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	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.
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 windfarm 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.
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?
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.
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.

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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. 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?
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.
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 o Capital contribution for deep and shallow reinforcements o Use of system charge for generators o Static loss factors
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.
Concepts for capacity valuation P30	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?
P35	Using best fit would give almost entire reliance on the 10% POE case. Is this an issue?
P44	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.
Pacific Hydro	
Methodology	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.

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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.
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.
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?
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.
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.
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.
Mid West Energy	
LOLP	MWE considers that the LOLP is <u>not</u> a suitable methodology for the following reasons: o Small number of observations o Complex o Expensive o Hard to understand

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	o Time consuming
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: o Small number of observations o Complex o Expensive o Hard to understand o Time consuming
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.
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: o Accurate (good approximation to the values based on LOLP weighting) o Reliable o Simple o Easy to understand o Inexpensive o Entities can self assess their likely level of capacity credits.
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.

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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.
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.
Volatility	It is critical for investment certainty that any capacity credit methodology have low volatility from one year to the next.
Correlation Section 6.7	Day to day correlation of solar thermal output by interval seems low.
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.
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).
Skyfarming	
Glossary of terms	Suggest a glossary of terms in the report to assist readers.
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.
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).

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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 windspeeds.
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.
Synergy	
Methodologies	It is important to focus on developing robust, yet easily understood capacity valuation methodologies for investors and off-take counterparties' confidence.
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.
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.
Office of Energy	
Key Issues	o 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. o 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

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	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. o 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. o 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. o 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.
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 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

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	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.
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. 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: o Identify for the relevant year(s) the top 250 periods which experienced the highest load for scheduled plant. o 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. o 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). o 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

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	exceedance, while acknowledging the value of fleet diversity. o 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. o 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.
Outcomes and discussion	o 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). o 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 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. o 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. o 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)

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

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	with 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.
	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. 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: o For each of the years for which MMA has actual or modelled data o For each of the period numbers: 12, 60, 160, 250, 500 and 750 o For each of the selection approaches: load for scheduled generation ; total load o For each of: each modelled/actual plant; total wind; total solar; total of all plant modelled (Note this has been provided by MMA)

[2] Last para p4.

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	System Management
Methodology	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.
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.
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

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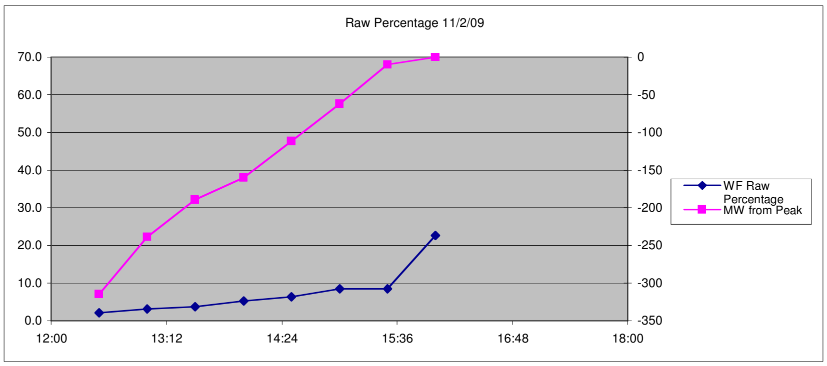
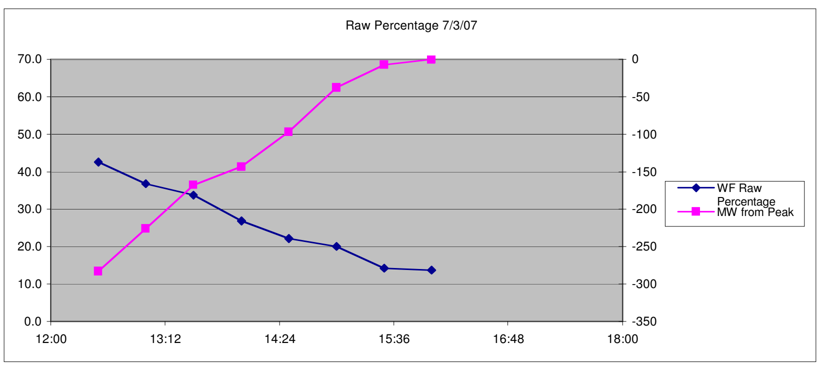
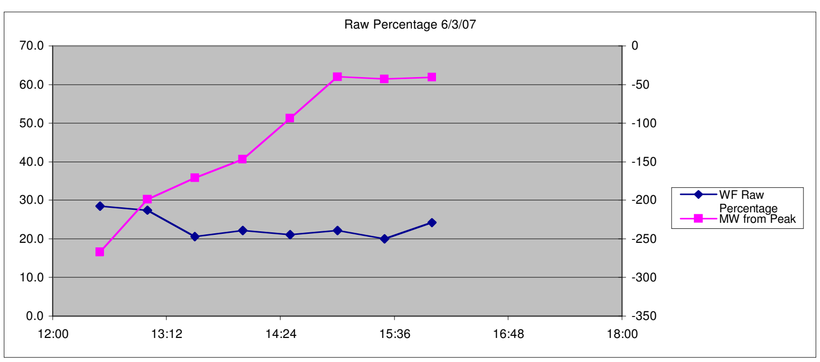
	(e.g. 7/3/07) showing the windfarm contributions (WF Raw Percentage) alongside the system load relative to the peak for the year (MW from Peak). Where the windfarm contribution increases as the load relative to peak increases the situation is improving. Conversely where the windfarm contribution decreases 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.   

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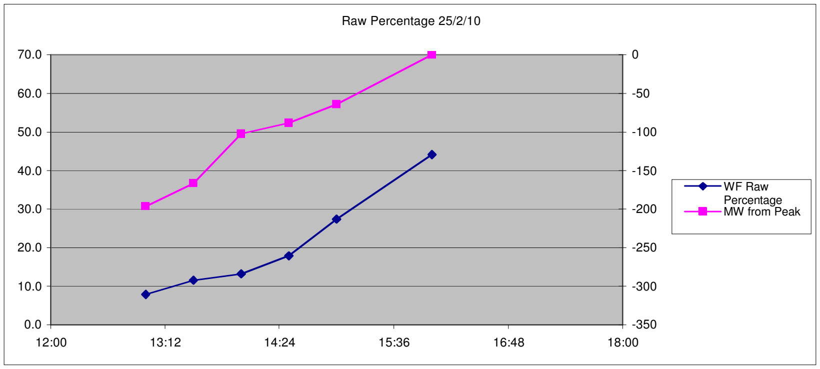

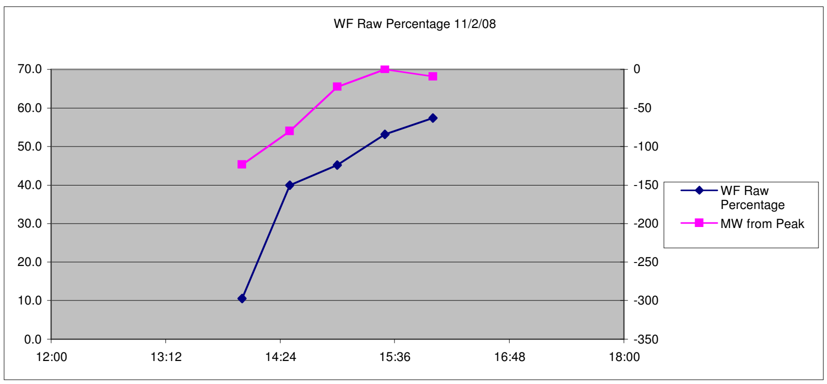

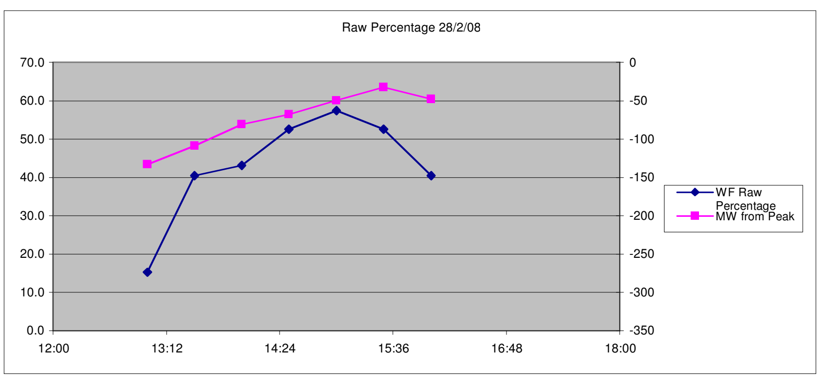

We conclude from the analysis that there appears to be great diversity in windfarm contributions for different days. However it is clear that on certain peak days there may be little assistance from the windfarms. Depending on actual capacity margins available in the capacity year, if there is a contingency 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.

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Issue	**Comments**
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 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 favors a capacity margin calculation based on LOLP rather than the USE approach.
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.

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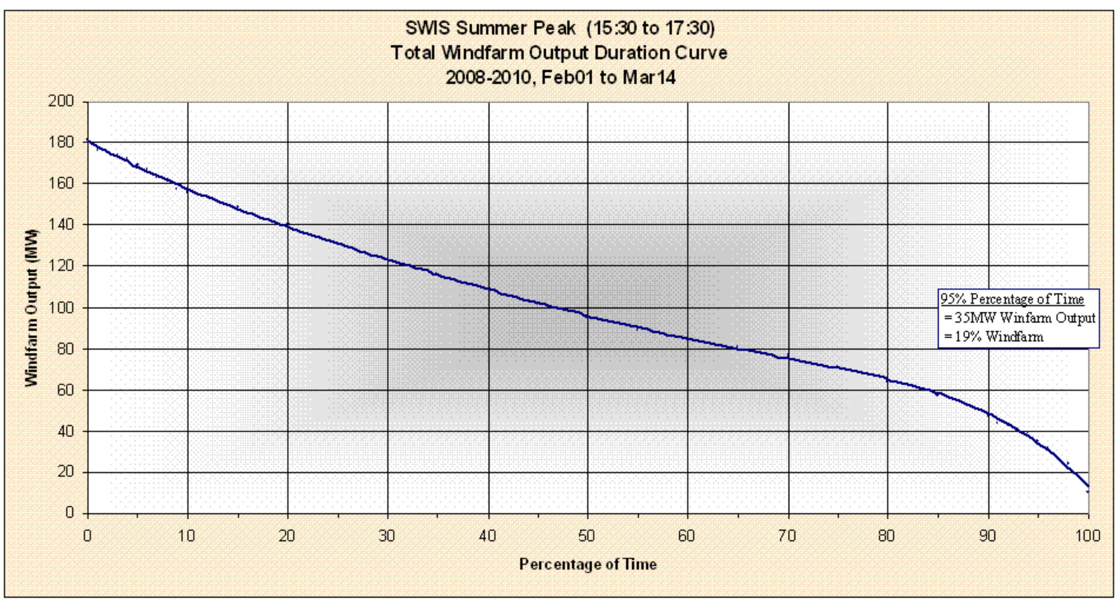
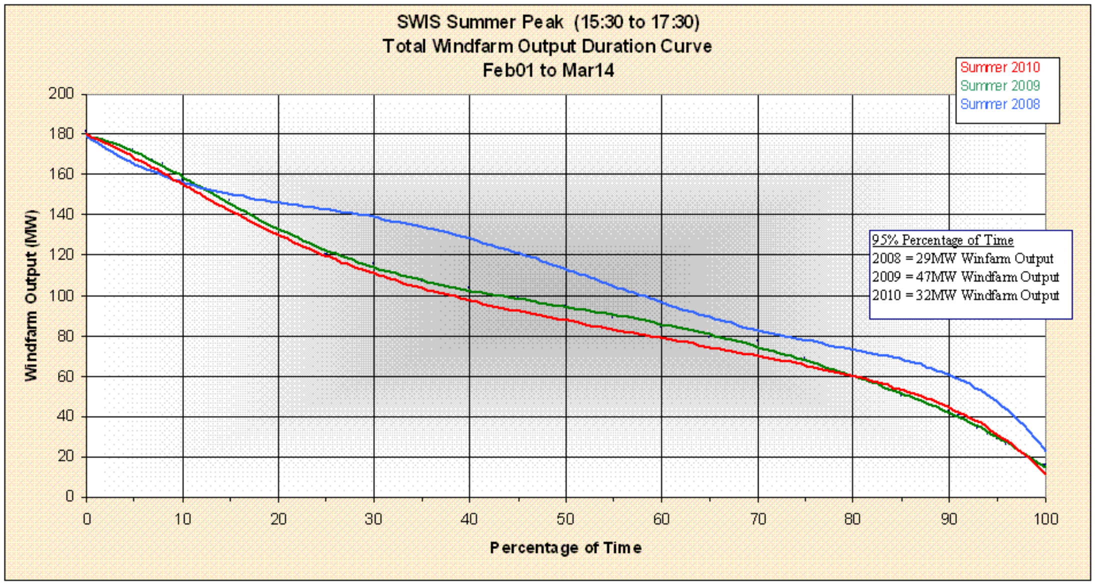
Issue	Comments

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



<table>
<tr><th colspan="2">Work Package 2 Report “Valuing the Capacity of Intermittent Generation in the SWIS” - REGWG Comments</th></tr>
<tr><th>Issue</th><th>Comments</th></tr>
<tr><td></td><td>
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<tr><td>Unserved energy</td><td>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.</td></tr>
<tr><td></td><td>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.</td></tr>
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