

# WACM Wind Production Summary Overview

October 2006



Summary by Joseph Liberatore

The following report is designed to give a graphical representation of the wind production on Western’s transmission system in the Western Area Colorado/Missouri (WACM) control area for five (5) wind farms. A map and the general locations of the various farms is shown in figure A. Production output graphs of farms A, B, C, D and E were created to be read as follows

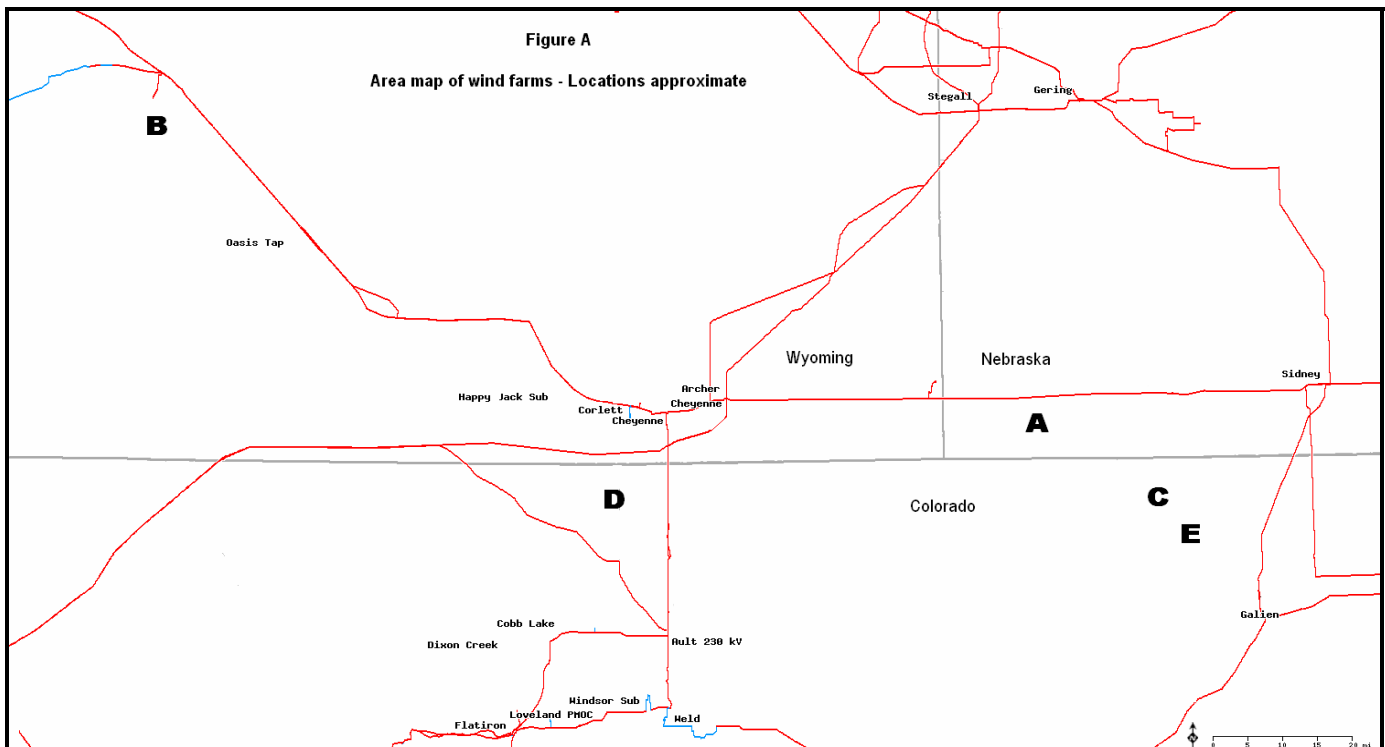
The horizontal (X) axis is hour of day in military time and  
 The vertical (Y) axis is month of year from January thru December, 1 thru 12 respectively.

Color variations are to be interpreted as follows: Dark blue areas represent little or no wind production and are graduated to bright red which depict maximum wind farm output. All levels are normalized and though values at the darkest blue shade are nearly equal in all plots - zero output, the values of graphs in red areas are NOT equal. Typically, red values will indicate nearly the maximum nameplate (rating) of that particular farm. Wind farm maximum outputs are as follows:

Farm A	10.5	MW
Farm B	8.4	
Farm C	30.0	
Farm D	30.0	
Farm E	60.0	
<b>Total</b>	<b>138.9</b>	<b>MW</b>

Wind data for all 5 farms was retrieved for calendar years 2004, 2005 and through the end of September, 2006. Additionally, there is a composite plot of all wind farm output for years 2004, 2005 and through the end of September, 2006. Note: wind farm E was not in commercial production until early 2006 and therefore the zero output graphs are not in error.

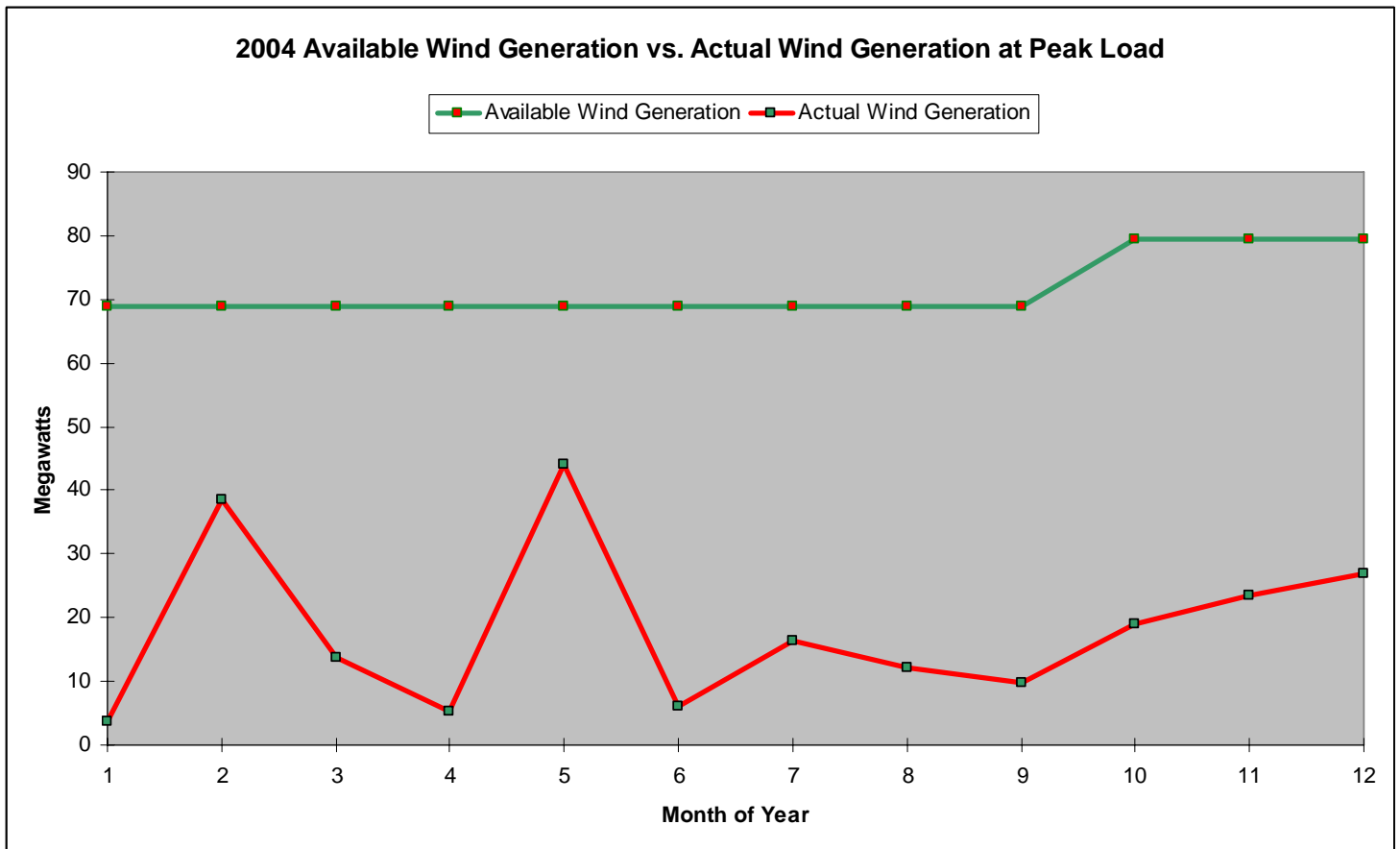
Special thanks go to Dr. Abraham Ellis for the use of the Matlab.m file code which was used to produce the yearly summary output graphs



**Table A**

<b>2004</b>	Control Area Peak Load MW/Day/Hour	Total Wind Capacity at Peak (MW)	Actual (total) Wind Generation at Peak Load (WM)	Percent Wind Generation at Peak Load (%)	Percent Wind Contribution to Load at Peak
January	2807-5-19:00	69 <sup>1</sup>	3.8	5.5%	0.14%
February	2704-11-20:00	69 <sup>1</sup>	38.6	55.9%	1.43%
March	2464-2-19:00	69 <sup>1</sup>	13.6	19.7%	0.55%
April	2313-29-21:00	69 <sup>1</sup>	5.4	7.8%	0.23%
May	2385-10-15:00	69 <sup>1</sup>	44.2	64.1%	1.85%
June	2797-7-17:00	69 <sup>1</sup>	6.2	9.0%	0.22%
July	3080-13-17:00	69 <sup>1</sup>	16.3	23.6%	0.53%
August	3071-2-16:00	69 <sup>1</sup>	12.2	17.7%	0.40%
September	2727-1-17:00	69 <sup>1</sup>	9.82	14.2%	0.36%
October	2329-25-20:00	79.5	19	23.9%	0.82%
November	2777-29-19:00	79.5	23.5	29.6%	0.85%
December	2846-23-19:00	79.5	26.8	33.7%	0.94%

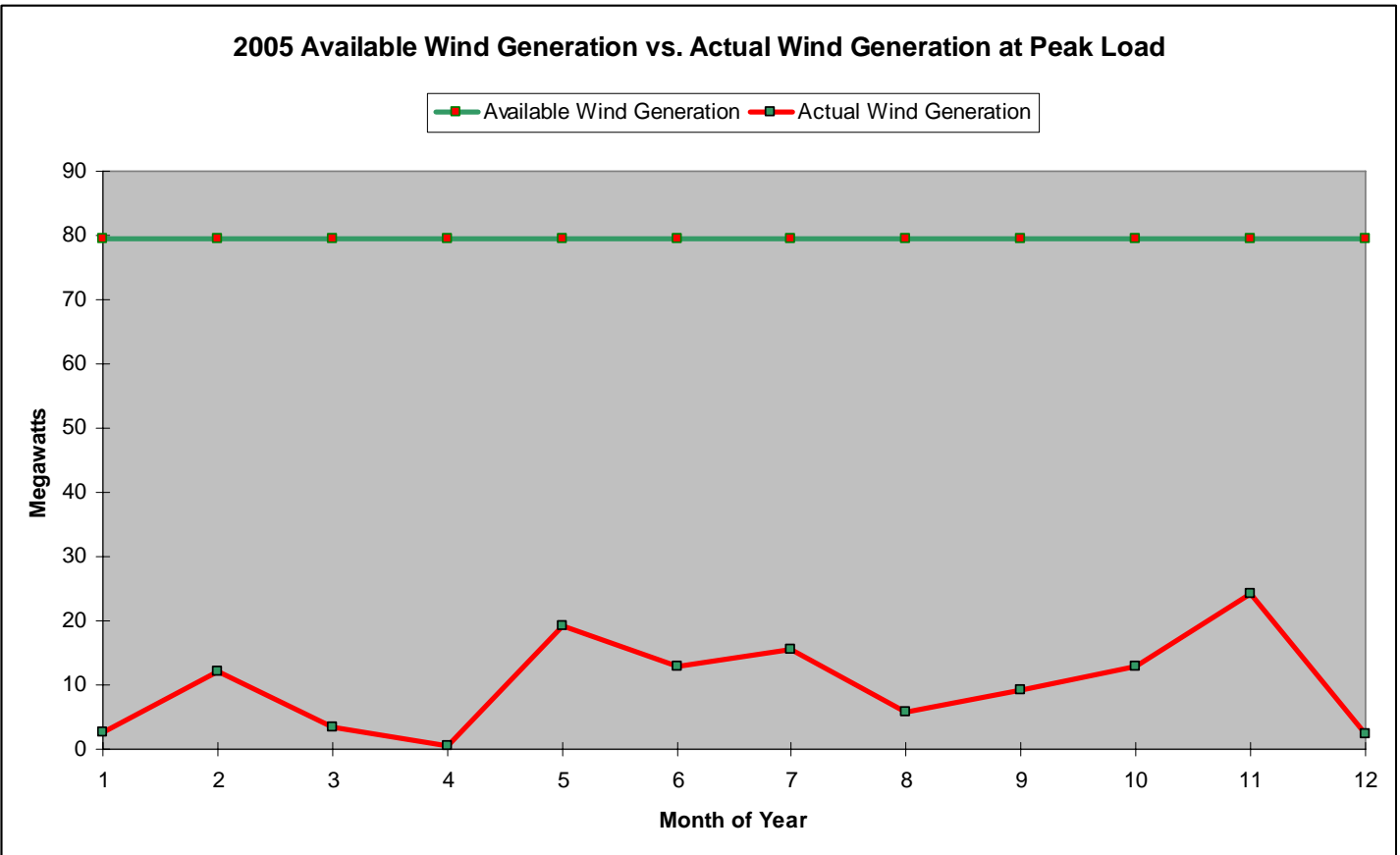
<sup>1</sup> Data obtained from farm A was not consistent in format and omitted from January thru September for accuracy. The ‘jump’ of the green line in the graph below represents capacity in relation to available data.



**Table B**

<b>2005</b>	Control Area Peak Load MW/Day/Hour	Total Wind Capacity at Peak (MW)	Actual Wind Generation at Peak Load (WM)	Percent Wind Generation at Peak Load (%)	Percent Wind Contribution to Load at Peak
January	2867-5-19:00	79.5	2.71	3.4%	0.09%
February	2725-7-19:00	79.5	12.2	15.3%	0.45%
March	2553-14-20:00	79.5	3.5	4.4%	0.14%
April	2339-28-21:00	79.5	0.5	0.6%	0.02%
May	2609-20-16:00	79.5	19.3	24.3%	0.74%
June	2889-22-16:00	79.5	12.8	16.1%	0.44%
July	3320-22-16:00	79.5	15.6	19.6%	0.47%
August	3238-1-16:00	79.5	5.8	7.3%	0.18%
September	2800-8-16:00	79.5	9.16	11.5%	0.33%
October	2445-10-20:00	79.5	12.95	16.3%	0.53%
November	2799-28-18:00	79.5	24.3	30.6%	0.87%
December	3018-7-19:00	79.5	2.3	2.9%	0.08%

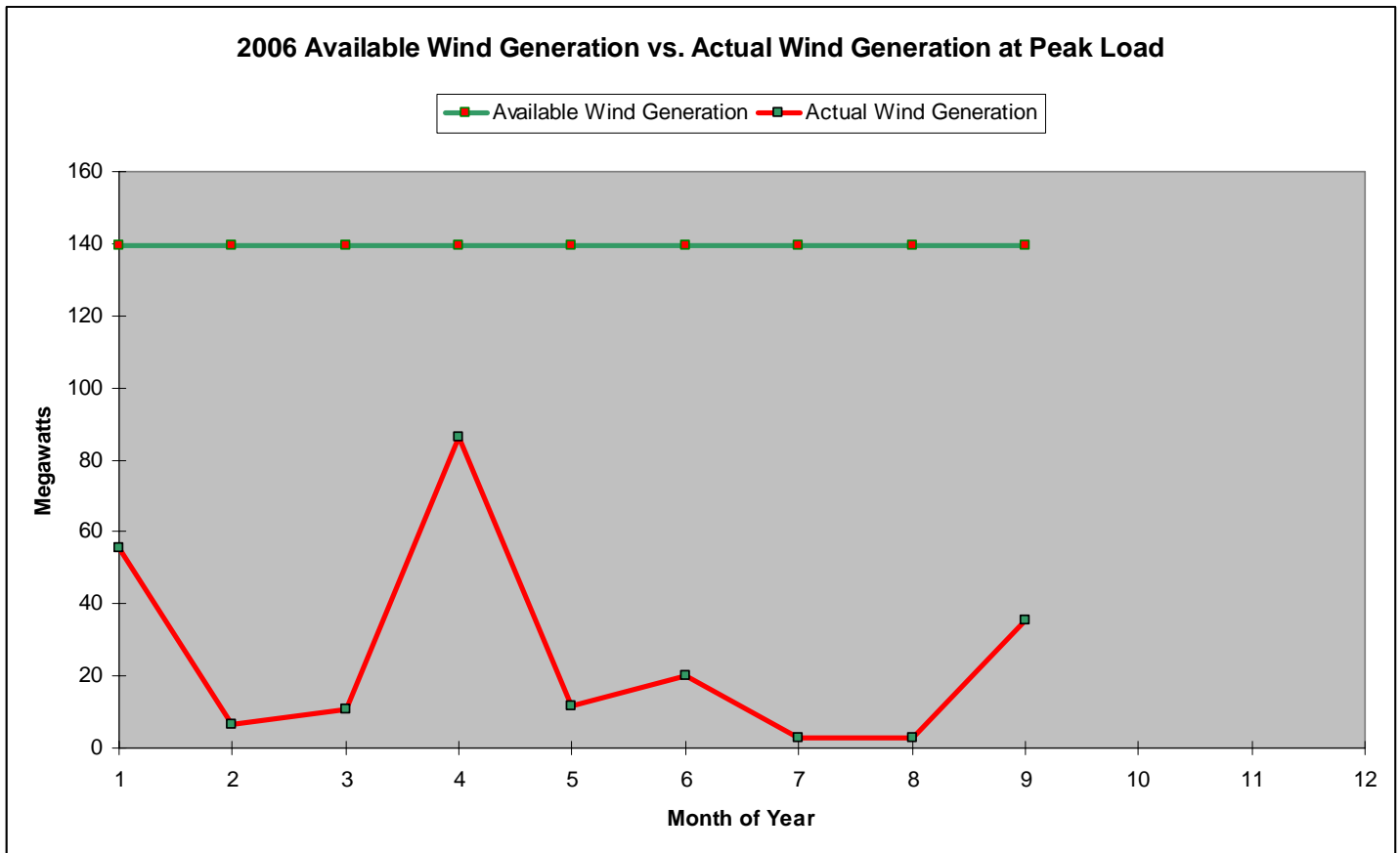
**2005 Available Wind Generation vs. Actual Wind Generation at Peak Load**



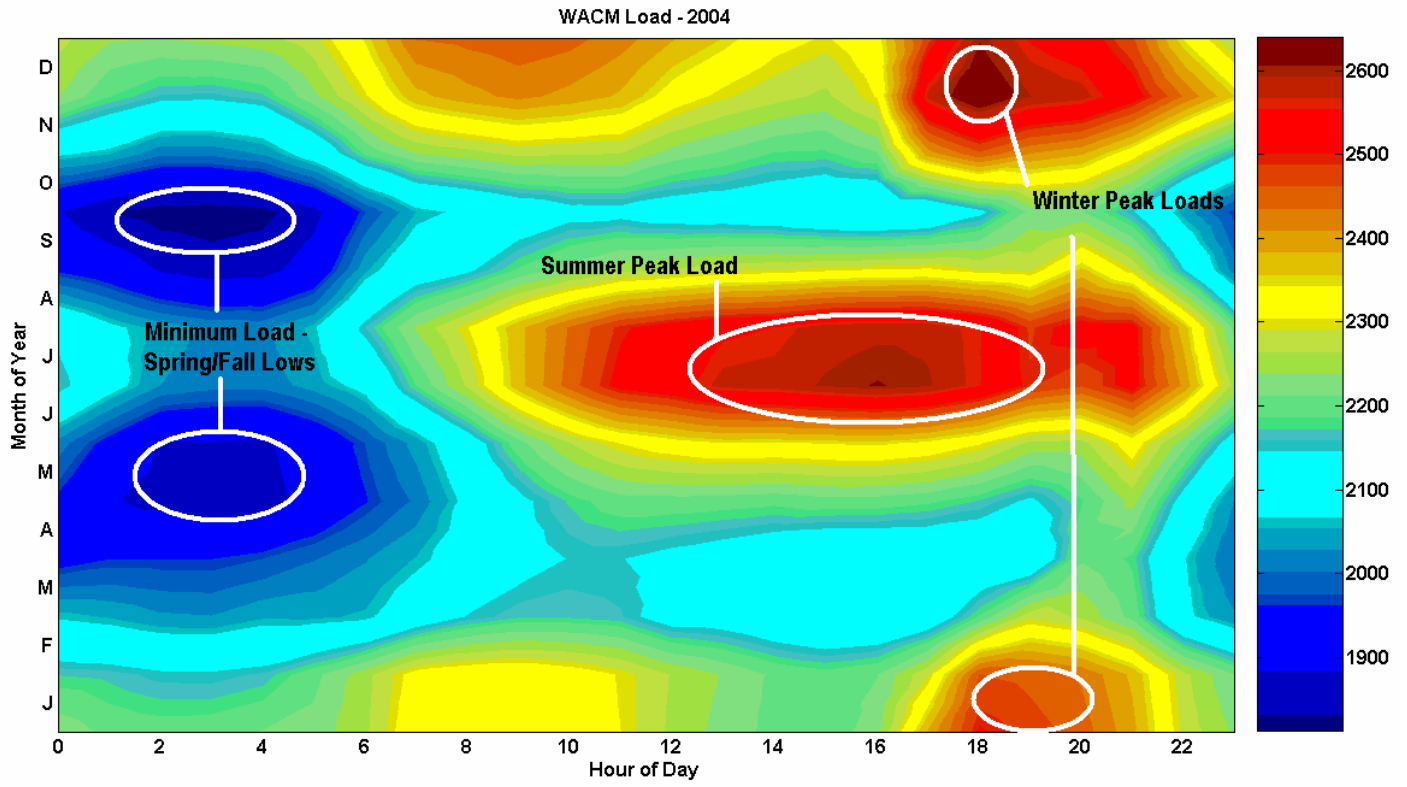
**Table C**

<b>2006</b>	Control Area Peak Load MW-Day-Hour	Total Wind Capacity at Peak (MW)	Actual Wind Generation at Peak Load (WM)	Percent Wind Generation at Peak Load (%)	Percent Wind Contribution to Load at Peak
January	2741-16-19:00	139.5 <sup>2</sup>	55.3	39.6%	2.02%
February	2852-17-19:00	139.5 <sup>2</sup>	6.6	4.7%	0.23%
March	2721-20-20:00	139.5 <sup>2</sup>	10.8	7.7%	0.40%
April	2465-24-21:00	139.5 <sup>2</sup>	86.2	61.8%	3.50%
May	2646-25-17:00	139.5 <sup>2</sup>	11.7	8.4%	0.44%
June	3098-30-16:00	139.5 <sup>2</sup>	19.9	14.3%	0.64%
July	3321-24-16:00	139.5 <sup>2</sup>	2.7	1.9%	0.08%
August	3172-9-16:00	139.5 <sup>2</sup>	2.6	1.9%	0.08%
September	2583-7-17:00	139.5 <sup>2</sup>	35.5	25.4%	1.37%

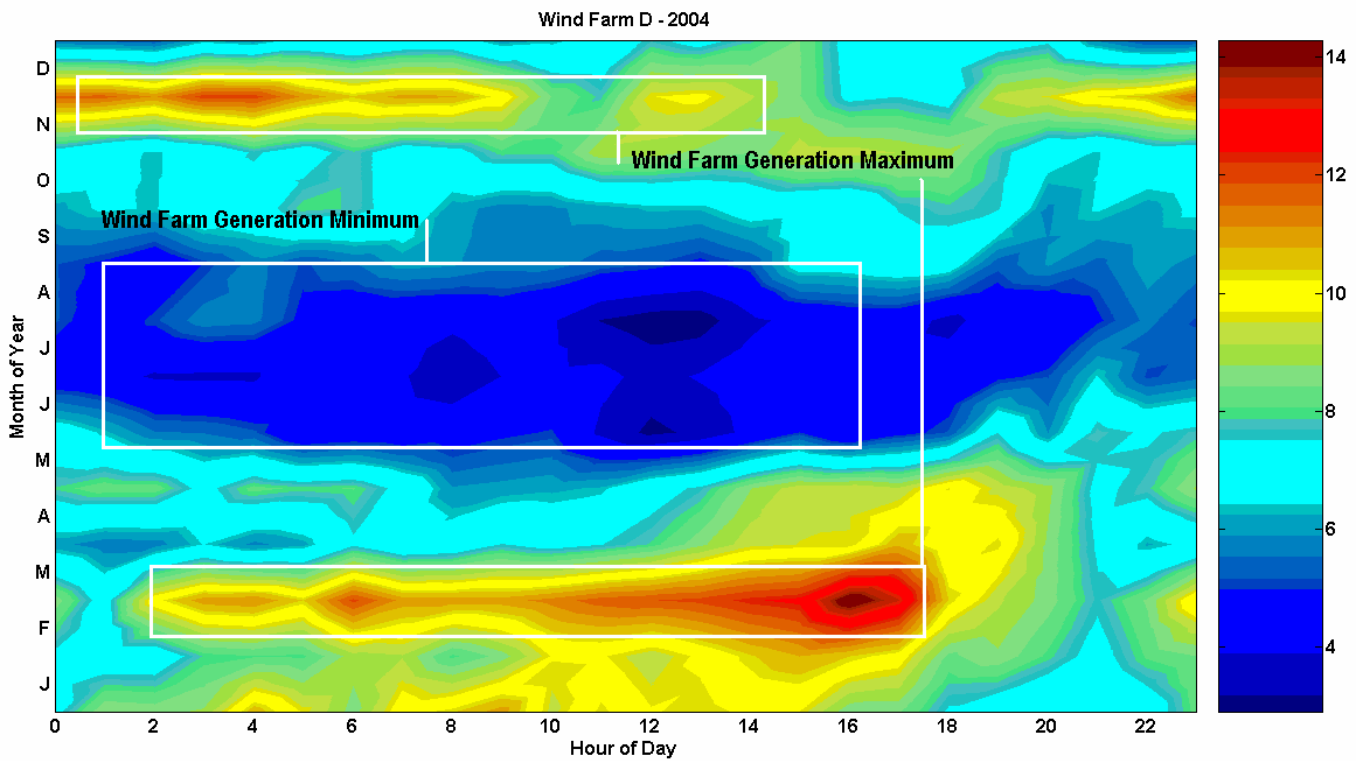
<sup>2</sup> Data from wind farm E was deemed consistent beginning January 2006



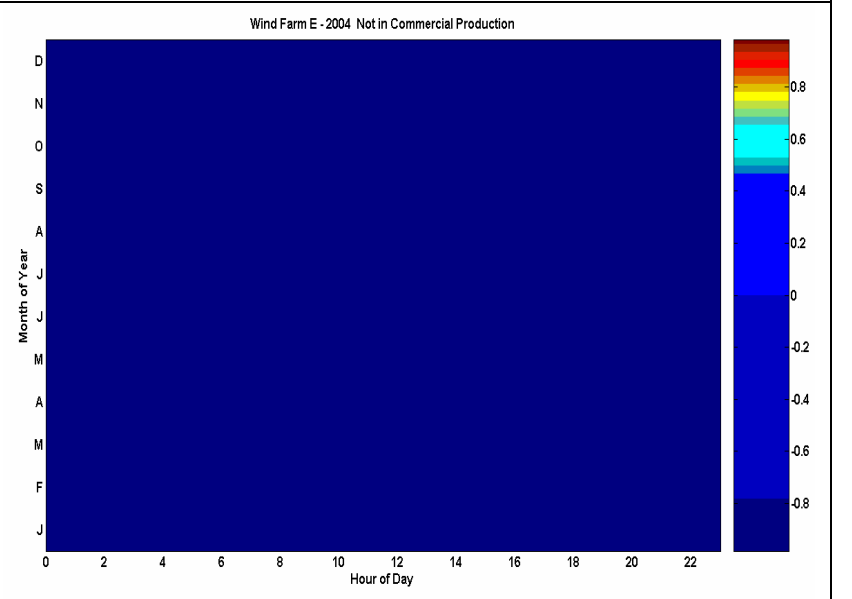
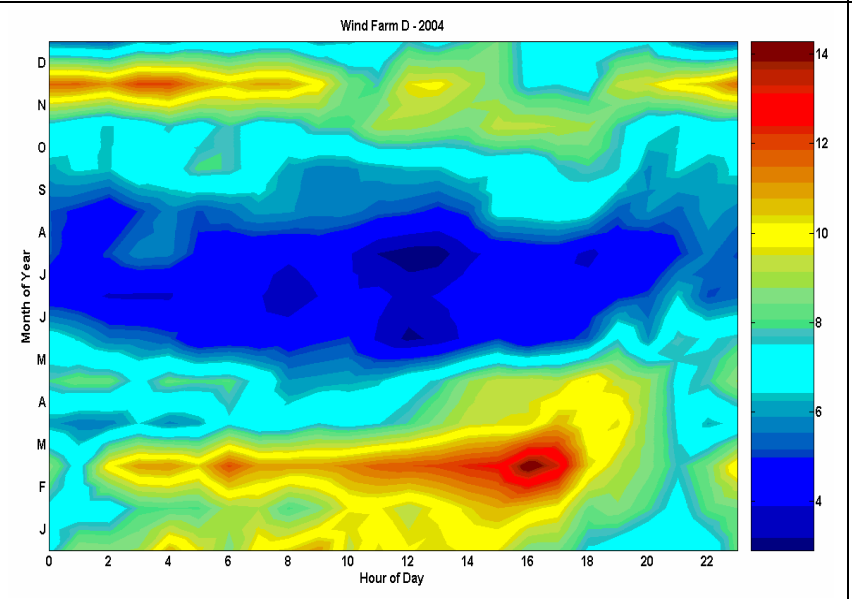
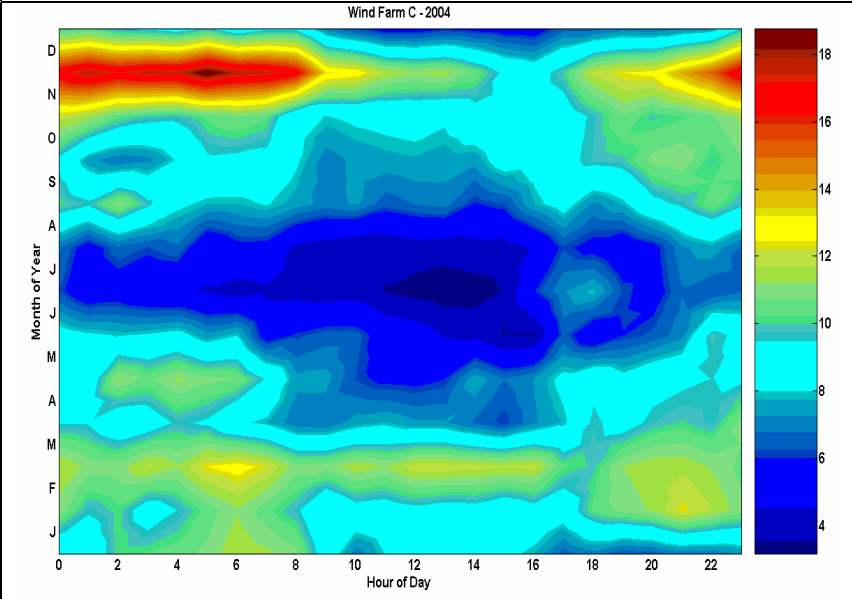
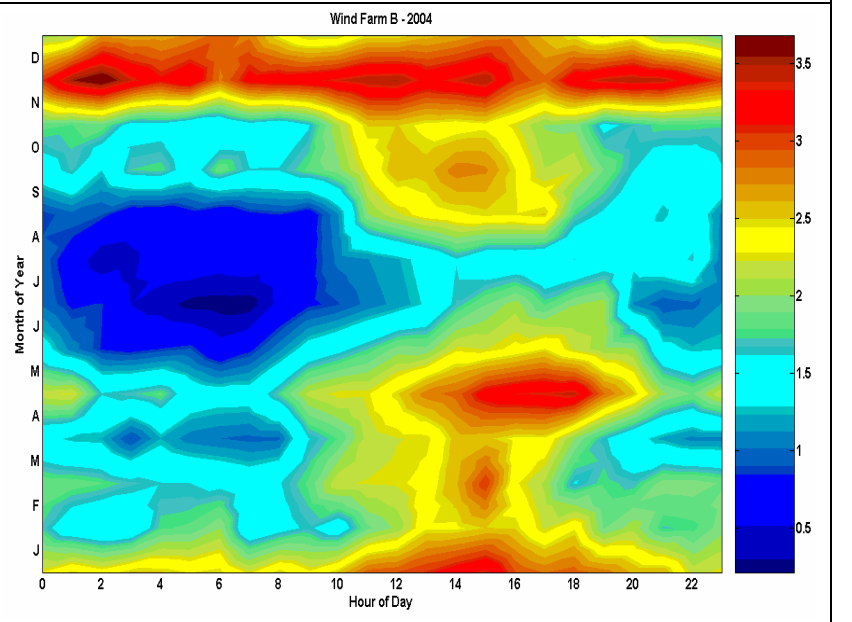
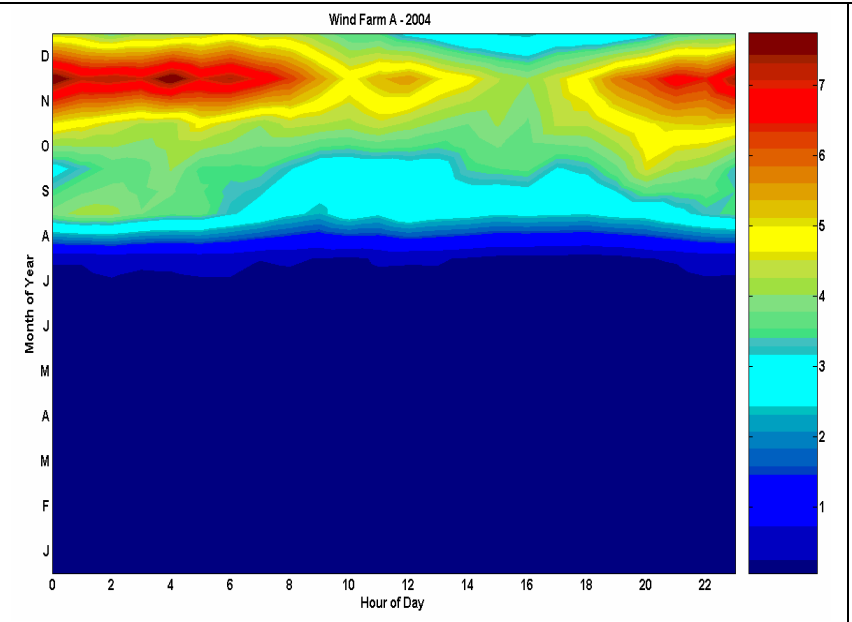
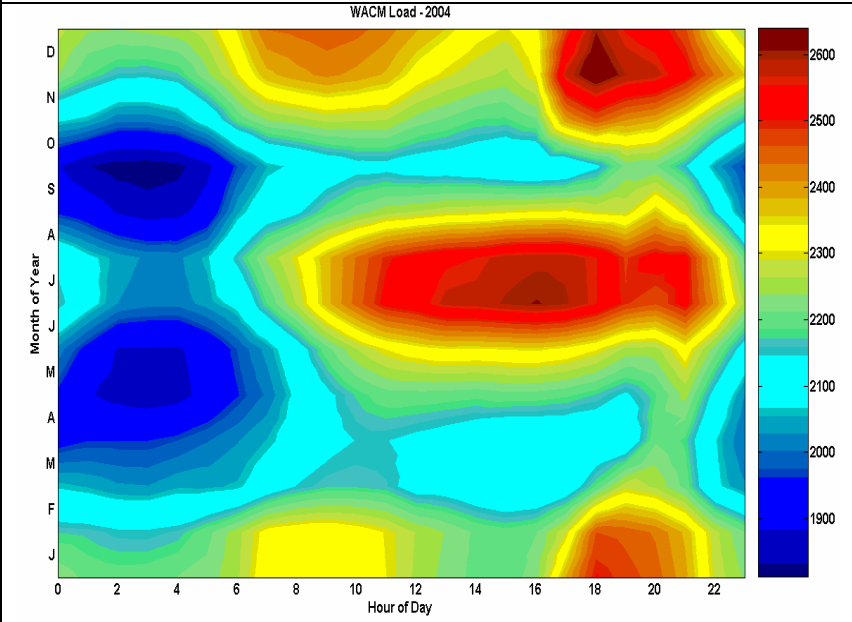
## Interpretation of Load Plots



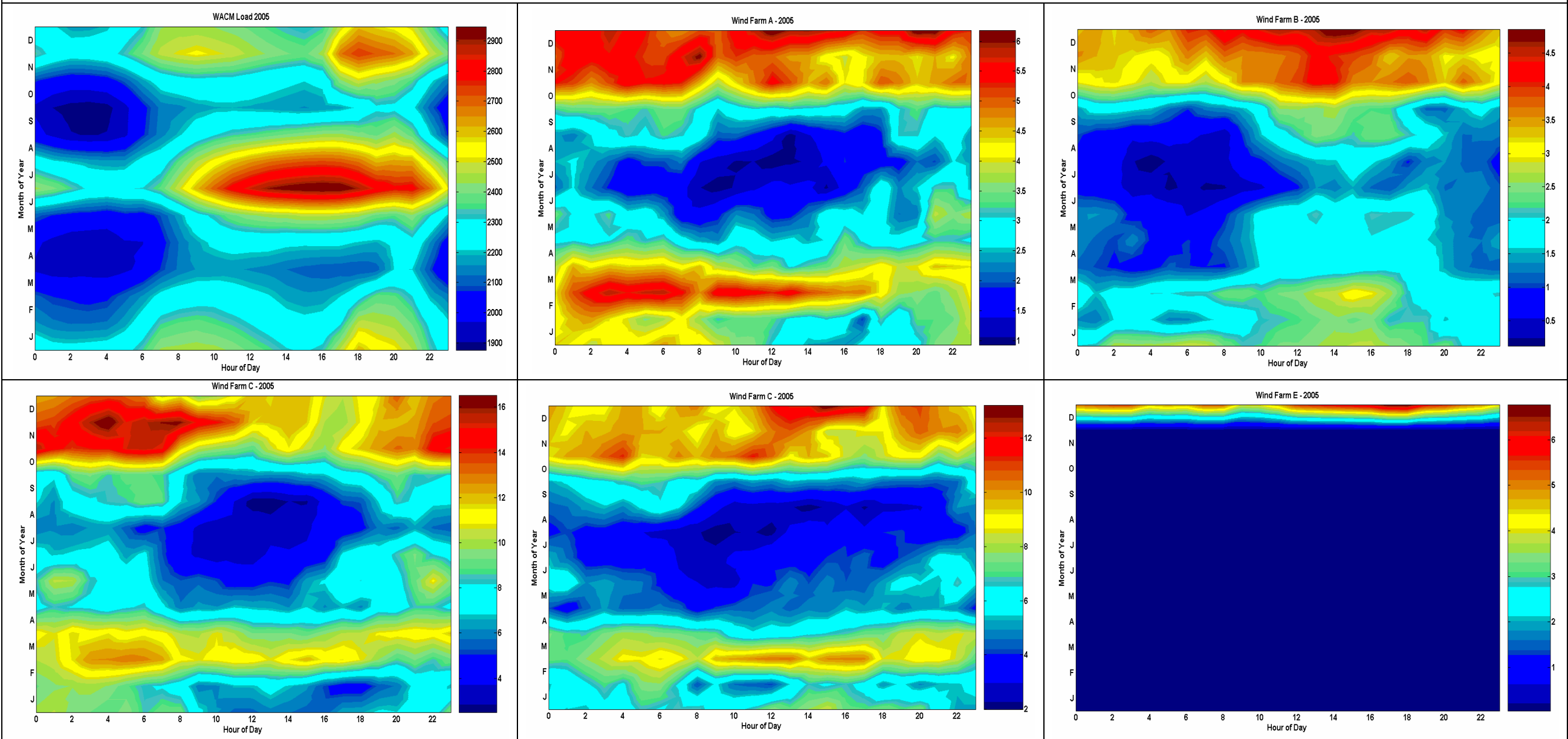
## Interpretation of Generation Plots



# Table D - 2004 WACM Load and Wind Generation Comparison (individual plant output)

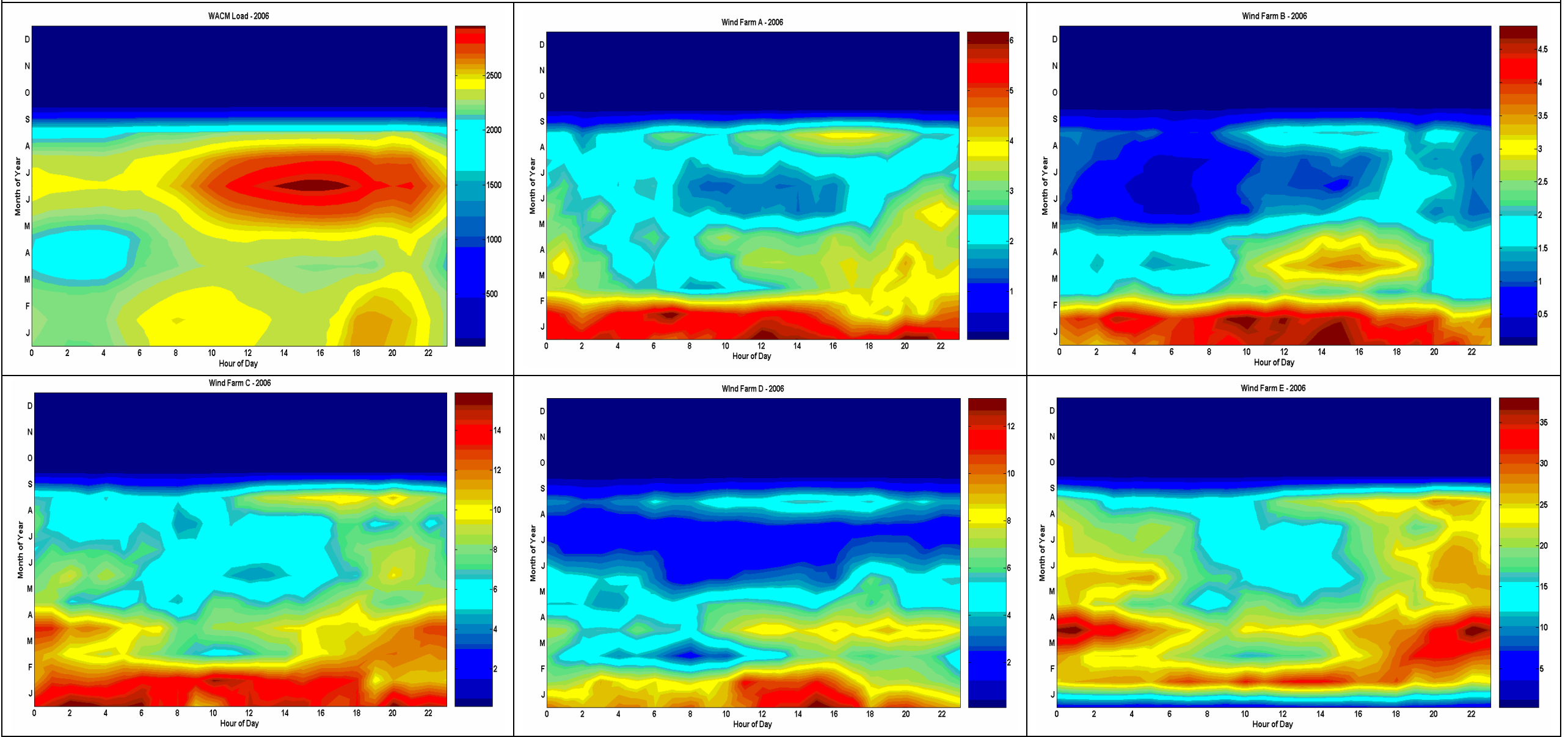


# Table E - 2005 WACM Load and Wind Generation Comparison (individual plant output)





# Table F - 2006 WACM Load and Wind Generation Comparison (individual plant output)



**Table G - 2004 - 2005 - 2006 WACM Load and Wind Generation Comparison (composite plant output)**

