senergy									
econnect The Treatment of Intermittent Generation in the SWIS Capacity Market									
Review of Certified Reserve Capacity Calculation Methodologies for Intermittent Generators Senergy Econnect Project No: 2413									
Office of Energy									
Prepared For: Covernor Stirling Tower,									
Prepared For: Governor Suming Tower, 197 St Georges Terrace, PERTH WA 6000									
197 St Georges Terrace,									

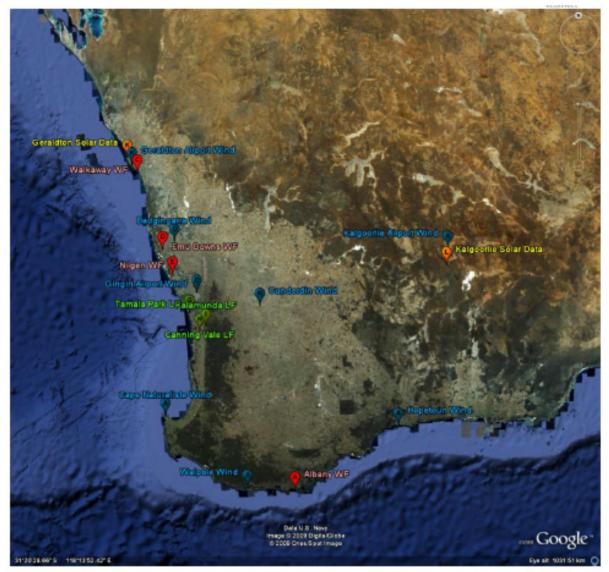


Figure 2: Map of the SWIS region with the location of recorded data identified by markers corresponding to their source (see Table 2). Red labels denote Wind Farms (WF), Green denotes Landfill Gas Plants (LF), Yellow denotes Solar Resource Locations (Solar) while blue denotes a BOM recorded wind data site. Image produced courtesy of Google Earth.



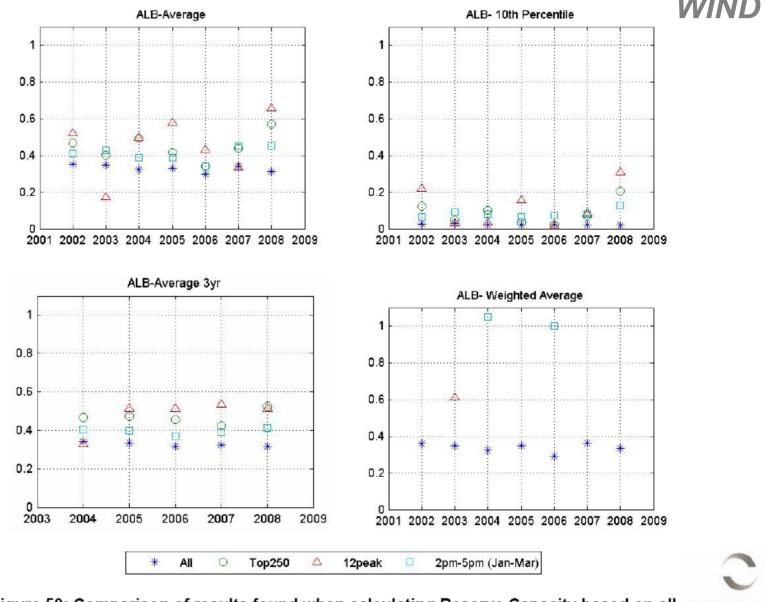


Figure 50: Comparison of results found when calculating Reserve Capacity based on all senergy methodologies for ALB wind generation over single year time frames.

econnect

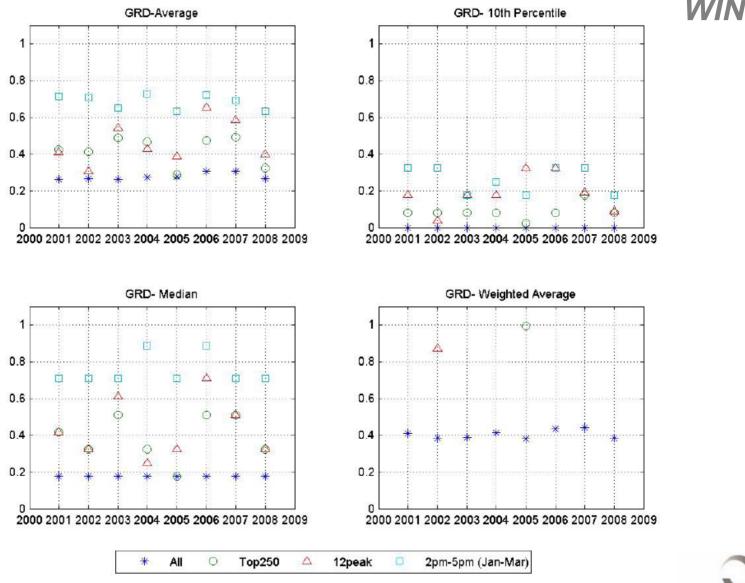


Figure 42: Comparison of results found when calculating Reserve Capacity based on all methodologies for GRD modelled wind generation over single year time frames.



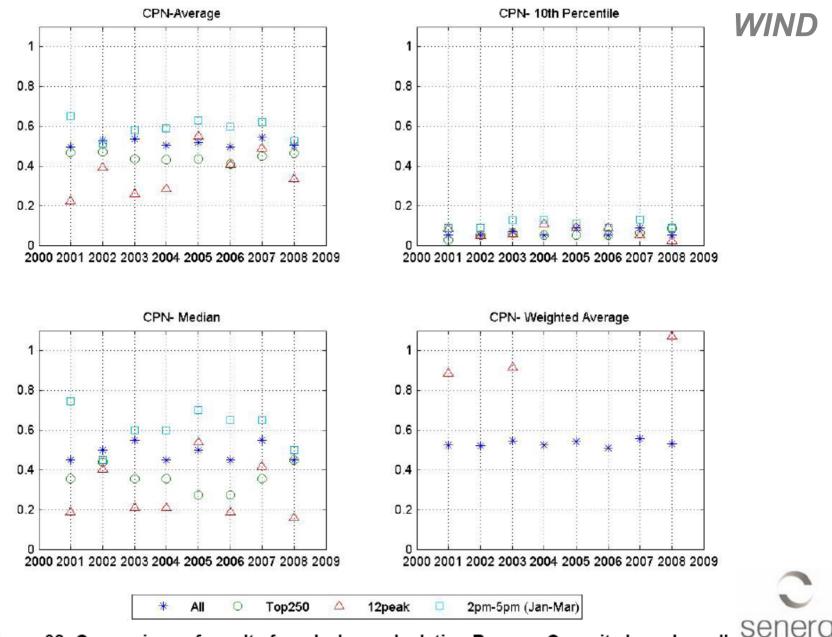


Figure 38: Comparison of results found when calculating Reserve Capacity based on all methodologies for CPN modelled wind generation over single year time frames.

alternative energy

econnect

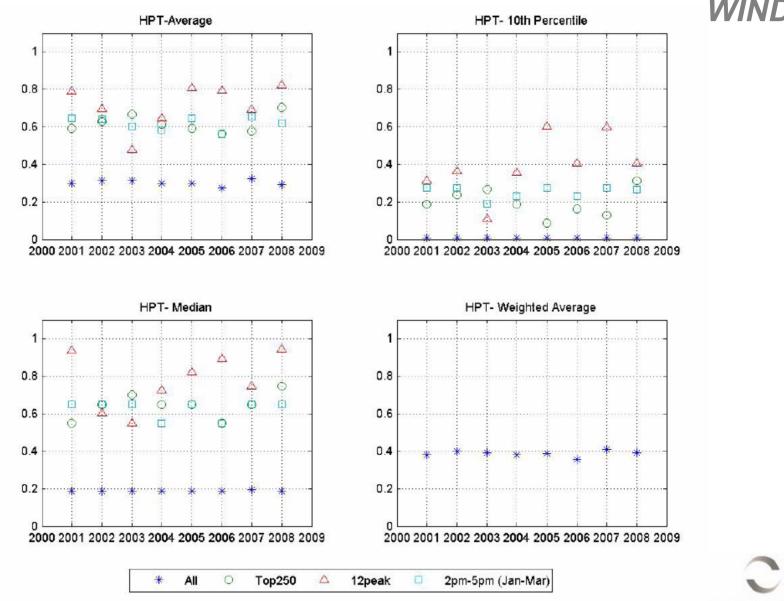
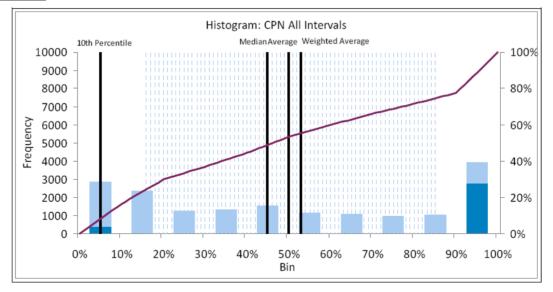


Figure 44: Comparison of results found when calculating Reserve Capacity based on all methodologies for HPT modelled wind generation over single year time frames.

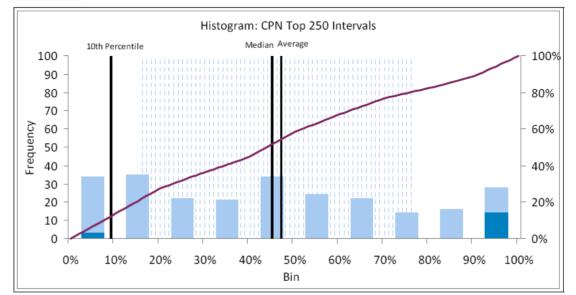


16.5 CPN Histograms and Distributions (Wind)

All Intervals



Top 250 Intervals

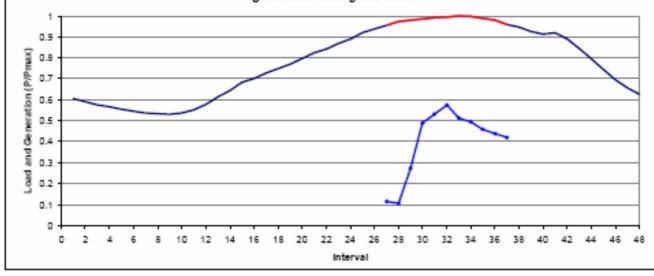




WIND

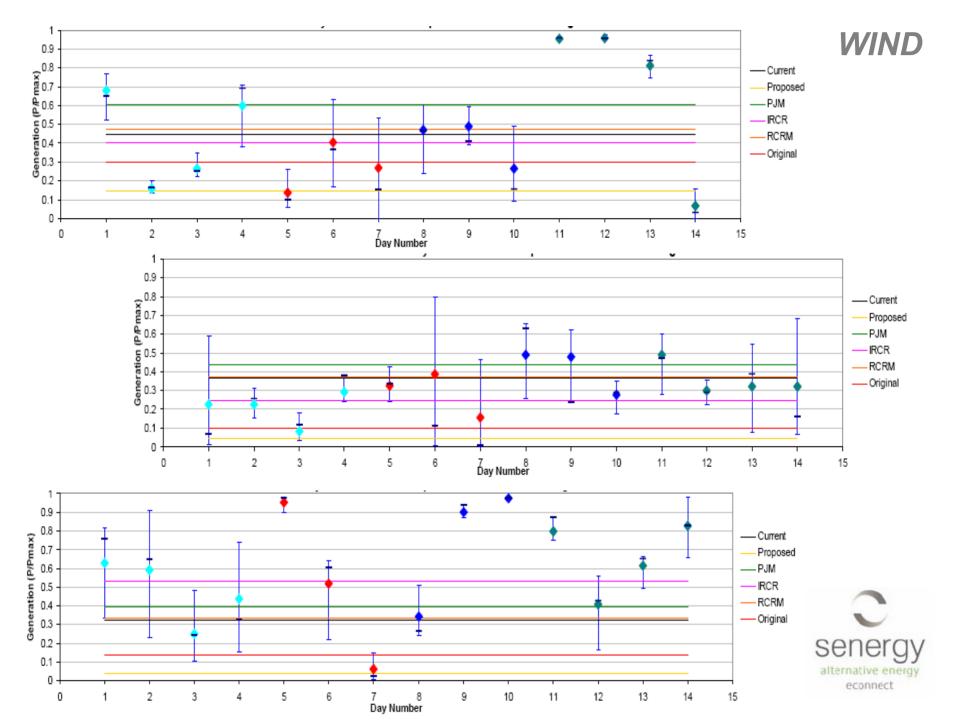
Day Number	Date	Day	Peak Load (MW)	Intervals of 0.95 x peak	Max. Temp. (Deg. C, North Perth)	Min. Temp. (Deg. C, North Perth)	
1	05-Mar-07	Mon	3010	11	39.60	22.6	
2	06-Mar-07	Tue	3521	10	41.60	21.9	
3	07-Mar-07	Wed	3561	9	42.10	18.7	
4	06-Mar-07	Thu	3346	10	37.60	19.9	
5	24-Dec-07	Mon	2845	8	35.80	19.1	
6	25-Dec-07	Tue	2563	15	40.40	21.6	
7	26-Dec-07	Wed	2952	18	43.20	20.2	
8	11-Feb-08	Mon	3603	9	36.90	22.5	
9	12-Feb-08	Tue	3477	8	36.30	20.7	
10	13-Feb-08	Wed	3413	10	36.30	22.6	
11	25-Feb-08	Mon	3187	7	35.40	17.2	
12	26-Feb-08	Tue	3331	9	36.70	17.3	
13	27-Feb-08	Wed	3482	8	37.50	20.6	
14	28-Feb-08	Thu	3571	11	41.30	20.9	

Comparison of the SWIS load and the actual wind fleet generation on February 11th 2008. The period where the load is 95% of the peak is shown along with the actual fleet generation during this time.

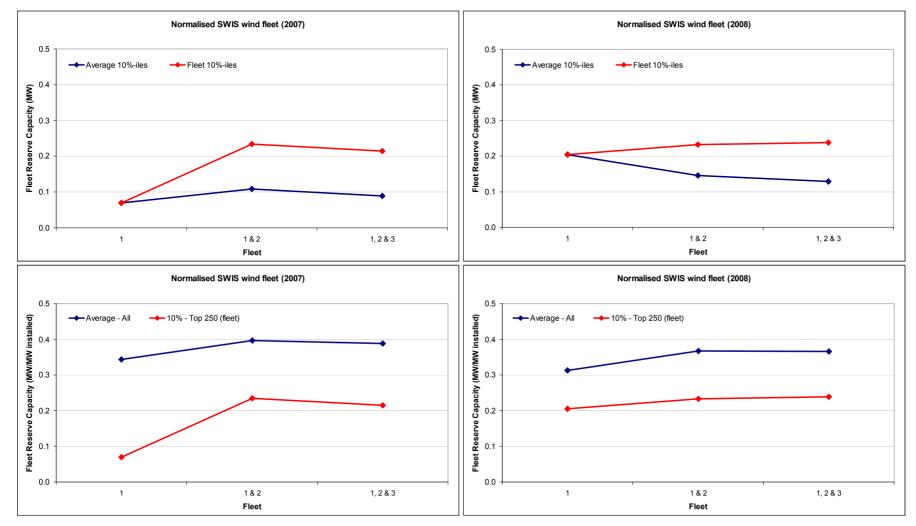




WIND



WIND





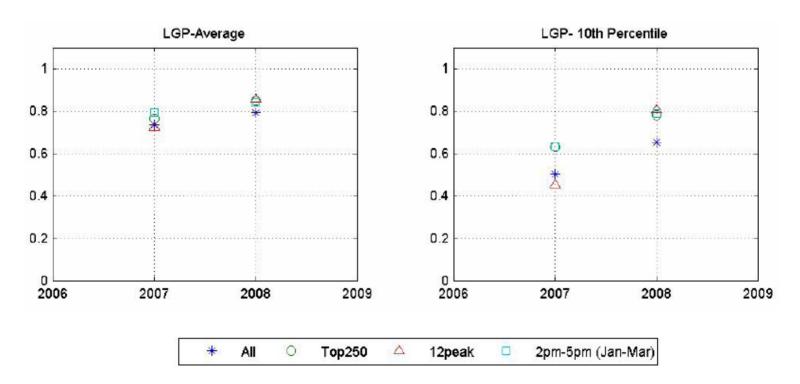
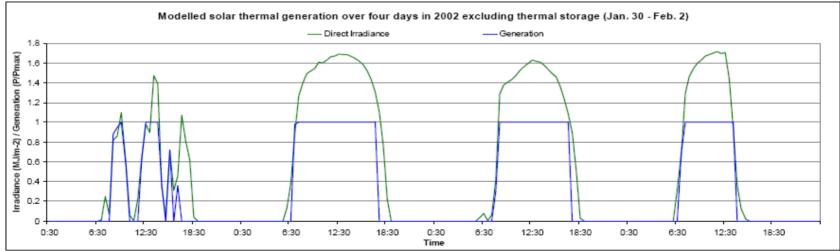
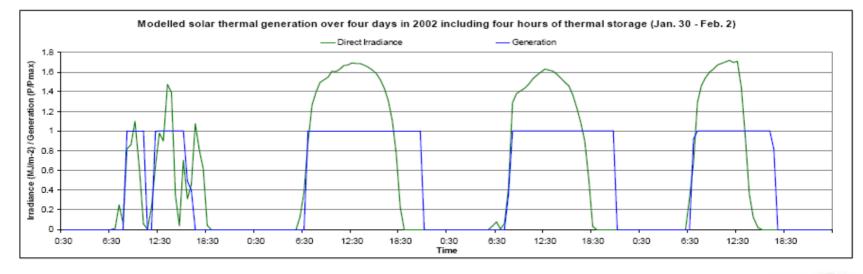


Figure 58: Comparison of results found when calculating Reserve Capacity based on all methodologies for LGP landfill gas generation over single year time frames.

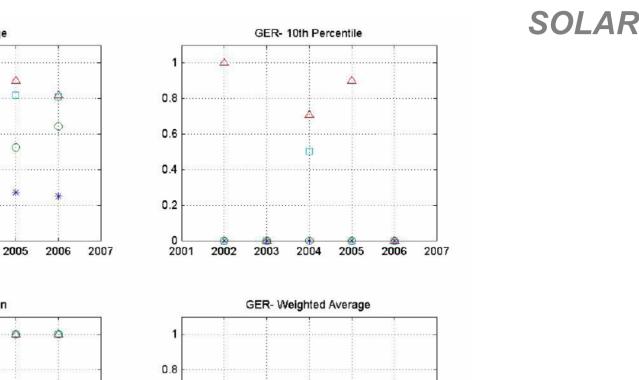


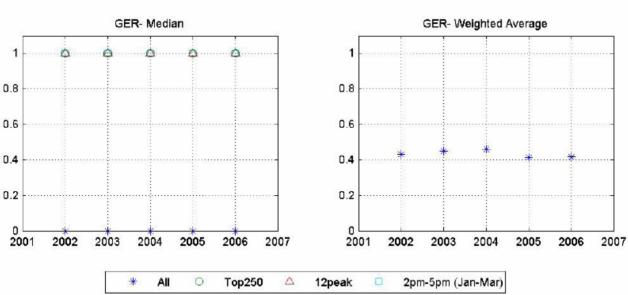
SOLAR











GER-Average

(A)

2004

0.8

0.6

0.4

0.2

n

2001

2002

2003

Figure 62: Comparison of results found when calculating Reserve Capacity based on all methodologies for GER solar thermal generation over single year time frames.



SOLAR

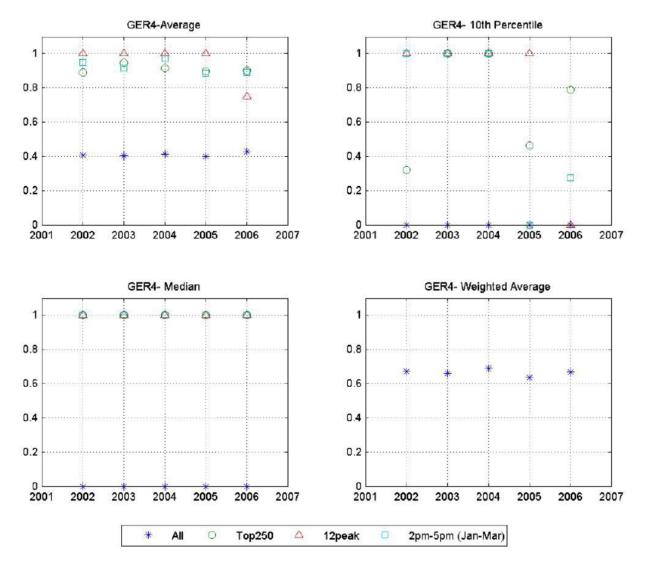


Figure 64: Comparison of results found when calculating Reserve Capacity based on all methodologies for GER solar thermal generation over single year time frames when considering thermal storage potential for four hours of generation without effective irradiance.



- Wind in the SWIS is highly variable but seasonal and diurnal patterns evident.
 - → Site and turbine selection could influence expected generation at system peak times.
 - ➔ Output volatility is evident at very high risk times, but no obvious pattern.
- Small numbers of intervals introduces volatility.
 - ➔ Avoid spurious boom/bust cycles in market.
- Independent wind regimes improve overall reliability of wind generation.



- Solar radiation is high correlated with SWIS load during high load summer days.
 - ➔ Balance reliability in meeting high loads in the daytime with unavailability at other times.
- LFG

- Landfill gas generation is stable.
 - → Unlikely to be greatly affected.



	Summay Table for Reserve Capacity allocations based on single year time frames												
Site	Avail. Current			PJM				Proposed					
316	points	Min	Ave	Max	Std. Dev.	Min	Ave	Max	Std. Dev.	Min	Ave	Max	Std. Dev.
BRS	8	36.69%	40.02%	47.41%	3.57%	54.65%	59.43%	63.87%	2.89%	2.77%	7.73%	18.93%	4.93%
CDD	8	20.25%	22.08%	24.28%	1.46%	27.27%	32.92%	37.80%	3.97%	0.00%	1.12%	2.77%	1.06%
CPN	8	49.51%	51.58%	54.32%	1.85%	51.30%	58.78%	65.13%	4.89%	2.77%	5.61%	8.67%	1.63%
GIN	8	18.32%	19.38%	20.61%	0.86%	45.18%	49.18%	53.15%	2.70%	0.90%	3.51%	8.67%	2.48%
GRD	8	26.38%	27.86%	30.79%	1.82%	63.10%	68.52%	72.91%	4.02%	2.36%	8.43%	17.68%	4.21%
HPT	8	27.54%	30.16%	32.27%	1.46%	56.11%	62.00%	65.43%	3.39%	8.67%	19.75%	31.47%	7.36%

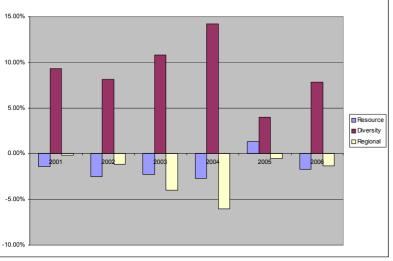
Summay Table for Reserve Capacity allocations based on three year time frames*												
Avail. Current				PJM				Proposed				
points	Min	Ave	Max	Std. Dev.	Min	Ave	Max	Std. Dev.	Min	Ave	Max	Std. Dev.
6	37.70%	39.13%	42.03%	1.52%	57.39%	58.78%	60.48%	1.19%	5.26%	8.03%	10.78%	1.86%
6	21.39%	22.18%	23.51%	0.84%	28.66%	32.11%	34.78%	2.35%	0.00%	1.68%	2.77%	1.23%
6	50.60%	51.71%	52.33%	0.61%	56.33%	59.09%	61.48%	1.88%	3.79%	6.11%	8.67%	1.70%
6	18.45%	19.14%	19.80%	0.53%	46.97%	48.34%	50.01%	1.09%	2.77%	3.99%	5.26%	1.34%
6	26.53%	28.06%	29.77%	1.39%	67.10%	68.62%	69.63%	0.95%	7.90%	11.16%	17.68%	5.05%
6	29.11%	30.11%	30.87%	0.68%	59.69%	61.38%	63.15%	1.15%	18.93%	25.81%	31.47%	4.32%
	Avail. data points 6 6 6 6 6	Avail. data points Min 6 37.70% 6 21.39% 6 50.60% 6 18.45% 6 26.53%	Avail. data points Cur 6 37.70% 39.13% 6 21.39% 22.18% 6 50.60% 51.71% 6 18.45% 19.14% 6 26.53% 28.06%	Avail. data points Current Min Ave Max 6 37.70% 39.13% 42.03% 6 21.39% 22.18% 23.51% 6 50.60% 51.71% 52.33% 6 18.45% 19.14% 19.80% 6 26.53% 28.06% 29.77%	Avail. data points Current Min Ave Max Std. Dev. 6 37.70% 39.13% 42.03% 1.52% 6 21.39% 22.18% 23.51% 0.84% 6 50.60% 51.71% 52.33% 0.61% 6 18.45% 19.14% 19.80% 0.53% 6 26.53% 28.06% 29.77% 1.39%	Avail. data points Current Min Ave Max Std. Dev. Min 6 37.70% 39.13% 42.03% 1.52% 57.39% 6 21.39% 22.18% 23.51% 0.84% 28.66% 6 50.60% 51.71% 52.33% 0.61% 56.33% 6 18.45% 19.14% 19.80% 0.53% 46.97% 6 26.53% 28.06% 29.77% 1.39% 67.10%	Avail. data points Current Min Ave Max Std. Dev. Min Ave 6 37.70% 39.13% 42.03% 1.52% 57.39% 58.78% 6 21.39% 22.18% 23.51% 0.84% 28.66% 32.11% 6 50.60% 51.71% 52.33% 0.61% 56.33% 59.09% 6 18.45% 19.14% 19.80% 0.53% 46.97% 48.34% 6 26.53% 28.06% 29.77% 1.39% 67.10% 68.62%	Avail. data points Current PJM Min Ave Max Std. Dev. Min Ave Max 6 37.70% 39.13% 42.03% 1.52% 57.39% 58.78% 60.48% 6 21.39% 22.18% 23.51% 0.84% 28.66% 32.11% 34.78% 6 50.60% 51.71% 52.33% 0.61% 56.33% 59.09% 61.48% 6 18.45% 19.14% 19.80% 0.53% 46.97% 48.34% 50.01% 6 26.53% 28.06% 29.77% 1.39% 67.10% 68.62% 69.63%	Avail. data points Current PJM Min Ave Max Std. Dev. Min Ave Max Std. Dev. 6 37.70% 39.13% 42.03% 1.52% 57.39% 58.78% 60.48% 1.19% 6 21.39% 22.18% 23.51% 0.84% 28.66% 32.11% 34.78% 2.35% 6 50.60% 51.71% 52.33% 0.61% 56.33% 59.09% 61.48% 1.88% 6 18.45% 19.14% 19.80% 0.53% 46.97% 48.34% 50.01% 1.09% 6 26.53% 28.06% 29.77% 1.39% 67.10% 68.62% 69.63% 0.95%	Avail. data points Current PJW Min Ave Max Std. Dev. Min Std. Dev. Min Ave Max Std. Dev. Min Std. Dev. St	Avail. data points Current Prop. Min Ave Max Std. Dev. Min Ave Ave Ave Ave Ave	Avail. data points Current PJW Max Std. Dev. Propesd Min Ave Max Std. Dev. Min Ave Max Std. Dev. Min Ave Max Std. Dev. Max Std. Dev. Min Ave Max Ave Max Std. Dev. Min Ave Std. Dev. Std. De



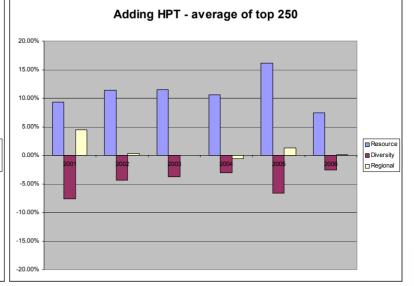
Adding HPT - 10th percentile of top 250

2005

2006



Adding CPN - 10th percentile of top 250



2003

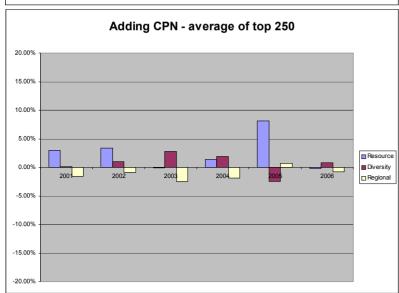
2001

-5.00%

-10.00%

2002

2004



senergy alternative energy econnect