

The Energy Challenge

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BBBD – 2010

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The Energy Challenge

How can we improve if we don't know how well we are doing?

The Energy Challenge

How can we improve if we don't know how well we are doing?



The Energy Challenge

How can we improve if we don't know how well we are doing?

How can we claim to be “green” if we don't know how well we are doing?

The Energy Challenge

- Collect energy data from your projects
- Look at it
- Learn from it
- Share it!

The Energy Challenge

- Collect data
- Look at it
- Learn
- Share it! ***Warts and all!***



The Energy Challenge

Maclay Architects Commitment:

- Track energy use of all projects
- Feedback to whole design team to compare actual to projection
- Feedback to owners on how their building is performing
- Compare to other buildings, from EIA benchmark to high performance to Architecture 2030 Challenge

Collect data – Basic Building stats

- Building Name
- Location, city, state and zip
- Total building conditioned sq ft

Collect data – Basic Energy Data

- 12 months usage -- all sources
- ccf natural gas
- gallons oil
- gallons propane
- kWh electricity (all sources)
- cords wood
- tons wood chips
- tons wood pellets

Collect the data – Basic

ENERGY USAGE DATA		Total Square Footage
	Occupancy	
Yestermorrow School (rehab)	office/classroom/shop	10,210
TVRA Rent-all	office/warehouse	10,020
Phantom Labs, phase 1	office/manufacturing	7,300
Maclay Offices	offices	2,568
NRG 1	office/manuf./warehouse	46,500
NRG 2	office/manuf./warehouse	31,000
Bennington Downtown Office	offices	22,000
Burlington Cohousing	multi-family	26,450
Waterfront Housing	multi-family	45,000
Evergreen Place	elderly housing	17,240
Shapiro 1988 house	single family	1,800
Ellingwood CoHo	single family	1,800
Wilmerding Residence	single family	5,510
Green Residence	single family	4,880

Collect the data – Basic

ENERGY USAGE DATA	Total Electricity kWh [1]	Oil Gals	Propane Gals	Nat Gas cu ft	Wood Pellet tons	Cord Wood	Solar Panel kWh	Wind kWh
Yestermorrow School (rehab)	41,788		3,520					
TVRA Rent-all	5,384	2,823						
Phantom Labs, phase 1	25,700	1,497						
Maclay Offices	13,536	637					2,131	
NRG 1	168,520		1,566		24		75,120	6,237
NRG 2	88,705		455		10			
Bennington Downtown Office								
Burlington Cohousing	105,372			14,241				
Waterfront Housing	202,000			10,545				
Evergreen Place	81,840	1,397						
Shapiro 1988 house	4,200		230			2		
Ellingwood CoHo	4,000				2			
Wilmerding Residence	12,936		360		9		5,136	
Green Residence	8,471	1,564						

Look at the data – Basic

PERFORMANCE DATA		
ALL ENERGY SOURCES		MMBtu
Yestermorrow School (rehab)	office/classroom/shop	465
TVRA Rent-all	office/warehouse	402
Phantom Labs, phase 1	office/manufacturing	291
Maclay Offices	offices	133
NRG 1	office/manuf./warehouse	1,102
NRG 2	office/manuf./warehouse	504
Bennington Downtown Office	offices	
Burlington Cohousing	multi-family	1,812
Waterfront Housing	multi-family	1,765
Evergreen Place	elderly housing	469
Shapiro 1988 house	single family	79
Ellingwood CoHo	single family	46
Wilmerding Residence	single family	221
Green Residence	single family	242

Look at the Data – Basic

Total energy intensity –
from all sources, including renewables

Look at the Data – Basic

Total energy intensity –
from all sources, including renewables

Btu/sq.ft-year

kWh/sq.m-year

Look at the data – Basic

PERFORMANCE DATA			Btu/ sq.ft.-yr	kWh/ sq.m.-yr
ALL ENERGY SOURCES		MMBtu		
Yestermorrow School (rehab)	office/classroom/shop	465	46,000	145
TVRA Rent-all	office/warehouse	402	40,000	126
Phantom Labs, phase 1	office/manufacturing	291	40,000	126
Maclay Offices	offices	133	52,000	164
NRG 1	office/manuf./warehouse	1,102	24,000	76
NRG 2	office/manuf./warehouse	504	16,000	50
Bennington Downtown Office	offices		40,000	126
Burlington Cohousing	multi-family	1,812	69,000	217
Waterfront Housing	multi-family	1,765	39,000	123
Evergreen Place	elderly housing	469	27,000	85
Shapiro 1988 house	single family	79	44,000	139
Ellingwood CoHo	single family	46	26,000	82
Wilmerding Residence	single family	221	40,000	126
Green Residence	single family	242	50,000	158

Learn – Basic

PERFORMANCE DATA			
ALL ENERGY SOURCES		Total Square Footage	kWh/ sq.m.-yr
Yestermorrow School (rehab)	office/classroom/shop	10,210	145
TVRA Rent-all	office/warehouse	10,020	126
Phantom Labs, phase 1	office/manufacturing	7,300	126
Maclay Offices	offices	2,568	164
NRG 1	office/manuf./warehouse	46,500	76
NRG 2	office/manuf./warehouse	31,000	50
Bennington Downtown Office	offices	22,000	126
			0
Burlington Cohousing	multi-family	26,450	217
Waterfront Housing	multi-family	45,000	123
Evergreen Place	elderly housing	17,240	85
			0
Shapiro 1988 house	single family	1,800	139
Ellingwood CoHo	single family	1,800	82
Wilmerding Residence	single family	5,510	126
Green Residence	single family	4,880	158

Benchmark: <100 is very good

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Shapiro 1988 house	single family	1,800	139
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Learn - Deeper

PERFORMANCE DATA		Thermal Only (non-electric)		
		MMBtu	Btu/ sq.ft.-yr	Btu/ sq.ft.-yr- dday
Yestermorrow School (rehab)	office/classroom/shop	322	32,000	
TVRA Rent-all	office/warehouse	384	38,000	4.9
Phantom Labs, phase 1	office/manufacturing	204	28,000	3.7
Maclay Offices	offices	87	34,000	4.4
NRG 1	office/manuf./warehouse	527	11,000	1.4
NRG 2	office/manuf./warehouse	202	7,000	0.9
Bennington Downtown Office	offices			
Burlington Cohousing	multi-family	1,453	55,000	7.1
Waterfront Housing	multi-family	1,076	24,000	3.1
Evergreen Place	elderly housing	190	11,000	1.4
Shapiro 1988 house	single family	65	36,000	
Ellingwood CoHo	single family	32	18,000	
Wilmerding Residence	single family	177	32,000	4.2
Green Residence	single family	213	44,000	5.7

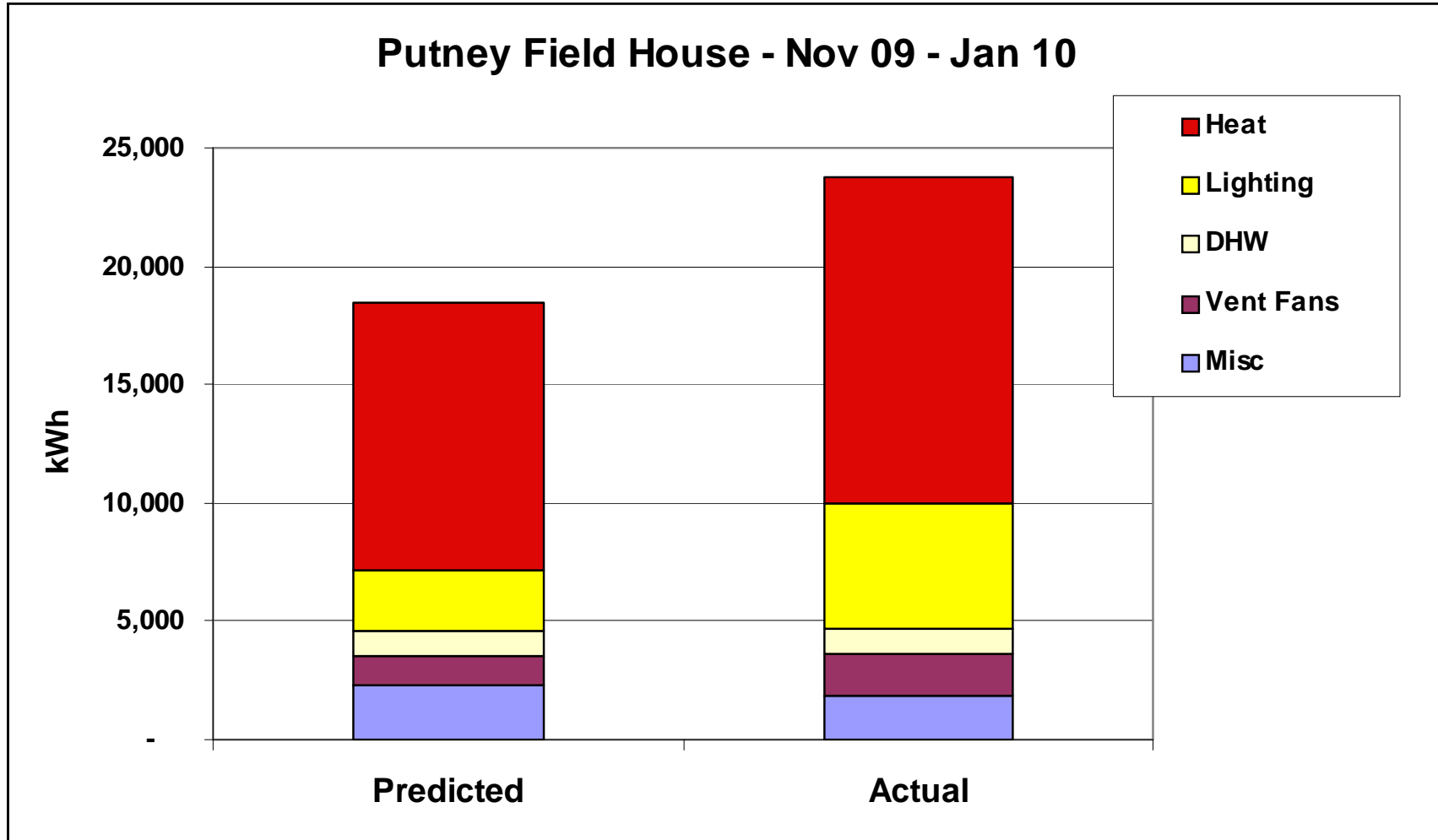
Learn - Deeper

PERFORMANCE DATA		Heating Only		
		Heating only kBtu/yr	Degree Days	Btu/ sq.ft.- yr-dday
Yestermorrow School (rehab)	office/classroom/shop			
TVRA Rent-all	office/warehouse		7,700	4.9
Phantom Labs, phase 1	office/manufacturing		7,500	3.0
Maclay Offices	offices		7,700	4.4
NRG 1	office/manuf./warehouse		7,700	1.4
NRG 2	office/manuf./warehouse		7,700	0.9
Bennington Downtown Office	offices			
Burlington Cohousing	multi-family		7,700	
Waterfront Housing	multi-family	16,000	7,700	2.1
Evergreen Place	elderly housing		7,700	
Shapiro 1988 house	single family	47,000	7,700	3.4
Ellingwood CoHo	single family	16,000	7,700	1.2
Wilmerding Residence	single family		7,700	
Green Residence	single family		7,700	

Learn – Deeper – Compare to Predicted!!

NRG Addition, predicted vs actual performance			Actual/ predicted
predicted	2,009		
94,886	54,213	kWh thermal fuels	57%
81,045	88,705	kWh electricity	109%
175,931	142,918	al fuels kWh used	81%
31,000	31,000	sq.ft	
2,881	2,881	sq.m	
61	50	kWhsq.m-yr all sources	
324	198	thermal MMBtu	
10,400	6,400	Btu/sq.ft.yr, thermal only	
1.4	0.87	Btu/sq.ft.yr-dday , thermal only	

Learn - Deeper - Compare to Predicted!!



Learn - Deeper - Compare to Predicted!!

Putney Field House -- Nov 09 - Jan 10

	Misc	Vent Fans	DHW	Lighting	Heat	Total
Predicted	2,332	1,200	1,050	2,534	11,345	18,461
Actual	1,856	1,728	1,054	5,322	13,789	23,749
Variation	-20%	44%	0%	110%	22%	29%

Learn – Deeper – Track over Time – Data to Improve

NRG Systems (first building)	2005	2006	2007	2008	2009	Average
wind kWh	5,309	6,496	7,096	6,516	5,767	6,237
tracker kWh	35,066	35,493	41,910	39,427	39,525	38,284
bldg PV kWh	38,862	34,387	33,789	36,870	40,276	36,837
bldg total kWh consumption renewables+ purchased	131,851	152,090	189,809	213,363	155,488	168,520
heat/DHW propane, kBTU	81,750	49,500	98,000	140,292	140,797	102,068
generator propane, kBTU	1,875	500	3,000	4,500	1,575	2,290
pellet tons	25	24	25	26	24	25

Learn - Deeper - Track over Time - Data to Improve

Summary		2005	2006	2007	2008	2009	Average
NRG Systems (first building)		2005	2006	2007	2008	2009	Average
Total electric kWh		131,851	152,090	189,809	213,363	155,488	168,520
Total MM Btu thermal fuel		491	433	493	565	521	501
Total kWh all fuels		275,661	279,040	320,310	378,916	308,120	312,409
Total MMBtu all fuels		941	952	1,141	1,293	1,052	1,076
kWh/sq.m-yr		64	65	74	88	71	72
Btu/sq.ft.-yr		20,233	20,481	23,510	28,739	23,369	23,908

Learn - Deeper - Track over Time - Data to Improve

Summary						
NRG Systems (first building)	2005	2006	2007	2008	2009	Average
Total electric kWh	131,851	152,090	189,809	213,363	155,488	168,520
Total MM Btu thermal fuel	491	433	493	565	521	501
Total kWh all fuels	275,661	279,040	320,310	378,916	308,120	312,409
Total MMBtu all fuels	941	952	1,141	1,293	1,052	1,076
kWh/sq.m-yr	64	65	74	88	71	72
Btu/sq.ft.-yr	20,233	20,481	23,510	28,739	23,369	23,908

Aprox avg number of regular occupants	45	60	100	82	65
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Learn – Deeper - Submetering

- Electricity (import, export and net)
- Heating energy
- Fans and pumping energy
- Lights
- Water heating
- Other
 - One time measurement of parasitic loads

Learn - Deeper - Submetering



One time measurement of parasitic loads

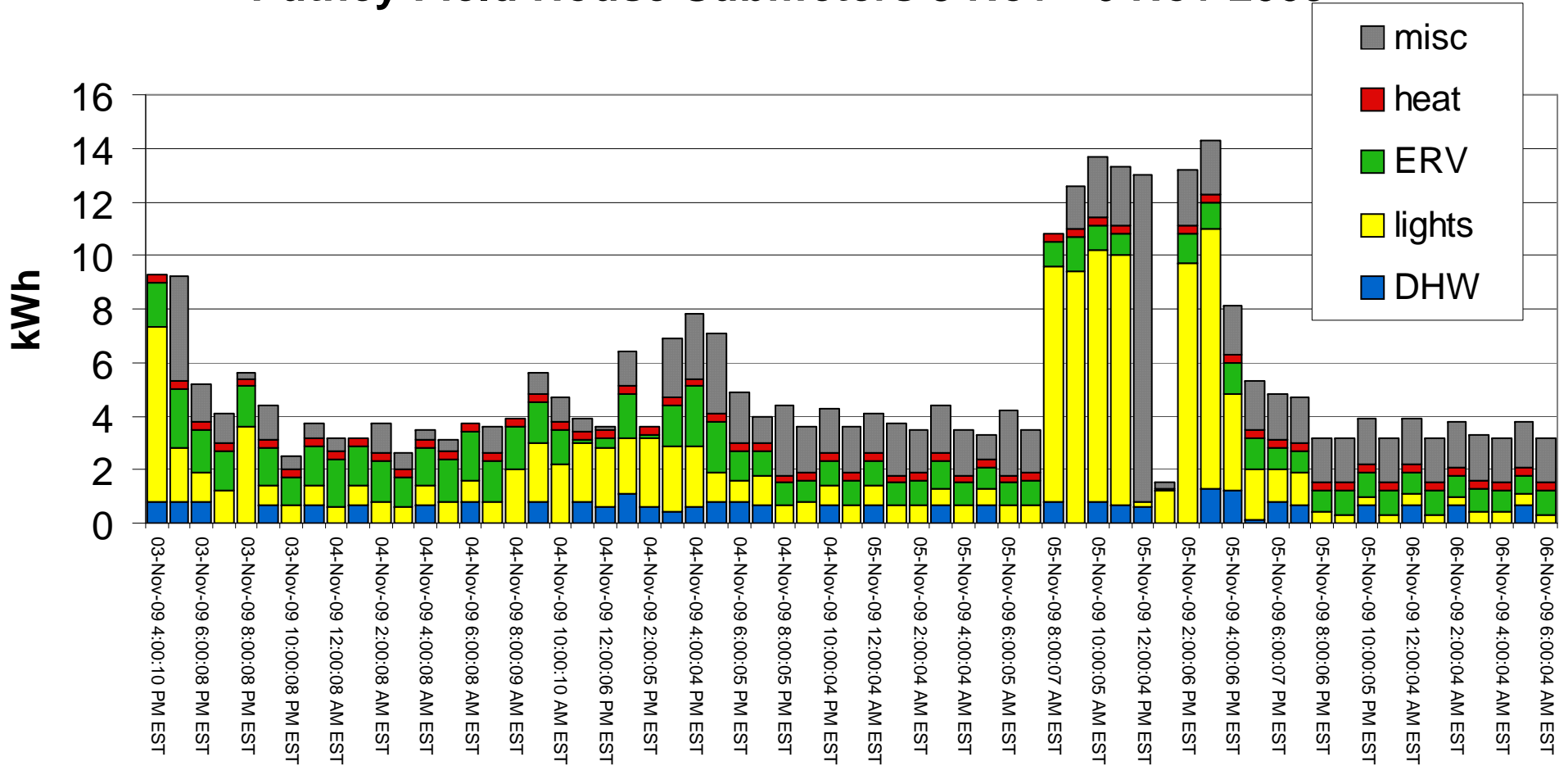
Putney Field House
Measurement of Standby Power Consumption

14-Jan-10

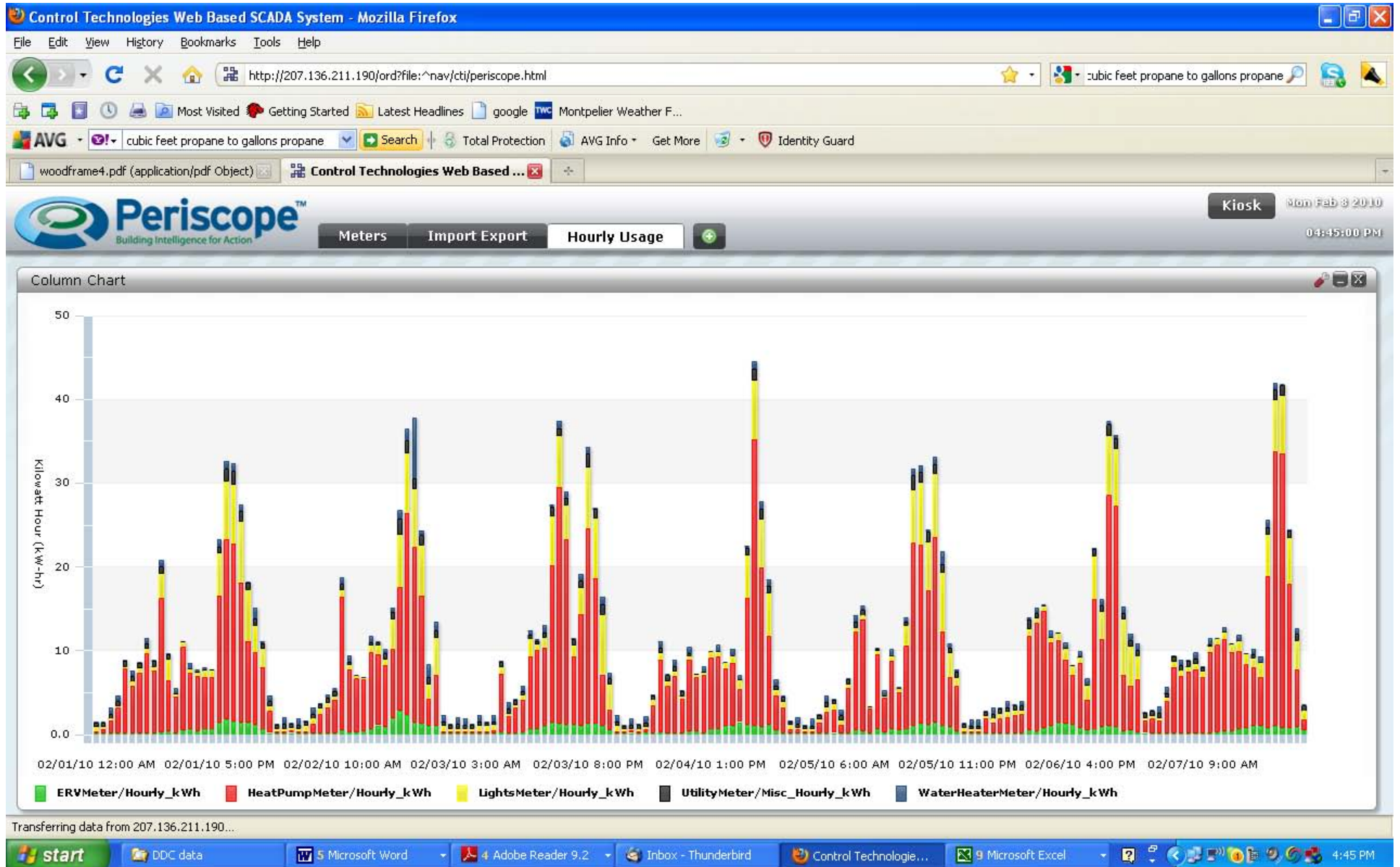
	amps	volts	watts	kWh/year
Wattstopper hardware quiescent watts				
LCP (lighting control panel)	0.333	120	40	350
LCO (3 step daylight harvesting control)	0.016	120	2	17
Automation appliance (computer interface for LCP)	0.114	120	14	120
DDC circuit includes power supply and router*	0.602	120	72	633
Composting toilet controls and fans	0.277	120	33	291
Teledata connection and UPS	0.362	120	43	381
Daikin interface	0.016	277	3	22
Fire alarm panel	0.356	120	43	374
Weight room receptacles	0.196	120	24	206
			273	2,394

Submetering

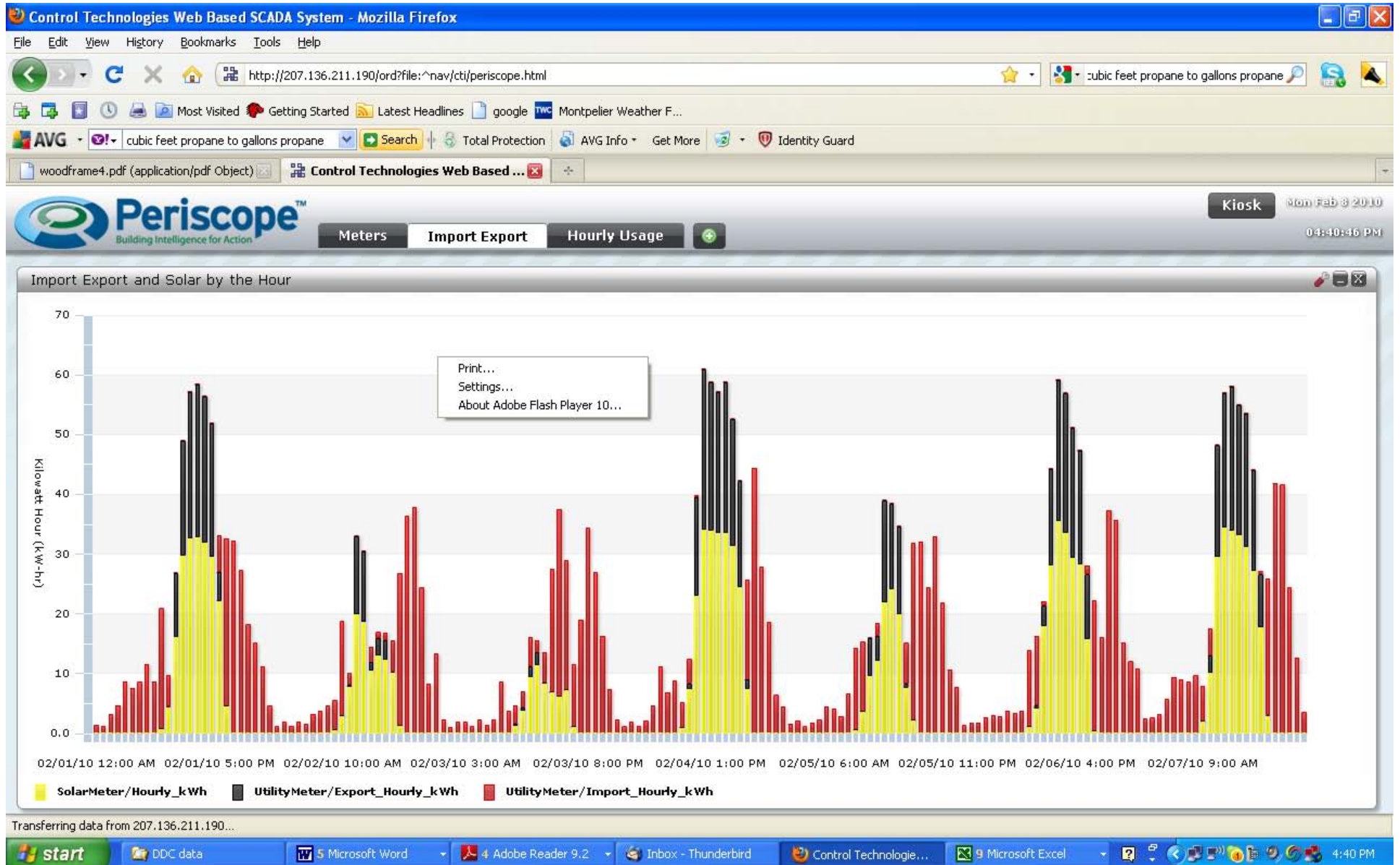
Putney Field House Submeters 3 Nov - 6 Nov 2009



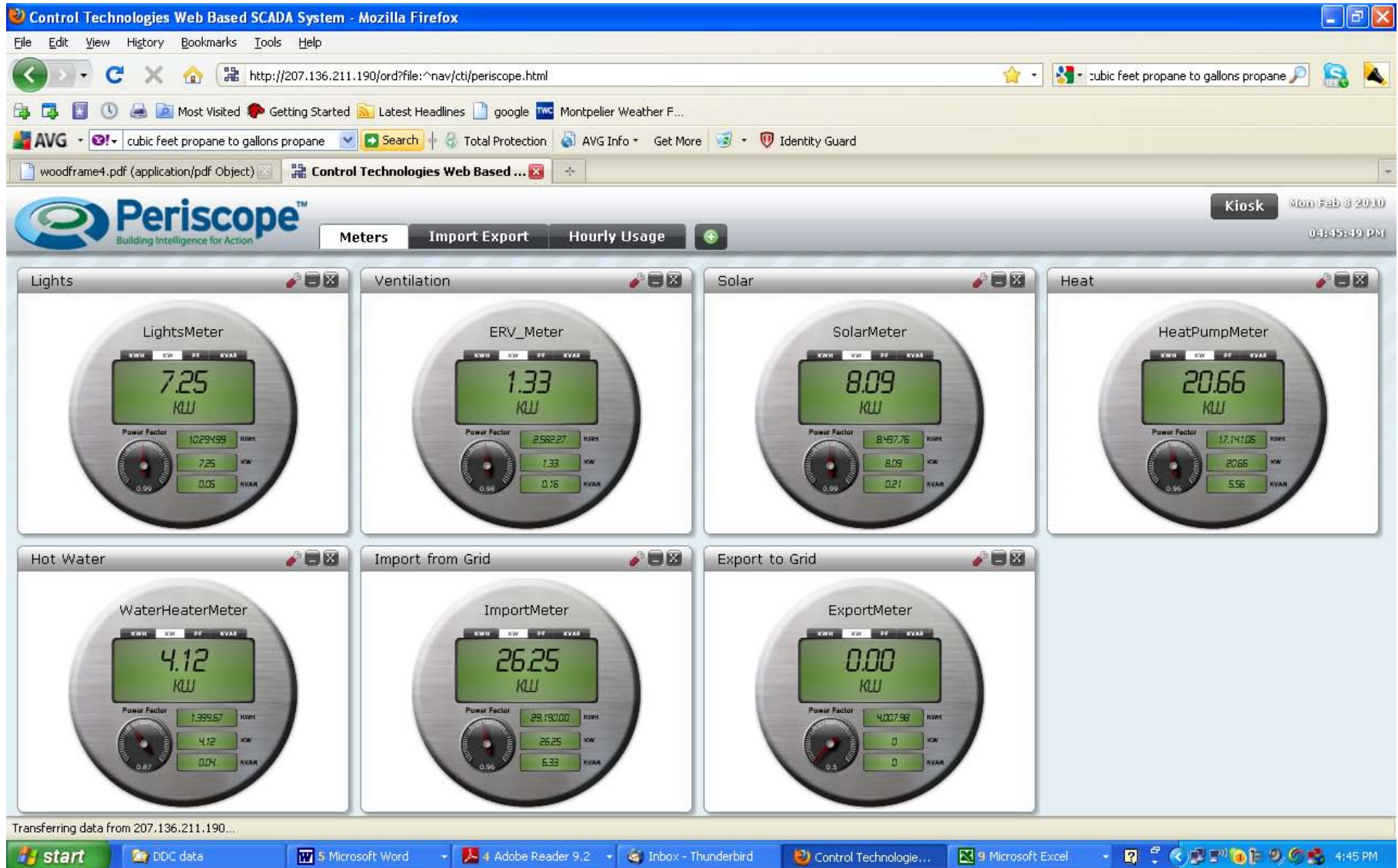
Submetering



Submetering



Submetering



Take the Energy Challenge!

Data collection file available from WMAP

wmap@maclayarchitects.com