A submission to the Australian Government Climate Change Authority regarding:

ACTION ON THE LAND: REDUCING EMISSIONS, CONSERVING NATURAL CAPITAL AND IMPROVING FARM PROFITABILITY

AN ISSUES PAPER

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Q.2. Do the four identified pressures adequately capture the major issues facing the agricultural sector that are relevant to the intersection of NRM, agriculture and climate policy?

No, there will be a serious new pressure that needs to be taken into consideration.

Australia will not reach the 2050 net zero carbon emissions target per the Paris Agreement if we continue to burn fossil fuels or any organic material. The only logical engineering solution for cost effective, reliable and secure power generation, nuclear, is illegal and dismissed out-of-hand as the way forward. This leaves the only option to try to make a highly intermittent power source, solar, into as close as possible to a base load supply.
A major part of the zero-carbon emissions strategy is to electrify everything that is practical instead of relying on carbon based fuels. To supply this hugely increased electricity demand reliably within 33 years from now presents serious engineering challenges. Can these challenges can be satisfied within the time frame, or if ever, over a longer time? Will some challenges ultimately prove to be fatal flaws in the proposition of using large scale solar power. I postulate solar energy could prove disastrous for agricultural interests.

1. **The first threat to agriculture from solar power will be direct competition for land.**

It would require 100,000 – 300,000 km^2 of solar farm to supply a highly, electrified Australia. Individual solar farms will need to be 10,000km^2 or greater to meet the demand. The Bulli Creek solar farm planned for construction in Queensland will be Australia's largest solar farm when completed in 2024. It will cover over 50km^2. It is misleadingly described as a mega plant. In reality it will be tiny, a mere pilot plant, compared with the massive plants that will be required.

The Bulli Creek solar farm is to be built near Millmerran because it is close to an existing node that gives access to the power grid. It is not easy to find such access to power grids. So as electrification demand requires supply to grow 200 times larger than the current proposed 2000MW capacity, the logical pressure will be to increase the size of the existing farm. It could be required to increase in size from something like 7km x 8km to something in excess of 100km x 100km.

Millmerran is right in the heart of the Darling Downs. The total area of the Darling Downs is 77,388km^2 so a single super large solar farm could occupy more than 10% of this prime agricultural area. And three other solar farms are also planned near Dalby, Chinchilla and Miles. As much as 25% of the

Darling Downs may need to be tiled with solar panels if they are to power an electrified SE Queensland.

Calculations are based on the following:

- Annual total energy use of 47,000kWh per capita. This is the level in France in 2003. Australia at that time used 39% more energy per capita than France.
- Total energy use is from all power sources. Calculations in this article assume 100% electrification with all power sourced from solar farms.
- Wind power is far more intermittent than solar energy plus output per square kilometre is typically only one fifth to one tenth of the output from solar farms of equivalent area, using 10% efficient panels. So it is discounted as a serious option.
- Traditional base load power supplies are generally sized 2.5 – 3 times average demand in order to cope with peaks. Calculations use a factor of 3 times. Intermittent supplies may need to be even larger.
- Calculations allow 15% transmission losses from inland desert areas, which would not be valid if solar farms were located in the Darling Downs or similar.
- Calculations allow for losses of 10% for inverting from DC to AC
- Calculations allow losses of 15% for transforming power to high voltage for transmission
- No allowance has been included for inverting or stepping voltage back down to suit battery charging.
- Calculations allow 10% losses for power-out versus power-in to storage devices.
- Calculations only account for storage devices at the main generation source. If storage devices are to be introduced to the network and deployed in huge numbers in residential and industrial sites, and in vehicles, then there will be additional significant losses from the storage devices plus any invertors and transformers that are associated with them. In theory utility supplier batteries could be used to replenish household or industrial batteries, and they in turn could be used to replenish third tier batteries for cars, transport, computers, phones, etc. In such a scenario, the extra losses and inefficiencies may demand solar array areas 40 – 50 % larger than estimated above.
- Calculations for the Darling Downs are based on supply of energy to a population of SE Queensland of 5.5 million people in 2050. Current population 3.4 million. This is in line with ABS Australian population growth estimates of up to 75% by 2050. SE Queensland population is expected to grow faster than the national average.
- Calculations allow no losses due to clouds, snow, dust or rain.
- Calculations are scaled up based on the nominal projected output of the completed Bulli Creek project.

2. The second threat to agricultural areas from solar power will be competition for labour

The Bulli Creek solar farm will take eight years to build. Based on the current number of people working there, expansion of the project to build 10,000km^2 of solar farm within 33 years (2050), will require an ongoing workforce of more than 25,000 people. Infrastructure will be required to accommodate this workforce. Australia wide replication of this feat would require about 3 million people to construct solar farms. Based on at least one overseas example, the completed Bulli Creek array may need a perpetual workforce of 160,000 just for cleaning and vegetation control.

3. It is postulated that the third threat to agriculture from solar power will be creation of rain shadows.

Commonly used solar panels convert about 10% of incident insolation into electricity. The other 90% of energy is given off as heat. Most of this is radiant heat. Most will be directed upwards to the skies. It will disappear into space unless it is impeded by dust, smoke, clouds, or greenhouse gases. Vegetation absorbs and converts some of the kinetic energy in sunlight, along with carbon dioxide and water, to lock-in or sequester these. Some of the energy is converted from kinetic to potential and is stored in the plant. But plants are less efficient users of solar energy than power panels. However, plants use much of the absorbed heat to evaporate water in transpiration. So they radiate less infra-red energy than hard surfaces, including solar panels. So replacing agricultural land with solar farms will increase infra-red radiation emissions. There will be some net increase in atmospheric warming and climate change if solar farms replace vegetated areas.

One thing to look for when scaling up from pilot sized solar farms to giant industrial sized operations is that the radiated infra-red heat may be enough to 'burn-off' clouds. If a major expansion of the Bulli Creek solar farm changed rainfall, it may well affect the Darling Downs. No one in the world has built such a large solar farm. And certainly no giant solar farm has been built right in the middle of a major agricultural area. Will the Darling Downs be the guinea pigs? It would be reckless to proceed building huge solar farms unless environmental impacts are fully understood.

4. It is postulated the forth threat to agriculture from solar power will be damaging whirlwinds

If the air above a huge solar array holds dust or smoke, then radiant heat coming off the panels will be absorbed by the particles and the air will heat up. The Coriolis effect will cause the hot air to spiral up. A similar effect is seen during and after bush and grass fires. The strength of such whirlwinds could vary considerably, depending on conditions. A super strong whirlwind could do enough damage to an array such that it may take several years to repair. Of course, a whirlwind may well move to areas beyond the perimeter of the solar farm with destructive potential to nearby agricultural assets. A sensible solution would be to locate mega solar farms further inland in desert areas. If far enough away they may not affect agricultural land. Just how far they need to be away is not something anyone has evaluated in all probability.

5. The fifth threat will be competition for water

The EIS of most existing solar farms seem to completely dismiss or trivialise the need for cleaning panels. Even if cleaning is generally minimal, any secure solar energy supply needs to have contingency action planned in case of a rare event such as a major dust storm, which could dramatically affect output. Clean up of $10,000km^2$ of solar panels after a major dust storm would require substantial resources. Included would be manpower, and water. Any threat to power supply would represent a major emergency. In such situations, priority may well be given to water use for cleaning solar panels rather than to agriculture. But even routine cleaning of such a large array could place a significant demand for water.

6. The sixth threat will be unreliable and unsecured power supply

Wind and solar are well understood to be intermittent forms of power. The 'simple fix' proposed is to use storage facilities to overcome the shortfalls. It is a major engineering challenge to change a substantial portion of Australia's energy sourcing to batteries by 2050. Even if this can be done successfully it will only cover predictable intermittency. Energy supply from large solar farms will still be vulnerable to less predictable events such as damaging flood, hail, tornadoes, earthquakes and fires. Then there is the potential for human accidents or deliberate sabotage. If a large area of an array were damaged, it may take years to repair. And as has been seen recently in both South Australia and Tasmania, natural or accidental damage to main interconnectors can potentially disrupt supply for extended periods.

It seems dubious that a highly, dispersed power system requiring considerable technical research and development, plus over 200,000sq km of array infrastructure, new towns, utilities, requiring new network additions of long distance transmission lines, numerous transformers, invertors, batteries and storage systems, plus contingencies not yet considered, is a serious prospect of a reliable, secure power supply within 33 years.

7. The seventh threat is that agricultural areas will pay a lot more for electricity

New costs that will have to be passed on to end-users include but are probably not confined to:

- Research into new technology
- Development of new technology
- Development of new infrastructure
- Damage to solar farms from storms and natural hazards likely to be greater than for large centralised fossil fuel or nuclear power stations
- Batteries – millions of them. Capital costs, installation costs, maintenance costs, disposal costs, recycling costs (Used batteries are classified as hazardous waste)
- Inverters and transformers to go with the batteries
- Mitigation of battery fire & explosion risks
- Inefficient, disruptive, decentralised household solar generators will make base load power supply less efficient and, more costly.
- SMART meters
- Isolation strategies for repair and maintenance work
- Large solar construction cost needs to include new towns, new infrastructure, airports, transmission lines, security against fire, hail, etc
- Maintenance for regular cleaning plus unforeseen events such as dust storms
- Fire protection
- Large area CCTV surveillance to protect against intruders
- Large area IR surveillance to identify faulty panels
- Legal claims from people affected by rain shadows
- Holding costs for millions of spare solar panels
- Extreme excess capacity required to counter intermittency
- 20yr cost of solar array must be compared with 50yr lifetime cost of a major base load power station
- Inflated land prices
- Higher labour charges
- Higher water charges
- Money wasted chasing unsuitable technologies. Vague government policy, the enticement of future subsidies such as carbon taxes, ETS and such, encourage investment in technologies that will not ultimately prove viable. Experimentation with wind and solar energy generation could come at a huge cost to agricultural areas.

It is inconceivable that all these new expenses have been taken into account when people claim solar is or will be cheaper than the current power supply.

8. The eighth threat is that the strategy of focussing on solar and wind power generation will leave carbon emissions at a high level that is insufficient to mitigate climate change and that will affect agricultural areas.

From an engineering view point it is highly risky to rely on massive untried scale-up of new, highly intermittent, renewable technology for which there are still many unresolved technical issues. There are also both natural and man-made threats to reliability and energy security from large solar farms. Without a nuclear option the only fall-back position is to keep emitting carbon into the atmosphere.

Governments are starting to plan for building gas-power back-up (base load) plants with 50yr life which is inconsistent with a target of zero carbon emissions by 2050, 33 years from now.
This will help stoke climate change. A warmer climate could lead to more severe storms, hail and floods in some areas and drought, dust storms and tornado damage in others.

Q.3. How can the government, non-government and private sectors address these challenges?

From mathematical modelling and research there is only one viable way to reliably supply most of the energy demand to a highly, electrified Australia in an emissions free and cost-effective way. That is with nuclear power. But it is contentious. It will never be agreed to by everyone. Therefore, the Federal Government needs to take control and lead Australia toward a secure energy future.

Clearly only bipartisan agreement between major political parties can bring this about. A great starting point is to commission consulting engineers to produce mathematical modelling to demonstrate whether or not there really is a feasible alternative to using nuclear power. The analysis needs to be conducted by engineering project experts, not scientists. It needs clear terms of reference with realistically achievable levels of carbon emissions by when. Is the Paris Agreement target, realistic? If not, we need to set new targets. If there is a viable model it needs to be published and the best solution identified by the model should be pursued. If there is not a viable solution using renewables, then the prerequisite is to amend legislation banning nuclear power generation in Australia.

Nuclear power will not encroach on agricultural land. It will not be susceptible to storms, floods, tornadoes, etc. Nuclear will not require complete redesign of the electricity network. It will not require inefficient storage systems. Nuclear power will locate power stations in centralised locations that feed into the grid much as current major power stations. Safety and waste are completely manageable in modern nuclear power plants.
Nuclear power will keep Australian electricity pricing competitive with the rest of the world, which will mostly be forced to use nuclear. Renewables are so clearly incapable of achieving zero carbon emissions in most countries. Australia will pay a premium price for electricity if we choose to be one of the few that go that way. And agriculture will be disrupted.

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