Work Package 2 Report "Valuing the Capacity of Intermittent Generation in the SWIS" - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
	Western Power		
LOLP criteria	Analysis seems to be based on the assumption that shedding 473 MW of load for an hour is acceptable as this equates to the 0.002% energy at risk. However the current capacity requirements are based on 8.2% of the forecast peak which is providing a lower energy at risk than 0.002%. It should be made clearer in the report that according to the energy at risk criteria we are accepting that lack of wind generation will result in load shedding during peak periods. The energy at risk of 473 MW is based on a 10% POE system forecast. The 50% POE forecast is only approximately 160 MW less than the 10% POE forecast. This means that on average we are prepared to accept the loss of 313 MW of load during the peak period. More discussion is required on whether assigning capacity credits based on a 0.002% energy at risk criteria is valid.	The assumption about 473 MW load interruption in one hour is incorrect. No claim has been made about the maximum amount of load shedding in one hour and no such analysis has been undertaken. We have not analysed the distribution of outage events as such considerations are not contemplated in the Market Rules. The energy criterion is an average criterion, not an event based criterion. The expected unserved energy is 473 MWh taken over a wide range of possible events. We are **not** accepting that the lack of wind generation will result in load shedding during peak periods. <u>We are accepting</u> that the lack of wind generation will result in the same level of risk of load shedding that we would have now if the operational characteristics of the system resources were such as to approach the unserved energy criterion, due to poor thermal plant reliability or extra scheduled maintenance. If the 0.002% unserved energy criterion is unacceptable or uneconomic then it ought to be reviewed. The contribution of intermittent generation to system reliability should be treated on the same basis as the contribution of scheduled generation to system reliability. If that means moving from an average criterion to an event based criterion or percentile criterion, then that is a separate matter in the context of the current scope of work.	
Generation reliability	Equivalent system reliability would require the same level of reliability of output from the wind generators as is achieved from conventional thermal plant. Work done in the NEM indicates that the average availability for thermal plant is 95%. This would lead to assigning capacity to wind equivalent to a value that is available at least 95% of the time. Analysing the 2007/08 wind data gives an average capacity for wind of 3.7%, although the capacity factor for each individual wind farm is significantly less. How does the reliability in output from wind compare to that of conventional generators in the WEM? Is there an argument to assign capacity credits based on an availability of generation so that capacity credits can be assigned independent of generation type? This will not however address the issue that the generation is required to cover the peak load period rather than average output.	The proposition in the first paragraph is false because the generation of intermittent generators above the 95% probability level makes a significant contribution to system reliability. The same does not apply to scheduled resources because there is no significant additional output above the output level which is exceeded 95% of the time. That is why percentile measures on a project or fleet basis do not equalise reliability. The analysis undertaken answers the question as to the comparison of reliability contribution relative to conventional generators except for the variability due to scheduled and forced outage performance, which are considered secondary factors. The only meaningful way that capacity credits can be assigned independent of generation type is to equalise system reliability so that it then doesn't matter what type of resource achieves the reliability standard. Basing capacity credits on the 95% capacity of exceedance without considering the value of the output above 95% probable capacity would well understate the reliability	

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Issue	**Comments**	**MMA Response**	**Member feedback**
		contribution of intermittent resources. This does address the fact that generation is required to meet peak load. It has very little relationship to average load.	
Reserve Margin	If increased penetration of wind leads to an increase in the current reserve margin then it indicates that we are assigning too much to the capacity of wind. If there is greater wind penetration, is the reserve margin likely to be increased above 8.2% of forecast peak demand to meet the 0.002% energy at risk?	The two concepts are not linked. If the allocation of capacity credits is based on system reliability equalisation, then new wind generators only receive capacity credits proportional to their contribution to system reliability. An increase in the reserve margin could result from less peaky demand profile, or less reliable controllable plant. If the capacity value of intermittent generation was overstated and nothing was done about it, then one might increase the reserve margin. However, it would be better to amend the capacity measure. The answer to the question is yes: An increase in reserve margin ratio above 8.2% may be required to meet the 0.002% criterion if wind power became the major generation source in the WEM. In that event the reliability criterion would need to be recalculated as 0.002% energy at risk would probably be no longer an economic criterion, if it ever was. Note that CRA did not conduct an economic analysis of the reliability criterion at the last review.	

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Use of average output	The analysis that has been done used the average output over a trading interval which equates to energy whereas capacity is a power issue. Has any consideration been given to the impact of using the minimum output over a trading interval? Concern was raised in the report on relying on the 10% POE due to its variability. However it is the 10% POE that is used to determine capacity requirements. Having variability in the output is the issue. It indicates that we can not assign high levels of capacity credits due to its variability. This approach would only be valid if the variability of wind at off peak times was the same as at peak times. This needs to be demonstrated before this approach is accepted.	No, because such analysis is unlikely to be of any help given that the average power over selected trading intervals shows a value commensurate with the values obtained from reliability equalisation. The use of a minimum output consistently undervalues capacity relative to system reliability. It is true that the proper capacity value should be based on 10% POE operational conditions but we have scant data to work with. We can assign high levels of capacity value if supported by the data but we have to accept the risk that it may be later reduced if another 10% POE period does not yield the same level of wind output. Variability in itself does not mean that we have to assign a low capacity value. The main problem is that if we have few data samples for 10% POE, we also don't know the variability unless we do a full weather and system load analysis based on 100 years of weather. However we don't have the local weather conditions measured for that task either. Thus the only reason for assigning a low value of capacity value would be either that the limited data support it (which they don't) or if not, that we don't want to take the risk of having to revise it downwards later. Perhaps the intermittent generators would be prepared to take that risk if it means they receive an equitable assessment based on the available data in the mean-time. If investors are informed that there is a risk of later reduction, they may accept a higher value in the mean time. The variability of wind power at off-peak times is not relevant to system reliability or capacity valuation.	
Frequency keeping	The presentation by ROAM on frequency keeping and load following requirements indicated that for scenario 1, by 2030 (1460 MW of wind), approximately 300 MW would be required for load following. Of this 54% is a direct result of intermittent generation. Has any consideration been given to reducing the capacity credits assigned to wind by the amount of generation required to provide a frequency keeping and load following service? For the 2030 scenario 1 of the ROAM presentation this would mean that for 1460 MW of wind with an average output of 40% would be assigned capacity credits of 1460*0.4 – 300*0.54 = 422 MW or 29% of capacity.	The frequency keeping requirement would be a separate ancillary service which would be paid for separately. There is no need to discount capacity credits unless intermittent generators are not paying for the cost of regulation. The regulation and reliability impacts can be analysed separately providing the reliability standard is properly developed.	
Impact of increased wind penetration	Currently if there is a reduction in the output of wind during the peak it can potentially be covered by the reserve margin, due to the relatively low penetration of wind. However as wind penetration increases, the capacity assigned to wind could exceed the reserve margin. This will lead to load shedding if the wind capacity is not available on the peak day.	Yes, high penetration of wind power could well cause an increase in the required reserve margin to meet the unserved energy criterion. High penetration of solar plant would not have the same effect because its output is concentrated into more favourable periods. The analysis to 2016/17 did not require an increase in the reserve	

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Issue	**Comments**	**MMA Response**	**Member feedback**
	Load shedding will occur if the capacity assigned to wind is not available. Is the requirement to use the reserve margin likely to increase with the proposed capacity credits?	margin for the proposed capacity credit values. The reserve margin may also need to increase if load gets less peakier or if the reliability of conventional plant deteriorates. As the system gets larger it should decrease unless unit sizes also increase commensurately.	
Use as capacity for network control service	It should be noted that the report considers system wide averages and should not be used to determine potential capacity for a network control service.	Correct. Equivalent capacity for a network control service based on local reliability would require a different kind of analysis based on local load patterns and transmission system performance in conjunction with the wind power variability at the times of critical transmission system loading.	
Potential Methodologies Page 12 Section 3.3	The report states that full modelling of the power system would be required. Why is this necessary when the WEM is operating on an unconstrained generation approach? Although the market rules may not provide locational signals for capacity value or to account for losses, they are accounted for in the following ○ Capital contribution for deep and shallow reinforcements ○ Use of system charge for generators ○ Static loss factors	Because even an unconstrained system in a planning context can find itself at risk of constraints, including the impact of network outages. Hence there could be some local capacity benefits that occur that would not be assessed by modelling the whole system as lossless and unconstrained. Essentially there may be some network control benefits from some wind power resources in specific circumstances.	
Availability of historical data P23 Section 4.2.1	“historical performance data is insufficient to develop models of plant performance for the intermittent resources”. What level of data would be required? Other areas only require 3 years of data and we have 3 years of wind data.	The amount of data depends on many factors, but more particularly the number of hours per year with significant exposure to system load shedding. The less hours, the more years of data required. One can produce a value with three years of data, but we have shown that the value will be volatile as new data become available. Ideally, a combination of regional weather and local weather for many peak seasons would be necessary to develop a robust model not subject to material variability arising from exposure to new weather and performance data. It is basically a risk assessment of the impact of variability and the trade-off with accuracy and consistency across technologies.	

<table>
<tr><th colspan="4">Work Package 2 Report “Valuing the Capacity of Intermittent Generation in the SWIS” - REGWG Comments</th></tr>
<tr><th>Issue</th><th>Comments</th><th>MMA Response</th><th>Member feedback</th></tr>
<tr><td>Concepts for capacity valuation

P30</td><td>The NEM use a 95% POE value for assigning capacity to wind. This is not mentioned in this table.
How is the equivalent capacity based on correlation with peak loads calculated and what would capacity assignments be if it was used in the WA market?</td><td>Table B.44 Wind Farm Availability Factors
<table>
<tr><th></th><th>Summer</th><th>Winter</th></tr>
<tr><td>Queensland</td><td>0.000</td><td>0.000</td></tr>
<tr><td>NewSouth Wales</td><td>0.050</td><td>0.050</td></tr>
<tr><td>Victoria</td><td>0.080</td><td>0.055</td></tr>
<tr><td>South Australia</td><td>0.030</td><td>0.150</td></tr>
<tr><td>Tasmania</td><td>0.000</td><td>0.000</td></tr>
</table>
The table above is provided in the 2009 NEM ESOO. This appears to be based on regional aggregates at the 95% probability level as applied by ESIPC. This method does not relate to supply reliability impacts but is used for an overly conservative reserve margin analysis.
If we applied a 95% exceedance rule at times of system demand, the Walkaway and Emu Downs data suggests a capacity of between 2% and 18% of rated capacity. We have not assessed this for the summation of the existing wind farms. In any case it is an excessively conservative approach.</td><td></td></tr>
<tr><td>P35</td><td>Using best fit would give almost entire reliance on the 10% POE case. Is this an issue?</td><td>That is correct. The 10% POE conditions represent about 95% of the capacity value. The 30% POE conditions represent 4% of the capacity value.</td><td></td></tr>
<tr><td>P44</td><td>LOLP calculated using top 250, 500 and 750 trading intervals. The top 12% of capacity occurs in the top 86 trading intervals. I would like to see more commentary on why analysing the data over a longer period is still relevant to the shorter critical peak period.</td><td>Using the longer period is merely a mathematical device to reduce the volatility of the measure until better models of the system load / plant output / system reliability relationships are developed. It’s a trade-off between accuracy with shorter periods and low volatility with longer periods. It’s only because there does not seem to be a significant loss of accuracy that we are proposing 250 – 750 trading intervals until better data and models are available. How much volatility owners are willing to accept is a commercial risk management decision.</td><td></td></tr>
<tr><td colspan="2">Pacific Hydro</td><td></td><td></td></tr>
<tr><td>Methodology</td><td>As the LOLP methodology coincides with a capacity credit methodology using the top 750 trading intervals, Pacific Hydro considers a 750 interval methodology should be applied. However, the lack of data and the potential for volatility in annual values a moving average system such as described by the Office of Energy would be preferable for adoption.</td><td>MMA does not object to the OOE approach for averaging over a number of years, although it should be based on periods of maximum load for scheduled generation which would be retrospectively assessed.
However, the assessment for the future period needs to model the load for scheduled generation in the future period as providing the trend signal. So we could take a moving average from the prior years plus the assessment for the future capacity year based on the expected pattern of load for scheduled generation using five standard weather years. If that data cannot be provided, then the default could be based on the historical data less a discount to reward data provision. The OOE method does</td><td>OOE: (Noting that the OOE would now suggest a different approach to the one it first suggested – see later comment.) While in theory assessment should “model the load for scheduled generation in the future period as providing the trend signal”, the value of this might not offset the added complexity. Growth in the intermittent fleet will be incremental. Basing assessment on historic data only (including just the proposed plant) could provide a sufficiently accurate assessment. Any improved “accuracy” from a more complex assessment would best be considered in the context of the underlying uncertainty of the whole process. The OOE would not be opposed to a more accurate approach, but believes the benefits of this should first be assessed against the added complexity.

MMA has correctly noted that the initial OOE method did not include a look-</td></tr>
</table>

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Issue	**Comments**	**MMA Response**	**Member feedback**
		not include a look ahead contribution that would foresee the effects of high penetration until after the event.	ahead contribution and would not foresee the effects of high penetration until after the event. However, this concern is mitigated by the incremental nature of growth in intermittent generation. As rapid as this growth might be, it is most unlikely to exceed the percentage growth rates that we have seen to date with the establishment of the first wind farms. For instance the introduction of the Alinta wind farm represented a 430% increase, Emu Downs a 72% increase and Collgar will be a 108% increase. Given the fleet size would then be 397 MW, these very large annual percentage increases are most unlikely to be repeated in the future. It follows that a look ahead facility will be less important in future than it has been to date and consequently a simpler approach based just on analysis of historic data might be satisfactory, especially if this provides a conservative result.
Unserved Energy	The objective of meeting the reliability standard of a 0.002% unserved energy should be expressed in terms of the outage % of demand for 1 hour at an average and peak level of system demand.	This is not a helpful measure as it doesn't represent the structure of the risk. Not all the risk is at peak demand. It is not clear what this approach would achieve.	
NEM Capacity Factor	In relation to comments made comparing the NEM planning 8% capacity factor used for planning purposes with the current MMA paper I make the following comments: The NEM planning team uses a 8% CF for wind farms to coincide with a 10% POE demand forecast with provides a conservative view for the MTPASA and Statement of Opportunities. In June 2010 the approach will be to utilise the 90% POE forecasts coming from the wind forecasting tool (AWEF) which will be the equivalent to a 25% CF for wind.	Noted. MMA considers that the current NEM approach materially under-estimates the capacity value of wind power. This has no direct commercial impact on intermittent generators as the capacity assessment does not affect their income. They do capture their actual capacity value through the spot and contract markets of the NEM.	
Reconciliation for 750 trading intervals	What will be the true-up mechanism given that the actual generation during the top 750 periods may be quite variable (both positive and negative). The smoothing technique described by the Office of Energy will reduce this volatility however a difference between actual capacity and forecast capacity will need to be reconciled. I would consider a forward adjustment into the next period should be the true up mechanism. What thoughts does MMA have on this process?	If the forecast capacity value differs from the actually realised capacity value, and the OOE moving average is used as well, then any variations from the original forecast will be reflected in the assessed value for future years. For example, three year moving average is used and if one year is forecast to be 40% and it turns out to be 30% then that -10% adjustment will be weighted into the next three years (plus the new forecast value) at -2.5% for three years (with some delay) until that year's data is replaced. Thus the true up would partially flow through automatically. A full true-up would require an additional adjustment over the next three years, to increase it to -3.3%. That is an adjustment of [Previous error] * (1/N – 1/(N+1)) for N years of moving average.	
Adjusted Scheduled Generation determinant	My understanding is that rather than using system demand as the determinant of peak power use an adjusted scheduled generation (scheduled generation minus intermittent generation) is being considered. This raises questions in my mind as to the ability of this Capacity Credit payment mechanism to be utilised for ALL WA generators at some future time. A capacity credit methodology based on scheduled generation that has take or pay limitations may result in perverse incentive for scheduled plant to make themselves unavailable during off peak times and amplify issues relating to overnight low load conditions.	The methodology would not consider the availability of scheduled generation, rather it is the load available for scheduled generation which is equal to the system load less the intermittent generation seeking capacity credits under this scheme. The value does not depend on the availability of the scheduled generation. Thus it would not create any incentives for scheduled generation to be available of otherwise. The proposed method only depends on the output of the intermittent generation and its relationship to system peak demand.	

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Issue	**Comments**	**MMA Response**	**Member feedback**
Access to market data	With this new approach to Capacity Credits investors will need reasonable access to market data that can confirm the "Excel Spreadsheet" model proposed by MMA. IMO should consider publishing the top 750 trading intervals by year including what plant was running to meet this demand as an indication of the transparency expected.	For the historical analysis it would not depend on what plant was running except for the intermittent generation in aggregate. For the future year the MMA method would model 3-5 equivalent years based on historical system load profiles and the corresponding output from incumbent and committed intermittent generators. The critical time periods would change according to the committed projects for that future period. If future analysis is conducted and the measure is only based on the last three years, then all that IMO needs to declare is the conditions for the top 750 trading intervals retrospectively. Only looking back would understate penetration effects and over-state capacity value during a growth phase.	
Impact of overall market design issues	I think it is timely to remind the REGWG that the MMA report is limited to its assessment of Capacity Credits for intermittent generation. It does not consider all of the market design issues that are weighed up in the context of new intermittent generation investment. Energy prices, ancillary services contributions, capacity credit prices, market caps, bilateral prices and transmission capital and operation costs all form the basis of an investment decision. To modify one element without consideration of the impact on the rest of the market requires careful consideration. I am pleased that a market design group has been formed to consider these broader issues carefully.	Noted and agreed.	
Mid West Energy			
LOLP	MWE considers that the LOLP is <u>not</u> a suitable methodology for the following reasons: ○ Small number of observations ○ Complex ○ Expensive ○ Hard to understand ○ Time consuming	The small number of observations applies to all methods. The only additional time and effort is for running the system simulations which need only be done annually. Once a method is established, they would be easy to conduct over a few days.	
Reliability Equalisation base on system simulations with up to 300 samples	MWE considers that the LOLP is not a suitable methodology for the following reasons: ○ Small number of observations ○ Complex ○ Expensive ○ Hard to understand ○ Time consuming	We assume that this comment relates to reliability equalisation rather than LOLP as stated. It is more expensive and time consuming than the LOLP method.	

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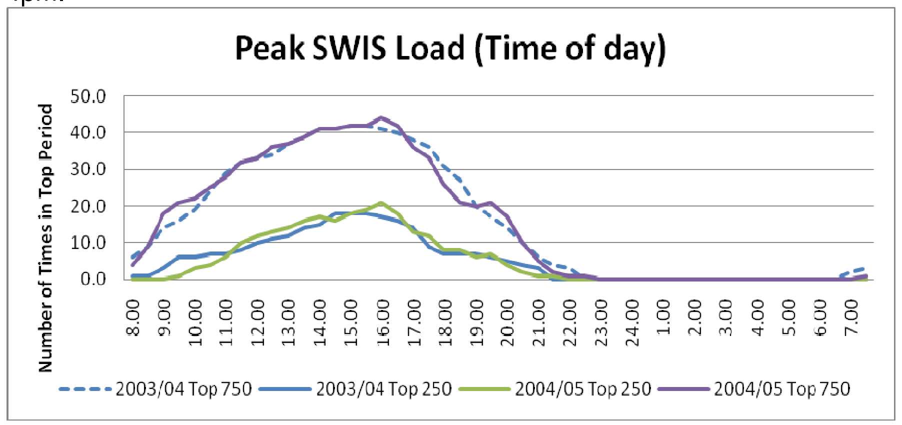
Issue	**Comments**	**MMA Response**	**Member feedback**
Average power	MWE considers that this methodology is unsuitable as it has no regard to project availability during times of peak demand which is the objective of the capacity credit market. It also severely disadvantages solar projects.	Agreed.	
Average power over selected trading intervals corresponding to high system load	MWE considers that average power by peak load trading interval is the most appropriate methodology for calculation of capacity credits for the following reasons: ○ Accurate (good approximation to the values based on LOLP weighting) ○ Reliable ○ Simple ○ Easy to understand ○ Inexpensive ○ Entities can self assess their likely level of capacity credits.	It is only accurate if benchmarked to LOLP or reliability equalisation methods periodically, say every 3 – 5 years.	**OOE**: While regular benchmarking may be worthwhile, it should be noted that its value is (and for the foreseeable future will continue to be) limited by data scarcity.
Coincidence with peak demand	MMA’s peak demand analysis is heavily weighted to 2003/04 capacity year which appears to account for approximately 90% of the proportion of use. The characteristics of peak demand (shape and duration) against which projects will be assessed is a critical component in assigning the level of capacity credits to a project. This is particularly true for solar projects whose maximum potential output at any point in time can be reliably measured (i.e. prior to allowing for potential cloud cover at any point in time). MWE has undertaken a preliminary analysis of the 2003/04 and 2004/05 capacity years to better understand the characteristics of the peak against which projects will be assessed, should either 250 or 750 periods be adopted. MWE requests that MMA provides further commentary and analysis of the times of peak demand in the SWIS. MWE believes that consideration should be given to further simplifying this approach in a similar manner to the methodology in the PJM jurisdiction (2pm to 6pm during the three hottest summer months) or California (of noon to 6pm during the five hottest summer months) by actually specifying the period of peak demand against which average output will be assessed.	MMA does not recommend using system peak demand if penetration of intermittent generation is proposed to increase markedly. Rather, the magnitude of the residual load for scheduled generation is preferable for the sake of accuracy and to encourage diversity of a resource profile matched to system peak demand. Selecting particular hours on a peak period basis may be inaccurate due to the peaky nature of the WEM summer load. We will update the final draft report with the supplementary analysis on the coincidence of peak demand and wind power generation.	MWE requests that MMA provides further commentary and analysis of the times of peak demand in the SWIS. The characteristics of peak demand (shape and duration) against which projects will be assessed is a critical component in assigning the level of capacity credits to a project. MWE has undertaken a preliminary analysis of the 2003/04 and 2004/05 capacity years to better understand the characteristics of the peak against which projects will be assessed, should either 250 or 750 periods be adopted. As shown in the diagram below, periods of peak demand on the SWIS generally occur in the afternoon, with the highest number occurring at approximately 4pm.  The table below summarises the percentage of time that peak periods fall between 8:00am and an evening time: **Peak SWIS load** **2003/04** **2004/05**

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			(see table and request below)

After 8:00am, but:	Top 250	Top 750	Top 250	Top 750
% Before 18:00	84.4%	81.7%	85.2%	83.3%
% Before 18:30	87.2%	85.9%	88.4%	86.8%
% Before 19:00	90.0%	89.5%	91.6%	89.6%
% Before 19:30	92.8%	92.1%	94.0%	92.3%
% Before 20:00	95.2%	94.4%	96.8%	95.1%

Request: As the time of peak demand is very important to solar projects, MWE requests that MMA provides further commentary and analysis of the times of peak demand in the SWIS.

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Storage	Solar thermal projects have considerable potential for the development of thermal storage technologies as a cost effective means of storing energy. Other energy storage mechanisms are becoming more cost effective and could be developed on the SWIS given the right market incentives in the foreseeable future. MWE considers that the market rules should encourage an appropriate amount of storage.	The alignment to load for scheduled generation would provide such an incentive on an economic basis by encouraging the control of generation to minimise the maximum load for scheduled generation.	
Refund mechanism	MWE is of the view that the 'Average power over selected trading intervals corresponding to high system load' methodology is already conservative and therefore a further discount for forced outage should not be applied. Solar projects can only produce electricity (and therefore REC's) during daylight hours and are therefore incentivised to minimise any forced outage events during this time.	Forced outages should be addressed explicitly if practicable.	
Volatility	It is critical for investment certainty that any capacity credit methodology have low volatility from one year to the next.	Agreed.	
Correlation Section 6.7	Day to day correlation of solar thermal output by interval seems low.	That's what the data showed.	
Project limits Section 6.6.1	The report states that 500MW is the limit for solar projects before an adjustment to project size is required. MMA indicates that 1,200 to 1,500 MW of wind could be tolerated on the system before reliability standards are compromised. MWE requests that MMA advise the comparative level of solar generation that could be incorporated on the SWIS before reliability standards are compromised.	This would require some additional analysis which would need to be requested by the iMO.	This could be a useful exercise as the numbers '500MW of solar' and '1,200 to 1,500 MW of wind' are not comparing like with like.
	DMT Energy		
Data	The data used for solar PV and solar thermal plant has been provided by manufacturers. Can this be relied upon or is it possible to identify field-based units from which this data might be more accurately determined? Or potentially, distributions of sunlight and its intensity across the SWIS to enable location-based signals for PV and thermal installations (i.e. my understanding is that a solar thermal unit located near, say, Albany would not provide the same capacity as the same unit located near Geraldton).	The data have been developed by proponents from weather observations for the North Country region.	
	Skyfarming		
Glossary of terms	Suggest a glossary of terms in the report to assist readers.	Shall include in final draft	
Wind data sites	Suggest using data from other sites (not grid connected) in place of BoM data. eg Esperance, Hopetoun, Bremer Bay, Rottnest and Denham.	There is no purpose in using such data for sites that are not connected to the WEM.	

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Transmission network constraints	Suggest more consideration of SWIS transmission constraints is required. Most of the 1000MW or so of wind plant currently trying for IMO accreditation is waiting on a very large transmission line to be built (north of Perth).	When the transmission line is connected, constraints should be negligible for north country wind farms.	
Capacity factor of wind turbines	Suggest consideration of different technology wind turbines that can increase cap factor at low wind speed sites such as Merredin. The market now offers different wind speed class turbines and that for a given site, lower wind speed class machines provide greater capacity factors. Ie class III machines are being used at Merredin why is why the CF is not much different to Albany, which enjoys class I wind speeds.	The method can accommodate any turbine model providing wind speed, power curve and temperature derating data and models are available and credible.	
SWIS load factor	MMA suggested we are only looking at 80hrs a year (my own work, summarized in attached paper, confirms this spiky trend) and I would suggest that with increasing amounts of wind and solar, that number will drop even further.	Noted.	
Synergy			
Methodologies	It is important to focus on developing robust, yet easily understood capacity valuation methodologies for investors and off-take counterparties' confidence.	Agreed.	While Synergy makes no specific comment on MMA's response to Synergy's work package 2 submission, we provide the following general observations: MMA's responses have: provided more clarity about the capacity equivalent methodology underlying their report and Synergy supports the notion that it is a meaningful way to assign capacity credit values independent of generation type (which Synergy notes is consistent with the Market Rules objective (c) not to discriminate against particular energy technologies) and that applying a capacity exceedence approach to intermittent generators fails to consider contributions to reliability made above the cut-off level; and clearly enunciated that if there is concern about with the current unserved energy criterion as set out in the Market Rules then it ought to be reviewed. Reducing capacity credit valuations for a technology that causes an increase in load following requirements is not transparent - as well as being potentially discriminatory - and is therefore not preferred to adopting a causer pays approach to allocating load following costs; The fact that another jurisdiction adopts a particular approach in valuing wind capacity (such as 95% POE) is, of itself, insufficient reason to import that methodology to the WEM without scrutiny as to whether it is fit for purpose as it takes no account of the WEM objectives or the reliability requirements (or limits if you like) as embodied in the Planning Criterion set out in the Market

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			Rules; MMA's analysis indicates an unserved energy level of 0.0004% given the current wind farm fleet and 8.2% peak margin which suggests a higher real reliability cost is being imposed on customers than is required under the Market Rules. However, this outcome reflects current circumstances and does not constitute a serious or sustainable argument to automatically reject capacity valuation methodologies, or other changes for that matter, that may result in the unserved energy level increasing, but not exceeding, the value set out in the Market Rules; and Basing the proposed valuation methodology on the load for scheduled generation (as opposed to total system load) seems a sensible and elegant approach, as it takes account of the impact of increasing levels of intermittent generation as well as any trend towards significant co-location of such generation.
Methodologies	Synergy would support further work on refining the valuation methodologies in the context of examining the impact on the capacity contribution valuations arising from adopting higher system reliability thresholds. This may take the form of amending expected energy shortfall levels, Minimum Frequency Keeping Capacity levels, or even adding an arbitrary risk premium to the Planning Criterion that working group members agree could be justified until such time as more confidence emerged about the system risk.	A thorough economic review of the reliability standard in the context of intermittent generation will be required in the next few years to ensure a consistent approach to all of these matters.	
Load Following	The preliminary work done by ROAM Consulting on work package 3 may be a relevant consideration here. Their work appears to indicate that a material increase in renewable energy penetration requires a significant increase in load following capacity available at any one time. This suggests that concerns about changes in system reliability resulting from increased renewable energy penetration should focus on the impact of load following requirements rather than arbitrary capacity valuation methodologies not linked to system reliability outcomes embodied in the Market Rules. A key issue related to increases in load following capacity required by higher renewable energy penetration, and a discussion the REWG needs to commence, is the appropriate allocation of the associated costs. That is, where it is administratively possible and cost effective to do so, changes in load following costs should be allocated to the causal technologies or factors in order to discover the true cost of particular technologies.	The load following requirement can be addressed separately and priced as a cost toward the regulation service based on the extra capacity required to support the regulation service.	
Office of Energy			

Work Package 2 Report "Valuing the Capacity of Intermittent Generation in the SWIS" - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
Key Issues	○ MMA's work has shown that only performance at very peak demand conditions is important to reliability. It follows that the present all-hours average approach is inappropriate, as it could lead to incorrect assessments of plants with a production bias away from the peak demand hours. ○ Both MMA's work, and Senergy's work, has shown that reliance on very small data sets will result in unacceptable volatility in the assessed capacity values. Whatever method is chosen going forward, this must balance the theoretical benefits of focussing on only the highest of peak demand periods against the need to manage the volatility and uncertainty that would result from reliance on small amounts of data. ○ It is important that the method chosen provides a capacity value in which the market can have a high level of confidence. Assigned capacity values should be more reliable than the expected or average capacity for the circumstances of interest. ○ A particular concern with the growth of intermittent generation has been that new generators should be encouraged to locate in a way that increases, rather than reduces, diversity. It will be important that capacity valuation takes account of close correlation of intermittent generators, for instance locational grouping of wind farms. ○ While not a major factor, the studies have confirmed that increasing levels of intermittent generation impact on the capacity value that should be assigned. There may be value in the chosen method being able to take account of the impact of increasing intermittent penetration levels.	Agreed Agreed This is not necessarily true. It depends on the value of the above average generation in managing the risk of outages. The modelling shows that average power during system stress periods does match the capacity value that equalises reliability. The proposed method based on load for scheduled generation will accomplish this requirement, as intended. Agreed. This is a reasonable and economic requirement.	
Methodologies	These studies strongly suggest a significant capacity contribution from real and modelled intermittent generation in the past, but the results incorporate significant uncertainty. There is also large uncertainty in the theoretically attractive LOLP weighted methodology that MMA has investigated. The large uncertainty in both the equalisation and LOLP methodologies (primarily related to the scarcity of data and secondly to uncertainty inherent in the calculation methodology) recommends against relying on these studies as a precise assessment of the capacity value of intermittent plant going forward. A related problem with the use of the LOLP methodology for future capacity assessment is its heavy reliance on a very small set of historic data for a prospective plant – data that is unlikely to be generally available. Also, where that data is available, the particular performance recorded or modelled for the relevant historic periods might unreasonably benefit or disadvantage a plant, as that performance might not reliably represent the plant's performance in such circumstances over the long term. The analyses do not, for any particular plant, provide a way to determine a capacity level that would have a high probability of occurring during peak demand hours – as would be consistent with expectations for the conventional plant with which it competes in the	Agreed that more data would be needed to apply LOLP and reliability equalisation methods directly.	

Work Package 2 Report "Valuing the Capacity of Intermittent Generation in the SWIS" - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
	capacity market. Rather, the methodology as it stands provides estimates of the expected value of capacity during those hours and the range of those expected values that might confidently be assumed.		
Possible way forward	The fundamental problem in capacity assessment of such plant is that we do not know the characteristic distribution of plant performance during the very small periods of time during which that performance would be of most significance to system reliability. Further, it is unlikely that we will ever be able to precisely determine the characteristic distribution of performance. The circumstances of interest are, by definition, rare, one-year-in-ten occurrences. Hence, very little sample data is, or ever will be, available specific to these circumstances. One might expect only one set of data to be available in every decade and perhaps only a few hours on one day within that set will dominate the capacity assessment. Any underlying climate change impacts, from whatever cause, would further complicate the analysis. An alternative to the use of historic data might be to analyse the physical linkages between very high system demand and plant output. However, this is also unlikely to be a viable approach because of the unknown (and likely very complex) relationships between the weather conditions that might result in high demand and the coincident weather conditions that might prevail at the location of the particular plant being assessed. There would also remain the uncertainty in the relationship between weather and demand – it would be wrong to assume that this is, or is ever likely to be, very well understood for the unusual and extreme conditions relevant to this issue.	Agreed.	
Supplementary analysis paper	In the conclusions to its Supplementary Analysis, MMA notes that analysis of averages should be based on load for scheduled generation rather than system peak. The use of load for scheduled generators would value diversity in new resources, for instance, if this method was used, closely located windfarms would be likely to attract relatively lower capacity valuation, as their correlated outputs could significantly reduce load on scheduled generation. Consequently, assessments would be less likely to be based on periods when these correlated resources were producing at high levels. This approach would also make the assessment method responsive to increased intermittent penetration over time, without adding great complexity to the assessment. MMA has recommended the use of assessments based on 10% and 30% PoE peak demands, but while this may be theoretically sound, it is not a practical way forward. This is because reliable data for the specific periods in question is unlikely to be available for new plant and because there is significant uncertainty as to whether the plant performance during those very few particular periods in the past would be truly reflective of what might be expected in similar situations in the future. MMA has also commented on the concern that increasing intermittent penetration might adversely affect the reliability of conventional plant.	Agreed. It is confirmed that we may use more than the 10% and 30% POE without unduly influencing valuation error and thereby reduce the volatility of the measure.	

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Issue	**Comments**	**MMA Response**	**Member feedback**
	We would agree with MMA that it would not be appropriate to consider this matter in capacity assessment at this time. Within the market model, schedulable plant is assumed to be schedulable. If it is not schedulable, in the sense that it cannot be routinely shut down and reliably restarted, that would raise fundamental questions about the application of this aspect of the market model for all plant. At this stage it would seem more appropriate to address the issue of the impact of intermittent generation on overnight dispatch as a separate issue - as is being considered under Work Package 3 - and not as a capacity matter.		
Suggested methodology	The following section outlines one possible way forward using average performance during selected peak intervals and discounting that performance in line with the confidence interval for the particular technology fleet. The approach is necessarily heuristic, but attempts to address the principal concerns and desired objectives for capacity assessment. **T**his methodology is <u>not</u> presented as a recommended approach, but rather as a contribution to the Working Group's deliberations in determining a way forward. In this regard, the Office of Energy would appreciate the opportunity to discuss these comments with the Independent Market Operator at a mutually convenient time. Method: ○ Identify for the relevant year(s) the top 250 periods which experienced the highest load for scheduled plant. ○ Estimate in percentage for each technology fleet, the 80% confidence range for the annual average output over the selected periods, considering as many years as have data available. ○ For the particular intermittent generation plant, determine the average output over the selected periods for the previous year of actual data (existing plant) or modelled data (new plant). ○ Discount the value determined under step 3 by half of the 80% confidence range for the technology fleet (determined in step 2) to approximate the value with 90% probability of exceedance, while acknowledging the value of fleet diversity. ○ Assign capacity to the plant for the next year at the average of the amount calculated in step 4 and the amounts assigned in the previous two years. ○ For new plant where previous assignments have not been made, perform steps 3 and 4 for the years where there has not been an assignment, and then average the three years.	Noted. It should be noted that the uncertainty in the measure may be contentious.	
Outcomes and discussion	○ Based on the approximate indications provided in MMA's reports, this approach would be expected to result in typical assessments changing roughly from 40%[present] to 36%[new] for wind and from 25%[present] to 54%[new] for solar). ○ Overall, the focus on peak demand periods for scheduled plant, irrespective of the severity of the year, could provide a defensible proxy for a more theoretically desirable, but impractical, reliability	Noted and mostly agreed. MMA does not consider that the measure of volatility is sufficiently robust to use it for discount purposes.	**OOE**: The initial suggested approach was based on information in MMA's initial report. It was proposed just as a basis for further discussion. Things have moved on since then, although the OOE believes the principles and objectives that the original suggested approach sought to achieve remain relevant. In the light of further information provided by MMA and building on the

Work Package 2 Report "Valuing the Capacity of Intermittent Generation in the SWIS" - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
	based approach: ▪ Output at times important to reliability is highly valued and output at time unimportant to reliability is not valued, so driving developers to make appropriate location and technology choices. For example, wind generators biased towards summer afternoon production would be higher valued than those biased towards overnight production and solar plants further inland would be assessed lower than those further west, where output better matches system demand. ▪ The approach might see a rebalancing of present wind farm assessment. For instance in that MMA's WF1 may see less reduction in its assessment because the new methodology focuses on peak periods during which it appears to perform marginally better than wind farms 2 and 3. ▪ The use of highest load for scheduled plant provides a mechanism to accommodate change to the times most important for reliability as renewable penetration increases. ○ To ensure volatility is kept low, a significant amount of data should be used in the calculations - approaches that focus on very small numbers of peak hours would not be acceptable. ▪ A focus on the top 250 intervals may provide sufficient stability, especially if combined with a rolling average approach to actual assessment. ▪ A balance should be sought between the theoretically higher accuracy and the increased volatility that will come from the use of fewer intervals. ▪ From graphs in MMA's supplementary analysis[1] it appears that volatility (reflected in the confidence range) increases significantly as the number of intervals reduces below 160 for wind and solar. ▪ The quanta appear to become unstable for solar below 250 periods. ▪ Consequently 250 periods may be an appropriate, if arbitrary target. ○ The application of a fleet based discount to the bottom of the 80% confidence band provides a proxy for an assessment of reliable contribution while acknowledging the diversity benefit of the existing fleet of equivalent technology generators. ▪ The method discounts individual plant assessments by the same percentage as between the mean and the bottom of the 80% confidence band for the particular technology fleet. ▪ This would take some account of variation in performance, in that the bottom of the 80% confidence band is effectively the value (of the average for peak intervals) with		REGWG discussions, the OOE would now suggest a different approach, though again only as a basis for further discussion. In essence, in this approach the fleet benefit of intermittent generators in key periods (perhaps 12 periods based on LSG) would be assessed to high level of confidence (perhaps 95%) for all available and relevant data. Individual plant capability assessments could be made using a larger number of periods (possibly 250 periods) and rolling averaging to manage volatility. Individual assessments would be used to apportion the combined fleet benefit. The capping of the permissible fleet allocation would ensure overall reliability is not jeopardised, while the less onerous individual assessment method could control volatility. Desktop analysis based on available information suggests that this approach could result in final assessments comparable to the MMA 750 period proposal. The method more directly addresses concerns about reliability and might better achieve other identified objectives than the 750 period approach. In particular, it should avoid the apparently unwarranted discount of solar resources that would occur if 750 periods were used.

[1] Fig 2.2, 2.3, 2.4, 2.5 pp 6 - 7

<table>
<tr><th colspan="4">Work Package 2 Report “Valuing the Capacity of Intermittent Generation in the SWIS” - REGWG Comments</th></tr>
<tr><th>Issue</th><th>Comments</th><th>MMA Response</th><th>Member feedback</th></tr>
<tr><td></td><td>90% probability of exceedance – notionally comparable to the 10% PoE concept used in demand forecasting for capacity.
▪ In contrast with the alternative of using individual plant confidence intervals, this fleet variability approach, acknowledges the diversity benefit in an intermittent generation fleet as demonstrated in both MMA’s and Senergy’s work.
▪ From MMA’s reports this would appear to require around 8% discount from the assessed 250 top period average for each plant for wind and around 4% discount for solar. (eg roughly 40%[present] to 37%[new] for wind and 25%[present] to 58%[new] for solar).
▪ Greater discounts would no doubt apply if fewer intervals were chosen, since the 80% confidence interval would be expected to increase, or alternatively if a larger confidence interval was chosen.
o Based on MMA’s observation in its further work[2] a further ~6% discount might apply if peak periods are selected based on load for scheduled generation. (eg roughly 40%[present] to 36%[new] for wind and 25%[present] to 54%[new] for solar)
o A rolling average approach, over three years as at present, should assist with managing volatility. Using more years in the average would improve stability, but would strengthen the case for intermittent plant to be exposed to the refund scheme used for conventional plant. This is because the consequence of poor performance in any particular year would be diluted by increasing the period of the rolling average calculation.
o As this approach would not see dramatic change to the present assessment methodology, it may be acceptable to use the rolling average approach to transition to the new methodology.</td><td></td><td></td></tr>
<tr><td></td><td>It seems likely that the finally selected methodology will be an average over a selection of peak periods, possibly based on load for scheduled generation, rather than total load. At present the concern remains that such a selection may not produce a value that reflects a high expectation of achievement (as desired), but rather the average on a particular occasion. There is also the question of volatility in results. Volatility has significant commercial implications that cannot be ignored and is clearly going to be higher with fewer periods, however, selecting fewer periods should focus more on the times that matter for reliability. The impact of multi-year averaging on volatility and reliability outcomes is also not well understood.
The REGWG and the IMO will need an understanding of the consequences in terms of volatility and confidence level for the range of methodology possibilities. While MMA has used a particular approach to modelling confidence, it would be useful to look at the "raw" outcomes in this regard.</td><td>This has been provided and additional years of historical data have been processed to fill out the picture.</td><td></td></tr>
</table>

[2] Last para p4.

<table>
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<tr><th>Issue</th><th>Comments</th><th>MMA Response</th><th>Member feedback</th></tr>
<tr><td></td><td>In response to your invitation at the last REGWG meeting, could you please request from MMA the following information. The data requested is the value of the calculated (normalised) average output for each combination across the following matrix:
○ For each of the years for which MMA has actual or modelled data
○ For each of the period numbers: 12, 60, 160, 250, 500 and 750
○ For each of the selection approaches: load for scheduled generation ; total load
○ For each of: each modelled/actual plant; total wind; total solar; total of all plant modelled
(Note this has been provided by MMA)</td><td></td><td></td></tr>
<tr><td colspan="2">System Management</td><td></td><td></td></tr>
<tr><td>Methodology</td><td>System Management has concerns that the findings in the report from MMA on the REGWG Work Package 2 may lead to a more optimistic assessment of capacity available from the windfarms at time of system peak. In view of these concerns System Management favors a more conservative assessment of the windfarm capacity credits.
1) In the SWIS capacity credits in the capacity market are tied to the amount of capacity procured to meet security requirements. An overly optimistic capacity credit for windfarms will increase the risk to the security of supply in the SWIS.
2) To date there has been only a relatively short period of recording historical data for the larger windfarms in the SWIS. Much of the data employed in the analyses is windfarm model data which is subject to uncertainty. In addition, forward projections of future windfarm project outputs may not be accurately calibrated to actual output and are therefore subject to further uncertainty.
3) An analysis of the average output of the windfarm fleet at time of peak has been favoured using interval counts of 750 down to around 250. The rationale for this is that as more intervals are used in the averaging the population increase reduces volatility and lowers the measurement uncertainty. As more intervals are employed in the averaging the windfarm capacity contribution generally rises towards its annual average. This average windfarm capacity contribution may not be available to the system during the system peak intervals.
4) MMA have stated that “Basing a capacity value on outputs over the 12 trading intervals applied for the IRCR would not produce a useful measure due to very high volatility”. From System Management’s perspective an important point to keep in mind here is that system security should not be thought of in terms of an “average probability”. There needs to be more surety in the analysis and if that is difficult because of a lack of data then a more conservative approach to system security is required.</td><td>MMA is unsure concerning the relevance to system security of long-term capacity assessments. System security is about having the resources available on the day to manage the possible contingencies that can disrupt system operation. If a favourable wind capacity assessment is made without discount and on the day the wind power is not available, then the system would be exposed to the loss of a large unit. This risk would have already been included in the reliability analysis as part of the unserved energy criterion with the appropriate probability. Load shedding may be required but the system should be secure as long as the wind power forecasting is adequate.
Security is a separate concept from reliability. It is more about the ability to forecast wind power the day ahead and manage system resources. If it means that pre-contingent load shedding is required to secure the system under extreme conditions. then so be it. The reliability analysis will determine the exposure to such events.
Providing the reliability standard encompasses these risks on an economic basis, there should be no need to apply further discounts, unless there is a wide range of uncertainty about the viability of the capacity measure itself. To date there has been no evidence that the generous measure afforded to wind power has threatened system security and it is unlikely to do so in the future if the exposure to load shedding is kept to a maximum expected value of 0.002% annually. This assumes that sufficient load following capacity is also provided to manage variations within the trading interval.
In view of the uncertainty of the analysis and the asymmetry of risk to customers, some conservatism is recommended. Using the 750 trading interval average will achieve that objective, based on the data available.</td><td>Security is both a short-term and a long-term viewpoint, particularly in an islanded system such as the SWIS. Reliability is meant to ensure security, by ensuring Power System Adequacy.
Evidence to date regarding the effects of wind on security is not particularly relevant due to the limited current wind resource.
Estimates of future wind resources suggest that the SWIS is currently at a turning-point, as indicated in the following table. The table indicates that, for the first time, load shedding is likely to occur if the wind output does not meet the capacity credit allocation, given an outage of the largest unit.
This is a greater level of risk than currently exists in the SWIS.
<table>
<tr><th>Scenario</th><th>Actual</th><th>Projected</th></tr>
<tr><td>Year</td><td>2010/11</td><td>2011/12</td></tr>
<tr><td>2009 SOO Reserve Capacity Target</td><td>4836</td><td>5191</td></tr>
<tr><td>Additional Load Following on top of SOO</td><td>0</td><td>0</td></tr>
<tr><td>Amended Reserve Capacity Target</td><td>4836</td><td>5191</td></tr>
<tr><td>10% POE Maximum Demand</td><td>4397</td><td>4725</td></tr>
<tr><td>8.2% of peak demand</td><td>361</td><td>387</td></tr>
<tr><td>Maximum wind output</td><td>192</td><td>460</td></tr>
<tr><td>Capacity credit value for wind</td><td>30%</td><td>40%</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Capacity assigned to wind (WC)</td><td>57.6</td><td>184</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Planning Criterion (PC)</td><td>439</td><td>466</td></tr>
<tr><td>PC less 8.2% of peak demand</td><td>78</td><td>79</td></tr>
<tr><td>PC less 8.2% of peak demand less WC</td><td>21</td><td>-105</td></tr>
</table></td></tr>
</table>

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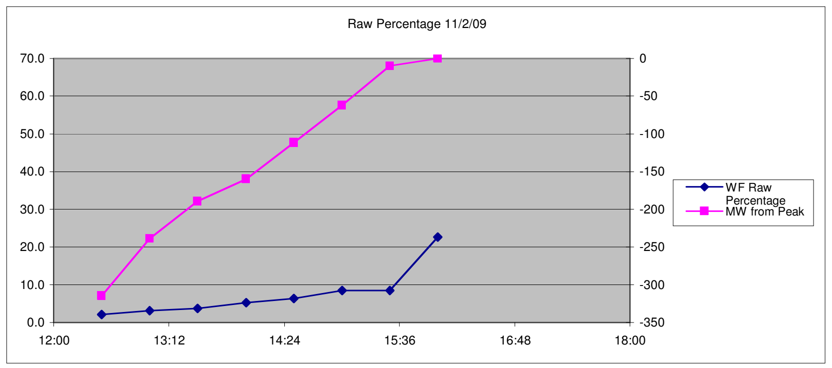
Issue	**Comments**	**MMA Response**	**Member feedback**
AEMO approach	Windfarm capacity contribution to the generation during system peak is calculated quite differently by AEMO where a more measured approach is taken. The following is a quotation from the AEMO planning report of 2009: "… the Planning Council considers that a level of dependability at least as good as that from other forms of generation is appropriate. A 5% level of unavailability as a result of forced outages would be considered at the low end of acceptable performance by industry standards. It is therefore reasonable to use this as the assessment criteria for the contribution of wind power during peak periods." Using this methodology the capacity credits from windfarms in WA would be approximately 20%. System Management doesn't believe that the state of Western Australia should use different criteria to the rest of Australia.	The Planning Council approach fails to take account of the proven fact that the wind farm output that occurs above the 95% level of probability makes a significant contribution to system reliability. It's not consistent to use the same approach as for scheduled plant because the 95% probable capacity and the rated capacity for conventional plant are very similar. There is no up-side for conventional plant whereas there is for intermittent generation. This is why the contribution to reliability is similar to the average power output at times of system stress even though the reliability criterion is so stringent at 0.002%. MMA is not aware of any reliability equalisation analysis done for the Planning Council.	However, the Planning Approach, which is an industry standard, will ensure greater Power System Security, and reduce the likelihood of load shedding due to unavailability of wind.
Correlation with wind farm output	System Management has evidence to believe that days of exceptional temperature may correspond to days of lowest windfarm output. The concern is that the averaging approach doesn't take account of the possibility that the specific intervals of greatest risk (highest system load coupled with lowest windfarm output) may be correlated with days of exceptional temperature leading to the 1 day in 10 year system peak. On these days the intervals may be consecutive giving a number of hours of highest demand coupled with lowest windfarm output. The System Management analysis attached has quantified this concern. It shows the interval contributions from the windfarm fleet (in percent of total installed capacity) for the individual dates included in the top 25 intervals of each financial year. A selection of dates are charted (e.g. 7/3/07) showing the windfarm contributions (WF Raw Percentage) alongside the system load relative to the peak for the year (MW from Peak). Where the windfarm contribution increases as the load relative to peak increases the situation is improving. Conversely where the windfarm contribution decreases as the load relative to peak increases then the situation is worsening. On 3 separate days the windfarm contribution remains well below 40% as the load moves towards the peak (11/2/09, 7/3/07, 6/3/07) and on 7/3/07 the windfarm contribution worsens. 	The data available to MMA has shown that there is minimal correlation between output and temperature on very hot days in the later afternoon, except for some doubt about some potential derating of Emu Downs which needs investigation. It is certainly important to understand the peak day characteristic as this and the adjacent days are where 95% of the capacity value is created. If load following is provided for 20% to 25% of the wind farm capacity, then this may cover the risk of low wind reasonably well. Certainly the reliability analysis indicated that, although the wind profile in the model was static and not sampled, based on the particular weather year.	The concern is that the data set is too small. There are many instances where low outputs occur on days of high temperatures. Due to this, an averaging approach, or an approach based on simulated data, would lead to a reduced security outcome.

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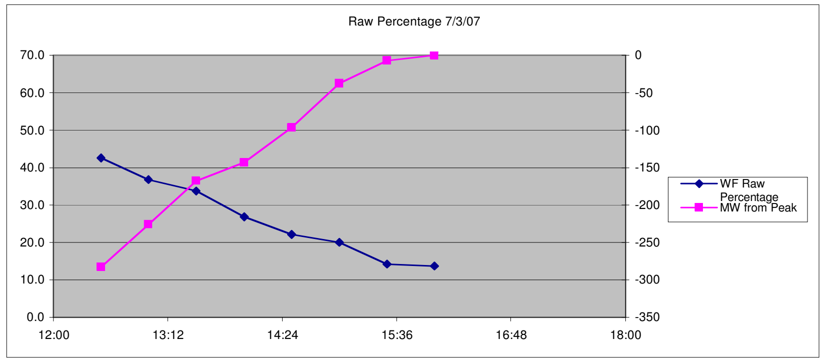
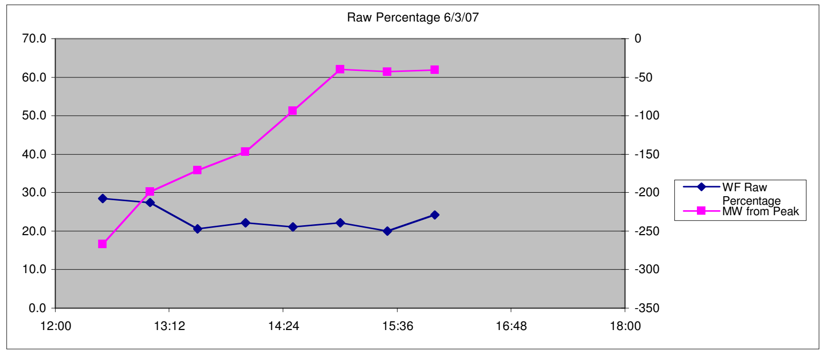
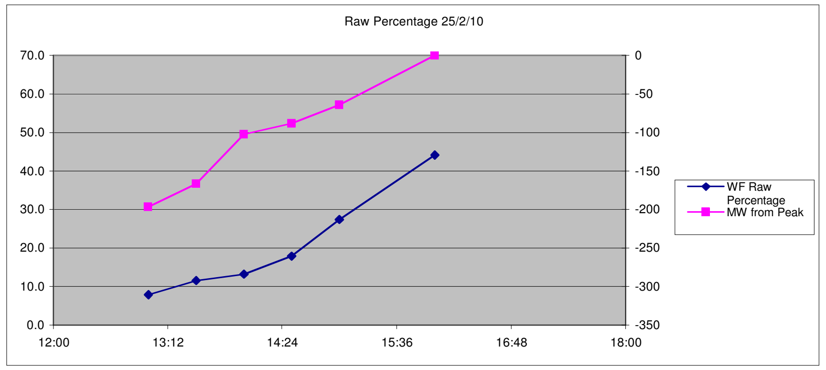
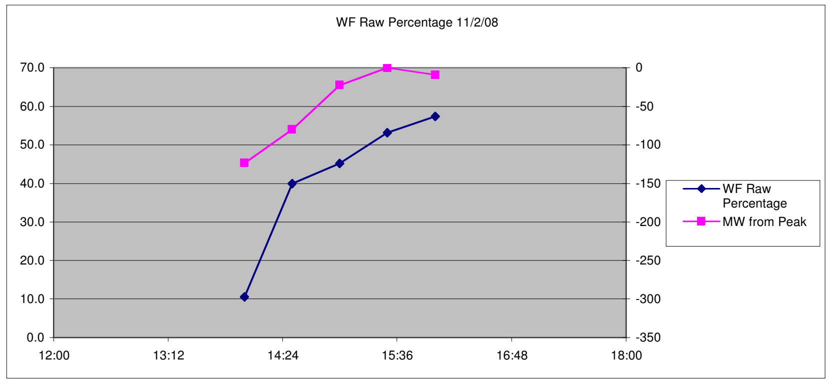
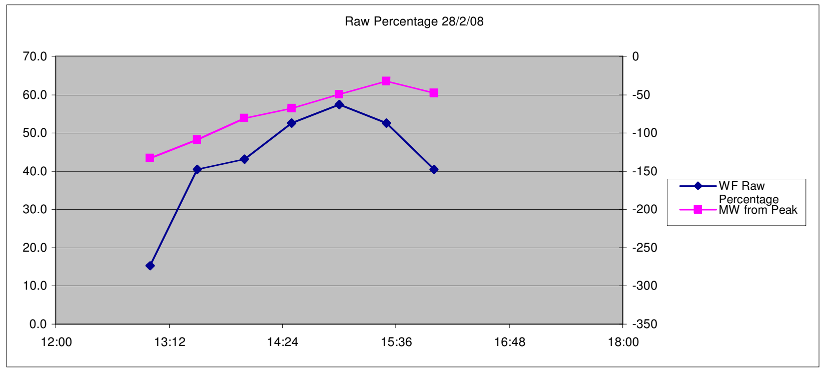
Issue	Comments	MMA Response	Member feedback
	   		

Work Package 2 Report “Valuing the Capacity of Intermittent Generation in the SWIS” - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
	 We conclude from the analysis that there appears to be great diversity in windfarm contributions for different days. However it is clear that on certain peak days there may be little assistance from the windfarms. Depending on actual capacity margins available in the capacity year, if there is a contingency then the capacity may become critically low if windfarm capacity credit is pitched optimistically too high. At this stage System Management doesn't think there is a sufficient statistical base to confidently forecast the probabilities involved. As more data becomes available we are therefore undertaking more analysis of the windfarm outputs and attempting to identify the nature of the type of day under consideration (i.e. is the day a 1 day in 10 year (so called 10%) day or a day of some other probability). The intent is to be able to positively identify the windfarm contribution for a real 1 day in 10 year.	Such analysis will assist in improving the reliability modelling on these peak days.	
LOLP	The unserved energy (USE) approach may be used to determine capacity requirement to manage risks to power system security. Risk is a combination of impact and probability. Risk also has quantifiable parts and intangible parts. In considering the quantifiable risk impact on SWIS power system security System Management believes that the 0.002% USE approach is more appropriate where the load factor is high and the load duration	Certainly the maximum amount of power at risk is greater in a peakier system for a given USE standard. Analysis of the optimal reliability standard for Victoria showed that the economic level was 0.004% due to the cost of reserve, the very little energy at risk over the sharp peak and the way load shedding was distributed. It would be feasible to sample event characteristics and put a probability on load shedding events by magnitude to address these issues.	As indicated above, a multiple contingency now becomes, for the first time: • 8.2% of generation unavailable, and • wind output not reaching the capacity allocation.

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	fairly flat. The SWIS on the other hand is characterized by a low load factor and a very peaky load duration curve. The USE approach may understate impact whereas a capacity margin based on a Loss of Load Probability (LOLP) approach may paint a more appropriate picture of the risk in SWIS. The amount of load at risk (i.e. the impact) is considerably higher in SWIS than for systems with high load factor, flat load duration curve. On the intangible component of risk, the political and reputational fallout of a significant amount of interruption to load is likely to be very high. System Management favours a capacity margin calculation based on LOLP rather than the USE approach.	However I suspect that the additional load following capacity will cover some of this risk and the extra power above the valued level will also reduce the overall incidence of disruption. It is more likely to occur under multiple contingencies.	
Other jurisdictions	Another analysis performed by System Management, using similar methodologies to those adopted by Ireland and AEMO?? to examine the output of windfarms over the summer peak intervals, has identified the average MW production of wind over the peak intervals during the summer months (1 February to 14 March) for the years 2008 to 2010. It is evident that the 95% POE output of the existing windfarm fleet in SWIS is higher during the summer peak interval periods than for the whole of the year with a trend for higher output closer to the peak. This accords with MMA's findings. However it is also evident however that the 95% confidence average output over the summer peak intervals ranges between 9.5% and 26.1% of connected capacity in the years studied much less than the average using the top 250 to 750 intervals. This reflects System Managements concern that the values proposed by MMA may be overly optimistic. The following table and graphs illustrate the findings.	It is not reasonable that the 95% POE output should be the sole basis for capacity credits due to the value of production above that level in reducing load at risk.	Due to variation in wind output that clearly exists, it can only be shown that on average, wind farm outputs will be above the 95% reliability level. With an increase in the quantity of windfarms, system security is more likely to be impeded. If system security is impeded then the value of any production is questionable.

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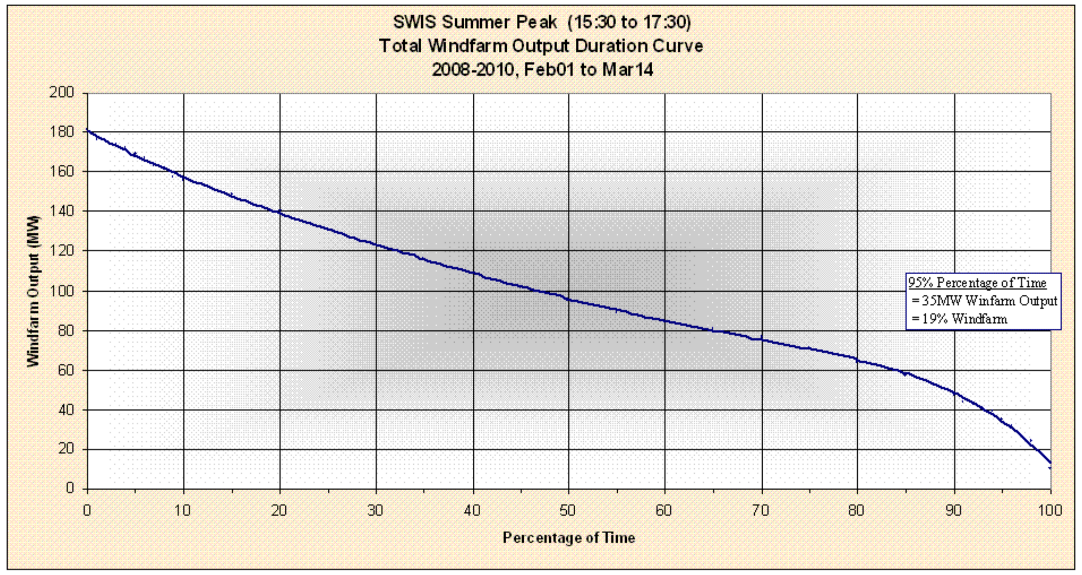
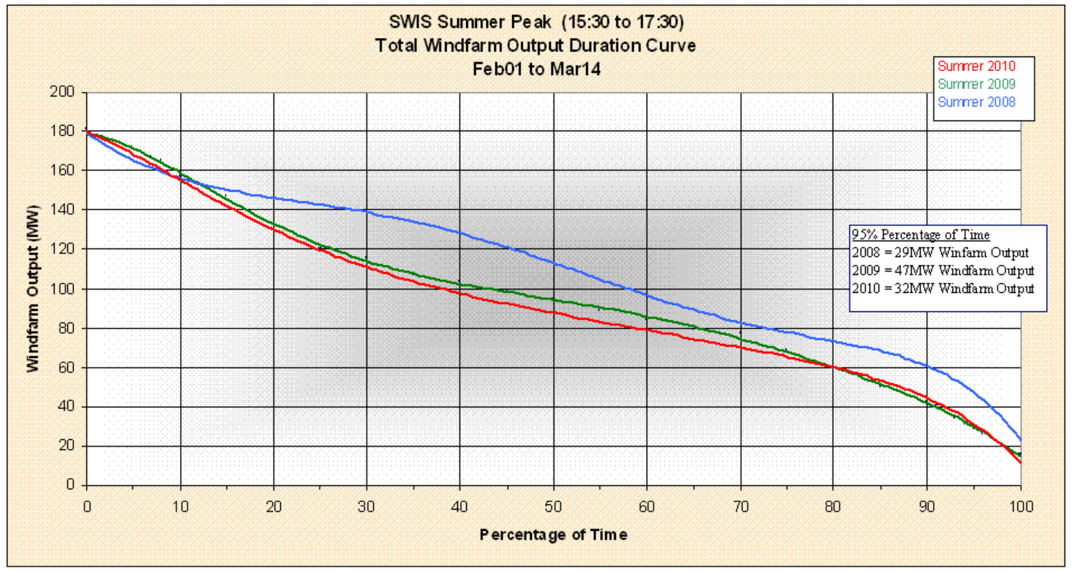
Issue	Comments	MMA Response	Member feedback

SWIS Summer (Feb01-Mar14) Windfarm Generation
Percentage Of Time Duration Values

Peak Intervals	Min	5%	10%	15%	20%	25%	30%	35%	40%	50%
13:00 to 17:30										
2008	6	19	25	37	47	52	59	65	73	84
2009	1	17	30	43	52	62	67	72	81	91
2010	7	24	32	40	44	50	56	62	67	76
2008-2010	1	20	29	40	47	54	61	67	72	84
13:30 to 17:30										
2008	13	21	29	43	49	55	62	68	75	86
2009	4	21	38	49	59	66	72	78	83	96
2010	10	24	36	42	48	54	59	65	70	80
2008-2010	4	22	34	44	50	58	64	70	76	87
14:00 to 17:30										
2008	14	22	32	45	51	59	65	73	78	88
2009	4	28	45	55	63	70	77	82	86	101
2010	10	25	37	44	51	56	63	69	71	82
2008-2010	4	25	39	47	55	62	68	73	78	89
14:30 to 17:30										
2008	15	24	40	48	55	64	70	76	79	90
2009	4	38	49	61	67	73	80	84	88	107
2010	10	26	40	47	54	61	65	70	74	85
2008-2010	4	28	42	50	59	65	71	76	81	91
15:00 to 17:30										
2008	15	26	42	49	60	67	75	78	84	93
2009	17	43	56	63	70	77	82	86	91	111
2010	10	32	41	51	57	63	69	72	76	86
2008-2010	10	32	45	54	62	69	74	78	84	94
15:30 to 17:30										
2008	16	29	43	50	59	69	77	79	85	95
2009	17	47	61	67	73	80	83	88	97	113
2010	10	32	44	54	61	65	70	74	78	87
2008-2010	10	35	47	57	64	71	77	81	85	96



Work Package 2 Report “Valuing the Capacity of Intermittent Generation in the SWIS” - REGWG Comments			
Issue	**Comments**	**MMA Response**	**Member feedback**
			
Unserved energy	In its report MMA wrote “For the current 8.2% reserve margin factor, the expected unserved energy is about 0.0004%. For a given reserve margin factor and load profile, the expected unserved energy would increase with respect to forced outage rate and the amount of scheduled maintenance. If wind plant replaces reliable controllable plant at a capacity level that maintains 0.002% expected unserved energy, irrespective of any other constraint on reserve margin, then it would be expected that the expected unserved energy would increase toward 0.002% with increasing penetration.” MMA estimate that the USE with the current margin criteria and the current windfarm fleet is about 0.0004%. System Management is concerned about a relaxation of the USE from its current position. This concern stems from the potential consequences of the increased probability of load loss using the 0.002% USE criteria to determine the capacity margin in an environment of further windfarm capacity increase.	In that case the reliability criterion needs to be re-optimised on an economic and risk analysis basis.	
	In conclusion System Management would add that it believes that a regular review of the capacity credit criteria for renewable energy sources (perhaps every 3 years) is warranted given the uncertainties associated with lack of historical data and relative lack of operational experience in SWIS and elsewhere with high penetrations of windfarms. Further to this, there may also be good reasons to provide strong incentives to windfarms installing in diversified regions to provide more diversity in weather patterns and hence more certainty about capacity at the time of the peak periods.	Agreed.	