# SUBMISSION FOR QUEENSLAND 50% RENEWABLE ENERGY TARGET BY 2030

**Covering Letter - Personal Background Information, (this first page is not for publication) with a summary of the submission on the following page, and then the submission itself.**

My name is Anton Lang. I am retired and I live with my good lady wife in Rockhampton Queensland.

I served for 25 years and 3 Months in the RAAF, as an Aircraft Electrical Tradesman, rising through the ranks and moving away from the hands on work and into Administration, Supervision, Teaching, and Man Management for that electrical trade. For the last 6 years of my service, I was an Electrical Trades Instructor and the Senior Electrical Trades examiner at the RAAF School of Technical Training at Forest Hill in Wagga Wagga. As a result of that original trade training, and the many years spent working in that Electrical Trade, I was awarded an Associate Diploma in Electrical Engineering.

Upon discharge, I then worked for a Printing Company in the position of State licensed and accredited Workplace Health and Safety Officer. In late 2000, that position was sub-contracted out, and I was made redundant.

I then went on the Carers Pension as the principal carer for my wife who has Epilepsy, and requires care. I have now reached the age where I am now receiving the Age Pension.

Since March of 2008, I have been a contributor to, and am now the Senior Editor of a relatively large U.S. based Blog site, PA Pundits International, based out of Harrisburg in Pennsylvania. The main area of expertise I write on is electrical power generation in all its forms, with a concentration on the two methods of Renewable power most currently in favour, Wind Power, and all the versions of Solar Power. Originally, I used my electrical trade training as the basis for my writings, and over the intervening seven years, I have visited quite literally thousands of sites on that renewable power subject, mainly looking for information about them, as opposed to opinion, and then writing about it in a manner so as it can be more easily understood by the general populace. I have contributed almost a thousand Posts on these subjects over these last eight years.

In that time, I consider I have become quite well versed in nearly all versions of renewable power generation,  mainly Wind Power as it is the larger of those two renewables of recent choice, and in fact, all methods of electrical power generation, both renewable and non renewable.

I was made aware of this Enquiry into the target of 50% of generated power to be sourced from Renewable sources by 2030, and if it pleases you, I have made a decision to add a submission for your consideration.

Anton Lang.

Address (on original submitted document)

Telephone (On original submitted document)

## SUBMISSION FOR QUEENSLAND 50% RENEWABLE ENERGY TARGET

## SUBMISSION SUMMARY

This submission addresses consultation questions in the following areas:

**Policy options for increasing renewable energy**

Are there any other considerations that should be taken into account when defining a renewable energy target for Queensland?

And of far more importance, the following points:

**Impact on the electricity system**

►What factors should the Queensland Government consider when assessing power system reliability and stability outcomes from policy options?

►How might the policy options affect the efficiency of the current NEM design?

►What changes to the NEM design might need to be considered with the implementation of the various policy options?

►What capabilities should be considered as requirements for new renewable generators of different technologies?

In his Foreword, the Panel Chair, Colin Mugglestone says this: (and here I have highlighted the part of most importance)

*As well as opportunities, moving toward a greater share of renewable energy will also be a complex and challenging task,* ***and there will be many factors that will need to be investigated in relation to technical integration and consumer impacts.***

My Submission explains some of those factors which will need to be addressed if that integration of renewable power to this extent is to be implemented. While the Submission is long, and detailed, I have attempted to explain it in a manner which is relatively easier to understand.

I deal with some of the problems with respect to the size of the State of Queensland, its decentralisation, the total power consumption, and a detailed explanation regarding some of the major problems of large scale renewable power plants and their ability to supply a constant, regular, and reliable form of electrical power, especially in respect of what is proposed to be a huge amount of renewable power installation.

In seeking to achieve this 50% of renewable power, that entails the closure of existing reliable supply, and here that is currently large scale coal fired power, spread across the whole State. I explain what is required to reduce this coal fired power, and then to replace it with renewables. I also explain how problematic it will be to replace reliable 24 hour supply with renewable power which is marginal, intermittent, and unreliable.

While the Submission is long, and detailed, I hope that you take the time to read it and understand how difficult, if not impossible, a target of this nature will be to achieve.

Anton Lang.

# SUBMISSION FOR QUEENSLAND 50% RENEWABLE ENERGY TARGET

This submission goes directly to the heart of this matter, and that is from the Issues Paper itself, detailed in Section 4 – Issues for electricity system operation, and specifically at Point 4.2 - Is 50% renewable energy technically feasible?

I understand that the Committee would have had advice that something like this can be achieved, and while the debate may seem to be closed because of that, I hope I can build a case here to explain why it is problematic at best, and in fact, may not be able to be achieved at all.

Something like this may be an easy thing for me to just say it, but to be effectively explained, it is complex, and it must be a matter of building that explanation so that it then becomes easier to see, so while this submission might seem long and involved, it does build that case.

There are a number of areas to be covered for that correct explanation, and I hope to mention them all here so you do get the full picture.

**Area, Decentralisation, and Power Consumption.**

The biggest factor in why something like this 50% Renewables total cannot be achieved is the physical size of the State of Queensland itself, the decentralisation of the cities and regional areas across Queensland, and the total power consumption, and I will deal with each of those three points here.

The case study in that Issues Paper itself under Part 4.2 mentions South Australia as an example. The area of South Australia may only be half that of Queensland, but in South Australia the main concentration of electrically covered area is in the South East of that State, while here in Queensland, the main coverage, while in the main, also centred around a much larger area in the South East, is also spread out along the large Coastline, with major cities all along the length of that Coast, all of them requiring large amounts of constant and reliable electricity. The same applies for cities and towns away from the coast, some of them major, as with Mt.Isa. So here we have a very large area to be supplied with electricity, unlike the fairly centralised situation in South Australia.

With respect to power consumption, and again referring to that same case study for South Australia, that small State only consumes around 6 to 6.5% of Australia's total power while Queensland is the second highest consumer in Australia by State at almost 32%, so Queensland consumes almost five times as much power as South Australia. A larger profile of Renewables, in this case Wind Power, is an easier thing to cover in a State with such small power consumption, when compared to Queensland. South Australia also has access to the Heywood Interconnector, now upgraded to 650MW, giving Sth.Aus. access to virtually instantaneous power enough to cover nearly all contingencies if their wind power falls, and that Interconnector is supplying brown coal fired power from Victoria. Tasmania is perhaps another example of renewables being able to supply, in this case Hydro filling their requirements, but again, Tasmania has only 4% of Australia's total consumption, and again that small State, only the smallest fraction of the area in size of Queensland also has access to Basslink, also Victorian brown coal fired power, even considering that Basslink is unserviceable at the moment. The ACT is another example and again, only tiny when compared to Qld. And while the ACT says it will soon have 100% renewable power, those four new renewable power plants are in Victoria, (2) South Australia (1) and Northern NSW (1), so again, this is virtually a clever application of wording, when the ACT is connected solely to the NSW grid, in the main, supplied by coal fired power.

Queensland is vast, and while most electrical power is consumed in the South East of the State, Queensland also has its consumption areas spread out across the length and breadth of the State, making the proposed impact for renewable power problematic at best, and unobtainable at worst.

**Nameplate Capacity versus Actual generated power**

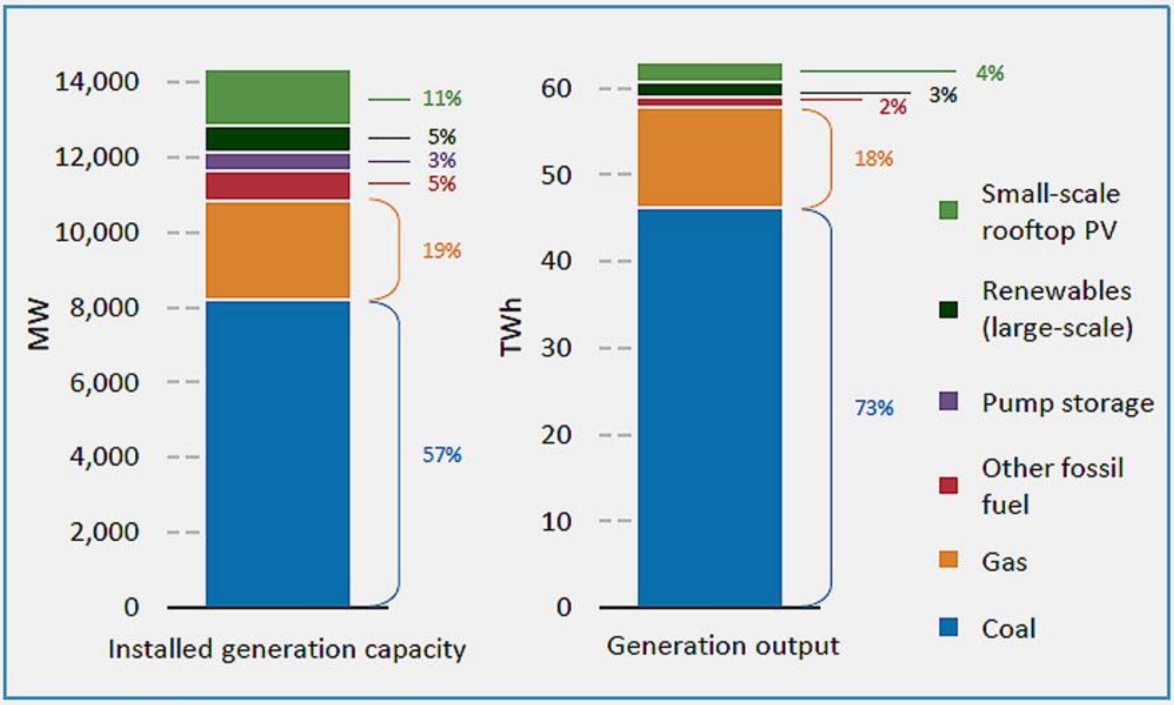
This is where most people incorrectly attribute the percentage factors involved with any form of power generation, namely the Nameplate Capacity, or actual Generation of power.

In his Introduction, the Panel Chair Colin Mugglestone mentions this:

*Like many economies, Queensland produces the vast majority of its electricity from coal fired generation –around 73% of total generation in 2015.*

This goes directly to this diagram, Figure 8 in Section 1 – Background, shown here below.

**Figure 8:** Queensland electricity capacity and output (including off-grid), by fuel type (2015)




Source: AEMO[7]; Clean Energy Regulator[8]

This shows Installed generation capacity (also referred to as Nameplate Capacity) and Generation Output, and the two are completely different things. That 73% mentioned is actual electrical power generation, and note that it comes from only 57% of Nameplate Capacity for the same coal fired power generation. Note also here that while Rooftop Solar Power has 11% of Nameplate Capacity, it only delivers 4% of generated output, again highlighting the difference between Nameplate Capacity and actual generation. Some use Nameplate as the basis for comparison of renewables versus fossil fuelled supply, but correctly applied, it should only be a comparison for actual power generation.

So, when it comes to the target for 50% renewables, that target MUST be associated only with actual power generation, and not Nameplate Capacity.

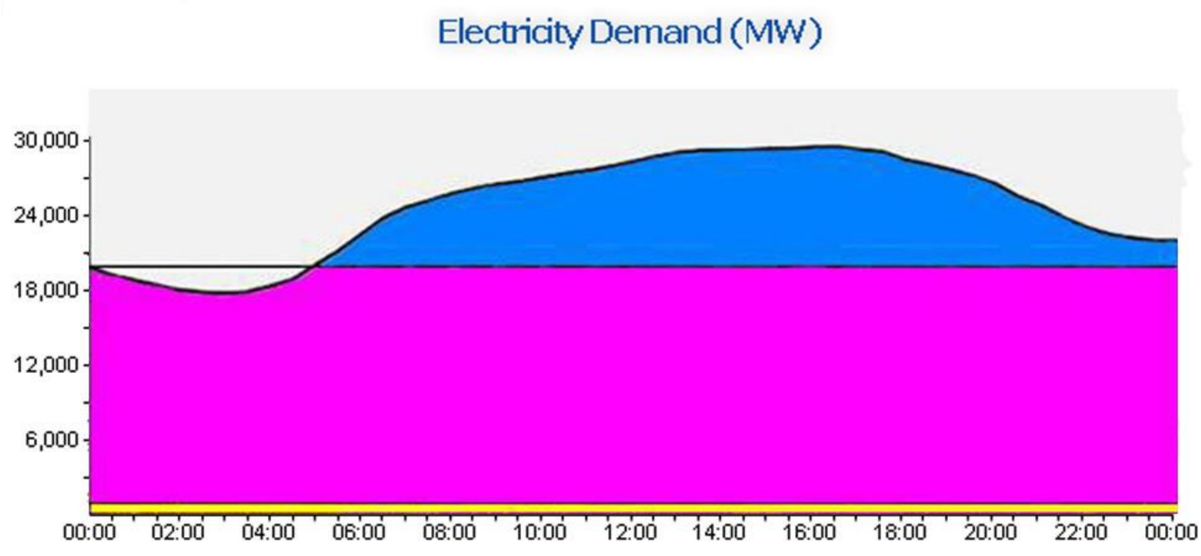
On this diagram, note that the total generation of power from non renewable fossil fuelled sources is 93%. So, for a 50% renewables target that has to come down to 50%.

The intent is to lower CO2 emissions, and that means the target here is coal fired power, which has a much higher rate of emissions than Natural Gas (NG) fired power generation. So, if that CO2 emitting sector is to be taken back to 50% in total, then that effectively means that it all has to come off coal fired power, lowering generation in that sector from 73% to only 30%. With NG and other fossil fuel remaining at 20%. That is a lowering of that Power Generation of 27TWH, a significant amount.

Now using a simple ratio mathematic equation, if 57% (Nameplate) gives 73% generation, then that will lower the Nameplate Capacity of coal fired power to only 3,300MW. Here I have used a simplified ratio, because actually it will be more than that, with an even smaller resultant Nameplate Capacity than that 3,300MW, because of the nature of some coal fired power, some of it being used for Rolling Reserve, in other words the plant running but not delivering power until called upon in a manner similar to the faster ramping plants in the NG fired sector here. Now this new total of only 3,300MW Capacity for coal fired power is important because of this next point I make here.

**The importance of the Load Curve for Actual power consumption.**

The deceptively simple looking image below is for a typical Load Curve for electrical power consumption, and this is for the area covered by the AEMO, all areas East of the WA border. I have coloured it in to indicate the supply of power from the different sources for generation.

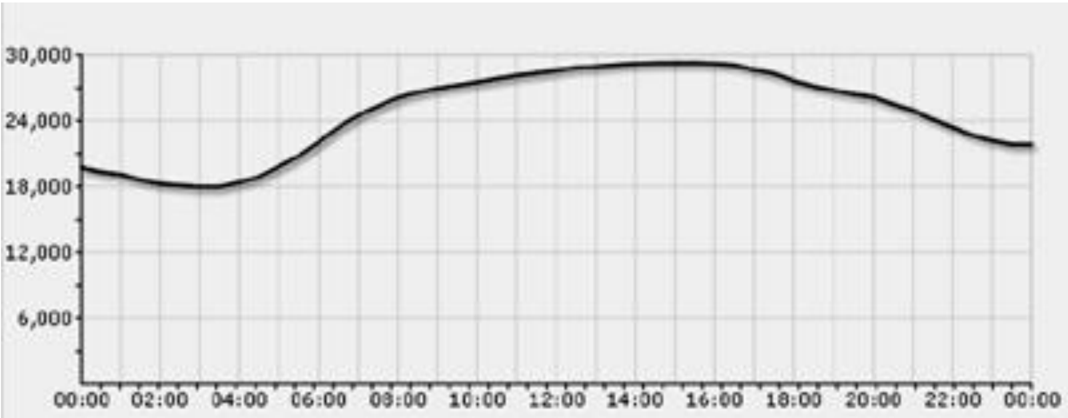


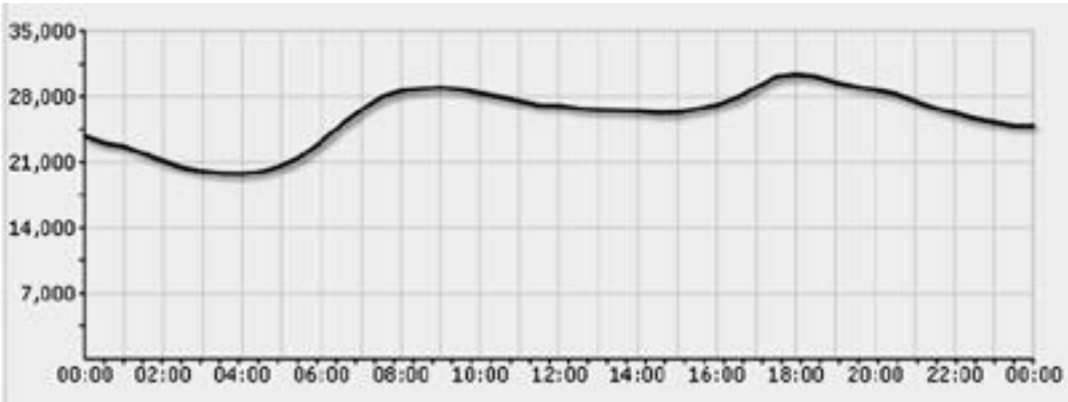

For this diagram, the vertical axis indicates total power in MW, and the horizontal axis is for hours during the day, starting at Midnight and going through the day and back to Midnight. Now, while this Load Curve is for all of that vast area of most of Australia, the diagram would look similar to this for a small town, a large town, a city, a Capital city, a State, and a Country, and not just for here in Australia, but for everywhere on Planet Earth where there is a regulated and constant supply of electrical power in the already Developed World. The shape of this Load Curve has not varied all that much from the time when electrical power first became readily available.

Here, the pink colour is all coal fired power. The blue colour is a mix of Natural Gas (NG) coal fired power, (the Rolling Reserve I mentioned earlier) and other forms of power generation. In this blue area, these power plants are called upon to supply power only when it is required. That Pink area is referred to as Base Load Power, power which is required absolutely, and the Blue area is referred to as Peaking Power. The yellow colour along the bottom of this image indicates wind power and solar power, and while spread throughout the curve, due to its intermittency, for ease of showing it, I have indicated it here as a combined supply of around 4 to 6% for ease of explanation. That pink coloured area is critical here as this power is required for 24 hours of every day.

So then, why is this 24 hours of actual total power delivery so critical?

While this Load Curve is a typical power consumption curve for the Summer Months, a Winter Load Curve has the basic similarities except it shows two peaks with a slight dip in the middle of curve as shown with the following two images, typical of Summer (top image) and Winter Load Curves, (bottom image) again, both of these are for this same coverage area.




Both Summer and Winter have approximately the same maximum power consumption, in this case, around 28,000 to 30,000MW of power. What is the same with both Load Curves however is that dip at the start of the curve, and the low value, the same for Winter as shown here on this Summer curve, again, around 18,000MW.

The single main point that is of utmost importance here is not the total power consumed, but that dip you see there between Midnight and 5AM. Note here that in the time from Midnight to 4AM, when nearly all of the people in Australia are comfortably tucked up in bed, asleep, power consumption is still around 18,000MW, which is approximately 60% of maximum power generation. That low point of around 18,000MW is the same, Summer, Winter, all year round, 365 days of every year, excepting

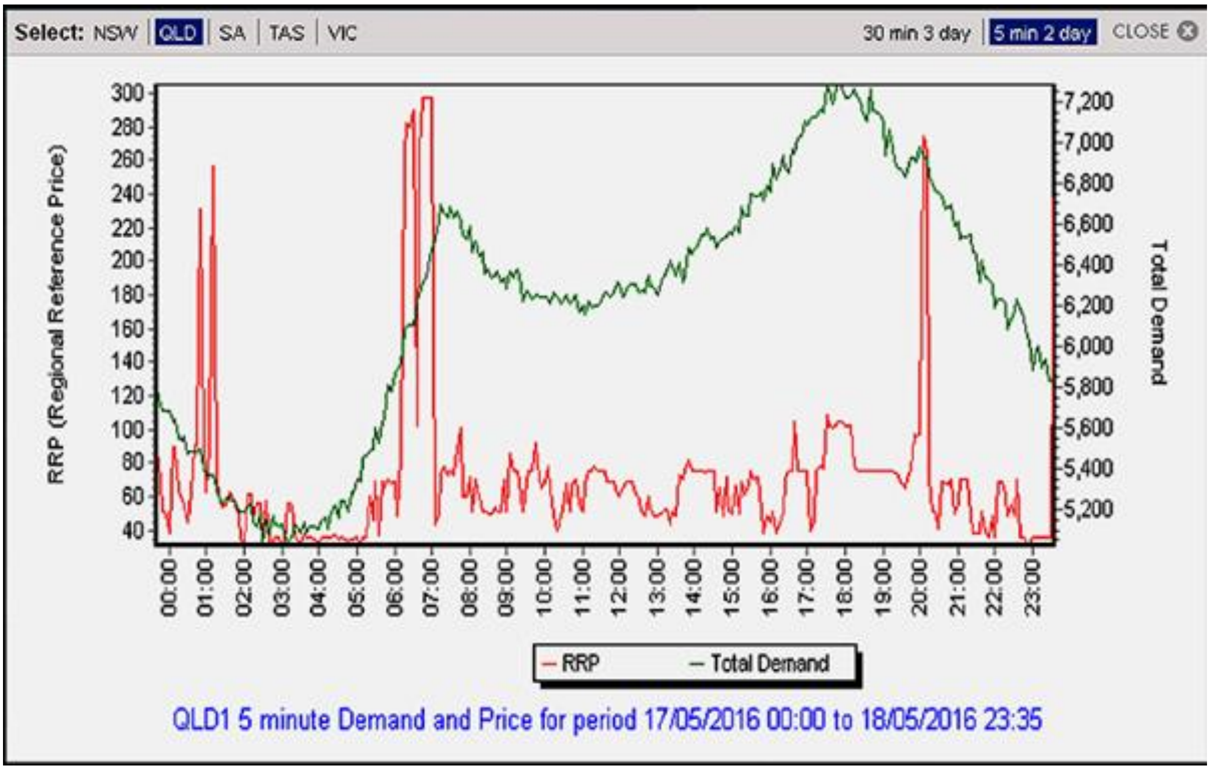
Christmas Day only, when it is lower than that, mainly because everything is closed. Total power consumption never falls below that level. That is 60% of every watt of power being generated, required absolutely for 24 hours of every day. This is referred to as the Base Load requirement.

That absolutely required power is consumed in a number of areas, all of them vital. It is the power required to have breathing air circulated through every building taller than two or three stories, where there are air conditioning units on the roofs of every one of those buildings. Now, while it is referred to as air conditioning, the main reason for them is to circulate breathing air into and out of all those buildings, because there is no other access to breathable air from outside in all of those buildings. The power to keep those units in operation is required all the time. You cannot just turn it off overnight and then back on the next morning. That air inside the structure needs to be circulated for the full 24 hours of every day.

That Base Load power is also required for the 24 hour operation of the electric rail system, inter urban and city transport, trams and electric buses, for traffic control and lighting in towns and cities, for hospitals, for all Commercial outlets, especially places like Coles and Woolworths with their huge banks of cool and cold storage for food, all of them needing absolutely, and in fact mandated to be in operation for 24 hours of every day. It is also required for Industry which operates around the clock, for the mining companies which operate around the clock, and for a myriad of other things which require electricity to always be there all the time, including every refrigerator in every home, and for most off peak hot water systems in the Residential sector of power consumption.

So, as this power is required around the clock, there is a need for that amount of power to always be there, available for the full 24 hours.

A similar load curve for the State of Queensland is shown in the following image, and this is taken from the AEMO site.



This diagram was taken from the AEMO site, and shows power consumption in Queensland for Wednesday 17th May 2016, and the green line here indicates actual power consumption, (Demand) and, as you can see, it closely resembles the typical Winter Load Curve I included above, with the dip from Midnight to 5AM, and then the rising consumption as people awake, do their morning things at home, and workplaces and schools begin to open, hence the rapid increase in consumption, easing off at 8AM to 9AM and then rising again to the daily peak at around 5PM to 6PM, when people arrive home from work and go about their things in their homes, and then gradually falling later in the night and back to the next morning's dip point.

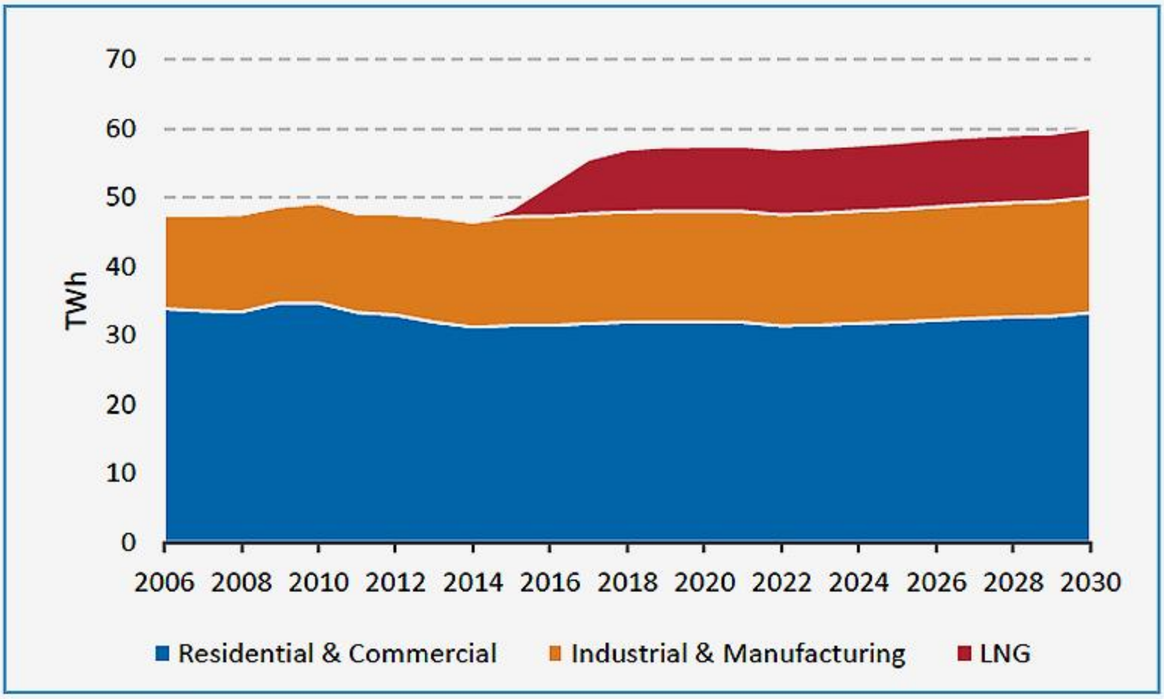
Note that low point of the dip at around 4AM, and that's 5,200MW. That is the lowest point consumption reaches every day, and, as I mentioned that's around 60% of average daily power consumption, and here, for Queensland, that absolute requirement is around 70% or more.

As things stand right now, that absolute physical requirement of that 5,200MW is covered by the 73% of generated power from coal fired sources as shown in Figure 8 above.

However, with the now lowered total for the coal fired sector of only 3,300MW, that's almost 2,000MW under what is required absolutely. Even adding in the total from every available NG plant, (which are only designed in the main for short periods of operation) that total (only 50% maximum power from fossil fuel plants) is still well under that 5200MW absolute requirement. The coal fired plants are specifically designed to supply constant and huge amounts of generated power to actually cover that absolute requirement. Take them away, and you can see the problems for all those areas I mentioned above requiring 24 hour access to reliable power.

From that, also refer to Figure7 from the Issues Paper showing the projected medium scenario power consumption, and look at what is projected for 2030.

**Figure 7:** Operational Queensland electricity annual consumption, medium scenario




Source: AEMO[5]

In 2030, almost half the consumed power is required for the Industrial and LNG sectors, and most of that power will be required for 24 hours of every day. Even in the Commercial sector, again, there is a large requirement for 24 hour power supply, as I mentioned above where I listed just some of the areas where Base Load power is required. So, while there is a proposal to cut back on coal fired power, here you have sectors which will require MORE of that power which must be supplied for 24 hours, currently the province of coal fired power. This again makes the proposal for 50% Renewable power problematic at best, and unobtainable at worst.

So then, even with this in mind, let's attempt to do the exercise to strive for that 50% Renewables target, and this will have implications in two areas, that of the renewable power sector, and also for the existing coal fired sector, and I'll do that in two parts below.

**The Implications For The Coal Fired Sector**

Currently there are 8 major coal fired power plants spread across the length and breadth of Queensland, and they are as follows

Plant – Nameplate- Date Opened

Callide B – 700MW – 1988 and Callide C – 920MW - 2001
Gladstone – 1680MW – 1976
Kogan Creek – 750MW – 2007
Milmerran – 850MW – 2002
Stanwell – 1460MW – 1996
Tarong North – 443MW – 2003
Tarong – 1400MW – 1986

Total Nameplate 8203MW (as shown in the Nameplate Capacity, left column of Figure 8 above)

Only three of them, Callide B, Gladstone, and Tarong are older than 20 years old, so it might be considered that they would be the first to close as the time arrives for this proposed 50% renewables target.

As I detailed above, this proposal calls for a cutback in coal fired power to only 3300MW, and that takes out almost two thirds of that currently existing Nameplate Capacity. By 2030 even those plants now only 20 years old will be only 35 years old, and still with possibly a maximum of 15 years operation in them, with four of them less than 30 years old with perhaps another 20 years operation in them. Those plants, at construction, would have had contracts for supply to ensure viable operation and recovery of costs, so closing them would possibly lead to calls from the operators for compensation, which could quite possibly be (unfairly) legislated away, but again, surely a legal process would ensue from that. Even so, closing large plants of this nature will dramatically thin out access to reliable constant power across the State, considering the vast size of the State. Even closing the aging Gladstone Plant is problematic because of its need for the large Industry footprint at Gladstone, the Alumina Plant and the recently upgraded port facilities there, both requiring large amounts of 24 hour power availability. Also, thinning out that 24 hour power availability leaves the State Capital Brisbane short of the huge requirement for power that it has. Keep most of the South East plants for Brisbane, and take away Stanwell, Callide and Gladstone and there would be no reliable 24 hour power supply from Gladstone to the Cape and all points West of that. So, reducing that coal fired power Capacity is highly problematic.

You could take away some of the Natural Gas plants, but again, they are lower emitting, and designed for short run periods during peaking power periods of time, so the target here is that large footprint of coal fired power, and again, see how the vast distances inherent in Queensland make this removal of coal fired power a difficult thing to accomplish.

Either way, to achieve this 50% renewables target, then that fossil fuel, here coal fired power needs to be reduced by a huge 27TWH to take that non renewable sector back to 50%.

**Construction of Renewable plants.**

So then, having shown that a reduction of 27TWH from coal fired power to take that back to 50%, we now need to construct renewable plants actually capable of delivering that same amount of power 27TWH, and that's just taking into consideration rooftop solar power already installed and the Biomass plants, both of these being direct use power, rooftop solar for the homes with them on their roofs and those Bagasse plants, virtually all of them supplying the power being used by the Sugar mills themselves.

This Committee will report in November of 2016, so if the Government were to immediately implement this proposal, then the time frame is now only 13 years. As with any power plant, even renewable power plants, there is a period of time before construction actually begins, and the average for that to cover every aspect of planning is usually three to five years, so now the time frame for that target to be reached again squeezes up. If the Government plans to cover all of that power needed from renewables, then it may not even begin until 2020, so now, that only leaves ten years for the construction of all of these plants to actual power delivery status.

Ten years. 27TWH. That's a huge ask.

**Capacity Factor**

Here I will be talking about Capacity Factor, (and from here on I will use the acronym CF) and that is the Industry Standard for actual power delivery versus Nameplate Capacity total. That term CF is widely misunderstood. It can be looked at in two ways. The first is total full power delivery over a period of time, or secondly, part of the power for the full time. So here, a CF of 30% can be looked at in two ways. Full power for 30% of the time, (so only 7.2 hours in a 24 hour day) or 30% of full power for the whole day. This CF is the average power delivery across a full year. (again, the Industry Standard) As mentioned in the Issues Paper, there are occasional times when South Australia is getting 100% of its power from Wind power, but there are also many times when that power delivery is below 10 to 20%, and sometimes as low as even 5% or even lower. So, that is understandable, but what will happen for reliable power supplies when there are days without wind? Electrical power for every use has to be available at ALL times. It could be said that across vast areas, then some plants somewhere will still be supplying, but here, the vast distances of Queensland make that problematic. A wind plant with good wind in the far North cannot be used for supplying power in the South East corner.

Even in South Australia, the average CF for the whole of the wind power fleet is only around 30%, and that's around the same for the whole of Australian wind power fleet. In some Countries, Germany and Spain, that whole of fleet CF is as low as 20% and lower. In China, now with perhaps the largest concentration of Wind Power, that CF is barely 15%. In the US, the whole of fleet CF there is 28%.

So now we have this problem of CF entering the equation for renewable power, so here a Nameplate Capacity will only deliver 30% of its full power across a whole year.

The second form of renewable power is Solar PV. The CF for Solar PV is an average of only 17% (real CF used here and not the modelled CF, which is usually higher, but hardly if ever achieved) So at an average 17% CF, then that equates to an equivalent of full power for only 4 hours a day on a yearly average. It will be delivering its power for most daylight hours, but that power delivery rises and falls, and dips sharply with even the slightest cloud cover. In Summer Months that power delivery is higher, but in Winter Months, it is considerable lower, hence the year round average of 17%. For a good example of this, you need look no further than someone actually on the Committee, Paul Meredith, and ask to look at the insolation versus power generation live feed capability of the units at UQ, and that will show you what the power generation curve looks like for any Solar PV installation.

The third form of renewable is Concentrating Solar Power (CSP) also referred to as Solar Thermal Power. While this is often touted as a viable replacement for that term 'Base Load' Power, it is in fact not that at all.

The problem is that the plants themselves are quite small, tiny in comparison to large units at coal fired plants, and even at NG plants. They are usually constructed as 50MW units, but there are a few now that have 125MW units, but they have proved troublesome in operation, as shown with the two Plants in operation in the U.S. as they deliver considerably less power than what they were modelled at originally. Nearly all CSP plants also utilise NG driven turbines to start the units and operate them until the solar part of the unit heats the compound enough for it to be able to take over operation of the plant for power generation from just the solar part. In fact, the two plants in the U.S. use so much NG that they are now subject to the CO2 cap and trade for emissions. The overall CF for these CSP plants is around 28%, barely the same as for wind power. As an example here, I have some analysis for ALL of those CSP plants in Spain, as shown at the image shown below, on the next page.

This shows the data for all 24 CSP power plants in Spain. Notice that in the main, the Nameplate Capacity is in multiples of 50MW, the average sized single unit actually able to be driven by this technology. It also shows the time in hours for heat storage, in other words the diversion of heat so that the plant might be able to operate after the Sun sets. Most have no heat diversion and the remainder are around 7.5 hours, however, this time would only apply in Summer, as, contrary to opinion, most of the plants operate very little in the Winter Months, with some even closing down completely. If the plant has heat diversion, this lowers the overall maximum power delivery, in other words, the more hours of heat diversion, the lower the Nameplate Capacity.

While CF differs for those plants, the average CF for all of those Spanish plants is only 28.7%. (and here, this is calculated across the whole year for the total power delivery versus the total Nameplate, and not just averaging all the CF listed here)

Now, adding together all the Nameplate Capacity for all 24 plants, the total Nameplate comes in at just 1781MW, and for example here I will compare this with the Stanwell coal fired plant here in Queensland. The Stanwell plant has a Nameplate Capacity of 1460MW, so it is a fair bit less than the overall Nameplate for all these CSP plants. However, when it comes to total power delivered, all these CSP plants deliver only 4480GWH, the same power delivered from Stanwell in 154 days, only 22 weeks, less than half a year. So here we have 24 CSP plants, and they haven't replaced the power delivery of ONE lesser Nameplate Capacity coal fired plant for half a year.

That shows just what would be needed were there a heavy concentration of these CSP plants.

| Plant Name | Plant Type | Area (Acres) | Heat Storage | Capacity (MW) | Generation (GWH) | Capacity Factor (%) | Hours Supplied |
|---|---|---|---|---|---|---|---|
| Andasol 1 | Parabolic Trough | 480 | 7.5 | 50 | 175 | 40 | 9.6 |
| PS 10 | Power Tower | 164 | 0.5 | 11 | 23.4 | 24 | 5.8 |
| PS 20 | Power Tower | 210 | Nil | 20 | 48 | 27 | 6.5 |
| Andasol 2 | Parabolic Trough | 472 | 7.5 | 50 | 158 | 36 | 8.7 |
| Andasol 3 | Parabolic Trough | 504 | 7.5 | 50 | 165 | 37 | 8.9 |
| Solnova | Parabolic Trough | 966 | Nil | 150 | 340 | 25 | 6 |
| Valle 1 and 2 | Parabolic Trough | 962 | 7.5 | 100 | 320 | 36 | 8.7 |
| Gemasolar | Power Tower | 520 | 15 | 20 | 110 | 62 | 14.9 |
| Lebrija 1 | Parabolic Trough | 492 | Nil | 50 | 120 | 27 | 6.5 |
| Palma del Rio | Parabolic Trough | 697 | Nil | 100 | 228 | 26 | 6.3 |
| Helioenergy 1 and 2 | Parabolic Trough | 685 | Nil | 100 | 190 | 22 | 5.3 |
| Solacor 1 and 2 | Parabolic Trough | 600 | Nil | 100 | 200 | 23 | 5.5 |
| Moron | Parabolic Trough | 495 | Nil | 50 | 100 | 22 | 5.3 |
| Soluz Guzman | Parabolic Trough | 312 | Nil | 50 | 104 | 23 | 5.5 |
| Manchasol 1 and 2 | Parabolic Trough | 1040 | 7.5 | 100 | 316 | 36 | 8.7 |
| Helios 1 and 2 | Parabolic Trough | 620 | Nil | 100 | 194 | 22 | 5.3 |
| Alvarado (La Risca) | Parabolic Trough | 334 | Nil | 50 | 102 | 23 | 5.5 |
| Extresol | Parabolic Trough | 1504 | 7.5 | 150 | 474 | 36 | 8.7 |
| Olivenza | Parabolic Trough | 509 | Nil | 50 | 104 | 22 | 5.3 |
| Majadas | Parabolic Trough | 365 | Nil | 50 | 104 | 23 | 5.5 |
| Solaben | Parabolic Trough | 744 | Nil | 200 | 400 | 23 | 5.5 |
| Orellanna | Parabolic Trough | 371 | Nil | 50 | 118 | 26 | 6.3 |
| Terrasol 1 and 2 | Parabolic Trough | 504 | 9 | 100 | 360 | 41 | 9.8 |
| Puerto Errado | Fresnel Mirrors | | | 30 | 49 | 18 | 4.3 |

So, now having explained Capacity Factor, (CF) let's then do a scenario to construct renewable power plants from these three areas to deliver that 27TWH of power required to achieve this 50% renewables target, keeping in mind the time frame of now only ten years, from 2020 to 2030, provided everything in that early planning stage runs smoothly, and there are no problems with anything, so actual plant construction begins in 2020.

**Renewable plant construction.**

As mentioned in the Issues Paper, it is problematic that any new major Hydro plants can be constructed, and while there may be some places where a Hydro plant as part of a dam could go in, the prospect of any new dams for any purpose at all is one that would be difficult politically for any Party in power in Queensland.

Those Bagasse powered plants are all of them at Sugar Mills, and incidentally, all of them relatively old, so the prospect of any new plants of this nature going in is also not very probable.

Rooftop Solar Power may increase, but again, that will provide only tiny levels of power, all of it used in the Residential Sector mainly by the homes with those installations, with very little, in fact only tiny amounts actually fed back to the grid. The Issues Paper also raises the prospect if this rooftop solar should even be included in this target at all.

So that only leaves the major large scale power plants in just three areas, CSP, Solar PV and Wind power.

So then, let's construct plants in those three areas to generate the required 27TWH of actual generated power.

**Concentrating Solar Power (CSP)**

Let's construct those same 24 CSP (Solar Thermal) plants that Spain has. Starting in 2020, that means a construction of two full plants each year, and half of the third plant so that all 24 of them are in operation and delivering power by 2030. This will deliver 4480GWH, call it 4500GWH or 4.5TWH.

**Solar PV**

Let's then look at the Queensland Solar 60 Case Study from the Issues Paper itself.

From that, let's go ahead and construct 20 of these 60MW Solar PV plants. So, that will be two of these plants constructed and delivering power each year from 2020 till 2030. The total power delivered from these 20 plants will be 1788GWH, call it 1800GWH, or 1.8TWH per year.

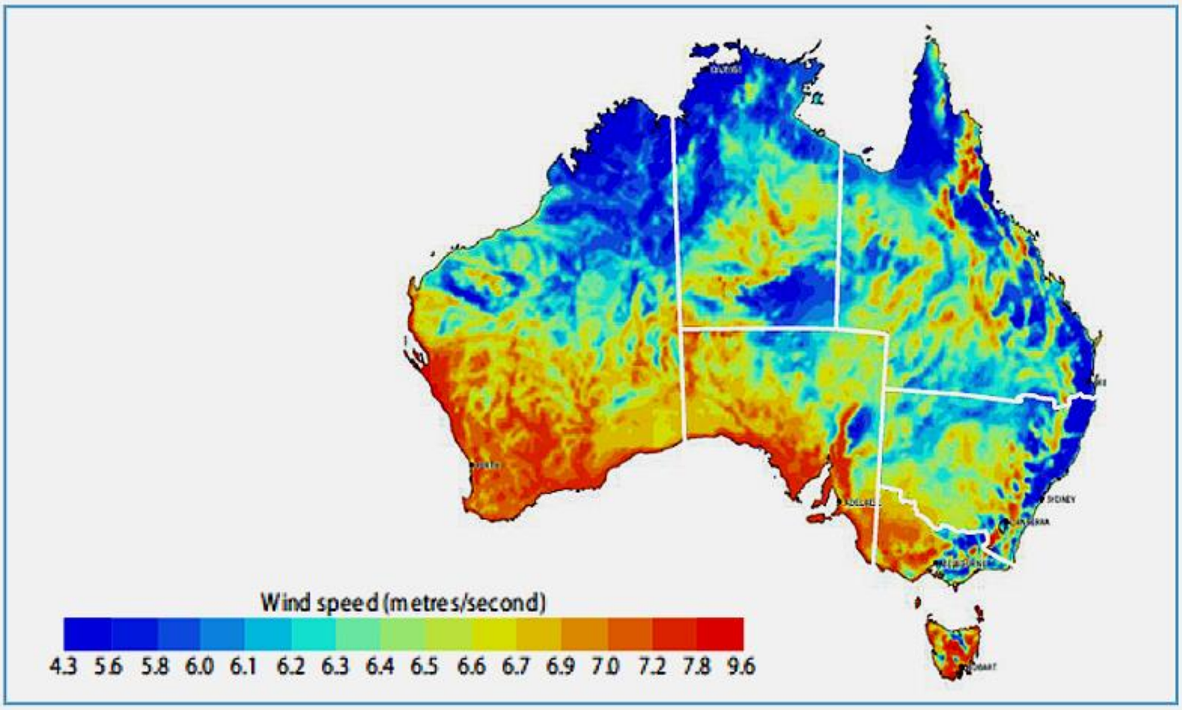
Progressive total is now 6.3TWH, and incidentally, that's still only 215 days supply from the one coal fired plant at Stanwell I mentioned earlier.

**Wind Power.**

So, now we have 6.3TWH of power from the two versions of Solar Power that means we now have to find 20.7TWH (per year) from wind power.

This part of the equation now harks back to CF, and that relates to this image from the Issues Paper, Figure 12, which shows the best sites for wind power in Australia, based on wind strength capable of supporting wind power plants.

**Figure 12:** Predicted wind speed at 80 metres above ground level, 1995-2005, Australia




Source: South Australia Government[13]

This indicates the best areas for wind and the consequent construction of wind plants to provide the greatest hoped for amount of power output. As you can see here, the best wind is in that area of South Australia and Victoria, where there is already a large aggregation of wind plants.

For virtually the whole length of the Queensland coastline, the wind speed is in the main only around half of what it is in S.A and even across the central areas of Queensland, it is still lower than S.A.

So, while those wind plants in S.A. have a CF of around 30%, that would not be achieved virtually anywhere in Queensland. So here, the CF must be modelled at a lower percentage, and here I might suggest it could be as low as 20%, but for the sake of the exercise, I'll go with the higher figure of 25%.

So now, needing 20.7TWH of delivered generated power, that translates to a Nameplate Capacity of 9,445MW, and let's call it 9,500MW, using the Industry Standard equation.

That Nameplate Capacity is 2.57 times the TOTAL Nameplate Capacity for wind power in the WHOLE of Australia.

The largest wind plant in Australia is Macarthur Wind Plant in Victoria with a Nameplate Capacity of 420MW, and that is 140 of those huge towers, each with a 3MW nacelle on top which houses the generator. If more plants, then it's a total number of wind towers coming in at around 3,200 of them.

So, with 9,500MW of Nameplate needed that's 22.62 of those plants the same size as Macarthur, so that's 23 of those wind plants required here.

Starting in 2020, if all the preliminary planning falls into place without any hitches, that gives us a construction schedule of 2.3 of these huge plants every year, operational and delivering its power, or, more succinctly, the current Australian total for wind power every four years.

This wind plant construction gives us the remaining power when added to both solar options to take it up to that figure of 27TWH by 2030.

**CONCLUSIONS**

However, now look back to what I mentioned about CF, and how it can be looked at in two ways, and this applies for all three construction cases here. The actual delivered power is only available for, on average for Queensland, only 25% or for only 6 hours a day on average. Some days will see more generation and some days considerably less. So in effect, while you still have the total power, it is intermittent at best, and all of these renewables are replacing a source of power, coal fired power, which has its availability of power for that full 24 hours of every day. Then there will be the significant upgrade to the grid itself to cope with all this renewable power to get the power from the area where it is generated to areas of consumption at a huge added cost.

You may notice here that I have not bothered to do the sums for how much all this would cost. There's no need to even begin to do this when what I have shown here is that this is a plan which cannot be achieved, no matter if that money is 'on tap' and readily available. At a conservative ballpark guess, I might suggest you would be looking at around $65 Billion for all of this here, and even that could be on the low side. So, starting right from the day this report is finalised, then that's a total of $5 Billion a year. However, as with nearly every renewable plant which has been already constructed, in most cases, two arms of Government, the Federal Government and the State Government have come to the party with up to half that total for each renewable power plant, so that's around $2.5 Billion each year, and I might suggest that even the Federal Government, which supplies the larger amount would balk at something on that scale.

Even so, finding $2.5 Billion a year for 13 years from the private sector is problematic in the extreme.

However, all of that is incidental really, as what I have here shows that something on this scale is something which just cannot be achieved, and would most probably lead to the State shutting down.

To reach a true 50/50 split, you need to take away existing regular constant and reliable power and then replace it with power that is intermittent at best. That 50/50 split MUST be based on the actual generated power to be truthful, and anything other than that is not true at all.

I fully understand that this is probably something that is not an acceptable thing for this Panel to hear, but while the concentration of this Panel is on sourcing the finance, the jobs that may come with this, and a 'feel good' do the right thing attitude, what I have written here goes directly to the absolute heart of this matter ….. Is a 50% Renewable target feasible?

What I have shown here is that this is not only NOT feasible, it is in fact something which cannot be achieved, and will not be achieved.

I thank you for the opportunity to make this submission, and I sincerely hope it will be seriously addressed. I know it is long, but something of this nature just cannot be addressed with anything shorter than what I have written here, where I have tried to explain in full why it cannot be done, building the case from the beginning.

If I might close on a personal note here, in 2030, I will be in my late 70's. I most probably will have long forgotten this submission, as will perhaps everyone on the panel, and even everyone in Queensland. However, I can guarantee you this. In 2030 Queensland will not have 50% of its power sourced from Renewable power, no matter who says it is achievable.