# Joint Expert Report to the Land Court by Jonathan Stanford, Andrew Offen and Antoine Nsair

## 1. Experts Details

### 1.1 Names

This joint expert report has been prepared by Jonathan Geoffrey Stanford, Andrew Offen and Antoine Nsair for the Land Court in accordance with paragraphs 9 and 10 of the Order dated 15 July 2013.

### 1.2 Previous Expert Reports

This joint expert report is supported by, and relies upon, the following expert reports:

(a) Expert Report of Jonathan Geoffrey Stanford, dated 30 May 2013;

(b) Expert Report of Andrew Offen, dated 30 May 2013; and

(c) Expert Report of Antoine Nsair, dated 11 July 2013.

### 1.3 Dates of Meetings of Experts

The experts met on 19 July 2013 in Antoine Nsair's office in Camberwell, Victoria. Andrew Offen participated in the meeting by telephone.

## 2. Key issues of Agreement

The three experts agreed on a number of points, including

- That the amount of coal combusted in the world, including for the purpose of generating electricity, will be determined by demand rather than restrictions on supply, at least under current global policy settings.
- That if the goal of limiting the projected rise in global temperatures to two degrees Celsius is to be met, in the absence of carbon capture and storage (CCS) becoming a commercially viable technology the share of coal in the range of technologies employed to generate electricity worldwide will need to decline. It is unclear whether the nations of the world will agree to the policy measures required to achieve this.
- That under current global policy settings, while the share of coal in the fuel mix for electricity generation will most likely decrease in the future as the relative cost of renewables declines, the absolute volume of coal burned may still increase due to increased power consumption mainly in emerging economies. Material increases in the cost of coal as a fuel, such as may occur through a widespread application of a price on carbon, could change this equation.
- It is recognised that power generation costs vary by location and can be different in Asia than in Australia. The experts agree that the cost of generating electricity using combined cycle gas turbines (CCGT) is particularly sensitive to the fuel price and that this can vary significantly between locations depending on the availability of natural gas.
- That while a number of attempts have been made to forecast the future absolute and relative costs of the various technologies that may be used to generate electricity, such forecasts of future costs would have a degree of uncertainty and should be produced within a range of estimates rather than a point estimate.
- That in making comparisons of the cost and attractiveness between coal as a fuel source for electricity generation and other low emissions technologies, it is important to compare like with like, that is to acknowledge that coal is used for base load, or continuous, power generation whereas some renewable technologies such as solar and wind would be unsuitable for that role, at least without fossil fuel back-up.

## 3. Key issues of Disagreement

There were also a number of points on which the experts disagreed. These are set out below.

### 3.1 Exhibit 6 in Jon Stanford's expert report

***Stanford's view***

Jon Stanford disagreed with Antoine Nsair's view that in presenting Exhibit 6 he should have described all the assumptions underlying the technology cost estimates. Stanford contends that he was merely presenting a snapshot of various estimates by internationally recognised bodies of the relative costs of various power generation technologies as a means of illustrating his response to the question he had been instructed to answer. He contends that he did note some key assumptions, such as that relating to the gas price, and also the cost of network connections and fossil fuel back-up for renewable energy, neither of which is included in the costs shown in the Exhibit. Stanford also notes that while Nsair was critical of him for not providing details of underlying assumptions, Nsair himself did not provide details of the assumptions that underlie some of his evidence, particularly as relates to Section 4.2 of his expert report. Stanford has referenced his sources and interested parties may gain access to the assumptions and qualifications attached to the estimates in Exhibit 6 should they wish to do so.

Stanford acknowledges that he did not include the caveat identified by Nsair that the measure of relative cost represented by the levelised cost of electricity (LCOE) is less suitable when it is applied to small scale generation technologies such as roof-top solar and distributed generation. He contends, however, that his main focus is on the low emissions technologies that compete with coal as a source of base load electricity supplies. He also notes that Nsair himself uses the LCOE measure when evaluating the future costs of renewable technologies in Section 4.2 of his expert report without including a similar caveat.

Stanford also disagrees with Nsair's conclusion in his expert report that the costs presented in Stanford's Exhibit 6 are not "reasonable". While he understands that Nsair made that statement largely on the basis that he did not consider that it would be safe to rely on the cost estimates in Exhibit 6 as a basis for forecasting relative costs to 2030, Stanford contends that he never suggested in his expert report that this was the purpose for which they should be used. While conceding that he could usefully have stated explicitly that Exhibit 6 was intended to provide estimates of current rather than future costs, he still considers that it is clear from the report that the chart shows relative costs in the period 2010-12 and not forecasts to 2030.

***Nsair's view***

Antoine Nsair reaffirms his view that Mr Stanford's report on the relative costs in Exhibit 6 does not explicitly refer to current prices in 2010-2012 but that the report implies that the comparisons are applied to show costs of technologies during the life of the Alpha mine.

Nsair acknowledges that he does not provide the underlying assumptions in his discussion about the graphs presented in Section 4.2. In his comments, Nsair is not evaluating and comparing costs

of different technologies, as Stanford attempts to do in his report, but is focusing on the cost trends of solar and wind technologies for the purpose of showing the anticipated decrease in costs.

### 3.2 Paragraph 4.3(a)(iii) of Andrew Offen's expert report

Offen and Nsair continue to disagree on the impartiality of the World Coal Institute as a source for data. There was also some difference of opinion in regard to the future prospects of an increase of the absolute volume of coal likely to be burned in the generation of power. Whilst qualified agreement was reached as specified above, the continued areas of disagreement are summarised in section 3.5 below.

### 3.3 Section 2 of Antoine Nsair's report

***Stanford's and Offen's view***

*Use of Australian-based data and information*

In Section 2 of his report, Antoine Nsair relies heavily on an Australian perspective as a basis of his analysis of alternative generation technologies. Both Jon Stanford and Andrew Offen challenge the relevance of using Australian data to evaluate the competitive position of coal from the Alpha mine as a source of electricity relative to other technologies, including gas, nuclear power and renewables. The availability of renewable resources such as geothermal, wind and solar varies between locations, as does the availability of natural gas. (While liquefied natural gas – LNG – may be made available in many locations, its cost is generally much higher than piped natural gas.) The LCOE for generation using different technologies may also vary widely between different countries and locations. Apart from the fuel/resource costs, other costs, including those for capital, labour and materials, may vary widely between countries and locations more generally. Stanford and Offen therefore contend that Australian data in regard to generation costs is only of limited value when considering the likely competitiveness of coal from the Alpha mine in those markets to which it is intended to be exported.

In Section 2.4 of his report, Nsair lists a number of considerations that need to be accounted for in any decision to invest in power generation capacity. Some of these, such as regulatory risk, environmental policy and reputational considerations, may be less relevant in emerging economies, where coal from the Alpha mine is likely to be combusted, than they are in Australia. A particular consideration in emerging economies may be to provide the cheapest possible electricity to households currently without access to power supplies as a means of helping them emerge from poverty.

*Comparing like with like*

Stanford contends that when evaluating generation technologies that may be considered as substitutes for coal, it is important to recognise that coal is used as a source of base load power. Some renewable technologies, such as wind and solar, are interruptible and cannot provide continuous supplies of electricity without expensive (and emissions-intensive) fossil fuel back-up. Stanford contends that while such technologies may be appropriate for intermediate duty, they should not be regarded as substitutes for coal in terms of base load duty. Lower emissions technologies that may be regarded as substitutes for coal include geothermal, nuclear power and natural gas CCGT.

***Nsair's view***

Nsair disagrees with Stanford and Offen that Section 2 of Nsair's report relies "heavily" on Australian based data. In Section 2.3.1, the report provides data to show an example of the relative emission intensities for different generator types as published by the Australian Energy Market Operator (AEMO). The relativities of these intensities would apply to other international power systems.

With regard to Carbon Capture and Storage (CCS), Section 2.3.2, Nsair refers to the Australian progress on CCS development but infers that internationally this technology has not been proven commercially and should not be considered as a viable option over the next 30 years.

In summary Section 2 has little reference to the Australian environment and presents issues that can be applied globally.

### 3.4 Section 5.2 of Antoine Nsair's expert report

***Stanford's view***

Jon Stanford disputes the data cited by Antoine Nsair in Section 4.2 of his expert report. He contends that the data contained therein should not be considered 'reasonable' estimates of the current and future technology cost of the three renewables – solar photovoltaic, wind and concentrating solar thermal – evaluated in the report. These charts are sourced to the Energy Research Institute at the University of Melbourne and were published in March 2011. The estimates they provide are substantially lower than others that are available, for example, the data presented from official sources in Stanford's Exhibit 6, described above.

Stanford contends that the costs (LCOE) of the three renewable technologies shown in the charts contained in Section 5.2 of Nsair's report have each been reduced by $50/MWh, not only in current terms but also out to 2030. All these costs have been originally estimated by other agencies, including the International Energy Agency, the US Department of Energy and the Australian Energy Markets Operator (AEMO). Yet the researchers at the University of Melbourne Energy Research Institute have seen fit to reduce the cost estimates made by these and other agencies by $50/MWh.

Why was this done? According to one of the University of Melbourne authors of the report:

> [There] "are actually two different versions of the report. In the initial version (the 'March' version), we were instructed to include Renewable Energy Certificate revenue in the cash flow within the LCOE calculation, (and we were instructed to use $50/MWh as the price of the scheme lifetime, this is briefly discussed on page 10 of this report).This is not a particularly standard approach (and we didn't actually want to do this) - so a second version was prepared ("May" version, - as published on our website) - and presents the more typical approach (which I think is more relevant)."[1]

In the opinion of Stanford, the inclusion of an assumed $50/MWh subsidy in the LCOE calculations for renewable energy represents a distortion. It does not provide a fair representation of technology costs (we could just as easily assume a subsidy for coal, gas or nuclear). It clearly does not provide

[1] Email from Dylan McConnell to Jon Stanford, 19 July 2013.

a fair estimate of the LCOE of renewable technologies in locations outside Australia, where renewable energy certificates (RECs) do not exist.

Further, even if we were to accept this methodology (which Stanford does not), the estimates do not even provide a fair representation of RECs themselves. When the report was published in March 2011, the REC price was around $26/MWh.[2] Therefore, even at that time when the price of RECs was known, the researchers chose to reduce the LCOE of renewables as estimated by other independent agencies by a further $24 over and above what was justified by the REC price. Then to continue to use a REC price of $50/MWh out to 2030, represents a truly heroic assumption. Not only is it highly unsafe to assume that the Renewable Energy Target will continue unchanged to 2030, but even if it does the imposition of a carbon price will lead to a gradual erosion of the price of RECs as the differential between fossil fuel-based and renewable-based electricity declines.

Stanford considers that Antoine Nsair should have acknowledged the assumptions underlying the data presented in section 5.2 of his expert report, including, most importantly, the inclusion of a very high REC price. Yet, at the same time, Stanford has no hesitation in accepting Nsair's assurances that he was unaware of the assumption of a $50/MWh cost reduction imposed by the University of Melbourne researchers.

***Nsair's view***

Nsair acknowledges that the charts in Section 5.2 of Nsair's report show that LCOE of wind, solar thermal and Solar PV in the March report of the Energy Research Institute, University of Melbourne, are lower than the LCOE published in their May report. The purpose of Figures 5, 6 and 7 of Nsair's report is to show the decreasing trends in costs of these technologies and not the absolute value as implied by the heading of Section 4.2 "Recent Movement and Projections of Wind and Solar Generation".

Nsair disagrees with the premise presented by Stanford and Offen that coal will be the cheaper fuel for electricity generation in the future and hence will increase its use for electricity generation.

### 3.5 Outlook for coal

***Stanford's and Offen's view***

*Absolute versus relative issues*

Whilst qualified agreement was reached, there remain some areas of disagreement between Stanford and Offen on one side and Nsair on the other in regard to the outlook for the demand for coal for the purposes of generating electricity.

As stated in section 2 all three parties agree that the *share* of coal in future generation around the world is likely to decline, that is the *relative* contribution of coal to the production of electricity globally will be lower in the future than it is now.

In terms of the *absolute* quantity of coal used for electricity generation in the next thirty years, however, Stanford and Offen consider that it is not at all clear that this will decline. They refer to the chart used by Nsair in his report (Figure 8 on page 23) and produced by the International Energy Agency (IEA) in 2012, showing projected generation technologies to 2035. From this chart it

[2] See, for example, the data on the Local Power website, http://localpower.net.au/recs.htm

appears that the use of coal in the developed economies of Europe, the US and Japan will decline in the future. This forecast decline, however, is outweighed by the increasing use of coal projected for China and India. Just in terms of the countries included in this chart, therefore, it appears that, according to the IEA, the demand for coal for the purposes of generating electricity will increase significantly to 2035. If other countries were to be included, Stanford and Offen believe that the future use of coal in emerging economies will provide a net addition to overall demand globally.

There seems to be some support for this in the IEA's note included in Nsair's Figure 8 to the effect that "the need for electricity in emerging economies drives a 70% increase in global demand [to 2035], with renewables accounting for half of new global capacity". This leaves room for a significant increase in the overall use of coal.

The continuing high demand for coal is confirmed by a more recent report from the IEA:

> Global coal deployment has risen steeply over the past two decades. Coal met the lion's share of incremental growth in electricity generation between 2000 and 2010, with coal-fired electricity generation increasing by almost 2 700 TWh, or 45%, to 8 700 TWh in 2010. The growth of coal-fired electricity generation has far outpaced the significant increase in generation from all other non-fossil energy sources … In 2010, coal's share of electricity generation reached 42%, up from 39% in 2000, compared with a 33% share for non-fossil electricity (down from over 35% in 2000).
>
> The current trajectory for coal is fundamentally inconsistent with a low-carbon future. Global coal demand is set to increase from an estimated 155EJ in 2011 to 180EJ in 2017 (+2.6% per annum), still driven predominantly by emerging economies, in particular China and India. Chinese coal demand alone is projected to increase from an estimated 75EJ in 2011 to 93EJ in 2017 (3.7% per annum). It is currently difficult to envisage a future in which coal is not used to meet growing power demand — not only in non-OECD regions, but also in many OECD countries.[3]

Finally, Stanford and Offen do not disagree with Nsair's conclusion in Section 5 of his report that it would be difficult to access debt finance in order to build a new coal generator in Australia. But they question the relevance of this to the proposed Alpha mine since its coal will be exported to countries where coal generation is playing a major role in increasing electricity supplies.

*Germany*

On page 23 of his report, Nsair quotes Stanford as stating in his expert report that "new coal generators (some of them using very high emissions lignite) are being built in Germany to replace nuclear power for base load duty". Nsair questions this statement and suggests that a majority of these new generators are to replace older, inefficient coal plant rather than nuclear capacity.

Stanford contends that, as described in the quotation from *The Economist* cited on page 34 of his expert report, part of the reason Germany (which has invested heavily in renewables) is planning to build more coal generators is that it has committed to close its nuclear plants and therefore needs a replacement for the base load electricity that would otherwise have been generated with very low emissions. To achieve this, it is turning to coal as well as continuing to invest in renewables. The same article in *The Economist* states that:

> While coal production and use plummet in America, in Europe "we have some kind of golden age of coal," says Anne-Sophie Corbeau of the International Energy Agency. The amount of electricity generated from coal is rising at annualised rates of as much as 50% in some European countries. Since coal is by the far

[3] International Energy Agency, *Tracking Clean Energy Progress, 2013*, page 49, http://www.iea.org/etp/tracking/

> the most polluting source of electricity, with more greenhouse gas produced per kilowatt hour than any other fossil fuel, this is making a mockery of European environmental aspirations.[4]

Stanford concludes from this that even some nations with strong "environmental aspirations" and an increasing share of renewables in power generation still have a requirement to use coal as an important source of base load electricity.

*Competitiveness of gas*

Stanford does not agree with Nsair's statement on page 24 of his report that "a moderate carbon price of about $12/tonne" would be sufficient to make gas CCGT generation competitive with coal. Stanford's understanding from industry sources is that a carbon price of at least $30/tonne would be required to achieve such an outcome. This was confirmed by the CEO of Origin Energy, Grant King, who stated in July 2013 that "a carbon price of more like $40/tonne is necessary to really swing the economics from building coal to gas".[5]

***Nsair's view***

Nsair acknowledges that coal generation is currently projected to increase moving forward, and also is renewable and gas generation. It is Nsair's contention that the narrowing costs between these technologies combined with potential environmental policies (by coal importing, coal exporting or financing organisations) means that the outlook for coal generation is uncertain, and that the outlook for coal generation could significantly reduce in the future.

Nsair agrees that Figure 8 of Nsair's report shows a decline in the use of coal in the US, Europe and Japan and an increase of coal use in China and India. The figure also shows rapid growth in renewable energy technology and gas generation. However changes in costs and policy could mean that renewable generation and gas generation could replace a significant component of the projected coal use as shown in Figure 8. To support this, Nsair notes the recent announcements in China and the US, as referred to in Section 6.2 of Nsair's report. These announcements relate to the US limiting investment in the use of coal for electricity generation in developing economies; this would apply in India as US energy companies invest heavily in India's energy market. Also, China introducing an emission trading scheme implies the strong move by China to encourage renewable energy generation and reduce coal fired generation.

In their new evidence above, Stanford and Offen state that the IEA's statement confirms the "continuing high demand for coal". Nsair agrees with the IEA that "it is currently difficult to envisage a future in which coal is not used" but disagrees with Stanford and Offen statement "high demand" due to the new measures and evolving policies to reduce CO2e emissions. Even the World Bank, which is a major financier for emerging economies, is "looking for all possibilities to avoid investing in coal" and acknowledging that this action should not lead to people "freeze to death"[6].

Nsair acknowledges that currently within Australia, a higher carbon price than $12/tonne would be required to make new gas generation economic with new coal generation. A key determinant in this

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[4] *The Economist,* 'Europe's energy policy delivers the worst of all possible worlds',5 January 2013, <http://www.economist.com/news/briefing/21569039-europes-energy-policy-delivers-worst-all-possible-worlds-unwelcome-renaissance

[5] Katie Walsh, 'Low carbon price fuels more coal: King', *The Australian Financial Review*, 22 July 2013, page 7, http://www.afr.com/p/business/companies/low_carbon_price_fuels_more_coal_a8vQrpcMQeP5CI9xq2ZPKM

[6] http://www.bloomberg.com/news/2013-04-17/kim-says-world-bank-can-t-reject-coal-if-people-freeze.html

is the cost of coal. The lower the cost of coal the higher the carbon price needed. The coal power stations in Australia have coal prices significantly less than the international coal price. This means a higher carbon price is needed to make current Australian coal generation uneconomic compared to gas generation.

Here two comparisons are noted, these being firstly comparing existing gas plant with existing coal plant and secondly comparing new gas plant with new coal plant. A higher carbon price is required when comparing existing gas plant with existing coal plant compared to new gas plant with new coal plant. The reason for this is that the capital cost of gas plant is substantially less than that of coal plant.

The $12/tonne carbon price was made with reference to comparing the costs of new gas generation with new coal generation under the cost and technical assumptions shown in Table 1 of Nsair's repot. These have coal and gas prices intended to represent international prices. In particular the coal price assumed is higher than paid by existing Australian coal power stations. This demonstrates that under conceivable cost assumptions, the cost of gas generation may be near that of coal generation. Nsair notes that Exhibit 6 in Stanford's report has new CCGT gas generation cheaper than new coal generation (thus not requiring any carbon price for gas generation to be lower cost than coal generation).

### 3.6 Conclusions in Antoine Nsair's expert report

***Stanford's and Offen's view***

Stanford and Offen do not agree with all of the conclusions presented in Section 7 of Nsair's report:

1. In regard to conclusion 1, we consider that the relative electricity cost estimates presented by Stanford in Exhibit 6 of his expert report are reasonable. They are drawn from official sources and, as discussed in 3.1 above, were not intended to represent forecasts of energy costs but rather to represent the current situation.
2. We agree with Nsair's view in conclusion 2 that the costs of wind and solar power are decreasing, but note that the cost of solar thermal technologies, which are most able to be considered as a source of base load power in competition with coal, remains very high.
3. While noting that Nsair is responding to a specific question contained in his instructions, we question the relevance of conclusion 3 since it focuses on the situation in Australia while coal from the Alpha mine will be combusted in other countries where different circumstances may obtain.
4. In terms of conclusion 4, as noted in 3.5 above we consider it likely that the demand for thermal coal in absolute terms will continue to grow over the next decades even if its share of electricity generation globally declines.
5. While we agree with Nsair's comment in conclusion 5 that the commercial viability of coal as a source of electricity generation will depend on the location, we again note that his report has been focused on the situation in Australia rather than the markets where Alpha coal is likely to be used.

***Nsair's view***

Whilst it is recognised, in Section 2 above "Key Issues of Agreement", that power generation costs vary by location and can be different in Asia than Australia, Nsair notes that there are similarities. Capital costs can be expected to be similar allowing for local differences, but the costs of fuel and supporting infrastructure can be different. However Australian gas and thermal coal costs are increasingly reflecting international costs.

Stanford and Offen state that the considerations, mentioned in Nsair's report, that need to be accounted for in any decision to invest in power generation capacity, such as regulatory risk, environmental policy and reputational considerations, may be less relevant in emerging economies, where coal from the Alpha mine is likely to be combusted, than they are in Australia. Nsair notes that there appears to be agreement that these issues while possibly less relevant remain factors, and that in addition the policy positions of financing organisations will also be relevant.

## 4. Expert's Statement

We confirm the following:

(a) the factual matters stated in this report are, as far as the experts know, true;

(b) the experts have made all enquiries that they consider appropriate;

(c) the opinions stated in this report are genuinely held by all experts;

(d) the report contains reference to all matters the experts consider significant; and

(e) the experts understand their duty to the court and have complied with the duty.

Jonathan Geoffrey Stanford

2 August 2013

Andrew Offen

2 August 2013

Antoine Nsair

2 August 2013