even in modest scale. But is of little value in modest scale and

http://www.renewableenergyworld.com/rea/news/article/2010/01/esolar-to-build-2-gw-of-solar-thermal-in-china

is and example of slow commitment (this turns out to be tower solar). Far from the roaring dragon I expected, even this is going to be slow. It might add light on Trieb's projection time frame. It is not capability it is commitment.

posted 18 May 2010 at 5:26 PM by BilB

BilB,

So now you admit that all the nonsense you've been spruking up to now is just that – nonsense.

Furthermore, I take it that you now realise your estimate of $180 billion for CSP to supply the NEM's 2007 demand is nonsense too, because CST cannot do the job at any cost. It is impossible. In fact it is unlikely it will ever be able to.

You will notice that the paper on CSP (that you haven't yet read) qualifies the figure of $2,800 billion by pointing out this is a theoretical figure because CST cannot meet the requirements at any cost. In case you do want to read it, it is here: http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/

posted 18 May 2010 at 5:40 PM by Peter Lang

BilB,

Now that you've realised that you don't have a clue about what you are talking, and you've realised that your estimate is ridiculous, it would be courteous if you could pluck up the courage to go back to the John Quiggin web site, point out that what you said is baseless and apologise to me, Fran and the others you insulted.

Then perhaps you might have the courage to apologise to all the customers you've misled.

Then walk into you bosses office and resign.

posted 18 May 2010 at 5:56 PM by Peter Lang

Peter ,

You clearly did not understand the information. There is no rocket science there, it is really basic. Four systems from standard field to full baseload, 4 prices, how can you not understand that?? Fortuneately you have retired and are no longer a threat to industry.

posted 19 May 2010 at 5:10 AM by BilB

Well I just read through it a gain. You need a new computer because the one you are using appears to be jumbling up the words. There is no way you can draw conclusions as you have. Maybe you're partially dislexic, Peter, and have never been diagnosed.

posted 19 May 2010 at 5:29 AM by BilB

Peter,

What I've decided to do here is put the documents together with your conclusions and send them to a friend who is a geologist with a masters degree from UNSW and has done both government and private work. He has managed some high profile enevironmental cleanups and now works as a kind of globe trotting trouble shooter for a major US environmental organisation. He is pro nuclear.

The question will be are the claims made in your JQ comments supported by your study. And are your statements generally reconcileable with the 2 documents.

Let one of your peers judge.

posted 19 May 2010 at 7:45 AM by BilB

BilB,

I look forward to your friend's contributions here.

posted 19 May 2010 at 9:10 AM by Peter Lang

BllB: if you are going to insult Peter, calling him dyslexic, get the spelling right because dyslexics have trouble spelling and you don't want the insult to backfire.

(good natured ribbing)

posted 19 May 2010 at 9:39 AM by greg meyerson

That is my own special form of dyslexia at work.

posted 19 May 2010 at 2:11 PM by BilB

I see the debate has gone on in my absence. I shall resume my engagemnent with it (if it's still going on) after I have returned from the necessary formal events relating to this:

http://channellingthestrongforce.blogspot.com/2010/05/in-loving-memory-of-iris-margaret.html

Should be back into it late Saturday evening.

posted 19 May 2010 at 6:43 PM by Finrod

Just for interest, I decided to update my calculations of the ratio of concrete and steel for a Concentrating Solar Thermal (CST) power station compared with a nuclear power station.

I used the figures from the NEEDS studies for the CST reference technology and for nuclear. These figures are probably about as comparable and authoritative as we can get.

I've calculated the tonnes of concrete and steel for 1, 3, 5 and 10 days of full power generation. This is for the case when there is sufficient insolation to generate full power throughout the day but insufficient to store energy. So the generation at night is from storage.

This is a very simple, approximate calculation. Many variations are possible. We could argue about which technology to use for the calculations, what may be possible in the future and lots more. This calculation makes one huge simplifying assumption: there is no heat loss from energy storage over periods of 1, 3, 5, or 10 days! If we properly allowed for the heat loss from storage, I'd expect the mass of materials (such as steel and concrete) would be more than I've calculated here.

The following table shows the number of days of storage and the ratio of the mass of concrete and steel(CST/nuclear).

days Concrete Steel
1 6 20
3 16 57
5 26 95
10 51 190

This means, a CST system with 1 day of energy storage would need 6 times as much concrete and 20 times as much steel as a nuclear power station of the same capacity.

These are little changed from the previous analysis. The analysis in the lead article (Table 5) had the ratio as concrete = 8.1 and steel = 14.6.

The implications for the amount of water needed to build the CST (for concrete), the size of the work force, the size of the construction town and the 'fly-in fly-out' airports for each are little changed.

References:
NEEDS (2008), Table 7.3,
http://www.needs-project.org/docs/results/RS1a/RS1a%20D12.2%20Final%20report%20concentrating%20solar%20thermal%20power%20plants.pdf

Needs (2007), Table 15
http://www.needs-project.org/docs/results/RS1a/RS1a%20D14.2%20Final%20report%20on%20nuclear.pdf

posted 19 May 2010 at 10:10 PM by Peter Lang

A way to interpret the 1,3, 5 and 10 days of energy storage is that the CST has the same availability as a nuclear power plant through 1, 3, 5 or 10 days of continuous overcast weather.

Sorry the table isn't very clear. The last line of the table would be interpreted as follows: a CST with storage capacity for 10 days of ful power generating would need 51 times as much concrete and 190 times as much steel as a nuclear power station of the same capacity.

posted 19 May 2010 at 10:36 PM by Peter Lang

I understand, yesterday, 18 May at 18:35, the total output from the wind farms conected to the NEM was just 0.6% of capacity. This is roughly at the time of peak demand (I haven't checked, I've just been told). See: http://windfarmperformance.info/

posted 19 May 2010 at 10:56 PM by Peter Lang

I need to correct my statement of last night about the performance of the NEM wind farms. This is what I should have said:

1. The following refers to the 1609 MW of NEM wind farms where the 5-minute output data is available from the AEMO web site.

2. On 17 May 2010 the average output from these wind farms was 31MW (CF= 1.9%)

3. On 18 May 2010 the average output from these wind farms was 16MW (CF = 0.97%)

4. On 17 May 2010, the output between 18:00 and 19:00 was 18MW (CF = 1.11%)

5. On 17 and 18 May there was negative generation for 67 5-minute periods. That is, the wind farms were drawing more power than they were generating.

Ref: http://windfarmperformance.info/

posted 20 May 2010 at 10:53 AM by Peter Lang

I tried to post this on the BZE web site, but the site does not accept comments or questions.

Questions about "The Zero Carbon Australia 2020 Stationary Energy Plan" by Beyond Zero Emissions

Could you please answer some questions about how the cost estimate of $370 billion has been derived. Given that modern society demands a power supply with almost 100% reliability the following questions arise:

1. What are your assumptions regarding what generating stations will be providing our 25GW average power and 33GW peak power (2007 figures for NEM) in July under the most unfavourable weather conditions? The most unfavourable weather conditions might be something like most of the solar power stations covered by cloud, and these conditions prevail for several days. What are the worst conditions you have assumed and where will the power come from under

such conditions?

2. If we assume that, say there has been little wind energy and the eastern Australian power stations have been under cloud for several days, and only the two Western Australian solar plants are generating, does that mean that every power station needs to be sized to generate the full 25 or 33 GW of power, or half that amount, etc. If not, then what size does each power station need to be sized at to ensure we have 99.997% reliability of our power supply.

3. Do the transmission lines need to be sized to carry the full power from every power station? For example, would the transmission line from WA to eastern states need to be sized to carry the full 25GW (or 33GW peak) power for the situation where only WA is generating significant power? I realise the situation will not be the absolute extreme, but could you please explain the assumptions and also explain what is the basis for these assumptions.

4. Does your cost estimate fully allow for the cost of infrastructure to support the construction of the solar power stations? For example, what is the cost of getting sufficient water to each site given that a solar thermal plant requires some 6 times as much concrete as a nuclear power plant of the same capacity, so the solar plant needs at least 6 times as much water? Does your cost estimate include the cost of dams, desalination plants, pipes, pump stations to get the water to each power station? Similarly, what is the cost of constructing and maintaining the construction towns, roads and 'fly-in fly-out' airports for each town given that the construction workforce will be some 10 times the size of the work force required to build a nuclear power plant of the same capacity?

5. Where will the workforce come from? If we think it will be a huge task to build nuclear power plants at the rate needed to decarbonise, how can we possible provide a 10 times larger work force to build solar plants?

posted 20 May 2010 at 12:35 PM by Peter Lang

Peter Lang on the E-W connector I think it might have to earn $450m a year to pay for itself. From Norseman WA to Pt Augusta SA is about 1400 km. At $3m/km that's $4.2bn. Add $100m converter stations at each end with some junctions or feeders in the middle, possibly with convertors. Apply 10% required rate of return. The unit cost will depend on total electrical flow.

While the economics is dodgy now I believe in 20 years the gas supply situation will be dire in SA, Vic and Tas. The west will have no trouble sending peaking power across. By coincidence it happens to fit in with a Ceduna NPP and some of BZE's ideas, with Siemens apparently onside.

posted 20 May 2010 at 3:56 PM by John Newlands

John Newlands,

> "At $3m/km that's $4.2bn."

What capacity is the $3m/km figure for?

The economics isn't just dodgy, it is ridiculous. You may recall the cost of transmission alone for CST is about 50% more the the total cost of nuclear to provide all our power (in 2007). Detalis explained here:
http://bravenewclimate.com/2009/09/10/solar-realities-and-transmission-costs-addendum/

posted 20 May 2010 at 4:34 PM by Peter Lang

Basslink at roughly 300km underwater transmits 500MW either way with limited higher performance. It was sold for $1.2bn including the converter stations which I surmised worked out at (300 X $3m) + (2 X $150m) or similar. Then someone whose name I can't remember said on this website that above ground HVDC that can transmit 1 GW would cost $3m per km and HVAC would cost $2m.

I suggest by 2030 or so most of the gas fired plant in SA, Vic and Tas won't have affordable gas. That includes Adelaide's 1.2 GW Torrens Island baseload station which is Australia's largest single gas user. A NPP at Ceduna would need 700 MW just for 'local' use including Olympic Dam. Whether it should export a surplus is an open question. Thus conceivably SA-Vic-Tas could want 2 GW or more of gas replacement power, both baseload and peaking.

An E-W connector might need to routinely transmit well over 1 GW and sometimes several times that. That probably means that the rest of the system has to be beefed up so the cost of the long stretch is barely a start.

posted 20 May 2010 at 5:14 PM by John Newlands

Building gas fired power stations in WA and transmitting power to eastern states seems almost as nuts as building solar and wind power stations. Surely Australia will get over its anti-nuclear belief before anything like this happens. I hope.

posted 20 May 2010 at 5:30 PM by Peter Lang

Peter,
Your calculations on concrete are questionable in various ways. For starters the primary information is based on assumptions, secondly it takes no account of new techniques, thirdly it takes no account of the lives of the various systems. On the life consideration Nuclear plants have a very distinct life time frame due to the consequences of neutron action (a problem also for fusion reactors). CSP on the other hand has an indefinite life which can conceivable stretch into hundreds of years. This angle of attack against renewables is a triviality.

posted 21 May 2010 at 8:37 AM by BilB

BilB,

I look forward to you providing some specifics so we can deal with them. It is impossible to discuss general statements like "Your calculations on concrete are questionable in various ways. For starters the primary information is based on assumptions, …"

CST has a design life of 20 to 30 years. Nuclear 40 to 60 years. The Gen ii plants with 40 year design life are now having their lives extended to 60 years. Meanwhile, here are some photos of 'decommissioned' solar and wind farms: http://webecoist.com/2009/05/04/10-abandoned-renewable-energy-plants/

I am still waiting for you to provide the basis of your cost estimate of $180 billion for CST to supply Australia's power, as you undertook on the John Quiggan web site to do. Once you have provided this I'll be able to explain to you why your belief in CST is based on flawed assumptions.

posted 21 May 2010 at 9:17 AM by Peter Lang

BilB, once again,

* what assumptions do you object to? What are your preferred alternative assumptions?
* What new techniques do you refer to? How do they alter the estimates?
* What lifetime do you think should be attributed to nuclear plants?
* What (definite, not indefinite) lifetime do you attribute to a capable CSP system?

Just throwing out unquantified, unargued statements like this is vacuous.

posted 21 May 2010 at 9:22 AM by John Morgan

Just for interest I've done a quick calculation of the mass and foot print for energy storage using Vanadium Redox flow cells (VRB). If we assume we need 25GW of power and we need storage for 18 hours per day, and we need this amount of storage for 5 days at every power station, so we have power supply throughout periods of overcast conditions, then the mass, footprint and cost are:

Mass: 290 Mt
Footprint: 180 km^2
Cost: $1,575 billion

Double those figures if we want power supply throughout 10 days of overcast conditions.

posted 21 May 2010 at 10:58 AM by Peter Lang

Via Crikey I've read Environment Victoria's proposal to replace the 1600 MW Hazelwood brown coal fired station with 1180 MW of combined cycle gas at 65% capacity and 1500 MW of wind power at 30% capacity
http://www.environmentvictoria.org.au/sites/default/files/Exec%20Summary%20Fast-tracking%20Victoria's%20clean%20energy%20future%20to%20replace%20Hazelwood.pdf
They present an additional scenario with demand management. They claim to reduce Hazelwood's annual CO2 emissions (elsewhere cited at 17 Mt) by 13.5 Mt, an impressive 80% reduction. Whether or not their calculations are correct I'd make some sobering points
1) the State has other brown coal burners like Yallourn and Loy Yang
2) brown coal evidently costs them 60c a gigajoule ($6 per tonne with 9.8 GJ) whereas gas probably costs $6 a gigajoule
3) Victoria exports gas to South Australia and Tasmania's gas comes from the Gippsland coast. No new major gas discovery has been made for years.

Therefore I suggest there are some whopping electricity price hikes in the pipeline if Hazelwood is retired. When the current electricity supply contracts run out for the Pt Henry aluminium smelter (ignoring the small Anglesea station) it may no longer be competitive with many of its rivals if it relies on gas power.

posted 21 May 2010 at 12:26 PM by John Newlands

There is another huge hole that has developed in your original paper on the Queenbeyan solar demonstration installation. As you have provided absolutely no specification information on the system there are unanswered questions. One is the efficiency of the panels installed, minor issue. Major issue is the nature of the inverter system. Most people assume that PV systems generate power and then all of that power is converted to electricity for use. Not so. Most commercially available inverters are struggling to be 90% efficient under full load. As the load drops away so does the conversion efficiency, to as little as 40%. Your reporting of the winter energy yields dropping away to near zero troubled me as this should not happen as a result of reduced winter solar strength. So it turns out that the drop in winter energy yields is a result of reduced solar eposure due to cloud cover, poorly arranged panels for the winter period, then compounded by inefficient inverters. You have then taken those extremely distorted figures and magnified the error by applying them to systems that do not convert energy electronically and are not subject to such efficiency losses.

What can I say. Your errors as they are exposed continue to devalue your conclusions exponentially.

posted 21 May 2010 at 12:44 PM by BilB

John Newlands,

Good points. There is lots to discuss here. The first one that jumps out at me is: why isn't Environment Victoria suggesting that Hazelwood be replaced by 100% solar and wind? If they believe solar and wind are viable baseload options, why do they need gas?

posted 21 May 2010 at 12:44 PM by Peter Lang

BilB,

Read the cited references if you want to know more about the Queanbeyan plant. It is built and owned by Country Energy and this and another similar one were built as state of the art at the time as part of an RD&D program with research organisations.

Similarly low capacity factor during the most heavily overcast days in winter are experienced on other solar power stations too.

I recognise the worst case scenarion will not be quite as bad in the desert regions. However, what is the worst case scenario? What are the figures? Do you have access to such figures?

When are you going to provide some actual data to back up your assertions. I've asked you previously to provide the detailed output readings for CST power stations. You haven't yet done so. What is the minimum capacity factor experienced during operating hours? If you can't do any better than make unsubstantiated assertions, your comments are of no value. They are simply your belief.

posted 21 May 2010 at 1:03 PM by Peter Lang

Calling something "state of the art" does not make it efficient or even relevent to the final conclusion. There is nothin quantitative about "state of the art". You can't even be sure that that is the case without full specification examination. I can understand that a geologist might not think to consider that such specifics are significant. Now what else has been overlooked?

posted 21 May 2010 at 1:29 PM by BilB

BilB,

When you can provide some better data than I have used, and your basis of cost estimate, we'll have something worth discussing. Until then, there is no point in continually writing unsubstantiated assertions. I think you are trying desperately to justify and defend your belief, and you realise, but can't admit, you've been propogating an irrational belief and misleading all your customers. That is why you are trying so desperately, but without anything to support your argument.

posted 21 May 2010 at 1:42 PM by Peter Lang

Peter,

So far I have identified systematic errors in you analysis that devalue you conclusions to 10% relevence to the extended conclusions that you have drawn, which are then fall further in to uncertainty by you admission that you take worst case data at every opportunity. But I am pretty sure that there are more errors here, but it might require a reverse error corrected simulation to find them.

posted 21 May 2010 at 2:24 PM by BilB

BilB,

You haven't identified any errors at all. You are simply making unsubstantiated assertions.

posted 21 May 2010 at 2:32 PM by Peter Lang

BilB,

I refer you to John Morgan's comment on 21 May 2010 at 9.22 where he asked you:

> "BilB, once again,
>
> * what assumptions do you object to? What are your preferred alternative assumptions?
> * What new techniques do you refer to? How do they alter the estimates?
> * What lifetime do you think should be attributed to nuclear plants?
> * What (definite, not indefinite) lifetime do you attribute to a capable CSP system?
>
> Just throwing out unquantified, unargued statements like this is vacuous."

posted 21 May 2010 at 2:37 PM by Peter Lang

BilB, Peter, why don't we work through this systematically, it'll be much easier for all of us. In that spirit, BilB, could you write a short comment outlining your highest priority critique of Lang's work (e.g. most glaring assumption, unjustified calculation, whatever), and explain (briefly) why you consider it flawed. That way, Peter (and others) can respond, and we can work our way iteratively through your list of concerns. Otherwise, we're not going to get anywhere.

posted 21 May 2010 at 2:42 PM by Barry Brook in reply to Peter Lang

Barry,

That seems an excellent approach. We need a circuit breaker to this discussion as it is going nowhere.

posted 21 May 2010 at 4:06 PM by Peter Lang

Good method, Barry. It will take me several days as my design load has piled up. I will read through Peter's paper item by item and log where I believe divergent errors originate.

posted 21 May 2010 at 5:02 PM by BilB

This is good. Maybe, if time is an issue for you, just start with one item – the one you think is the single biggest factor.

posted 21 May 2010 at 5:44 PM by John Morgan

Joh M,

I am working on it, but here is a little taste of what to expect. The subject "state of the art" Qeanbeyan Solar Farm was installed in December 1998 with BP 77 watt panels. That should tell you something about efficiencies, pricing projections, energy conversion technology, and industry knowledge that was used in this study, and their relevence to making projections on solar energy outcomes into the future. There is one positive, and that is that a current day study might

shed light on photovoltaic panel durability as these panels are half way through the oft sceptic claimed 20 year panel life.

posted 24 May 2010 at 8:16 AM by BilB

Thanks for that update BilB – we'll look forward to reading it.

If you do object to the use of the Queanbeyan example, the question will then be, what parameters do you think fairly represent the state of the art of solar farm technology, and do they change the ultimate conclusion? Referring to an existing installation would be nice.

posted 24 May 2010 at 12:36 PM by John Morgan

From Kent Hawkins:

> "I just published a four-part series on MasterResource of the recently released studies on the Netherlands electricity system and the Bentek study for Colorado and Texas. Both studies show zero CO2 emissions (the Netherlands at 3% wind penetration) to increased CO2 (Colorado and Texas – both at 5-6% wind penetration). I compared the results to what my calculator predicted. Part I starts here http://www.masterresource.org/2010/05/wind-integration-realities-part-i/#more-9977 . Comments are appreciated."

The links to the following parts are broken so here is the link Part IV (you can get to the others from here): http://www.masterresource.org/2010/05/wind-integration-realities-texas-iv/#more-10008

This reports on preliminary analyses that appear to confirm the the outputs of the Kent Hawkins' Calculator. That is, they show that the emissions from the fossil fuel back-up for wind power are similar to or exceed the emissions with no wind power in the system. In other words, Wind power is not reducing emissions. (But it is certainly raising the cost of electricity significantly).

posted 27 May 2010 at 10:57 PM by Peter Lang

That is purely an anomaly based on missmatched and incomplete systems.

posted 30 May 2010 at 12:32 PM by BilB

BilB, on 30 May 2010 at 12.32 Said:

"That is purely an anomaly based on missmatched and incomplete systems."

That's what we call hand waving BilB. You have to show where and how these calculations are in error.

posted 30 May 2010 at 12:37 PM by DV82XL

They are not in error, dv8, I would expect. They are the outcome of systems that are not tuned to operate harmoniously. Furthermore the parts of the system that do, by design, cooperate interactively are not installed. It is what you would call teething problems on a very large scale. There was a comment earlier about energy routing. Energy flow managers are only now coming to terms with the reality that energy flows in the future need to be bidirectional, rather than one way.

The inference that renewables do not reduce CO2 emissions is completely false. That poorly designed and coordinated energy systems can be less CO2 efficient is a more correct deduction.

posted 30 May 2010 at 5:03 PM by BilB

BilB, I have a strong sense of *deja vu* about your comment. I know I'm sounding like a broken record, but, can you please try to be specific in your comments, both in terms of your critique, and the alternative you would offer?

In this case, if you believe that wind power can be harmoniously integrated with gas backup, can you explain how your preferred system differs from our present one? How is wind harmoniously integrated with other generators? What exactly are you saying?

There is a genuine willingness here to discuss these issues. But without reducing these statements to concrete implementations, all we have to go on is your sense of "the vibe".

I trust your promised critique of Peter's analysis, and your geologist friend's contribution, is coming along soon.

posted 30 May 2010 at 8:26 PM by John Morgan

@ John Morgan – the poster BilB, has nothing, nothing at all. That's why the only think he can do is try and blow smoke in everyone's eyes with nonsense like like his previous comment.

The two-way grid is the worst of these smoke screens. A commenter called Rich at Atomic Insights put it best:

> "There are two problems with distributed power systems that the idealists do not discuss assuming these distributed generators are big enough to feed back to the grid. One is the fact that the present power distribution system is designed to take power from a central source and spread it out to where it is used. It is NOT designed to do the reverse. The big feeder breakers and the fault overload timing sequence is designed to cut off the fault closest to the fault and keep everybody else with power. (That is why your main breaker does not trip when your saw binds up cutting a board and trips the breaker for the shop.) The protective circuitry is NOT there (for both equipment and personnel). To correct this problem will take a "genius grid," a "smart grid" will not hack it. Each of these distributed generators will require protective circuits and controls with main dispatcher monitoring, control, and readout. Most existing substations would require an extensive overhaul, replacing all existing protective equipment with two-way protective circuits. Even then, IMHO reliability will decrease and power critical installations (e.g. hospitals, server farms, etc.) will get their own power and go off grid. The present control system is on the verge of overload now. This problem is not shown now because there are so few private generators feeding back on the grid.
>
> Secondly, the efficiency of a generation system drops drastically as you decrease the load from the optimum load, typically 90 to 100% of design, think of highway vs. city MPG in a big semi. Sending power from two areas where there is only 30% load to another area where there is 30% load to get one generator at 90 to 100% load heats up a lot of wire (I square R losses), not to mention the efficiency losses for the period of time until you can combine loads. You then have travelling maintenance crews, distributed maintenance facilities, warehouses, etc., etc. Look at the recent proliferation of high efficiency CCGT units – each that I have seen has more than one unit. No NRC B/S, so one crew can operate and maintain both, three, possibly even four. Put four single units on the four corners of your city and union rules will dictate four crews or work rules that would bankrupt you. Are we trying to save GAS? Electricity? reduce CO2? or create jobs? The only thing I see happening is creating jobs. "

Source: Here

posted 31 May 2010 at 1:55 AM by DV82XL

Most of what Rich has written there, Dv8 is hype and smoke spcreen. All except the breaker issue. That is real, and I'm going to have look into that very carefully. I suspect that the solution is in noise monitoring. By analysing the nature of the the waveform it should be possible to determine if a line segment has become isolated. These techniques are employed with phenomenal precision in motor control systems. Then again it might be as simple as monitoring line current imbalance, very simple.

posted 31 May 2010 at 5:05 PM by BilB

It's not Hype BilB, it's the truth, and I know it. The distribution problem is real and has been recognized by several in the renewable field as no yet solved. And the point about I square R losses, is simple physics.

Again, if you are going to mount a criticism of anyone's statements, it has to be substantive; merely stating it's hype without explanation, makes it look like you have no explanation to give. Every time you do this, you undermine your own credibility, far more than you damage that of you opponent. It is very clear to all of us here now, that you have nothing, and that you are incapable of mounting any sort of rational argument, supported by numbers, for your contentions.

I'm afraid you cannot be taken seriously, until you do.

posted 31 May 2010 at 8:06 PM by DV82XL

Dv8,

Rich points to the hysterical nature of his comments here

"This problem is not shown now because there are so few private generators feeding back on the grid"

where he says that there actually isn't a problem, there just might be, oneday. Which rounds out as there being a known problem which when properly specified into new equipment entering the system will ensure that there never is a problem.

Dv8, it is you who cannot be taken seriously.

posted 1 June 2010 at 7:57 AM by BilB

Well I'll leave the others here to be the judge of which one of us should be taken seriously.

posted 1 June 2010 at 8:00 AM by DV82XL

Fair enough.

posted 1 June 2010 at 12:19 PM by BilB

BilB, DV82XL, lets detach and wait until we have something specific to discuss.

BilB, you promised to seek a review of Peter's analysis from a colleague, and to formalize some of your objections, particularly with regard to the use of the Queanbeayan installation as a model. Are you still intending to provide these responses?

posted 1 June 2010 at 12:38 PM by John Morgan

Oh I'm detached all right. This poster has provided no facts, and no substantive logic to back his claims. He has made several transparently false attempts to style himself an expert, and then demands we accept what he says on that basis.

This is not the first time I have run across this sort of wannabe fraud on the net, nor will it be the last. It's always the same – they can never back up their claims ever and will string it out as long as they can. The usual pattern is for them to push as far as they can, until a critical number of people, demand reference, or call them out, then they disappear in a cloud of insults, suggesting that they are throwing pearls among swine.

After awhile you can pick up on these types almost as soon as they first post.

posted 1 June 2010 at 12:50 PM by DV82XL

Getting to it, Dv8, but having read your background an philosophy I'm surprised that you haven't picked the huge number of holes in Peter's projected conclusions from his essay. I've got to wonder how thorough you were as a technician.

posted 3 June 2010 at 12:20 PM by BilB

No numbers just noise, insults and now libel. Every time you post you dig the hole you are in a little deeper. Holding true to the pattern I wrote about above.

posted 3 June 2010 at 12:34 PM by DV82XL

Dv8 it is you who is flinging the insults around with gay abandon, so expect to eventually get some back. No libel there. Just a question. What sort of technician where you?

posted 3 June 2010 at 1:18 PM by BilB

I have enabled comments on the page that my screen name links to. If you want to discuss my qualifications and work history with me, do it there.

posted 3 June 2010 at 2:53 PM by DV82XL

BilB

We're still waiting.

posted 17 June 2010 at 10:15 AM by Peter Lang

BilB has been 'getting around' to a number of critical posts which contain the information and references needed to back up his points for well over a month now. He's only managed to find time to throw around unsupported assertions so far, so we can only conclude that he is extraordinarily busy.

Or something.

posted 17 June 2010 at 11:06 AM by Finrod

if someone consistently adds absolutely nothing, other than libel, then can't they just be banned? BilB back up your opinion with numbers, figures or facts. Otherwise go home.

posted 17 June 2010 at 12:43 PM by Scott

BilB is gone – this type fights until they are cornered with a demand for facts, and when they realize they cannot supply them, they first try and hijack the thread, then they vanish. If that person ever posts again here, it will be under another name.

posted 17 June 2010 at 12:55 PM by DV82XL

Gone but not forgotten. I'm confident that in a decade or so, the reality of what BilB and fellow-travellers were really fighting for will be well recognised in political and legal circles, and every effort will be made to track these people down so they don't evade their overdue appointment with the gallows.

posted 17 June 2010 at 1:32 PM by Finrod

I certainly wouldn't want to see anyone banned on this basis. When posters like BilB demonstrably fail to substantiate their assertions, they make our case for us.

That said, I would really like to see BilB's continued engagement with this discussion to some sort of closure, so if anyone encounters him in discussions elsewhere please remind him of his promises here, and drop a link here.

posted 17 June 2010 at 3:17 PM by John Morgan

I recall the thread on the John Quiggin blog (now in hiatus) in which the 'baseload fallacy' was taken as pre-condition for discussion. A certain commenter was given free rein while others were in effect censored. However one comment troubled me which was that European wind power had greatly increased while nuclear output had declined. It also grew faster in absolute terms than gas fired generation. Apart from retirement of nuclear plant I now believe the response should have been that European wind generators were made an offer too good to refuse.

To the best of my knowledge Euro wind gets multiple layers of help. On the one hand they get mandates or quotas i.e. guaranteed custom. That's the 'cake'. On top of that they get a thick layer of icing in the form of feed-in tariffs. If there was any way to integrate wind power into the mix it would be crazy not to take the money. I think that answers an open question from the Quiggin blog.

posted 17 June 2010 at 4:37 PM by John Newlands
Pingback: TCASE 12: A checklist for renewable energy plans « BraveNewClimate

The report indicated that 8x more concrete and 15x more steel is needed for construction of windpower per MW compared to nuclear. What the report failed to consider is the energy required to produce these materials and the hazardous wastes that are produced. My calculations indicate that more energy/MW over its life time is required for windpower compared to nuclear, thus resulting in a larger carbon footprint for windpower. This assumes centrifuge enrichment for

nuclear fuel production. I assume this would be worst for solar since it requires more materials. Any life cycle analysis needs to include this consideration. There is no free lunch in energy production

posted 8 October 2010 at 1:33 AM by William Dornsife

William Dornsife,

Thank you for your comment and also welcome to BNC (if you haven't posted previously; I haven't seen your posts before).

You are correct of course and these issues are coverend in much more detail on other threads and many comments on various threads. You might be interested in the TCASE4 and TCASE8 articles here:
http://bravenewclimate.com/renewable-limits/

And also this article:
http://bravenewclimate.com/2009/11/03/wws-2030-critique/

posted 8 October 2010 at 11:33 AM by Peter Lang

This is a very informative article..I have made my effort in explaing how the Current Energy

Order is Changing and Changing Fast..The link is given below..

http://authorshive.com/2010/11/24/current-energy-order-is-changing-fast/

posted 24 November 2010 at 2:57 PM by Talha Jamshaid

no relation to this Peter Lang who obviously hadn't heard of the approach of Sweden, Finland, Poland, Austria, Denmark etc in using biomass (and municipal waste) to produce a significant amount of their energy when he wrote this book.

In the case of Sweden it is over 31% (already more than any other source including hydro or nuclear) heading for over 39% by 2020. Finland gets nearly 20% of its electricity from biomass and 50% of primary energy in central Finland,
Brazil is a high achiever, India is developing biomass-fuelled baseload off-grid mini-grid systems for 10,000 villages using biomass fuelled gasifiers. Overall India can get 10% of electricity from biomass plus a vast amount of domestic and industrial heat. China is building biomass fuelled power plants using straw. But nothing about biomass in this book, or other books that portray themselves as authoritative, but have similar flaws in their initial approach.

posted 29 December 2010 at 11:15 PM by andrew lang
Pingback: Vaarallisen ilmaston muutoksen välttäminen… « PassiiviIdentiteetti

9 JANUARY 2010
BARRY BROOK
EMISSIONS, NUCLEAR, RENEWABLES