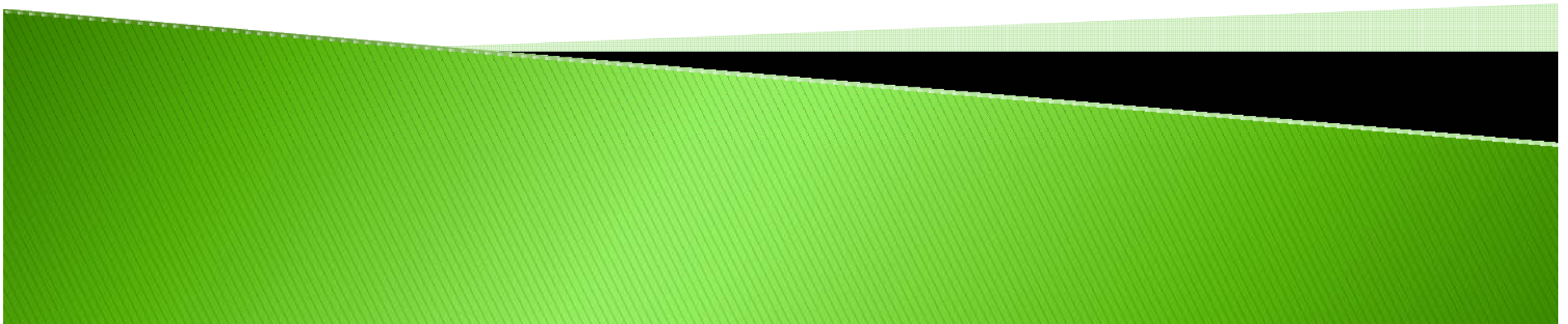


Tenant Metering Applications

Chris Trewartha
Power Application Group Inc.



Background

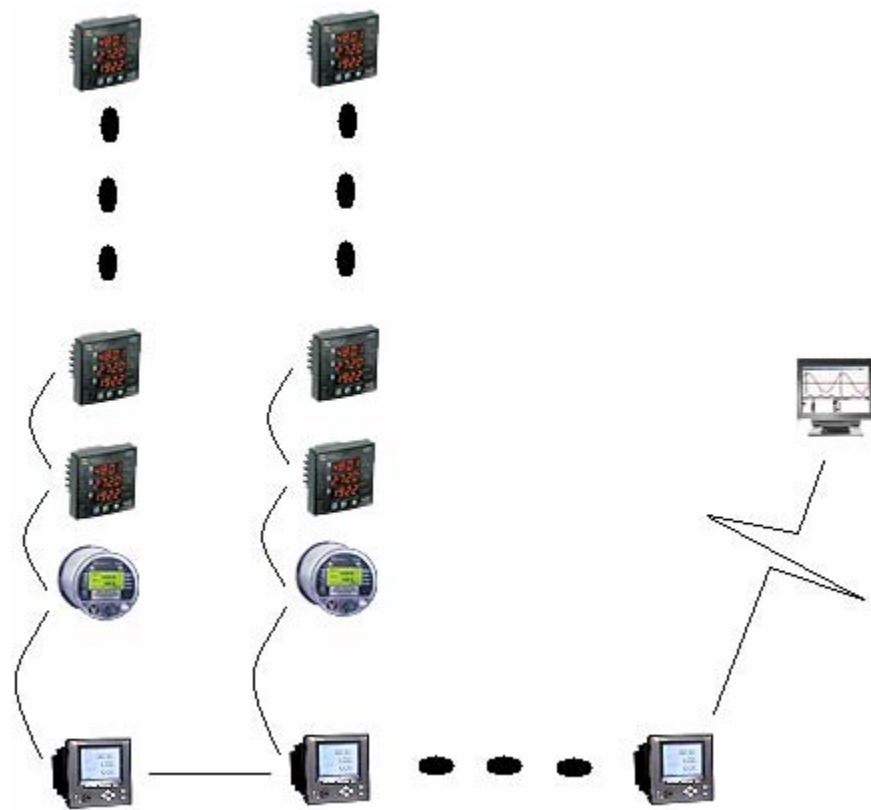
- ▶ 2 towers, 18 floors each
- ▶ 300,000+ square feet in each tower
- ▶ Metering System Progression:
 - Power Quality
 - Disproportionate electricity usage
 - Full sub-metering



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Metering System Architecture

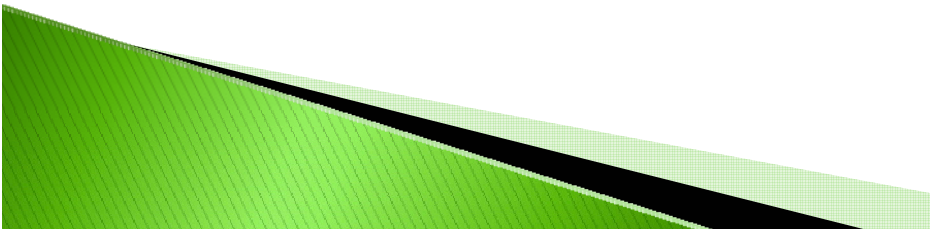


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ION Enterprise's Functions

- ▶ Communicate with meters
 - ▶ Track, trend, and store interval readings
 - ▶ Develop load profiles
 - ▶ Develop consumption reports
 - ▶ Develop cost per square foot reports
-
- ▶ Also used for power quality reports, complete building trending/benchmarking, and energy efficiency verification

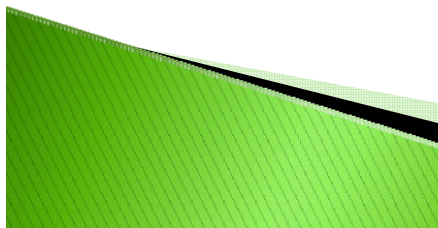


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STATUS**DEMAND****CONSUMPTION**

18		1 kW	6,569 kWh
17		16 kW	47,817 kWh
16		1 kW	51,119 kWh
15		3 kW	46,393 kWh
14		1 kW	7,669 kWh
12		0 kW	19,532 kWh
11		30 kW	140,896 kWh
10		40 kW	156,285 kWh
9		20 kW	129,604 kWh
8		31 kW	160,532 kWh
7		28 kW	136,081 kWh
6		10 kW	63,629 kWh
5		40 kW	137,080 kWh
4		58.0 kW	1,449,996 kWh
3		34 kW	175,990 kWh
2		41.8 kW	1,079,819 kWh



V_{ln} avg : 353.2 V

V_{ll} avg : 611.7 V

V_{ln} A : 352.6 V

V_{ll} AB : 610.4 V

V_{ln} B : 353.6 V

V_{ll} BC : 613.7 V

V_{ln} C : 353.5 V

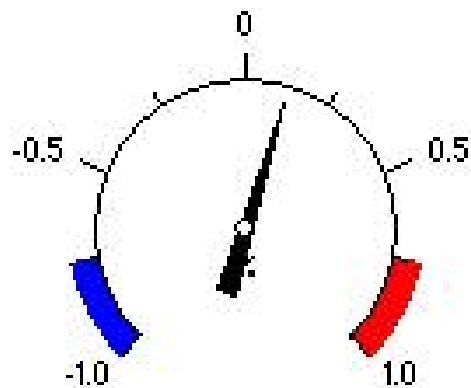
V_{ll} CA : 611.0 V

I avg : 20.6 A

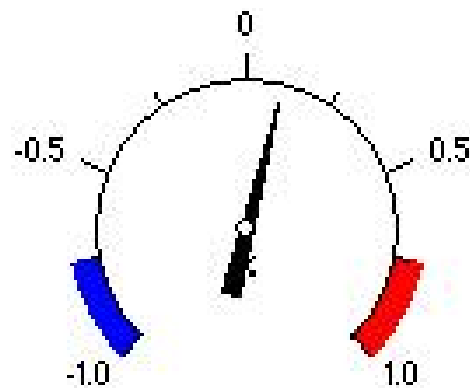
I A : 23.1 A

I B : 22.8 A

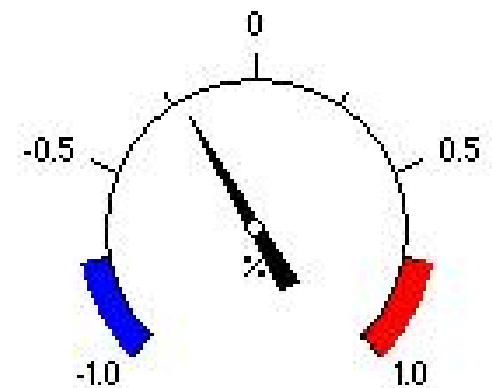
I C : 15.9 A



I A % from avg : 0.1 %

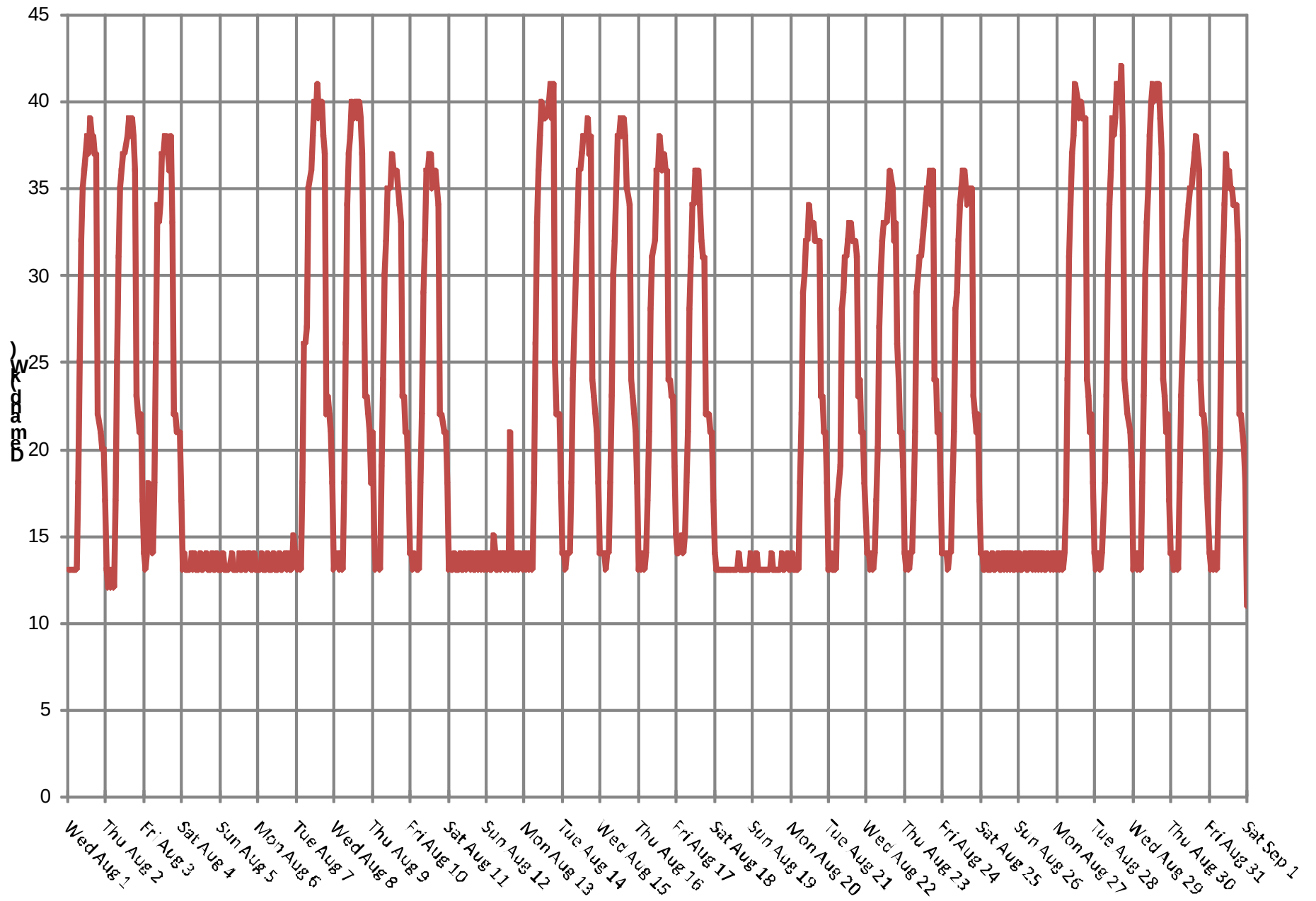


I B % from avg : 0.1 %



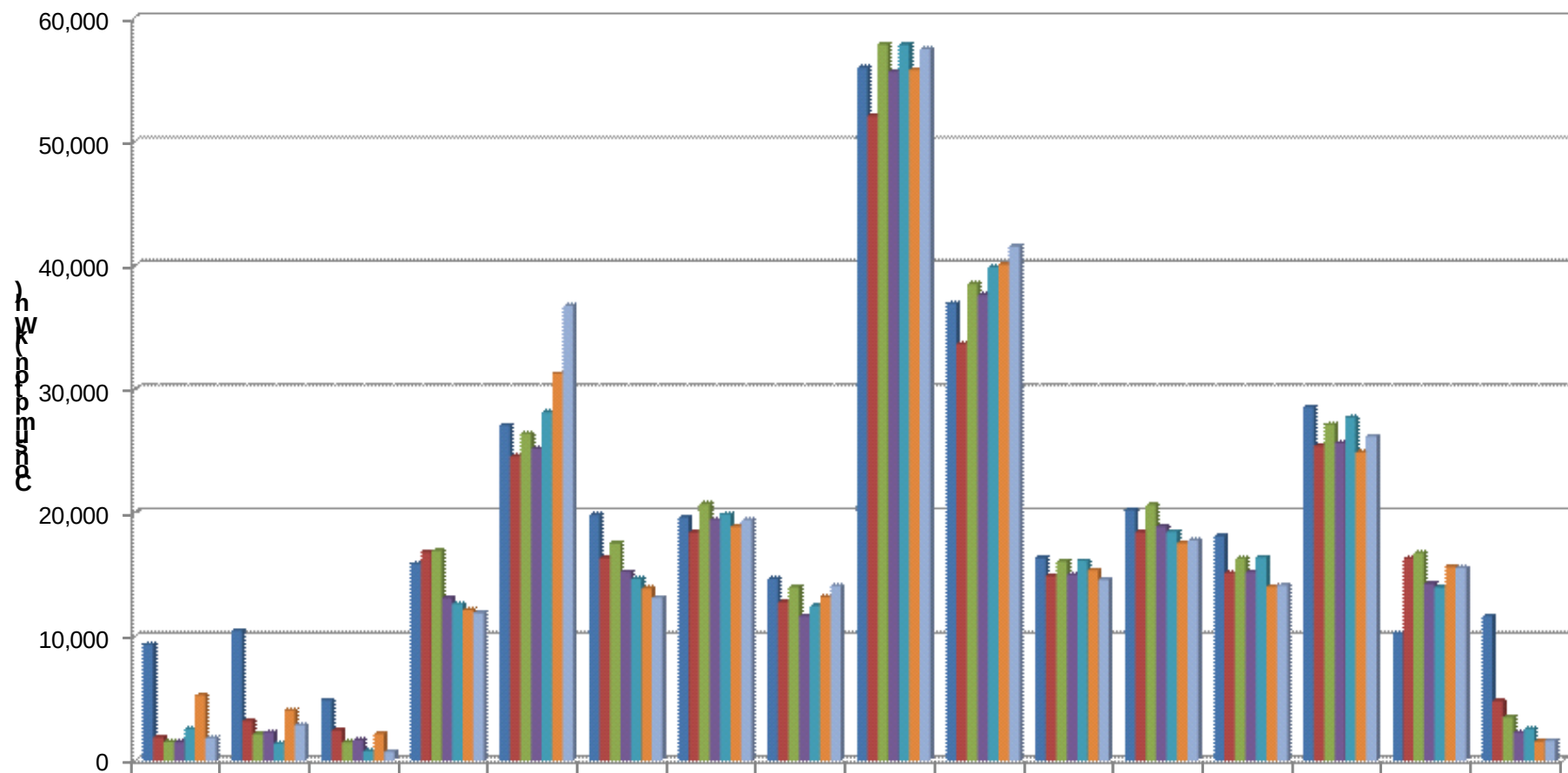
I C % from avg : -0.2 %

Sample Tenant Load Profile



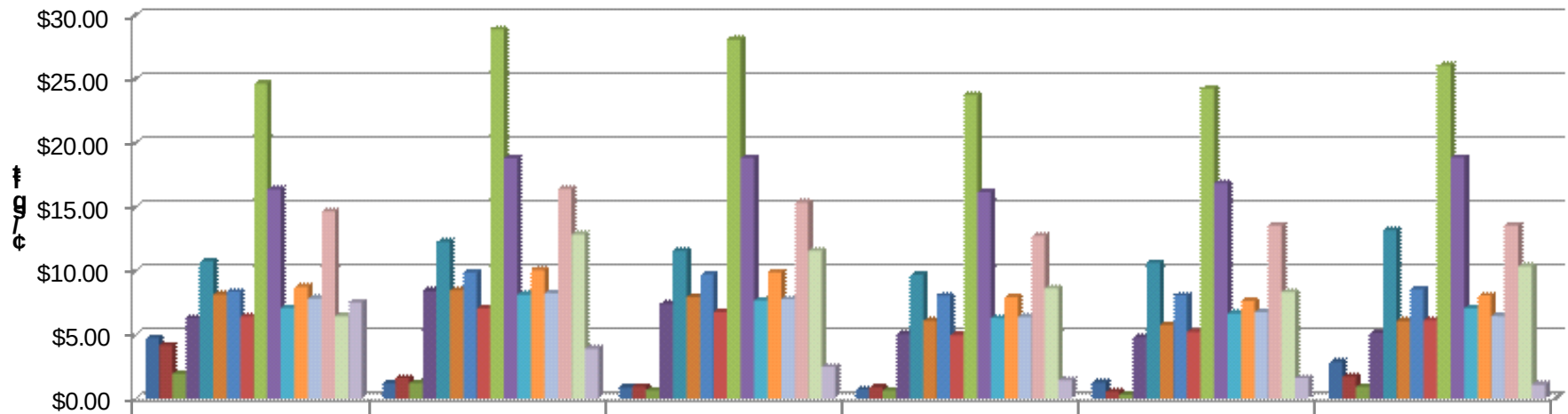
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Sample Consumption Report



	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18
Jan	9,396	10,510	4,863	15,904	27,073	19,823	19,661	14,670	55,976	36,941	16,362	20,243	18,120	28,573	10,301	11,674
Feb	1,883	3,209	2,419	16,829	24,556	16,365	18,412	12,795	52,087	33,670	14,922	18,442	15,150	25,405	16,335	4,805
Mar	1,519	2,134	1,480	16,955	26,401	17,536	20,720	14,014	57,840	38,478	16,091	20,677	16,334	27,175	16,798	3,499
Apr	1,465	2,284	1,664	13,133	25,201	15,258	19,480	11,694	55,647	37,600	15,014	18,912	15,228	25,656	14,282	2,287
May	2,594	1,391	764	12,669	28,115	14,687	19,888	12,510	57,826	39,873	16,147	18,488	16,427	27,702	13,999	2,596
Jun	5,296	4,060	2,161	12,179	31,253	13,917	18,918	13,195	55,800	40,074	15,372	17,570	14,049	24,891	15,636	1,558
Jul	1,823	2,887	722	11,926	36,749	13,156	19,450	14,140	57,468	41,511	14,627	17,783	14,161	26,203	15,584	1,622

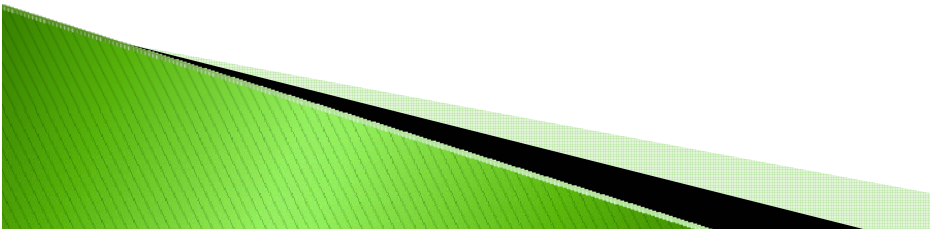
Sample Electricity Cost per Square Foot Report



	Jan	Feb	Mar	Apr	May	Jun
2	4.76 ¢/sq ft	1.20 ¢/sq ft	0.85 ¢/sq ft	0.72 ¢/sq ft	1.25 ¢/sq ft	2.85 ¢/sq ft
3	4.17 ¢/sq ft	1.60 ¢/sq ft	0.93 ¢/sq ft	0.88 ¢/sq ft	0.53 ¢/sq ft	1.71 ¢/sq ft
4	1.93 ¢/sq ft	1.21 ¢/sq ft	0.65 ¢/sq ft	0.64 ¢/sq ft	0.29 ¢/sq ft	0.91 ¢/sq ft
5	6.30 ¢/sq ft	8.40 ¢/sq ft	7.41 ¢/sq ft	5.05 ¢/sq ft	4.79 ¢/sq ft	5.13 ¢/sq ft
6	10.73 ¢/sq ft	12.26 ¢/sq ft	11.55 ¢/sq ft	9.68 ¢/sq ft	10.62 ¢/sq ft	13.15 ¢/sq ft
7	8.13 ¢/sq ft	8.45 ¢/sq ft	7.93 ¢/sq ft	6.07 ¢/sq ft	5.74 ¢/sq ft	6.06 ¢/sq ft
8	8.35 ¢/sq ft	9.85 ¢/sq ft	9.71 ¢/sq ft	8.02 ¢/sq ft	8.05 ¢/sq ft	8.53 ¢/sq ft
9	6.40 ¢/sq ft	7.03 ¢/sq ft	6.75 ¢/sq ft	4.95 ¢/sq ft	5.20 ¢/sq ft	6.11 ¢/sq ft
10	24.61 ¢/sq ft	28.86 ¢/sq ft	28.07 ¢/sq ft	23.73 ¢/sq ft	24.25 ¢/sq ft	26.05 ¢/sq ft
11	16.35 ¢/sq ft	18.78 ¢/sq ft	18.80 ¢/sq ft	16.14 ¢/sq ft	16.83 ¢/sq ft	18.84 ¢/sq ft
12	7.06 ¢/sq ft	8.11 ¢/sq ft	7.66 ¢/sq ft	6.28 ¢/sq ft	6.65 ¢/sq ft	7.05 ¢/sq ft
14	8.74 ¢/sq ft	10.03 ¢/sq ft	9.85 ¢/sq ft	7.92 ¢/sq ft	7.61 ¢/sq ft	8.05 ¢/sq ft
15	7.81 ¢/sq ft	8.23 ¢/sq ft	7.77 ¢/sq ft	6.37 ¢/sq ft	6.75 ¢/sq ft	6.43 ¢/sq ft
16	14.62 ¢/sq ft	16.38 ¢/sq ft	15.34 ¢/sq ft	12.73 ¢/sq ft	13.51 ¢/sq ft	13.52 ¢/sq ft
17	6.42 ¢/sq ft	12.82 ¢/sq ft	11.55 ¢/sq ft	8.63 ¢/sq ft	8.32 ¢/sq ft	10.35 ¢/sq ft
18	7.50 ¢/sq ft	3.89 ¢/sq ft	2.48 ¢/sq ft	1.42 ¢/sq ft	1.59 ¢/sq ft	1.06 ¢/sq ft

Results

- ▶ Tenants pay true cost for electricity
- ▶ Minimal human resources required
 - Remote monitoring and meter readings
 - Automatic report generation
- ▶ Trending / benchmarking
- ▶ Encourages energy conservation



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