Market Advisory Committee's Renewable Energy Working Group

- 28/8/09 meeting
- Prepared & presented by Taron Brearley, Sustainable Energy Development Office.

Introduction

[Slide 1]

Senergy Econnect were commissioned to undertake quantitative analysis to inform capacity allocation rule changes for intermittent generation.

Tom Butler and William Peter of Senergy Econnect provided a presentation on the interim results to this group in April 2009.

Senergy Econnect couldn't make this meeting. The following results have been made available from their report. The results illustrate key points arising from the analysis.

[Slide 2]

The basic analytical approach adopted by Senergy is statistical analysis based on available landfill gas, wind and solar data. The various credit allocation options were drawn from parameters already in the market or proposed for the market.

Thanks to the Working Group members who made their data available.

Senergy Econnect is in the process of clearing the release of results for individual commercial sites. Consequently the results in this presentation are aggregated, presented without identifiers, or are based on BOM data.

A number of caveats should be noted in relation to this project.

- It is not a review of the Reserve Capacity Mechanism framework.
- It does not seek to quantify the contribution intermittent generators may make to the reliability of the system.
- The implications of intermittent generation for the ancillary services components of the reserve margin are not considered, nor are any network constraint or support matters.

The parameters used as the basis for capacity credits allocation methods include interval selections, distribution parameters, weightings and the number of years.

- Time intervals include all intervals, a time range based on high load periods in hot season afternoons, the top 250 peak load intervals (in a year and over three years) and the 12 periods used to determine Individual Reserve Capacity Requirements. (The top 250 load intervals comprise the top 1.5 per cent load intervals over a year or 0.5 per cent over 3 years.)
- Distribution parameters included average generation, the 10^{th} percentile (ie the level of generation met or exceeded 90% of the time) and the median.
- Interval weights are based on the Reserve Capacity Refund ratio relativities.
- Allocations were analysed on an annual and three year basis.

Scan of results

Wind generation

Actual wind generation, test mast data and Bureau of Meteorology data at various sites around the SWIS were used to undertake this analysis.

[Slide 3]

Correlation with high risk times is an important determinant of the likely contribution variable generator makes to system reliability. Intervals when the load is highest give an indication of when the system is likely to be most at risk.

Overall, existing and prospective wind sites, particularly on the coast, appear to have a positive correlation with high load demand.

Taking the Albany wind farm as an example:

- Average demand during the top 250 load intervals (green circles) is higher than average generation over the year (asterisks).
- This is also evident in average generation during afternoon hours when the load tends to be high (blue squares).

At the existing wind farms on the northern line, generation during the afternoon is generally higher than average. However, generation during the top 250 peak load intervals is around the year average or marginally lower. Generation during summer peak load intervals (as reflected in the 10^{th} percentile generation) is more reliable than over the whole year.

[Slide 4]

Using results from the BOM sites, it is evident the correlation with SWIS peak demand varies across sites.

- Geraldton has strong afternoon seabreezes over summer, visible in high generation between 2 and 5 pm (blue squares).
- Wind correlation with peak loads (green circles) are not quite as high but are still well above capacity factor averaged over the whole year (asterisks).
- Generally, the Reserve Capacity Refund weightings suggest an overall correlation with load across the year (although this is not particularly strong in Albany).

[Slide 5]

- The Cape Naturaliste site the capacity factor is very high but generation is not as well correlated with peak load intervals.
- The relative reliability of generation during peak load intervals, reflected in the lowest 10^{th} percentile of generation, is also lower.

[Slide 6]

- Reliability during summer periods was particularly high at the Hopetoun site, with 90 per cent reliability over the top 250 loads (green circles) almost equivalent to the capacity factor over the whole year (asterisks).

The volatility of generation over years can increase markedly when the assessment is made over small numbers of intervals.

- Generation during the 12 peak load intervals used to determine the Individual Reserve Capacity Requirement (red triangles) for market participants is the smallest set of intervals examined and is the most volatile.

Looking across the BOM sites, the standard deviation roughly doubles for average generation summer on summer afternoons as compared to the whole year. Annual variation is substantially reduced when averaged over a number of years.

[Slide 7]

Overall, wind is a highly variable resource. Wind generation possibilities for any particular interval are highly dispersed across the capacity range.

- This BOM site based example is possibly a little extreme. The existing wind farms tend to bunch towards the bottom end a little more.

[Slide 8]

This volatility is present over very small timescales too. At extreme peak load times, there appears to be the possibility of both high and low levels of output.

Senergy Econnect had a look at wind generation over the peak load intervals on days in which the temperature had been above 35 degrees for 3 days.

[Slide 9]

Average generation (the point) and the range observed over the peak intervals is illustrated. Senergy Econnect identified 4 such events over 2007 and 2008, each indicated in a different colour. The particular days of interest are the 3rd and 4th days.

It's a small sample, but its difficult to see any obvious pattern. (Senergy had a look further back for the Albany wind farm and found another 4 events over the preceding 5 years, but the story is the same.)

A large degree of variation is evident, with above and below average outputs on critical days observed for all of the existing wind farms.

[Slide 10]

As the fleet expands, stochastically independent sources of generation are added. One effect of this is that the relative volatility of the total generation in any particular year will be lower.

- Due to the independence of wind sites, extreme low generation values are less likely, as are extreme high values.

This is reflected in an increase in reliability at lower levels of generation. Reliability at the 90^{th} percentile level over the top 250 load intervals improves as more sites are incorporated into the fleet.

- The level of generation at the 90 per cent reliability level is double that of the individual generators, based on normalised generation from the three existing wind farm sites in the SWIS in 2007 and 2008

This effect is not present for averages. These will tend to be the sum of the individual wind farm averages, although relative volatility will reduce.

A fleet analysis was conducted on different areas around the SWIS. Sites remote from the Perth/Geraldton area appear to have independent wind regimes. No compelling evidence of correlations between wind regimes was evident. It is unclear to what degree this holds for sites located close to the existing fleet.

[Slide 11]

<u>Landfill gas</u>

Landfill gas is a relatively stable generation source, although highly conservative reliability-focused rules may have some effect on allocations.

There is little evidence of correlations with load.

[Slide 12]

<u>Solar thermal</u>

Senergy modelled solar thermal output based on BOM irradiation data collected in Geraldton and Kalgoorlie between 2001 and 2006. These are a few solar generation profiles from some sample days.

Solar energy has two quite distinct components. Solar radiation is very predictable but varies over the day. It is also susceptible to interruption by cloud cover, which introduces a stochastic element into output.

- Some capacity to store power could reduce variability in output and extend generation beyond daylight hours.

[Slide 13]

Solar thermal results for the afternoon in summer are high and reliable, as expected. Average generation is getting up towards 100% over summer afternoons between 2 and 5 pm (blue squares).

However, there are a reasonably substantial number of the top 250 load intervals when the sun is not shining, regardless of cloud interference.

- In Geraldton, this proportion is estimated to be around a third to a quarter of the top 250 of peak load intervals.
- 250 load intervals represents 1.5 per cent of all the intervals in a year or 0.5 per cent of all intervals over 3 years. Senergy Econnect analyse the top 250 intervals over both periods.

This can lead to very low credit allocations if applying a high reliability focused rule, such as a 10^{th} percentile criterion.

Of the top 250 peak load intervals that occur during times when the sun is available, less than 10% per cent are affected by cloud cover.

[Slide 14]

A storage component (4 hours, in this instance) allows solar to meet peak loads in the early evening with a very high degree of reliability.

Some conclusions

[Slide 15]

Wind generation varies according to season. There is scope that a greater focus on peak periods could have some influence on site selection (and possibly wind farm design).

However, methods based on average levels of generation are unlikely to represent a wholesale change to long run allocations in comparison with the current rule.

The volatility of credit allocations can increase substantially as smaller numbers of periods as the basis for determining generation expectations.

- Smoothing, eg over multiple years, would better align credit allocations with future expectations and avoid introducing a spurious boom-bust cycle into the capacity market.

Rules that incorporate some kind of reliability-focused parameter may need to acknowledge the fleet benefit, to avoid under-rewarding the contribution of highly variable generation sources.

[Slide 16]

Solar generation technology is predictably high at some times and low or non-existent at others. High load periods occur in both times, although there are considerably more during summer afternoons when solar reliability is high.

- Consideration may need to be given to how the overall contribution to system reliability of generation of this nature may best be reflected in the market.

Landfill gas generation is highly stable, very reliable and may exhibit a small correlation with load. Rule changes predicated on consistency with conventional generation will have a limited impact for these generators.

[Slide 19]

Next steps

Senergy Econnect is clearing the presentations with the data providers.

A detailed report is being finalised with the Sustainable Energy Development Office and will be provided to this group.