GERALDTON – KALBARRI

The Geraldton load was also compared to output from the Kalbarri 20kWp PV facility. This facility was established in 1995 and consists of 256 panels and a 35kVA grid-interactive inverter. The panels are fitted to 16 tilted single-axis trackers.

Both July and August 2003 were missing from the dataset provided and so these months were taken from 2005. Only import and export data were available, not generation. During the day energy is used on site for the PV system auxiliaries (inverters, trackers, control hut air conditioner etc). Overnight, power is imported from the grid to keep the PV system and inverters energised, as well as run the on-site air conditioner etc. As a result, total annual import was 15-20% the size of export. The peak output from the Kalbarri data used for this analysis was 14.1kW, or only 70% of rated output.

The Kalbarri export data were directly scaled up by a factor of 100 to simulate a 2MW facility for this analysis, and this may have overestimated the proportion of energy that would be used on-site in such a large facility. Note that Kalbarri is about 150km north of Geraldton and so although their annual insolation may be similar, they would have different hourly profiles.

Annual PV profile

The export from Kalbarri shows an unusual decline during the summer months, even greater than the decline for the simulated Geraldton PV. This decline relative to Geraldton may partly be because of energy use on-site for air conditioning, and may also reflect cloud cover or operating characteristics such as effectiveness of tracking.

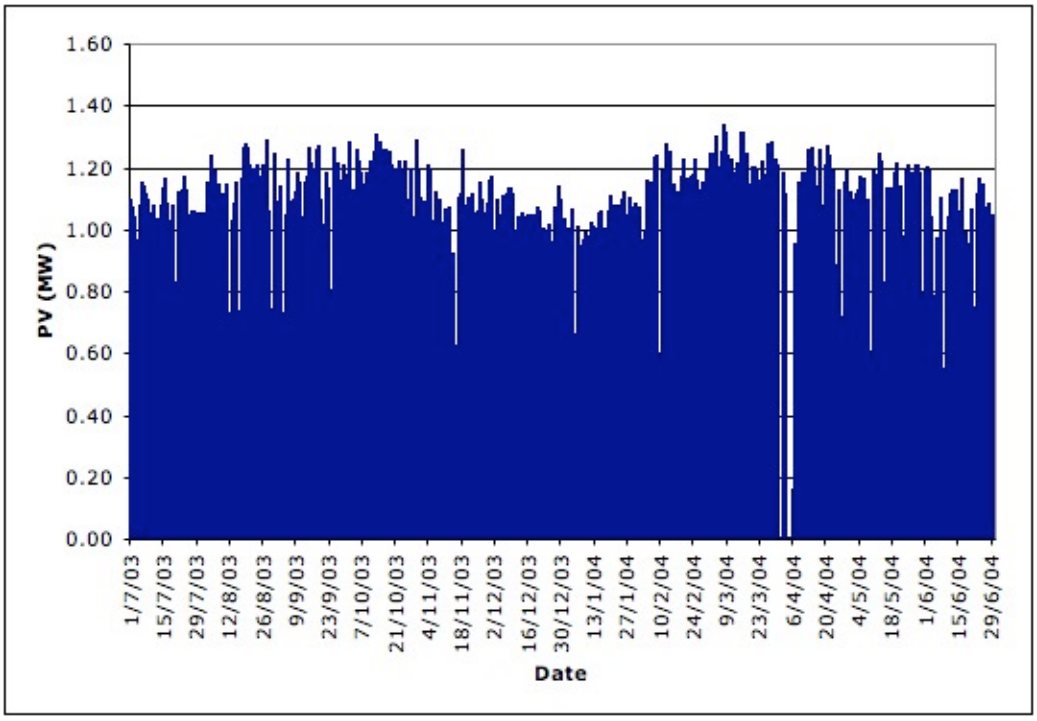

Figure 1: Kalbarri PV (Scaled to 2MW)
July 2003 to June 2004

Daily profiles

The main difference to the simulated north-facing PV is that the Kalbarri scaled PV output is lower and sometimes has a slightly asymmetric profile, with either morning or afternoon being higher.

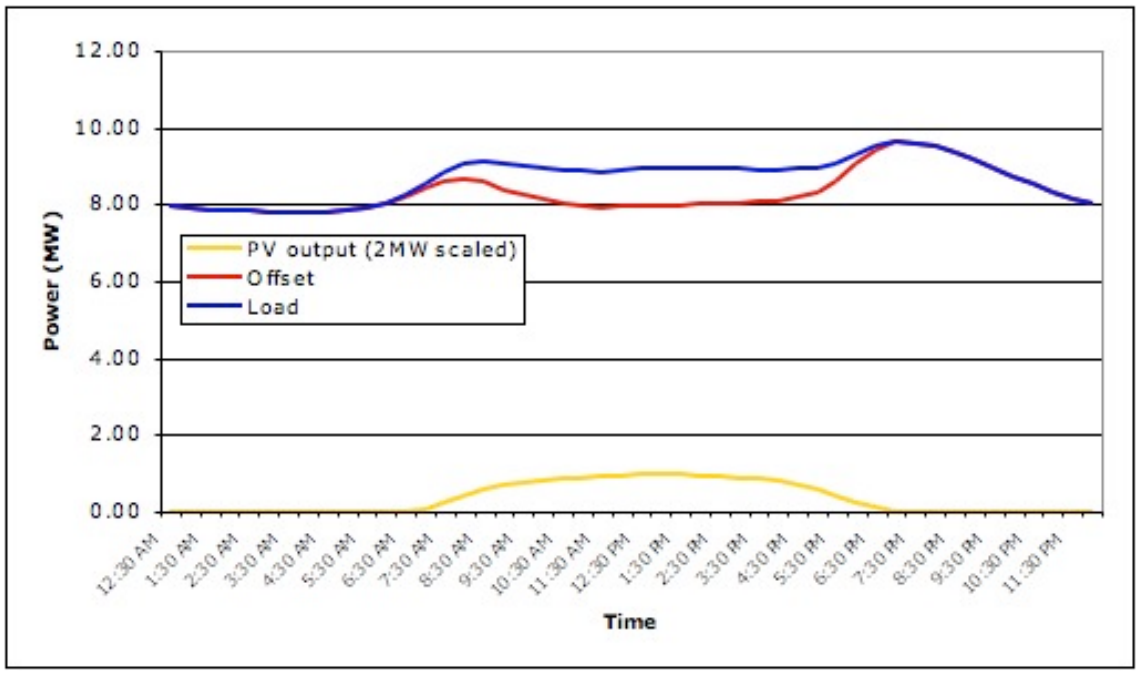

Figure 2: Daily Annual Average
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset
July 2003 to June 2004

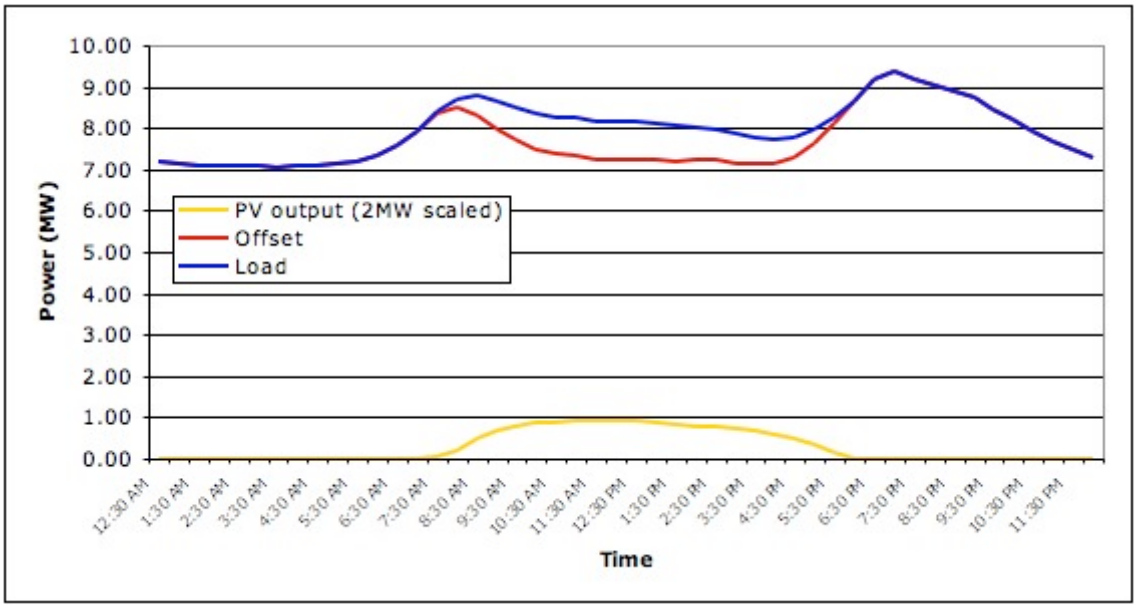

Figure 3: Daily Winter Average
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset
June 2004 and July/Aug 2003

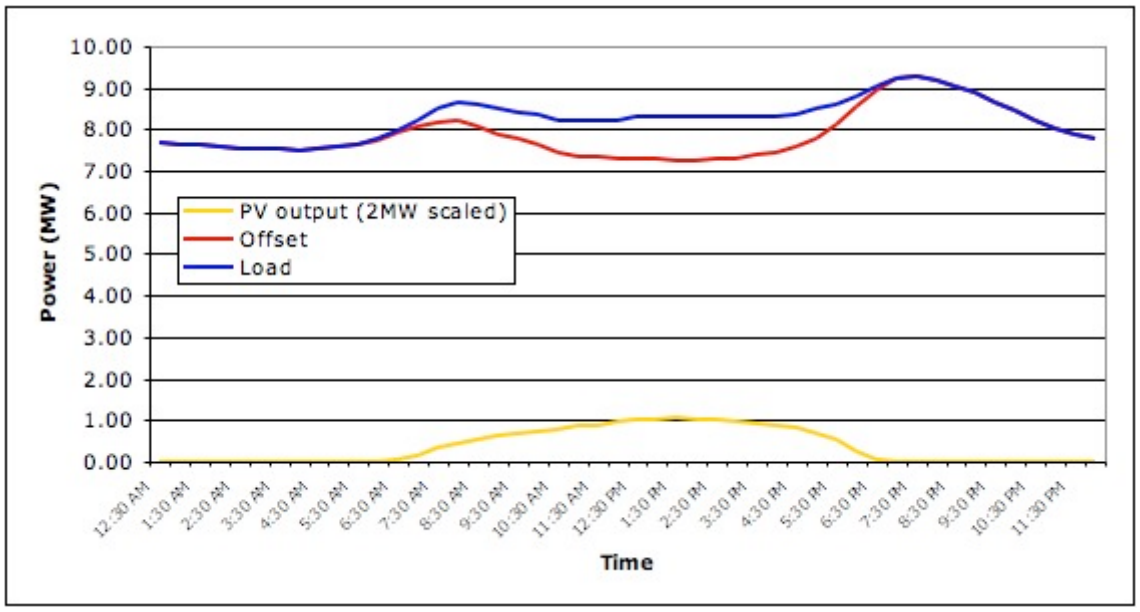

Figure 4: Daily Spring Average
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset
Sept 2003 to Nov 2003

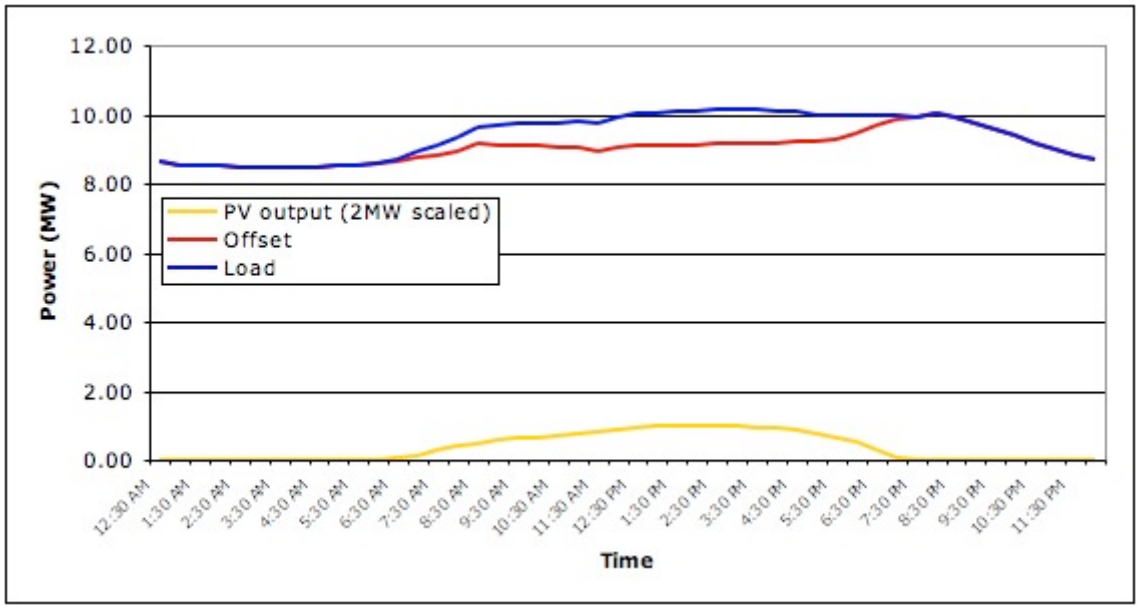

Figure 5: Daily Summer Average
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset
Dec 2003 to Feb 2004

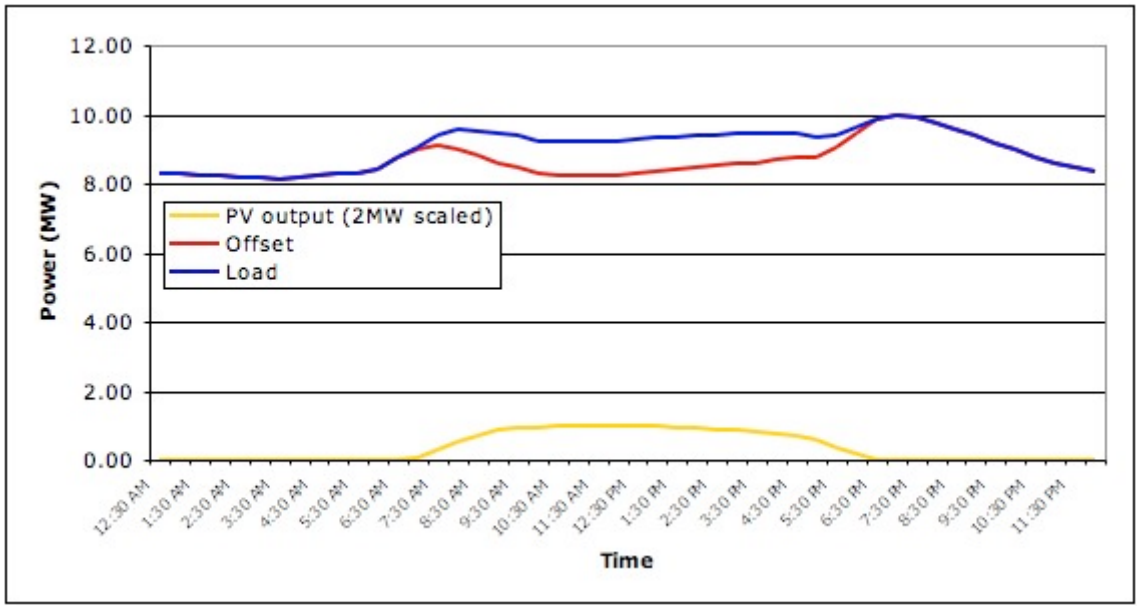

Figure 6: Daily Autumn Average
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset
March 2004 to May 2004

Times of peak demand

The main differences to the simulated PV during the peak demand days are:

a. 10th – 11th Dec 2003: the Kalbarri scaled output is slightly broader but not as high as the simulated north-facing PV data. As a result it does not have as great an impact on the study period's peak day, and as can be seen from the load duration curves in Figure 11 and Figure 12, reduces the peak half hour periods for the year by only between 0.7 and 0.9 MW.

b. 21st-23rd May 2004: because the load peaks occurred so late in the day, as for the simulated north-facing PV, the Kalbarri scaled output had little if any effect on the load profile.

c. 27th – 30th July 2003: the Kalbarri scaled output is much greater than the simulated north-facing PV on the 29th and broader on each day, the latter presumably because of tracking. As a result it reduces peak demand on these days more than the simulated PV.

d. 10th March 2004: the Kalbarri scaled output is much broader than the simulated north-facing PV and so while not as high in the middle of the day has a greater impact on the early morning load peak.

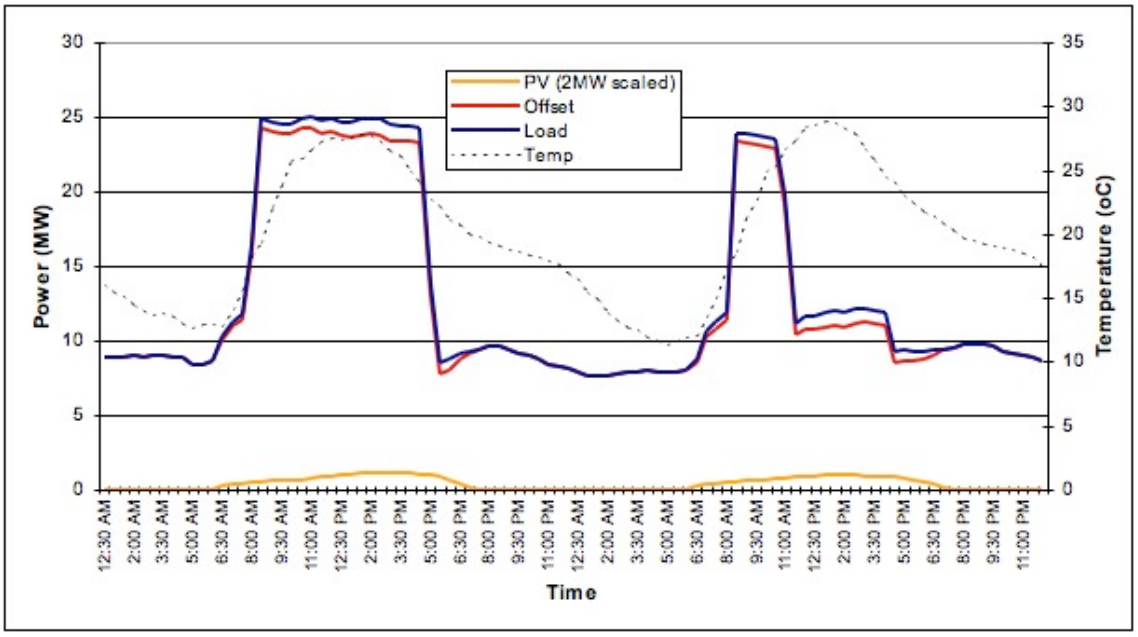

Figure 7: Summer peak days
10th – 11th Dec 2003
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset

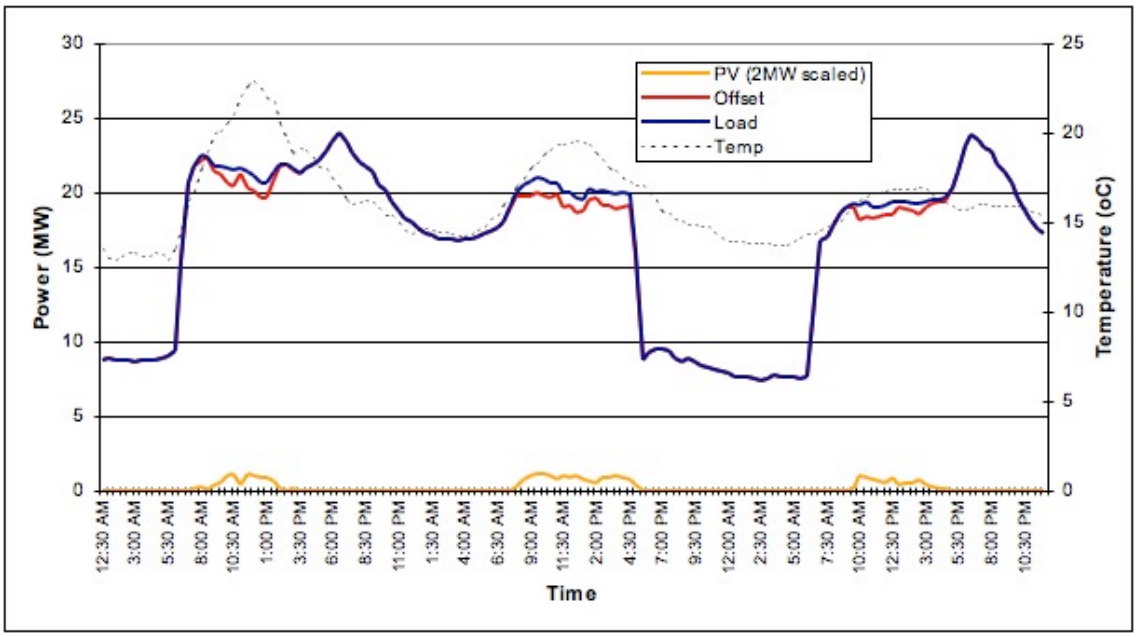

Figure 8: Autumn peak day
21st - 23rd May 2004
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset

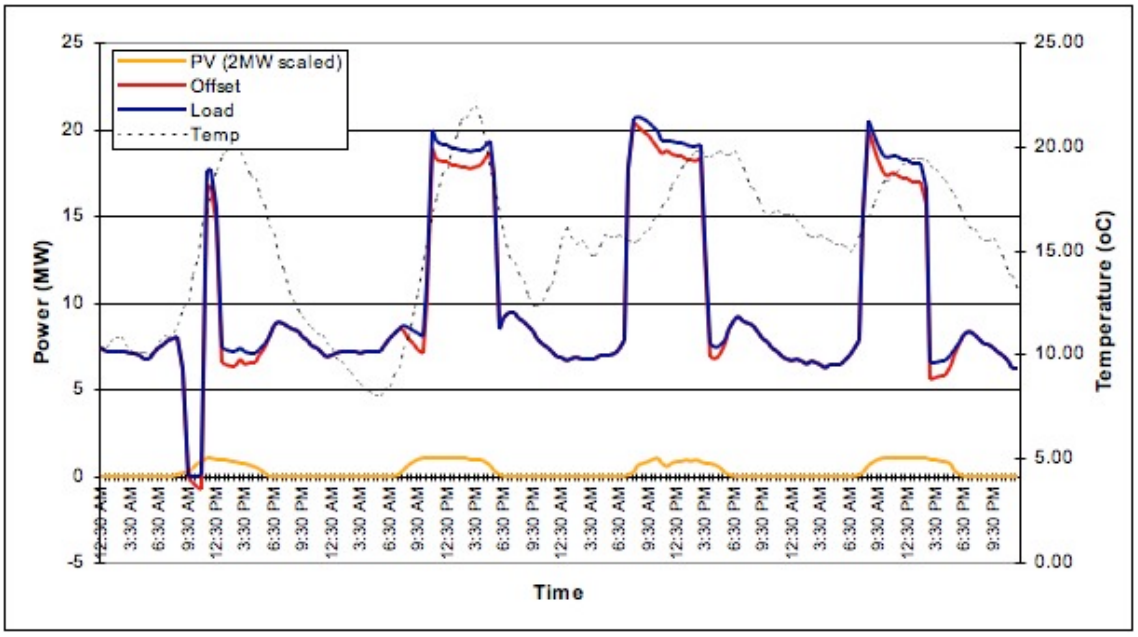

Figure 9: Winter peak days
27th – 30th July 2003
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset

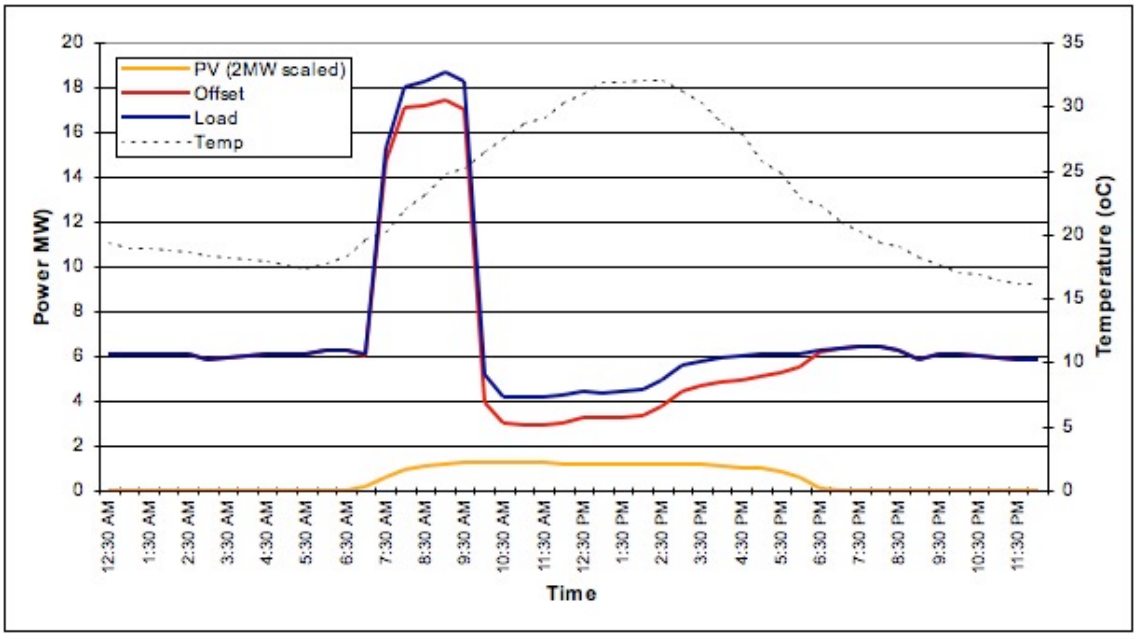

Figure 10: Autumn peak day
10th March 2004
Geraldton TX1 Load, Kalbarri PV (2MW scaled) and Net Load after PV Offset

Load duration curves

The effect of the scaled Kalbarri PV on the Geraldton TX1 load duration curve was very similar to the simulated north-facing PV, the only notable difference being that the Kalbarri PV did not reduce the top load points as much – see Figure 11.

The Kalbarri scaled 2MW PV resulted in the highest offset load period being 0.67MW lower than the highest original load period, and resulted in the top 10 offset load periods being lower by an average of 0.82MW. On the load duration curve where the offset points now correspond to the load points directly above them on the chart (Figure 12), during the day of the highest load point, 38% of the Kalbarri scaled 2MW PV would have contributed to load reduction, reducing it from 24.98MW to 24.22MW (although as occurred for the simulated PV data, what was originally a lower load point did not correlate as well to PV and so became the day's highest offset load point at 24.31MW). On average during the 10 highest load points, 45.5% the Kalbarri scaled 2MW PV was contributing to reducing peak load.

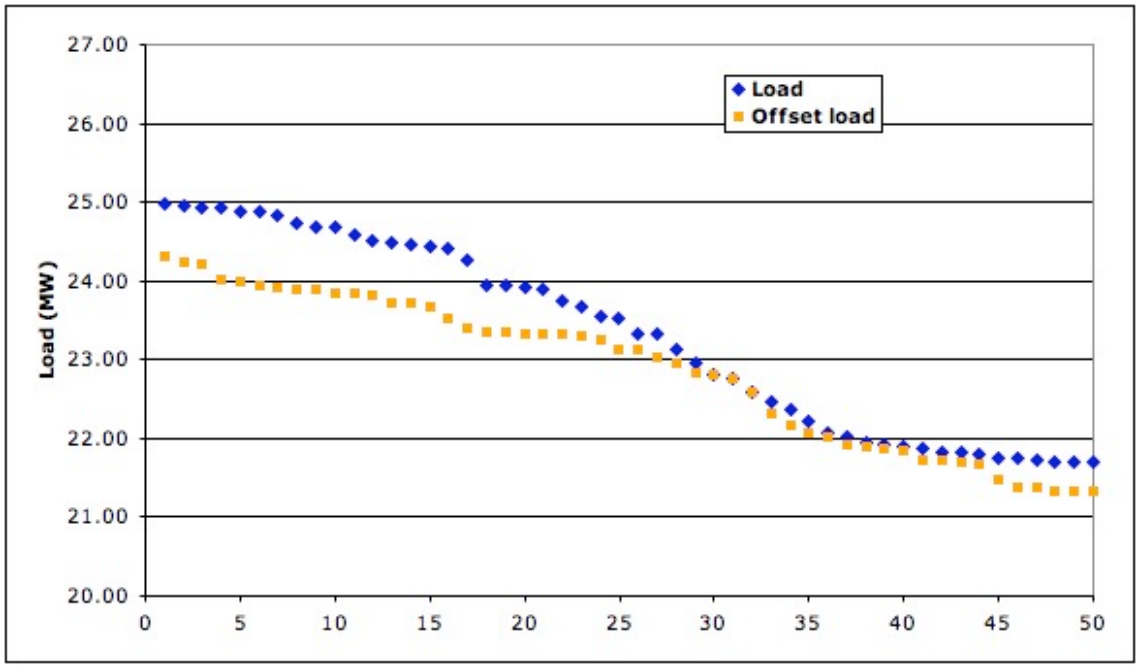

Figure 11: Load Duration Curve - top 50 load points
Geraldton TX1 Load and Geraldton TX1 Net Load after Kalbarri PV Offset (2MW scaled)
July 2003 to June 2004

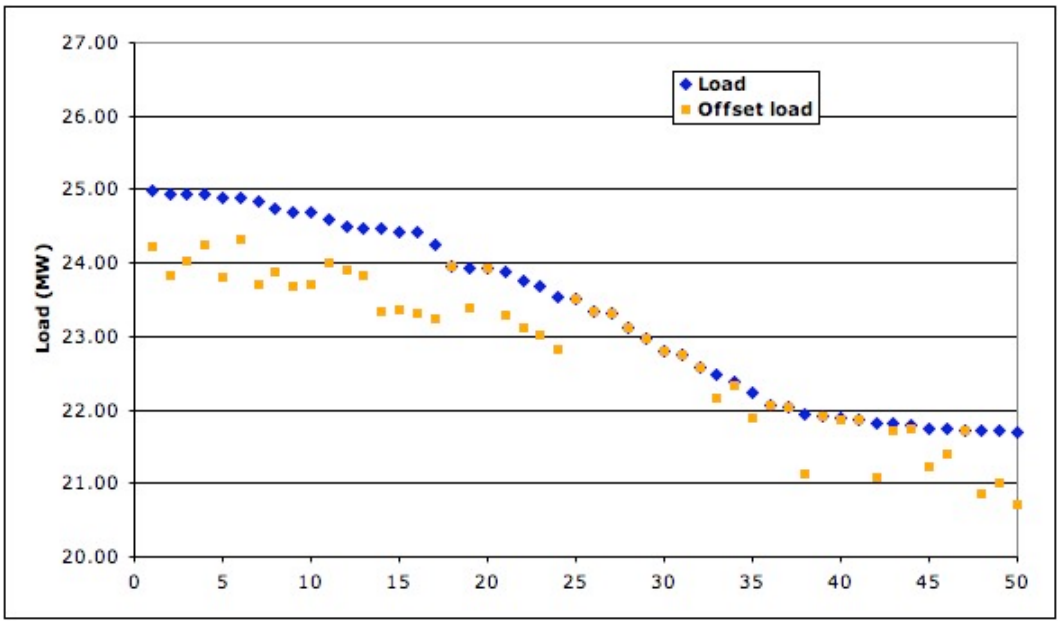

Figure 12: Load Duration Curve - top 50 load points (linked)
Geraldton TX1 Load and Geraldton TX1 Net Load after Kalbarri PV Offset (2MW scaled)
July 2003 to June 2004

General correlation between PV Output and Load

The scatterplot of Kalbarri scaled PV vs load was essentially identical to that of simulated north-facing PV vs load and so has not been included here.

Correlation with temperature

The only difference between the Kalbarri scaled PV output and the simulated north-facing PV was that the former had slightly higher PV output at lower temperatures – see Figure 13.

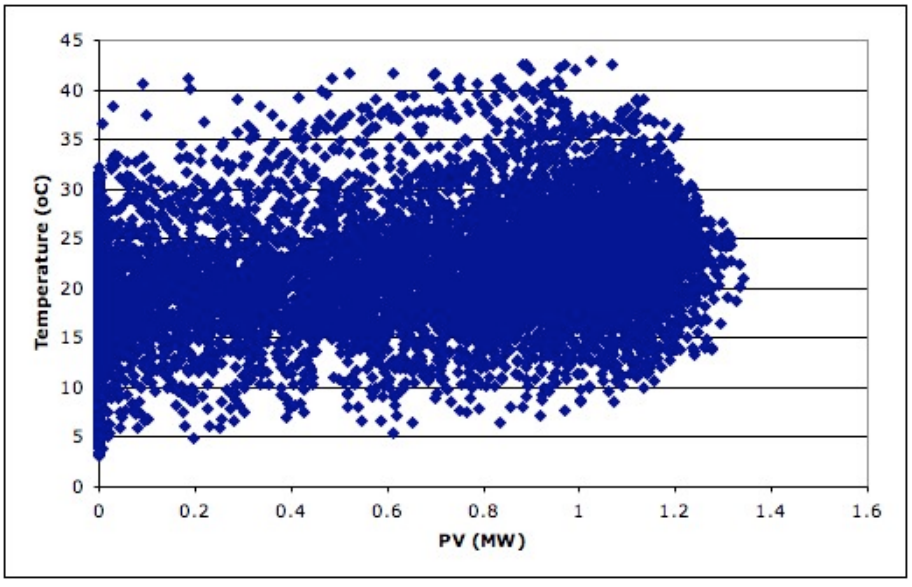

Figure 13: Kalbarri PV (2MW scaled) vs Temperature
July 2003 to June 2004