Role of performance tools in green buildings

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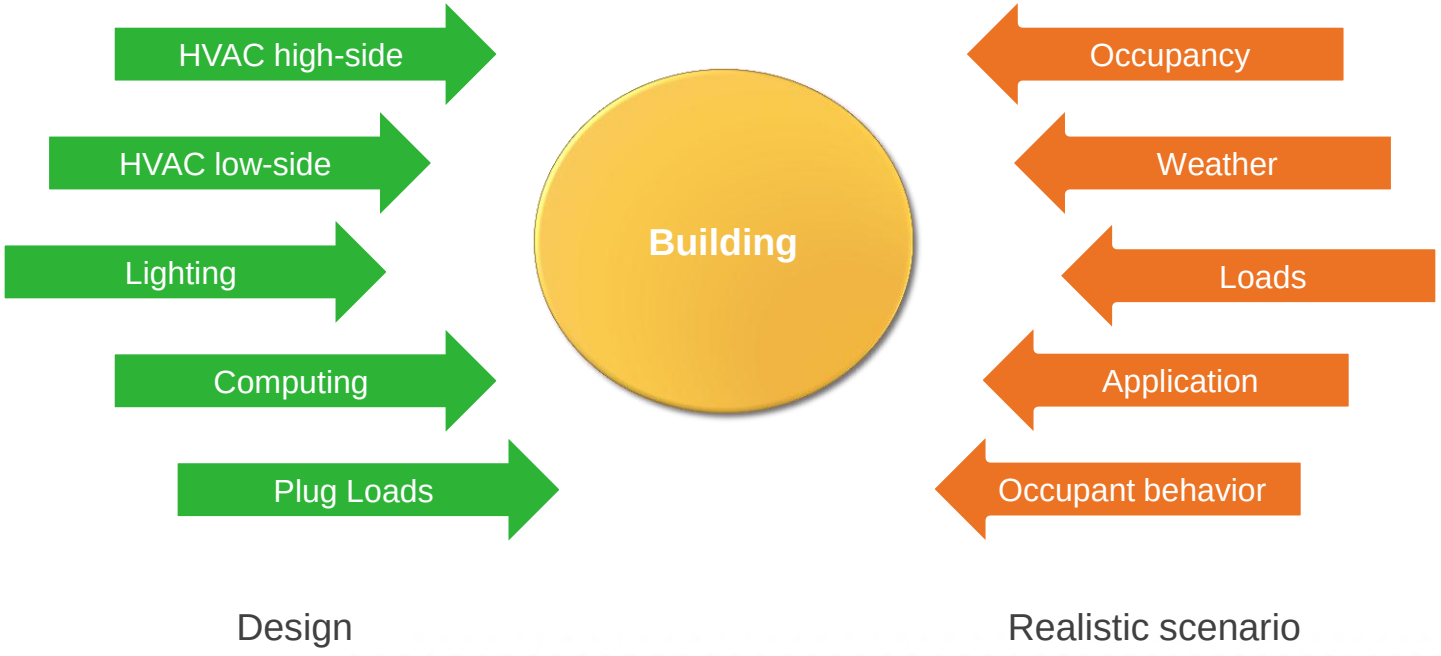
The realistic buildings scenario



This brings us to the next set of inquisitions (or opportunities)

- Are we taking benefit of,
  - Lower than design occupancy
  - Favorable outside temperatures
  - Favorabl
  - Bright da
- Are we e
- Are our equipments operating at design efficiencies through out the life of the building ?
- Are we making all systems work efficiently to deliver only as much as required ?
- Are we measuring and validating actual vs. design ?
- Are we delivering the best indoor air quality ?
- Are we maintaining our equipments right ?

Performance Measurement and control is the solution

How performance measurement and control can help improve building performance ?

1. Continuous Measurement and verification, continuous auditing

Design vs. Actual

Floor	Design Kw	Design Kw/Tr	Actual Kw	%	Actual ikw/Tr.	Kwh Today	% Today	Kwh Y Day	Kwh MTD	Mwh YTD
HVAC COMFORT										
Chiller - 1	252.0	0.48	0.7	0	0.00	97	3	1852	10182	27.70
Chiller - 2	271.0	0.51	122.0	45	0.56	1403	38	18	29676	31.64
LT CHW Pumps	44.0	0.04	8.9	3	0.04	201	5	313	4686	6.10
MT CHW Pumps	60.0	0.10	41.1	15	0.18	714	19	792	17286	48.73
CDW Pumps	60.0	0.06	15.0	5	0.06	231	6	292	4293	5.72
Cooling Towers	60.0	0.06	0.0	0	0.00	21	1	31	1364	2.79
DOAS's	74.0	0.14	51.8	19	0.00	699	19	1097	18213	81.75
HRW's	18.6	0.04	15.9	6	0.00	284	0	352	7604	29.13
Exhaust & Vent. Fans	14.7	0.03	17.6	6	0.00	338	9	351	7510	33.45
Total			273.5	100		3720	100	5098	100814	359.68

Measure energy as well as efficiency for UPS

- UPS energy
- UPS efficiency
- % Load

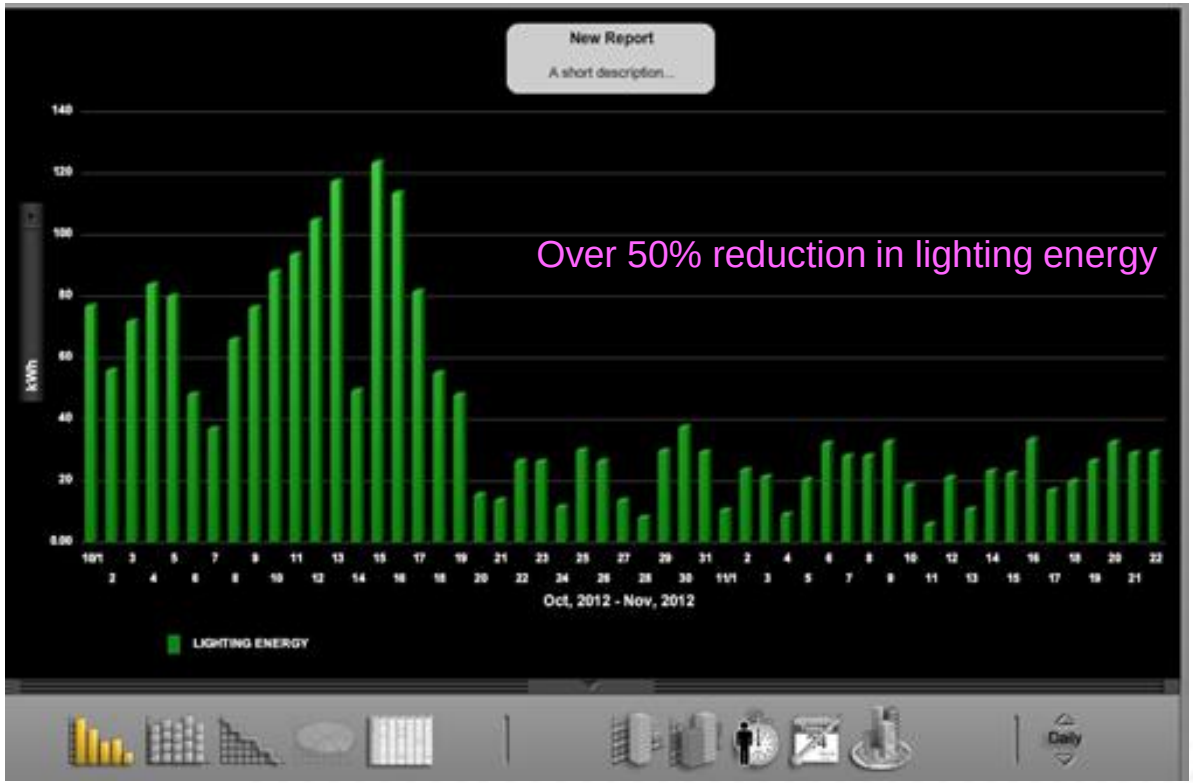
Parameters	UPS - 1 30kVA	UPS - 2 30kVA	UPS - 1 120kVA	UPS - 2 120kVA	UPS - 3 120kVA
Input Kw	3.4	3.4	40.9	40.8	40.8
Output Kw	2.6	2.7	39.5	39.1	39.1
Average Input PF	0.85	0.85	0.85	0.85	0.85
Average Output PF	0.00	0.00	0.87	0.89	0.89
Output KVA	2.6	2.7	44.0	43.5	43.0
% Load	8.7	9.0	36.7	36.3	35.8
% Efficiency	75.4	78.6	96.6	95.9	95.9
Battery Remaining Time (HR:MM)	6:19	6:14	0:33	0:34	0:34

2. Eliminating wastage by managing detail – for lighting, computing and plug loads

Trivandrum SDB-2 - Floor Energy Summary
Lighting, Fans, UPS & Rawpower

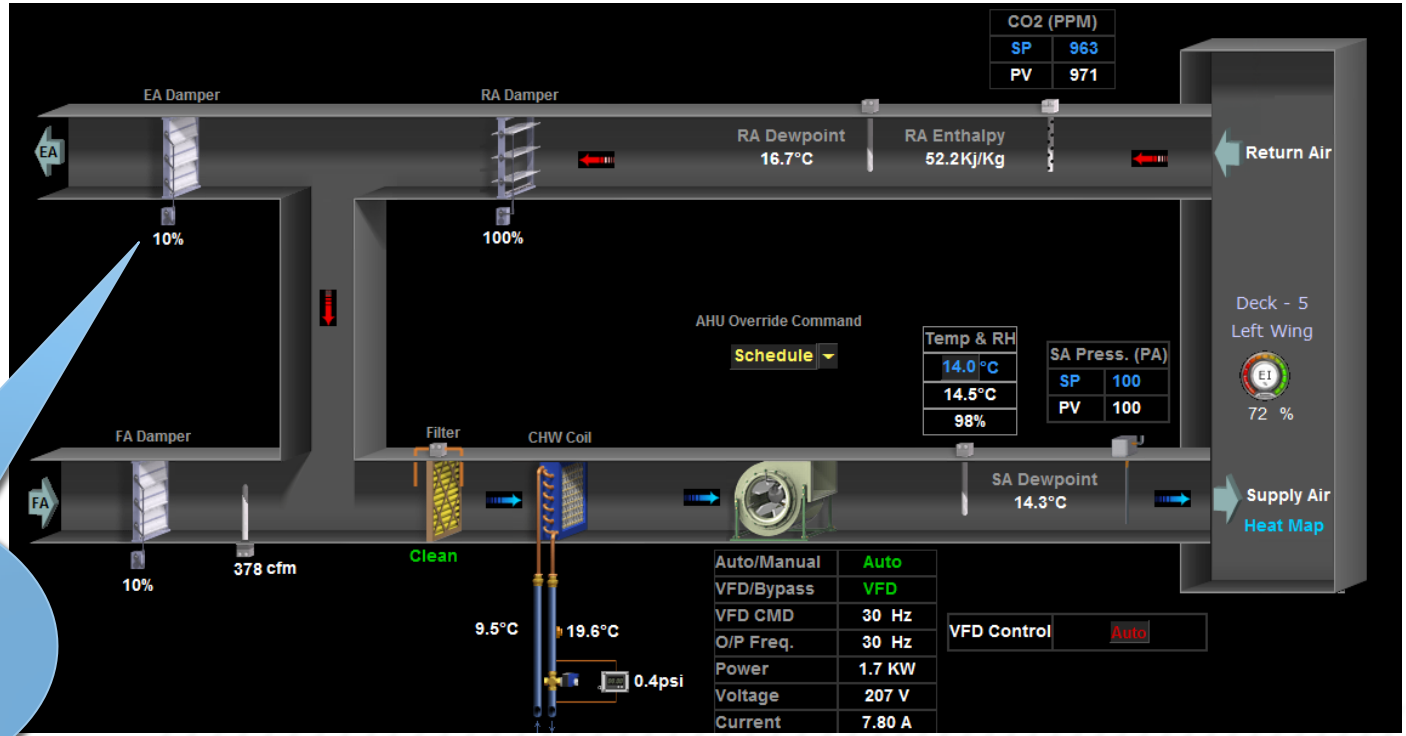
	Lighting		Fans		UPS			Raw Power	
Floor	Inst. kW	Target kW Unocc Mode	Inst. kW	Target kW Unocc Mode	Inst. kW	Target kW Unocc Mode	No. of PC's ON	Inst. kW	Target kW Unocc Mode
Deck 0	2.6	0.0	0.0	0.0	2.7	2.0	27	0.1	1.0
Deck 1	3.7	1.0	0.1	0.0	5.9	3.0	59	0.6	0.0
Deck 2	3.7	0.0	0.1	0.0	6.1	2.0	61	0.0	0.0
Deck 3	4.1	0.0	0.1	0.0	8.4	3.0	50	0.0	0.0
Deck 4	5.7	0.0	0.1	0.0	6.5	4.0	62	3.3	2.0
Deck 5	3.5	0.0	1.2	2.0	5.3	0.0	53	2.1	2.0
Deck 6	5.0	1.0	0.3	0.0	5.8	2.0	58	0.0	0.0
Total	28.2		2.0		40.6		369	6.2	

2. Eliminating wastage by managing detail – for lighting, computing and plug loads



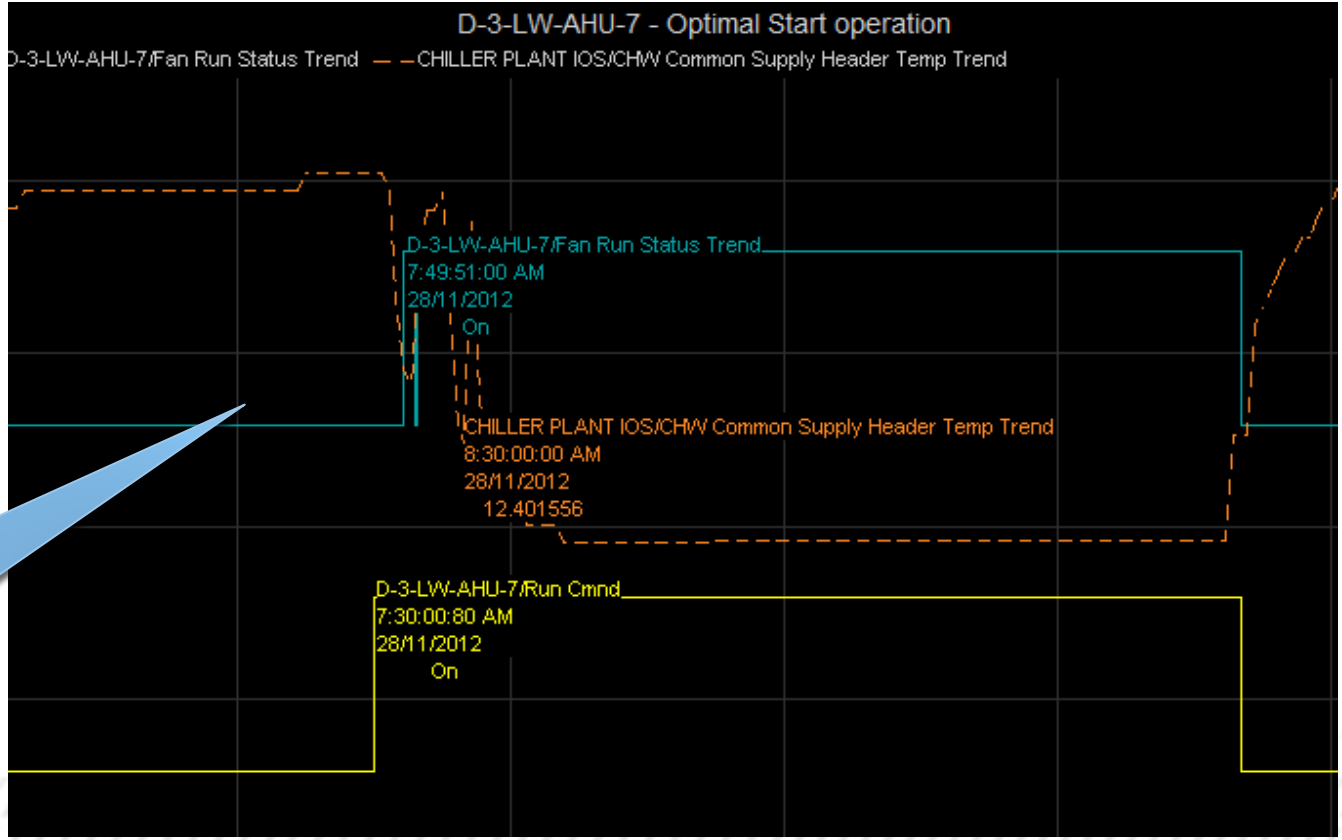
Over 50% reduction in lighting energy

3. Use automated energy saving strategies/logics
– Demand Controlled Ventilation (taking benefit of changing occupancy)



Fresh Air and Exhaust Air dampers are only 10% open as CO2 in limits

3. Use automated energy saving strategies/logics
– Optimal Start for AHUs



AHU started 20 mins after chiller. 5% saving in AHU run hours

5. Provides data to optimize future building designs

Electrical engineers love this data ! It helps them design their buildings more optimally

Equipments	Inst. watt / Sqft	Current Year Peak Value	Current Year Peak Time
HVAC - High Side	0.03	1.16	7:39 AM 4/9/2012
HVAC - Low Side	0.04	0.30	8:05 AM 3/10/2012
HVAC - CRITICAL	0.07	0.22	6:10 PM28/10/2012
Lighting	0.13	0.20	6:37 PM 6/11/2012
Fans	0.03	0.05	10:13 AM 7/8/2012
Raw Power	0.04	0.12	6:06 PM 27/10/2012
UPS - Work Station	0.56	0.70	3:16 PM 25/9/2012
UPS - Server	0.03	0.04	9:49 AM 16/11/2012
Misc.	0.00	0.85	1:45 PM11/10/2012
Total	0.95	2.32	12:32 PM27/11/2012
SDB-2 Main Incomer	0.92	1.37	2:46 PM29/11/2012

6. Allow equipment and system level diagnostics and correction

Example here shows chiller heat exchanger efficiencies being monitored through measurements

7. Manage water efficiency

Hourly and daily water consumption data

Hourly Consumption (Liters)			
10/12/2012	Water Meter-1	Water Meter-2	Total
Current Demand (L/Hr.)	2500	100	2600
0 - 1Hrs.	1259	133	1392
1 - 2Hrs.	102	100	202
2 - 3Hrs.	104	102	206
3 - 4Hrs.	108	100	209
4 - 5Hrs.	110	102	213
5 - 6Hrs.	120	99	219
6 - 7Hrs.	119	105	224
7 - 8Hrs.	159	104	262
8 - 9Hrs.	737	124	862
9 -10Hrs.	1753	111	1864
10 - 11Hrs.	2452	126	2578
11 - 12Hrs.	561	27	588
12 - 13Hrs.	0	0	0
13 - 14Hrs.	0	0	0
14 - 15Hrs.	0	0	0
15 - 16Hrs.	0	0	0
16 - 17Hrs.	0	0	0
17 - 18Hrs.	0	0	0
18 - 19Hrs.	0	0	0
19 - 20Hrs.	0	0	0
20 - 21Hrs.	0	0	0
21 - 22Hrs.	0	0	0

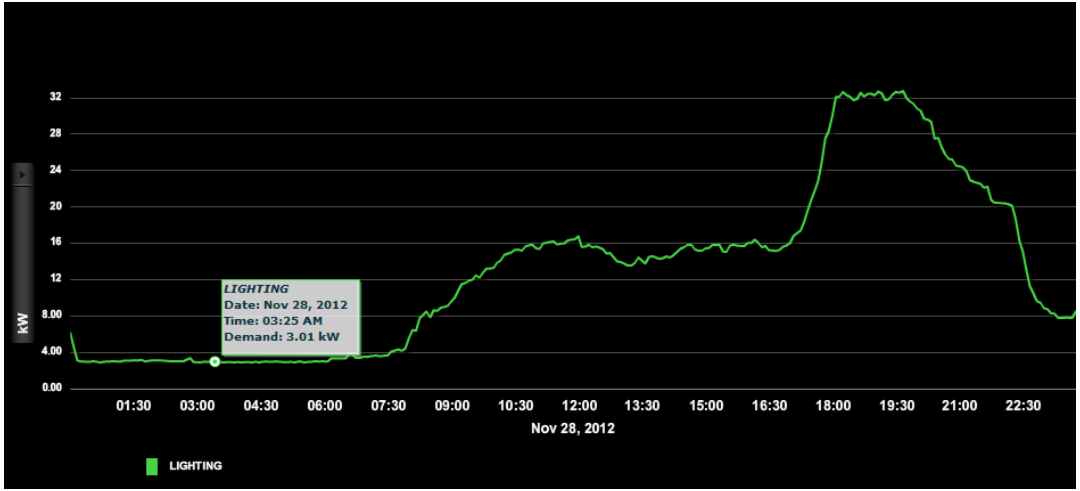
Date: 10/12/2012
Time:11:16:03 AM

Daily per Capita		1200	
Dec	Water Meter-1	Water Meter-2	Total
Day - 1	4.43	2.12	6.56
Day - 2	8.60	2.11	10.72
Day - 3	25.09	2.16	27.26
Day - 4	23.86	2.24	26.11
Day - 5	28.11	2.23	30.34
Day - 6	23.92	2.20	26.13
Day - 7	22.73	2.23	24.97
Day - 8	3.49	2.13	5.63
Day - 9	11.70	2.08	13.79
Day - 10	5.45	1.01	6.48
Day - 11	0.00	0.00	0.00
Day - 12	0.00	0.00	0.00
Day - 13	0.00	0.00	0.00
Day - 14	0.00	0.00	0.00
Day - 15	0.00	0.00	0.00
Day - 16	0.00	0.00	0.00
Day - 17	0.00	0.00	0.00

8. Enables trending and data analytics

- Trends allow us to verify performance of our systems and control intelligence :

- Identifying wastage
- Chiller loading
- AHU valve performance
- AHU VFD performance
- Demand control ventilation
- Economizer mode performance
- Optimal start performance
- Chiller efficiency performance
- Chiller VFD performance
- Cooling tower wet bulb vs. approach performance



Q & A

Thank you

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