SUBMISSION TO GENCOST 23 DRAFT DOCUMENT REVIEW

BARRIE HILL 16 February 2023

Submission Author

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Submission

Engineering evaluation of the options available to Australia for development of the electricity sector over the next decades is without any doubt a complex process. A large part of the complexity is the development of the whole of system capital and operating costs required for each of the viable options. Much previous work has simply looked at the overall cost of operating individual generation components and not progressed to the bottom line optimised minimum cost of high voltage supply for the Australian electrical generation and distribution system as a whole.

The basic steps using a standard business planning process adapted for analysis of the current Australian electricity supply sector would be as follows;

1 -Select five or six viable options and develop engineering solutions for high voltage supply to retailers. Simple unrestrained solutions for what is possible in an ideal world using all current best practice data should be developed. The first option should always be the current situation with like for like replacement to test all assumptions.
2 -Develop a costing and economic analysis framework for each workable solution.
3 -Optimise each option and balance of plant to define the most likely minimum cost and emissions outcomes.
4 -Rework each option to reflect current realities such as the market design, existing plant installations, subsidies, sensitivity to future demand and cost trends, etc
5 -Rework each option by optimising all factors to achieve minimum cost and define best practice. Prepare potential implementation plan, risk analysis, financial sensitivity analysis etc. for the top three options.
6 -Make recommendation and provide reasons for this choice.

As noted above all components required for a electrical supply system meeting mandated security and reliability standards must be defined for each of the viable options. This value is currently referred to as System Levelised Cost of Electricity (SLCOE). Options considered may be standalone or the progressive implementation of a pathway replacing ageing or high emission technology with low emission technology generation plant over a defined time period.

In effect the previous AEMO ISP and GenCost reports partially define only Step 4 the first rework outcome noted above for one option in any detail without any of the other steps published. An old Russian proverb likens this outcome to “Viewing the sky from the bottom of a well”, with all of the restrictions that proverb implies.

As a consequence of their partway structure the previous GenCost and AEMO documents have resulted in considerable misunderstanding within the Australian community, and a wide range of negative feedback from experienced engineers within the electricity sector. The Energy Policy Institute of Australia review paper on the subject and the CSIRO response cover some of the issues. The CSIRO response highlights what seems to be the core issues that have left many readers confused and floundering. Previous submissions to the recent AEMO ISP consultation draft and Federal inquiries by the Independent Engineers Group flag many more detailed concerns.

This is an unfortunate outcome given the credence usually given to the work of CSIRO, and the importance of the proposals for those with little working knowledge of the electricity sector. Many trusting Australians are now unique in the world, thinking that intermittent renewables are the cheapest option for reliable electricity grid renewal or expansion, whilst many national and international engineering studies suggest the opposite is true. Well funded lobby groups representing renewable energy industry component suppliers have worked to entrench low-cost ideological propaganda in support of their industry by avoiding any reference to whole of system costs. Sir Roger Scruton described ideologies thus: the facts no longer make contact with the theory which rises above them on a cloud of nonsense.

Although the provision of electricity is a State matter, the engineering management and operational expertise required to achieve Step 1 noted above has been continually diminished across all of the Australian public service. This may be the core issue compared with the work of previous State Electricity Commissions. The Snowy 2 implementation project fiasco is currently the worst possible example of this failure to ensure that appropriate engineering expertise is applied to the assessment and management of complex projects in the energy sector. This problem is easily rectified by the engagement of experienced consulting engineering groups currently working across the national electricity sector and I recommend CSIRO implement this option to ensure an appropriate foundation for the latest GenCost report.

Any rigorous business analysis would also carefully analyse all of those factors which currently impact the achievement of a best possible outcome as noted in Step 5 above.
The impact of the current electricity market arrangements is one clear example immediately obvious from the CSIRO response to the Energy Policy Institute of Australia paper. The previous GenCost reports simply accept the market structure as it is with all current distortions yet the informed community knows that the energy only structure and imposed subsidies is inappropriate and needs a complete revision. Increasing operational direction, financial intervention, and ever more complex new rules are clear indicators of potential failure in any market. The existing market structure will eventually have to be reconfigured as it precludes any major private sector investment without subsidy. CSIRO is in a good position to lead that work possibly in line with some of the concepts recently promoted by Federal Treasurer Chalmers. A review of previous submissions to State and Federal inquires on the subject of electricity sector market design details the full extent of the issues to be resolved. There are also a number of good examples available around the world that could be adapted to Australian requirements.

I have been involved with the electricity market changes as a reasonably large consumer (Queensland Magnesia) since the first paper trials and indirect involvement has continued. I initially welcomed the changes which were relatively simple. Over time I came to realise that the market design failed to take into account the long term need to run the electricity supply machine as an optimally managed fleet of units, as each State did in the past prior to privatisation.

Many early economists felt that the States had over-invested in power generation assets. Much comment clearly indicated an academic economic perspective and a complete lack of knowledge of basic engineering management principles such as planned maintenance, optimised capital replacement, and minimum cost business practice, for organisations with very high reliability obligations. A large part of my work for Rio Tinto in the past covered these concepts for large mining fleet management aimed at whole of life cycle minimum cost of operation. The basic engineering and economic principles do not change for the Australian electrical generation fleet but are very poorly understood and not recognised in the current market design.

Over the past decade the market has also been totally distorted by political direction and subsidies. All of this has led to the slow train wreck we now we now see emerging and a consequential state of learned helplessness. A number of commentators have noted that it may be best to wait for electricity supply failure around the country to force change. There is a very high chance that this will happen within a year or two as planned shutdowns and demolitions of plant are not in anyway linked beyond wishful thinking, to alternate replacement supply installations. Obviously electricity supply failure should be avoided at all cost and the GenCost exercise has a key advisory role to play by ensuring a more rational outcome that does not put current electricity supply at risk.

The two aspects of previous GenCost reports, which have raised the most comment, are the extent and cost of intermittent renewable energy supply support and the cost of nuclear power options. All business investment proposals must be grounded in reality. The importance of a reliable and cost-effective electricity sector to the well-being of Australia dictates that any investment proposal cannot contain the slightest element of hope, faith, or lack of truthfulness. The engineering imperative is that a system of such importance must be carefully evaluated to take into account the worst possible set of circumstances already experienced which could impact the investment outcome. Hoping that some particular new technology requirement will be found or resolved in the future has no place in rational investment planning or decision-making at national level.

Two examples. My understanding is that the control systems needed to ensure national grid level stability with high levels of renewable energy are still not commercially available and may never be. There is mounting concern that control signals cannot travel fast enough to control a widespread system of largely inverter-based technologies. CSIRO is in the best position to refute this concern and should do so immediately. Discussions with power plant operators indicate that system instability is now evident even with current low levels of renewable energy supply. This option is very high-risk. In addition, while many small modular reactors have been built and proven in the past current vendor proposals applicable to Australia still remain to be demonstrated. This is long term improving technology and the risk level is low.

Issues such as these must never be buried in the appendices or footnotes of planning documents but must be fully emphasised in executive summaries for potential decision-makers.

Many analysts have shown that support needed to insure generation reliability for the random intermittent characteristics of renewable energy can be fully engineered given the extent of historical data that is now readily available. Back up or firming requirements vary among countries and depend on the extent of their existing support systems such as run of the river hydroelectric generation. Firming levels range between 90% and 110% renewable installation capacity for reliable supply. If support is to be provided by batteries or pumped hydro installations the worst case time requirement for these operations can now be very clearly defined along with all of the extra charging and transmission costs needed. There is nothing unusual which might preclude accurate engineering analysis and all of the data is available from AEMO records. Current information indicates firming requirements will be required for days not hours. I recommend that CSIRO work to fully understand why this is by engaging experienced engineering staff to accurately define the current viable options that might be available for future investment.

Costing of nuclear power options in previous GenCost reports has been very controversial and I can understand all of the cautions that may arise with vendor quotations for emerging plant and political directions. However there are many nuclear power stations currently under construction and a site investigation would soon provide a detailed basis for accurate costing.

I went to South Korea and questioned all of the key players building reactors; designers, manufacturers, constructors, educators, etc. I visited Shin Kori 3 (operating), 4 (commissioning), 5 and 6 (both under construction). The capital cost for 5 and 6 was US$8.5b for two 1.4 GW units. I felt that this was a reasonably accurate number given the number of similar units that had been built in the past by the same experienced team, many in the same local area.

At the time my grid engineering colleagues considered that 1GW units were more suited to the current Australian grid. My final estimate for Australian construction, taking into account downsizing, exchange rates, and much higher labour and construction costs for local content with high contingency allowances for first of a kind in Australia was A$14B capital cost for two 1 GW units ($7000/kw).

A visit to the US Summer 2 and 3 nuclear power station construction site and ongoing discussion with vendor staff was enough to predict failure many months before the project was finally abandoned with costs out of control. All of the reasons for out of control costs have been clearly defined in a number of technical papers and are reasonably straightforward to avoid. The Summer 1 nuclear power plant and its nearby pumped hydro storage/generation combination supplying a similar electricity demand profile to Australia, is one of the best examples of low cost optimised generation supply I have seen.

I have previously commissioned and operated a small modular power reactor (100 MWe) and after discussion with a range of potential vendors I am confident that these units will eventually have an appropriate place in the Australian grid. Upgraded safety design concepts, which allow installation on existing power station sites, is likely to lead to infrastructure cost reductions by up to 30% compared with greenfield sites. I endorse previous recommendations to continue studies of these units as contracts are let and construction proceeds in other countries. Current legislated nuclear power prohibitions should in no way compromise rigorous and professional investigation by CSIRO for planning level documents.

The GenCost study has over time become an important document for Australian electrical sector planning, and no expense should be spared or time cut short for consultation and review, to ensure the final report is beyond any criticism and clearly understood by the Australian community in general. I would like to support the ideal outcome suggested in anyway CSIRO might consider appropriate.

Barrie Hill

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