2011 DFW Solar Home Tour
October 1, 2011
Reference

Bill Neukranz
bneukranz@verizon.net
972-516-0909

DFW Solar Home Tour

October 1, 2011

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http://www.dfwsolarhometour.org

- Home
- Solar Home Tour Locations
- Frequently Asked Questions
- Who is NTREG?
- Volunteer Today!

Home

Welcome to the DFW Solar Home Tour

The ASES National Solar Tour http://nationalsolartour.org/ is the world's largest grassroots solar event. This event offers you the opportunity to tour innovative green homes and buildings to see how you can use solar energy, energy efficiency, and other sustainable technologies to reduce monthly utility bills and help tackle climate change. More than 165,000 participants will visit some 5,500 buildings in 3,200 communities across the U.S.

3 Homes Added September 24!

Solar Home Tour Locations



Video

EVENT DETAILS

The DFW Solar Home Tour has two components…Self-guided tours and an online virtual tour.

What are tour hours?

The Solar Tour is a one-day event on Saturday, October 1. Generally speaking, tour hours are 10 a.m. to 4 p.m., but times may vary at the discretion of the tour host, so check the site hours before you arrive. NTREG will post visiting hours for each self-guided host site along with map flag, directions, brief property description and photos provided by the host site.

DFW Solar Home Tour

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NTREG
North Texas Renewable Energy Group

TEXAS SOLAR ENERGY SOCIETY

ASES National Solar Tour
www.NationalSolarTour.org

Solar Home Tour Locations

Allen Hall Terracourt House	**Azle** Duncan House	**Carrollton** O'Keefe House Sitkoff House
Denton Soph House	**Fairview** Westbrook House	**Fort Worth** Zero Energy Casita
Garland Roseberry House	**Hurst** Hawa House	**Lucas** Hendrix House
Plano Caldwell House Elliot House Neukranz House Perry House	**Rowlett** Rock House	**Weatherford** Renner House

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Introduction

Think of your structure (house) as a large engine with very poor fuel efficiency



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Summary

Overview:

East Plano located, 3400 sq. ft single story residence on shaded one-half acre lot, constructed in 1992. This home utilizes natural light and an open floor plan including a large porch to maximize space, functionality and spaciousness. Located near public greenbelts, parks, trail system and mass transit.

Green Features:

Broad real time energy savings monitoring system continuously verifies structure and equipment performances are per manufacturer/installer claims, identifies areas to improve, anticipates impending failures when repairs can be made more cost effectively, and facilitates cost/benefit analysis for contemplated projects. All details are available to anyone at http://www.welserver.com/WEL0043 .

8.1 kW roof-top grid-tied solar PhotoVoltaic (PV) system - provides 30% of electrical needs.

Solar system leased with help of local utility subsidy and federal tax rebates, resulting in $23 per month positive net cash flow from first day of operation.

Extremely efficient (24 SEER / 5 COP) geothermal heat pumps - one mile of underground pipe, and no outside equipment to wear out.

$57/month average heating/cooling monthly cost in spite of Dallas hot climate and using electricity for heating.

HVAC efficiency further enhanced with four independent zone air distribution, variable-speed air handlers (improves humidity control), and two-stage compressors.

Sheet metal ducts (inside attic) insulated with R-8 foil backed insulation and seams sealed.

Programmable thermostats adjust at different times of day, saving money and reducing energy use at peak times.

Large ceiling fans in every room, prevent air stratification and reduce demand on HVAC system.

All lights are Compact Fluorescent Lamps - no incandescents are used. Approximately $400 per year savings.

Extensive home automation system assists with comfort, efficiency, safety and security.

Windows are double pane with thermally broken anodized aluminum frames. All have thermally efficient shades to block out hot day time heat.

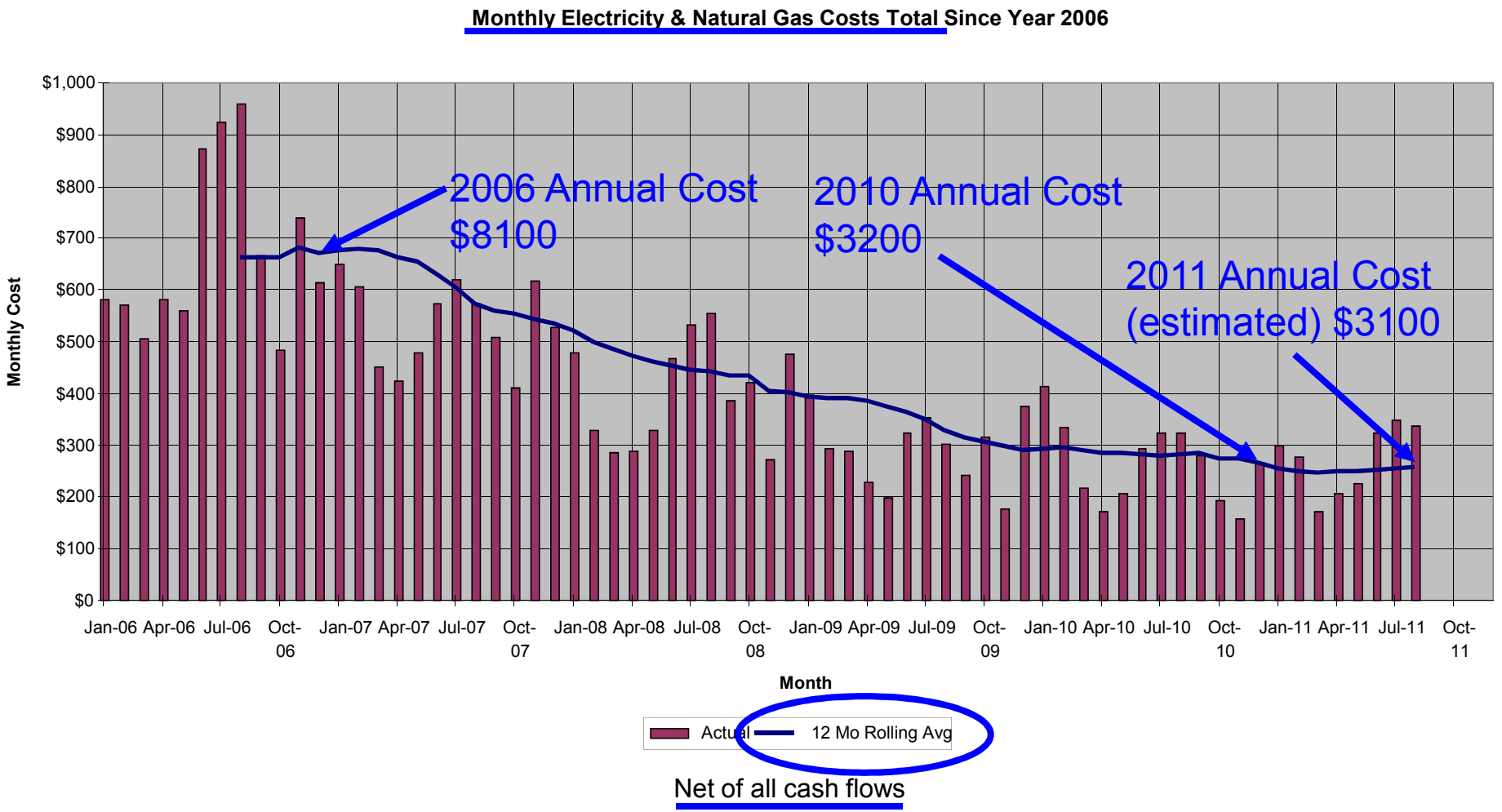
Minimal windows on hot west side; large windows on north and east walls and open floor plan provide ample day lighting.



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Summary

Bottom Line So Far ('10 EOY) = 60% reduction since '06



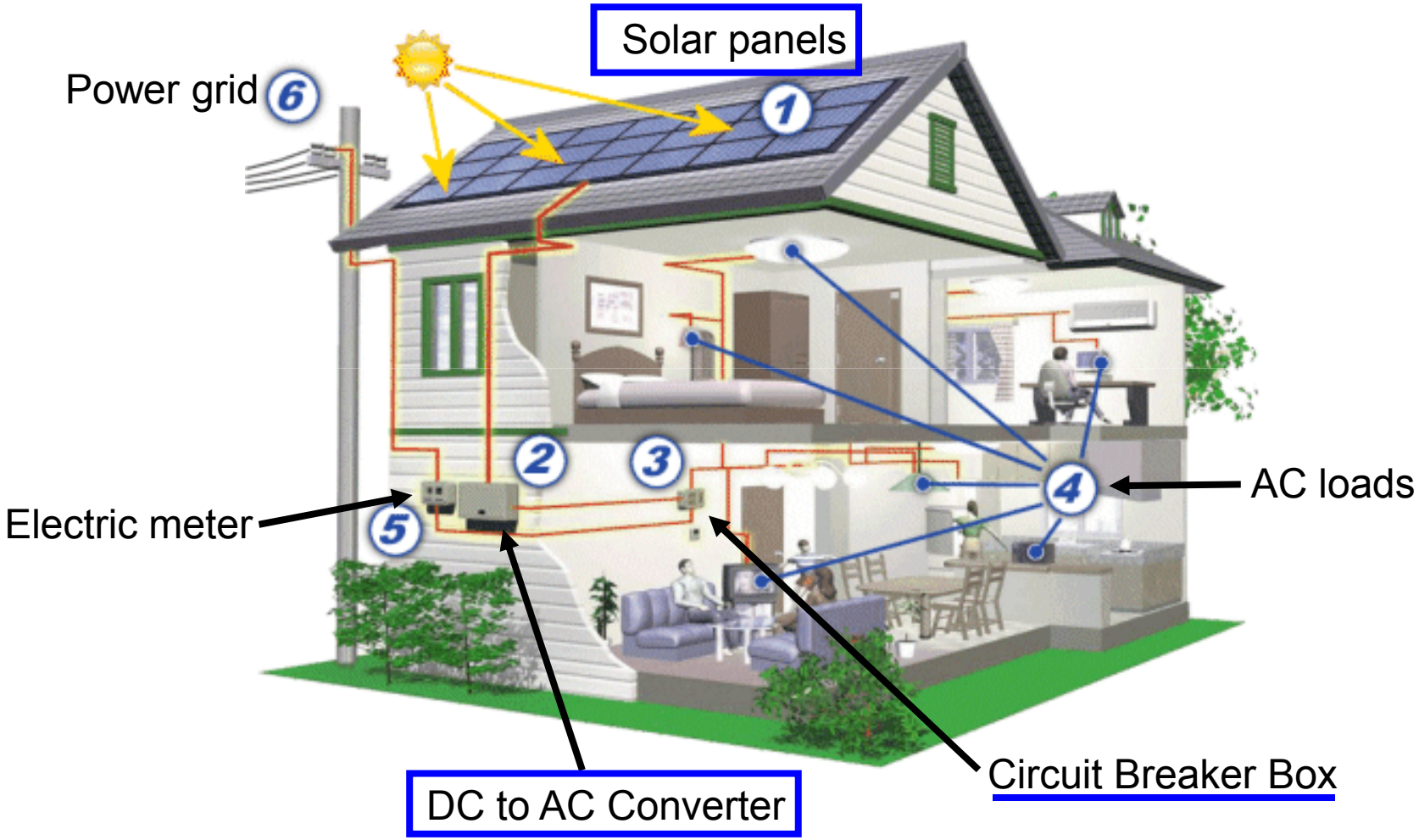
Net of all cash flows

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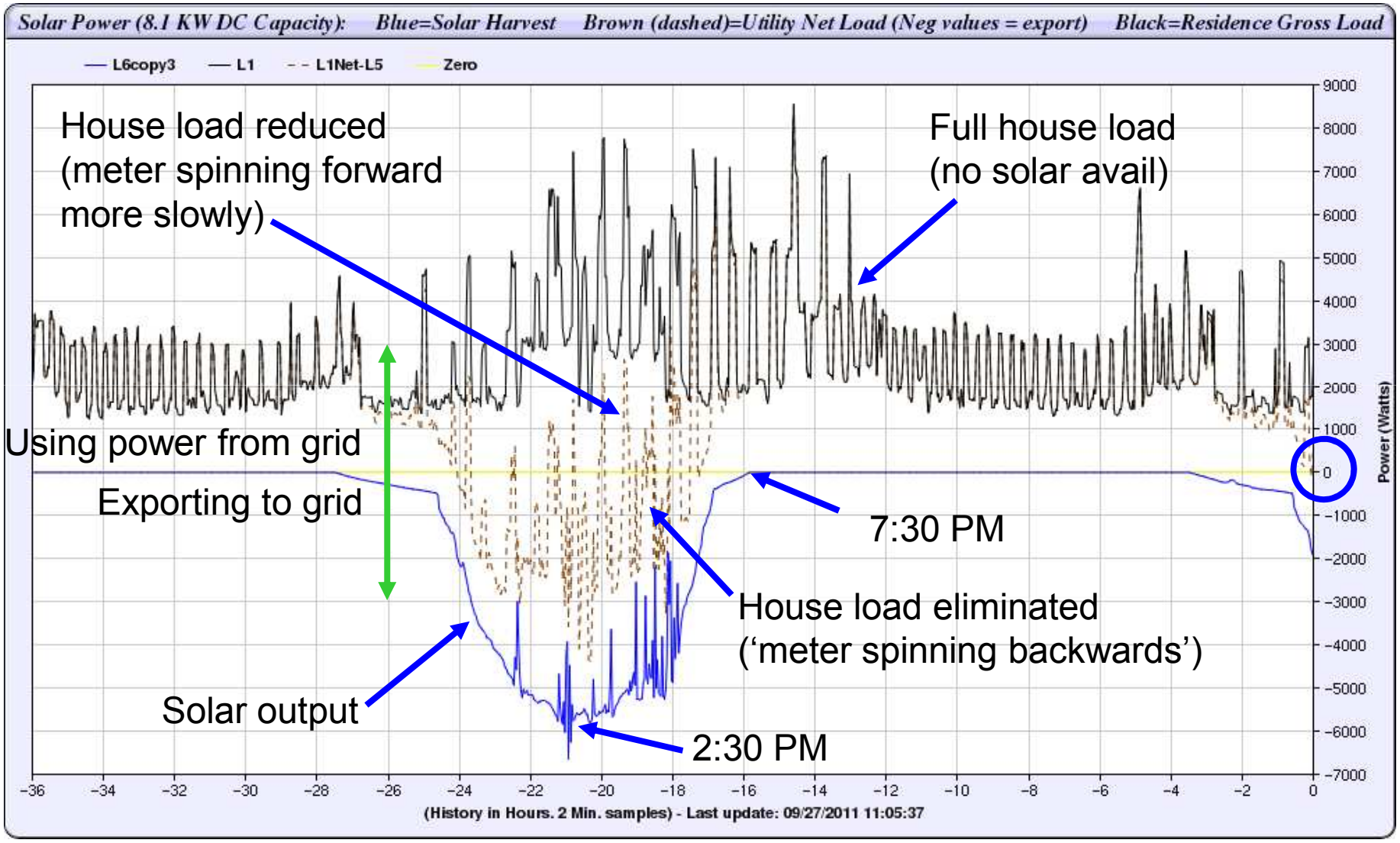
Solar PV

The Basics – Grid Tied, No Batteries



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Solar PV
Fundamentals



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Solar PV
Details

Overview

Commissioned: Feb., 2010

System Type: Grid-tied, batteryless PV

Mounting Location: Residential rooftop

Location: Texas, 32.8°N, 97.0°W

Solar Resource: 5.5 avg daily sun-hours (kWh/m²/day)

Record Low / Avg High Temperatures: +1° F / 76°

System Capacity: 8.1 kW STC

Annual/Monthly Production: 10,300/860 kWh

Efficiencies: Panels 14%, System 70% on annual basis

Export to Utility Annually: 18%

Utility Electricity Offset Annually: 30%

Costs

Financing: Leased system, 3rd party owned, subsidized with ONCOR rebate, Federal tax credit and Renewable Energy Credits (RECs)

Break Even: Immediate

Cash Flow: currently $23/month positive

System Components

Panels: 36 Astronergy monocrystalline, 225 W STC, Vmp 28.7 V, Imp 7.86 A, Voc 37.3 Isc 8.48 A, 1.64 m² (17.7 ft²)

Array: 59.1 m² (636 ft²); 4 strings of 9 series-connected panels each; each string: Vmp 258 V, Imp 70.7 A, Voc 336 V, Isc 76.3 A

Junction boxes: Carlon Molded Nonmetallic 6P Rated

Array Installation: Unirac SolarMount rails, oriented to 210° azimuth 35° tilt for 3 strings, and 285° azimuth 35° tilt for 1 string

Rails Installation: Lag screw direct penetration to rafters, with adhesive caulk

Inverter: SMA Sunny Boy 7000, 7 kW rated continuous output, 96.0% CEC weighted efficiency, 600 VDC maximum input, 250-480 VDC MPPT operating range, 240 VAC output

Energy Savings Monitoring: Web Energy Logger (WEL) – http://www.welserver.com/WEL0043



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Solar PV

Consideration Points



- Best investment? Efficiency and conservation – almost always better ROI
- Winning strategy: unshaded Southerly exposure, substantial subsidies, net metering
- Strongly consider leasing if terms are favorable – i.e. no up prepayment
- Availability of net metering and type (at wholesale or retail), along with grid retail kWh pricing strongly influence the subject
- Least expensive system type is grid-tied, no batteries – (panels won't work in sun w/o grid power though)

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Solar PV

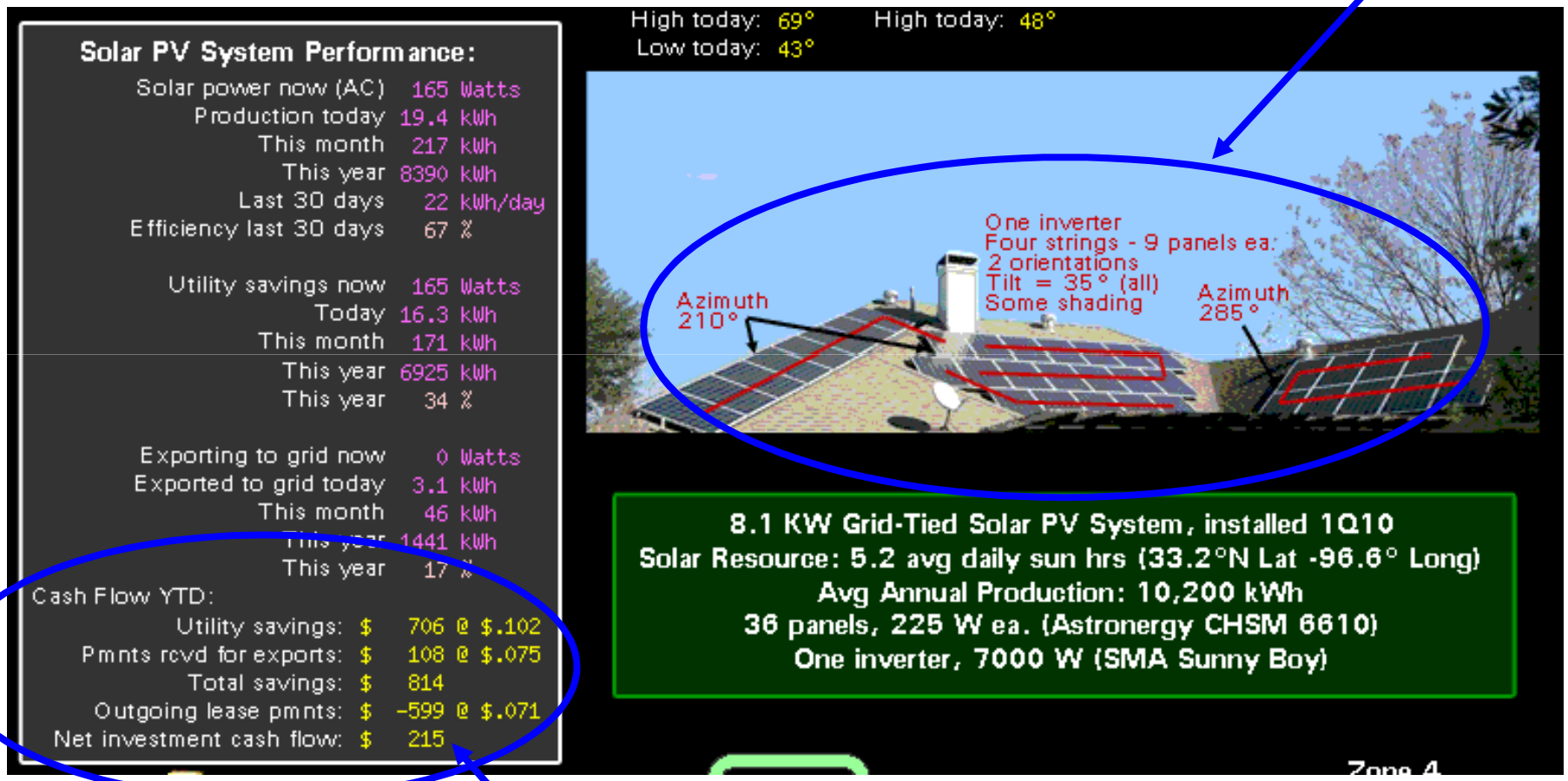
Solar PV vs Wind Turbine Consideration Points

- Likely to have zoning and deed requirements
- Usually requires substantial tower to get turbine high enough
- More ‘up front’ costs, and higher maintenance costs than solar PV
- Roof mounted units require *steady* 22 mph just for 100 W, and cost a lot more than panels (and require maint)
- Much more difficult to do a wind-survey vs a solar survey
- Unsubsidized grid tied PV is at $5/W, and sizeably less when subsidized
- Overall: tough to make wind competitive with solar PV at residential scale

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Solar PV

Actual Design and Cash Flow Illustrations



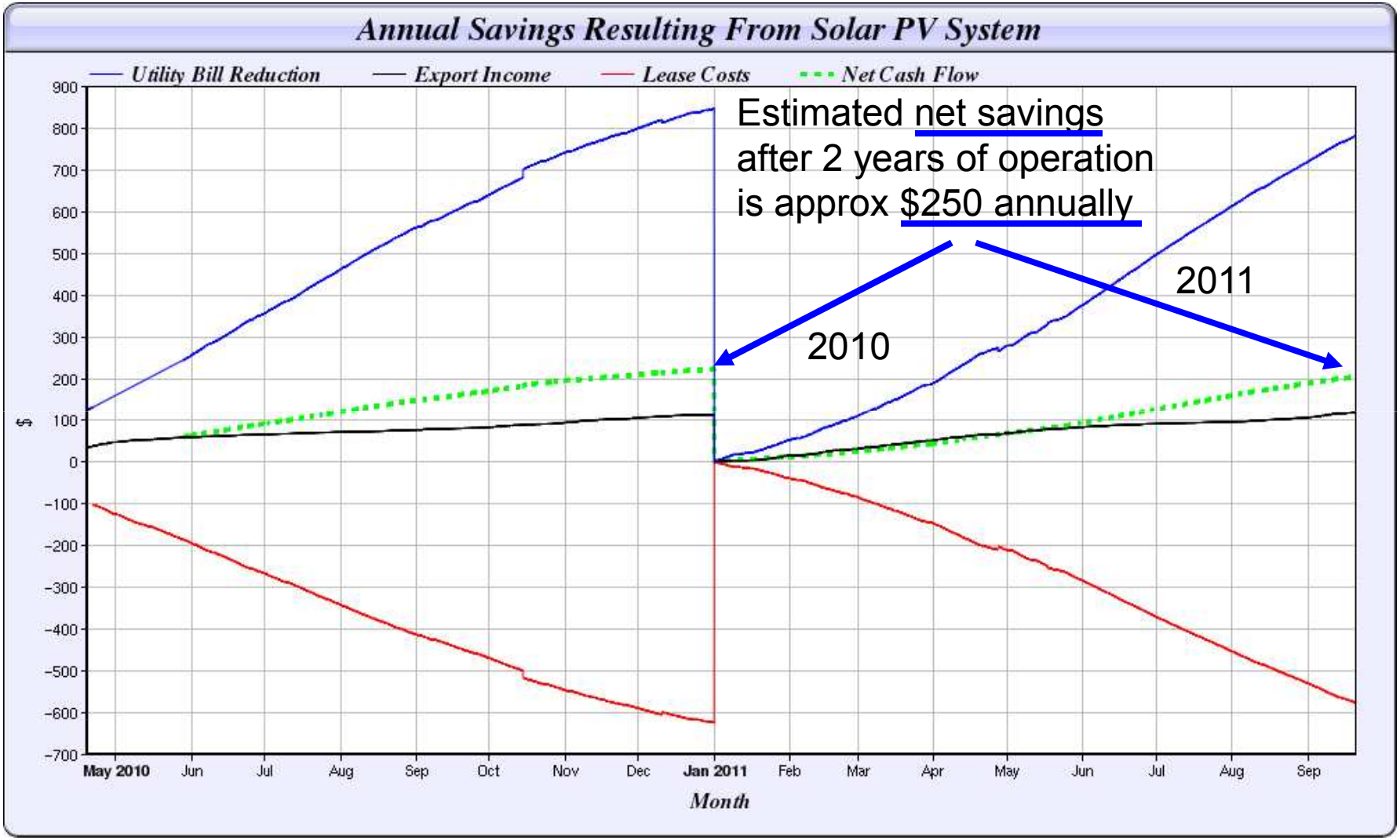
Currently approx $23/mo net savings on rolling 12 mo. basis (positive cash flow)

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Solar PV

Long Term Solar PV Leasing Economics

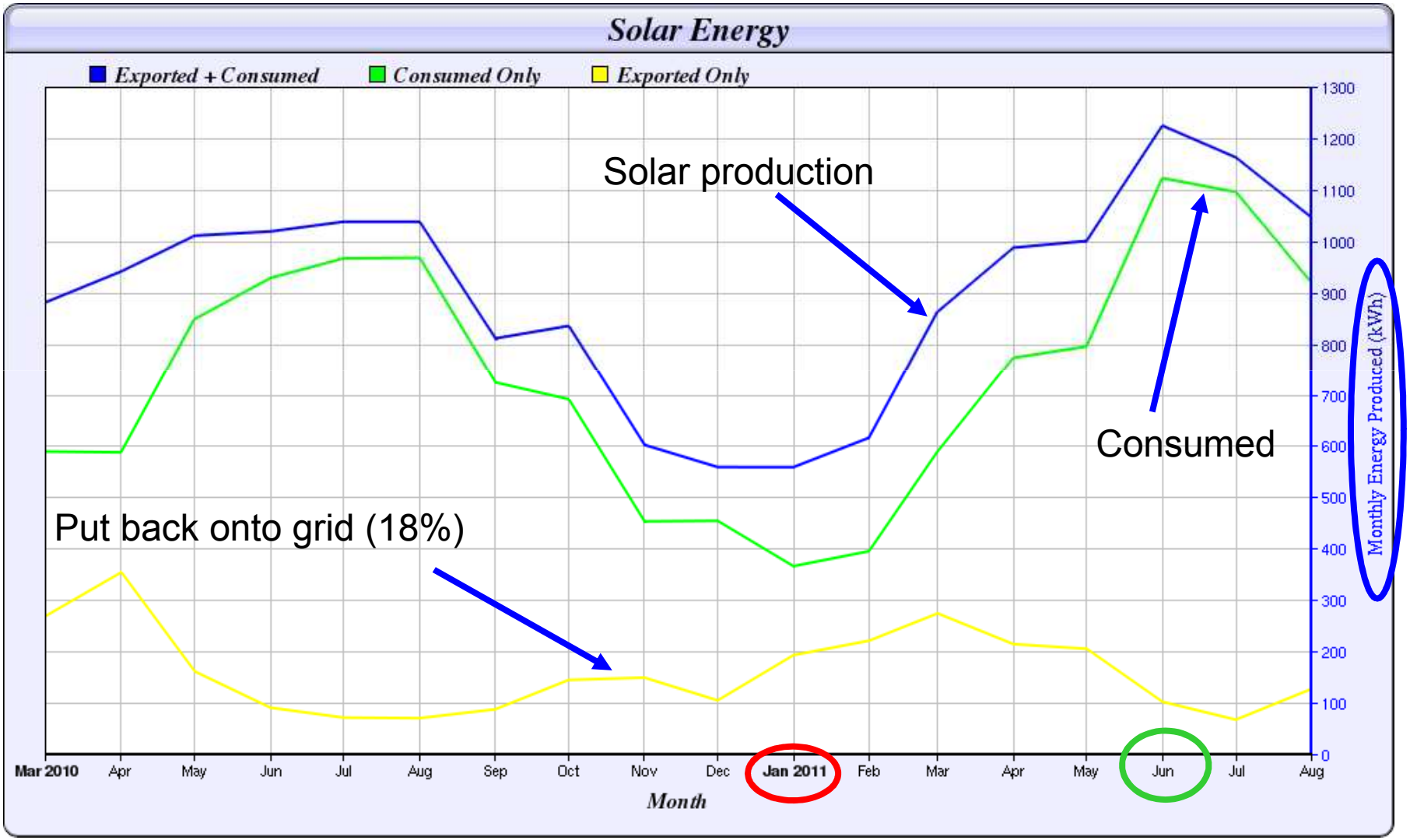


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Solar PV

How Much Electricity Is Being Produced, and Where's It Going?

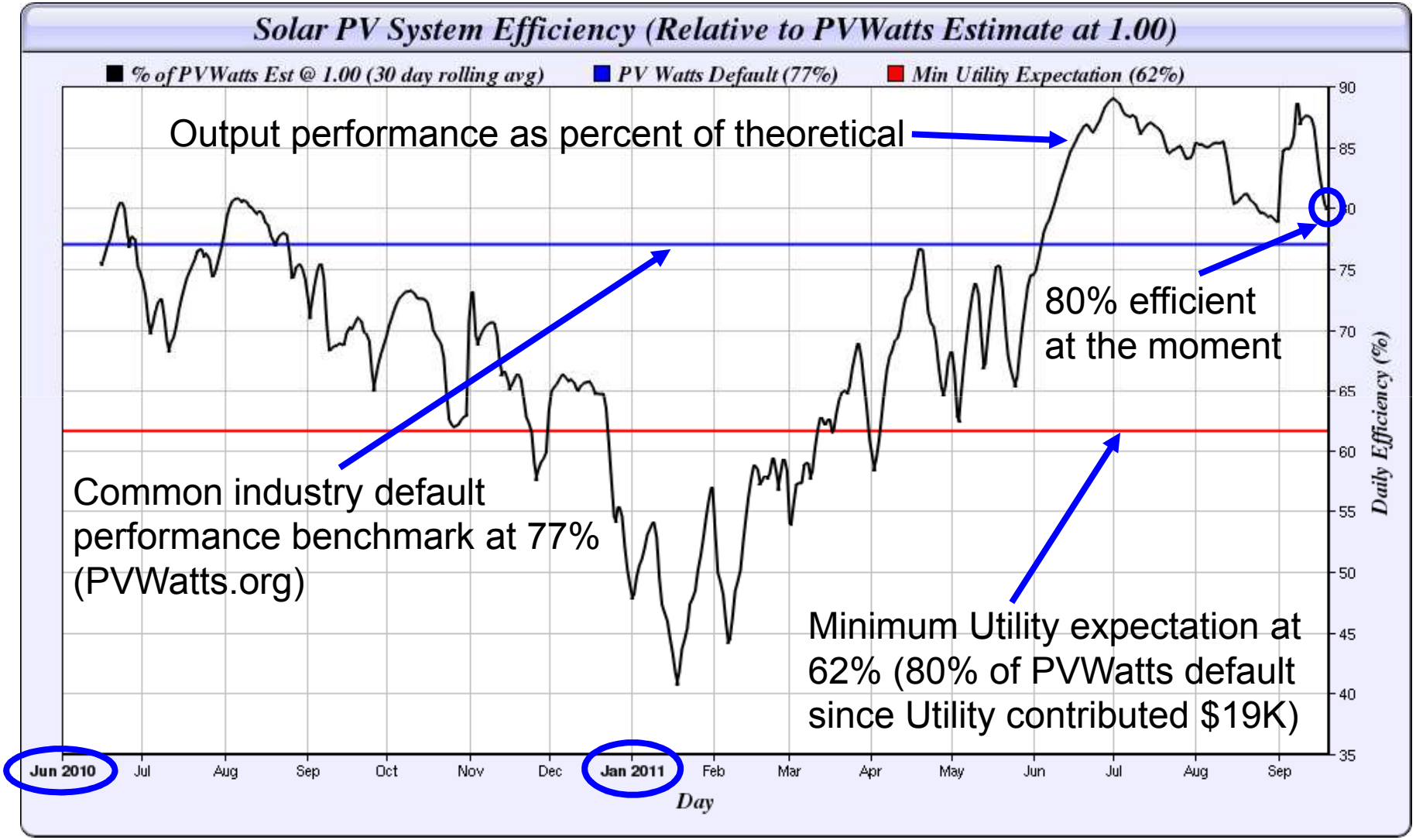


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Solar PV

How's the Performance on a Daily Basis?

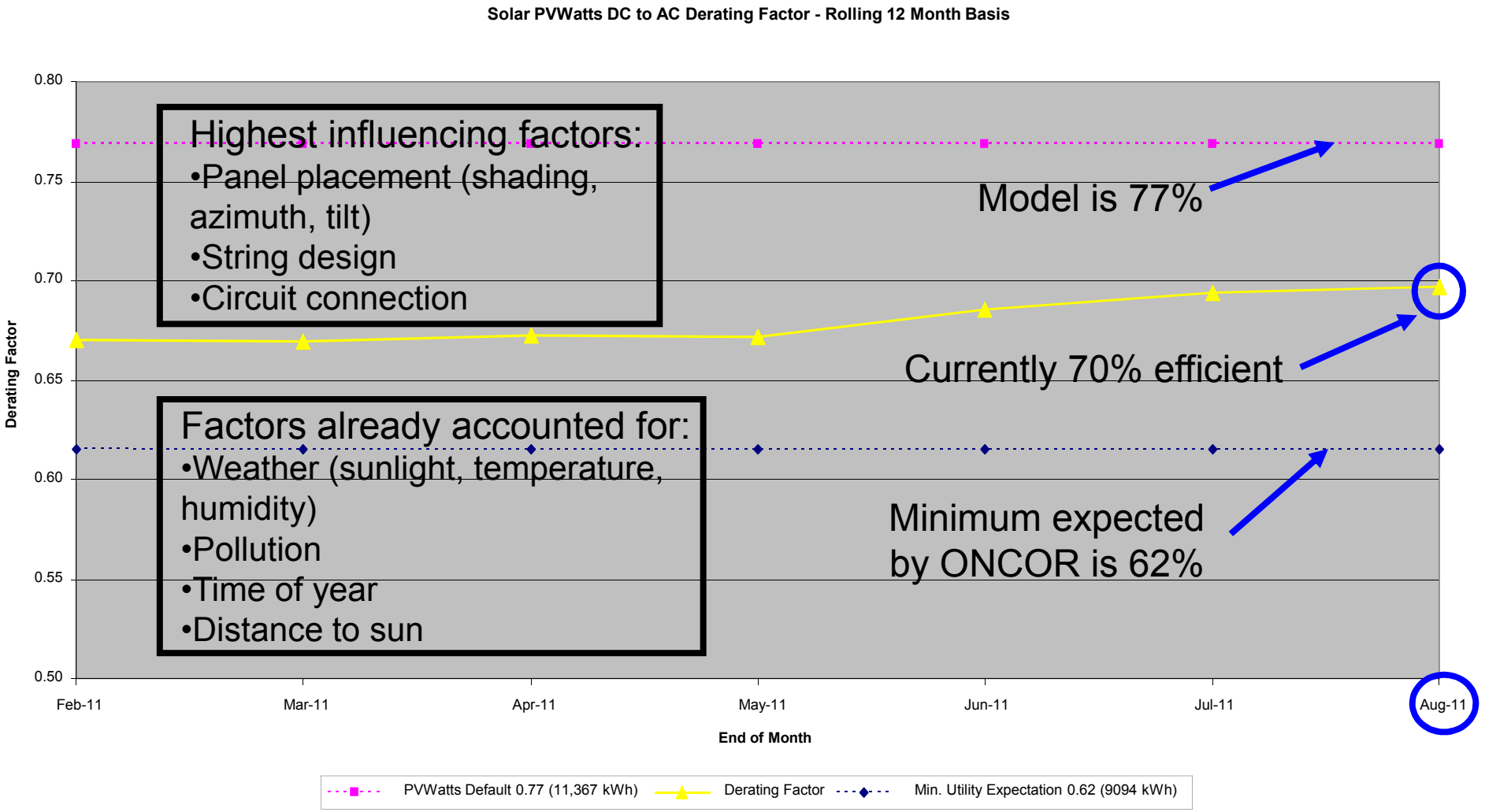


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Solar PV

How's the Performance Overall?

As compared to model for this location

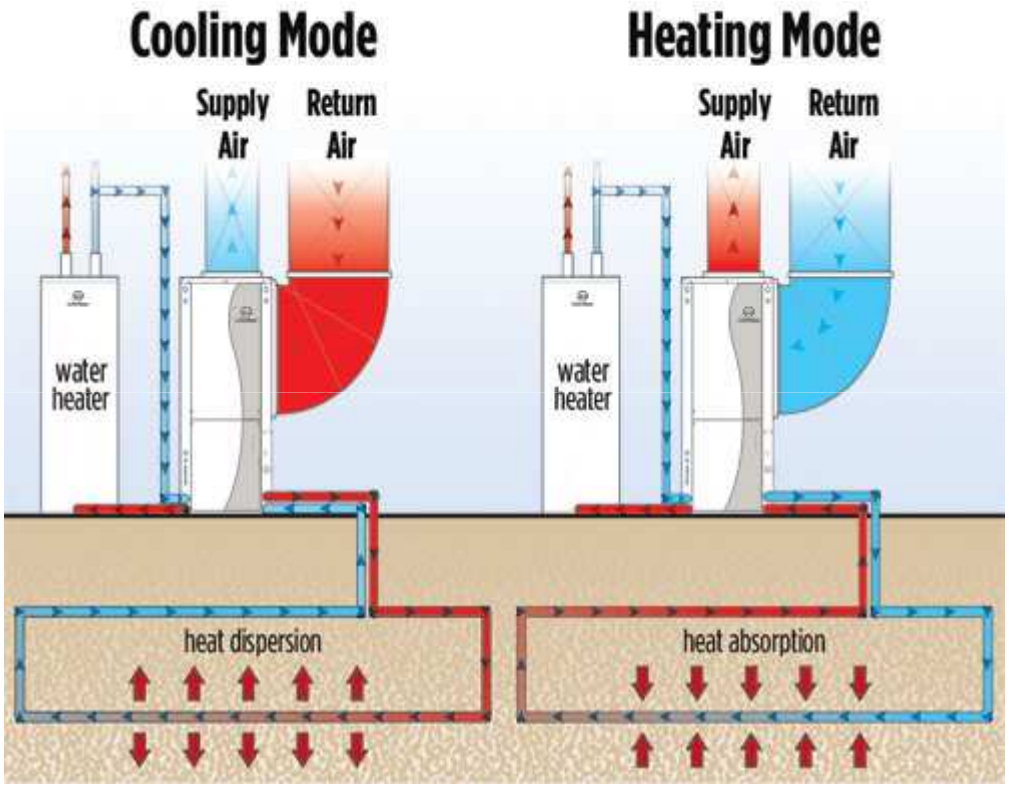


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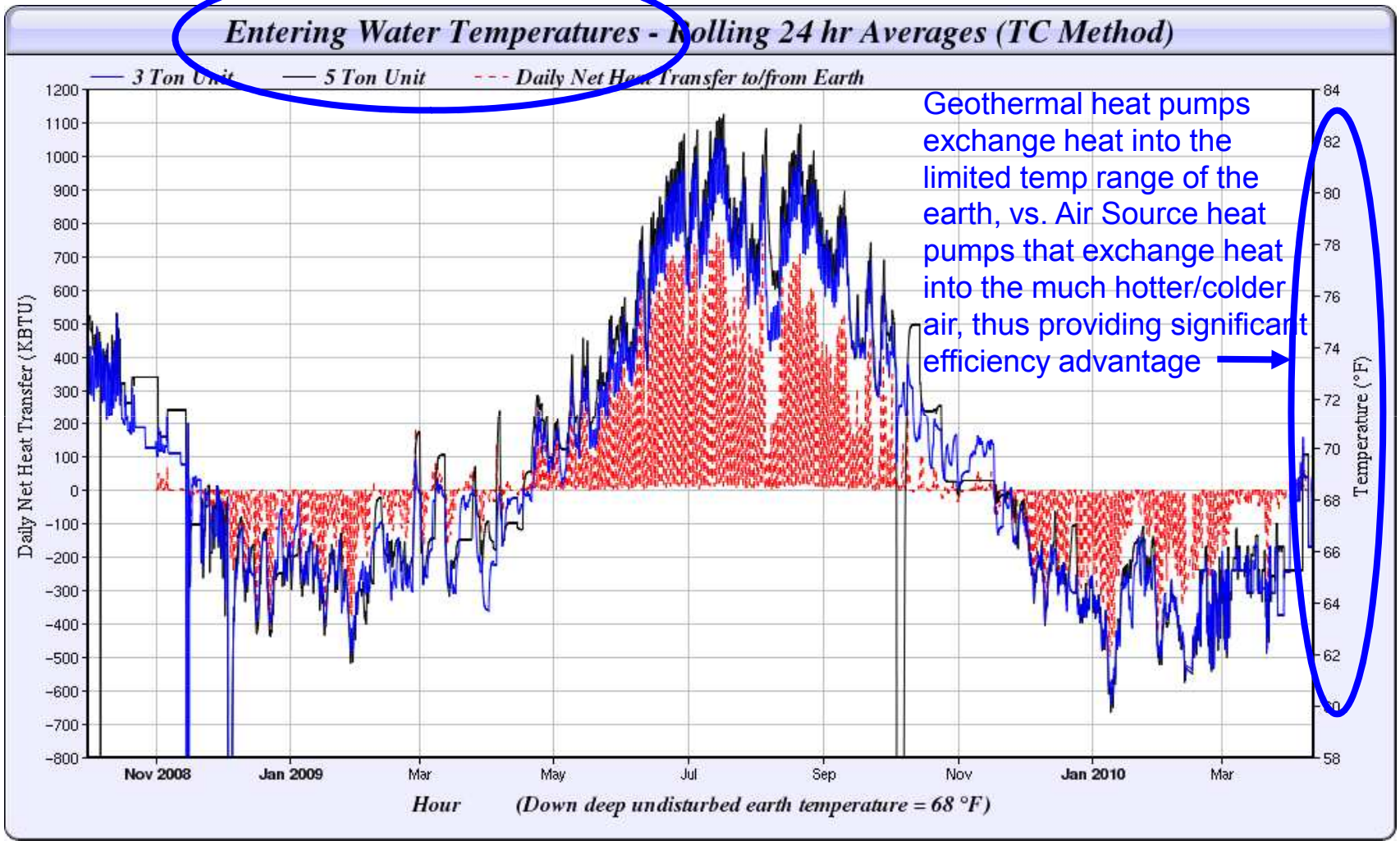
Geothermal HVAC

How Does It Work?



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Geothermal HVAC



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Geothermal HVAC

Overview

Seasons: Year-round heating & cooling

Energy Type Required: Electricity only

Size of Residence: 3400 sq feet, single story

Avg Monthly Heating/Cooling Cost: $57 (629 kWh)

Thermostats: WaterFurance Programmable (daytime: 77° living / 81° bedrooms; night time: 81° living / 74–76° bedrooms)

Energy Savings Monitoring: Web Energy Logger (WEL) – http://www.welserver.com/WEL0043/

System Summary

Commissioned: July, 2007

Technology: 2 WaterFurnace Envision (3 and 5 ton) geothermal-source heat pumps, with dual-speed compressors and variable speed fan blowers.

Refrigerant to Water Loop: Shared single loop, vertical wells, no antifreeze

Heat Pump Packaging: Self-contained (blower, compressor, heat exchanger, coil in single package); equipment is indoors - no refrigerant lines

Location of Heat Pump Unit(s) and Air Ducts: Attic

Other: R410A refrigerant; no aux heating capability; DeSuperHeater available but not connected

Number of Independent Air Distribution Zones: 4

Technical Details

Design Temperatures: +1° F / 112° (records)

Cooling Capacity: 2.1 - 8 tons max; 27 - 78 KBTU/hr (2.2 - 6.5 tons) typical; 750 KBTU/day heat rejection on 100°+ days.

Structure Performance: 516 sf / ton of cooling capacity

Heat Pump Performance (including blower & pumps): 21 EER (24 SEER) cooling, 5.0 COP heating

Inside Humidity Control Performance: 40 – 50% RH during cooling season

Lot Size: One-half acre

Water Loop: 8 wells, 300 ft each, 20 ft spacing

Water Pipe: 1” high-density polyethylene (HDPE), approximately 1 mile, 60 psi static pressure

Loop Water Temperatures: Extremes: 61° F (Winter) / 85° (Summer); Averages: 67° (Winter) / 80° (Summer)

Earth Heat Absorption/Supply: 80,000 KBTU annual heat absorption (cooling), 18,000 KBTU annual heat supply (heating)

Pumps: 3 Grundfos 1/6 hp, 385 Watts each; 14 – 30 gpm



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Geothermal HVAC

Needs good design, availability of land, comfortableness with water pipes in attic



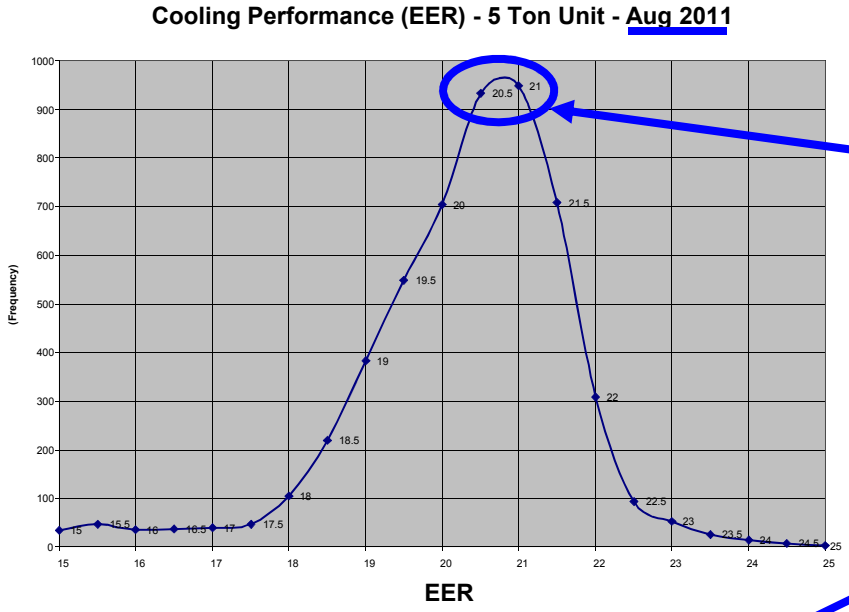






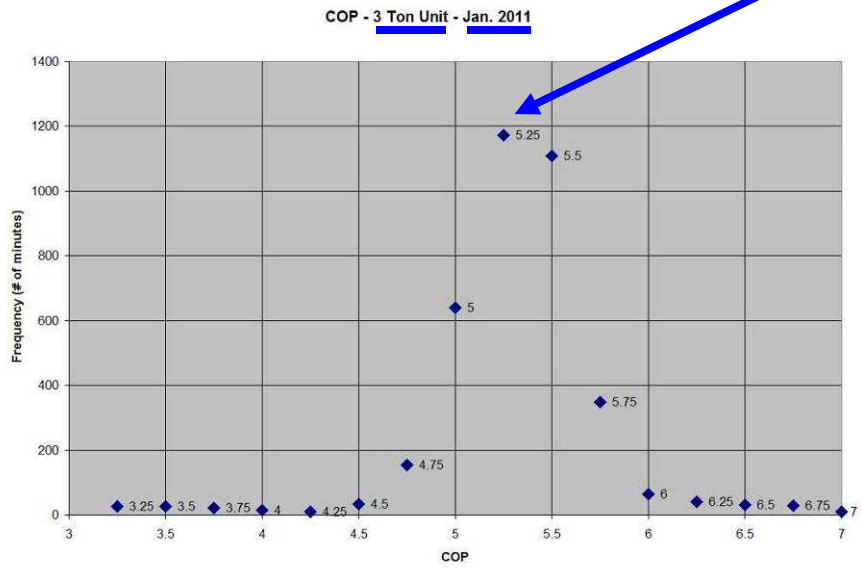
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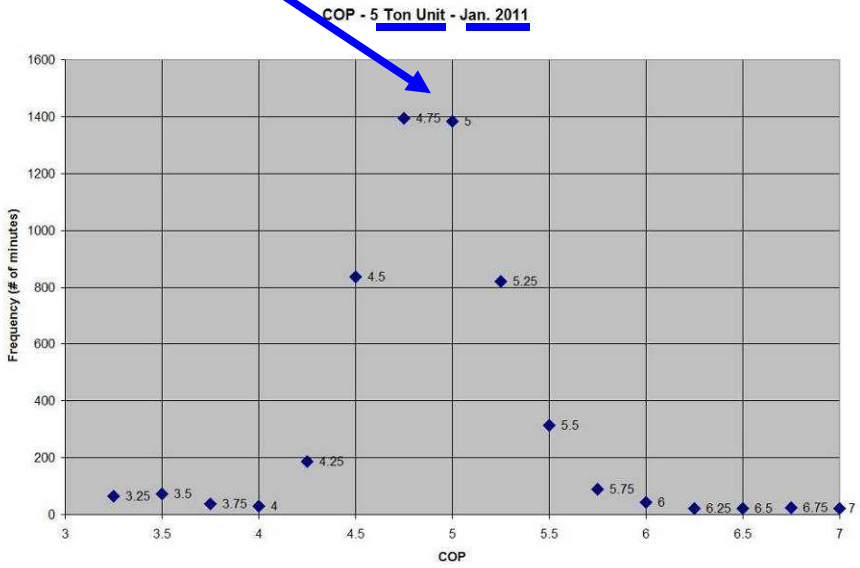
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Geothermal HVAC
Performance



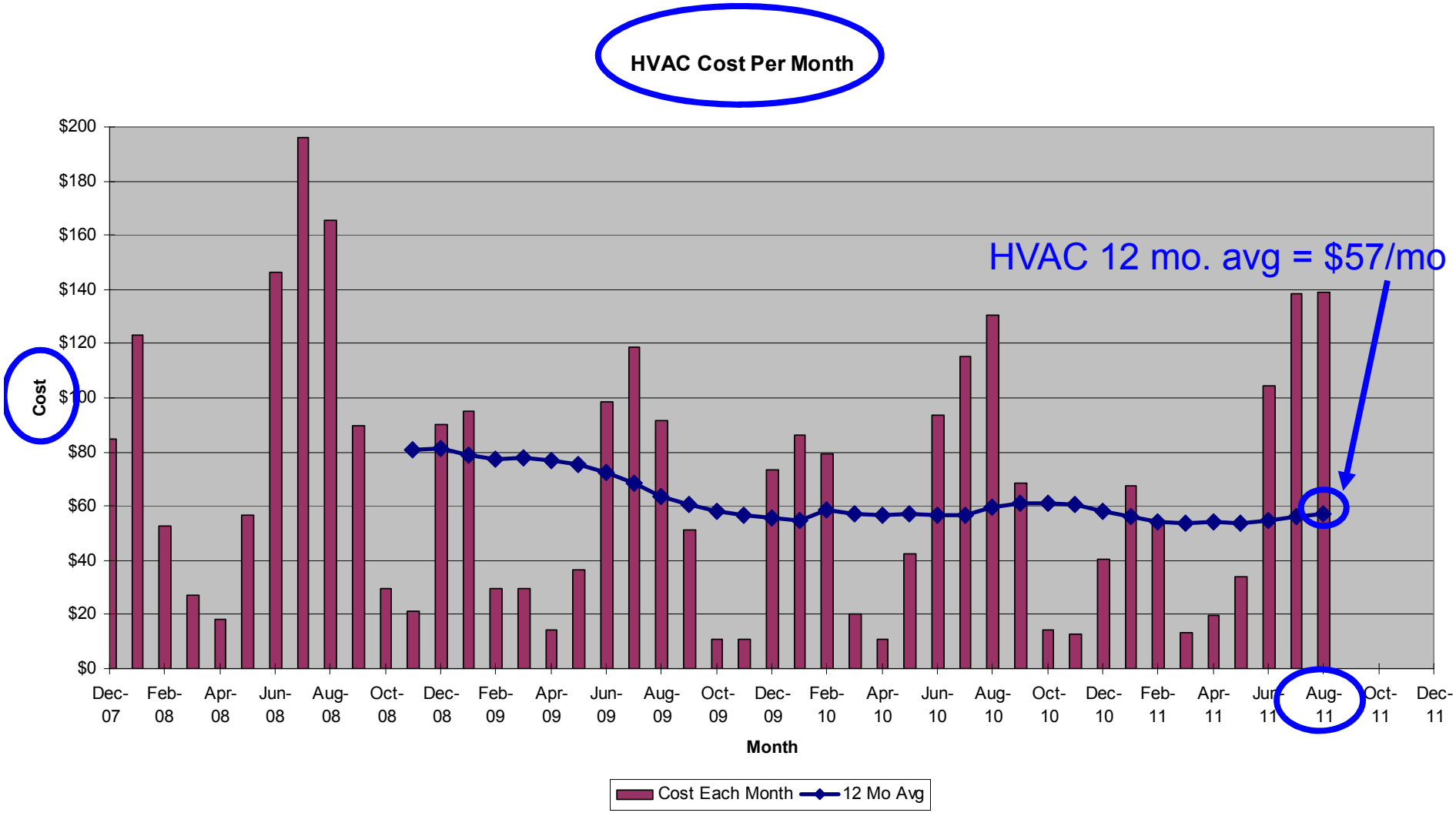
Aug. 2011 Actual Cooling Performance:
21 EER ~ 24 SEER
(matches WaterFurnace specs)

Jan. 2011 Actual Heating Performance:
~ 5 COP (matches WF specs)





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Geothermal HVAC
Operating Cost



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Compact Fluorescent Lamps

Example bulbs (none burned out since 4Q07; none 'ugly'):



R20: GE FLE11/2/R20XL (80892) reflector

- 10,000 hours
- 400 initial lumens
- 11 watts – replaces incandescent 45 W



R30: GE FLE15/2/R30XL (80893) reflector

- 10,000 hours – 7 years guaranteed
- 800 initial lumens
- 15 watts – replaces incandescent 65 W



R40: GE FLE26/2/R40XL (80894) reflector

- 10,000 hours
- 1400 initial lumens
- 26 watts – replaces incandescent 90 W



PAR38: GE FLE26/2/PAR38XL (80895) reflector (outdoor rated)

- 10,000 hours
- 1350 initial lumens
- 26 watts – replaces incandescent 90 W



A19 Bulb Style: Philips 15700-8 soft white

- 8000 hours
- Equivalent to 800 lumens
- 14 watts – replaces incandescent 60 W



Candelabra: GE FLE7/2/CAC (16103) candle shape

- 6,000 hours
- 370 initial lumens
- 7 watts – replaces incandescent 25 W



Post Light: GE FLE11/2/T14XL (89631) (outdoor rated)

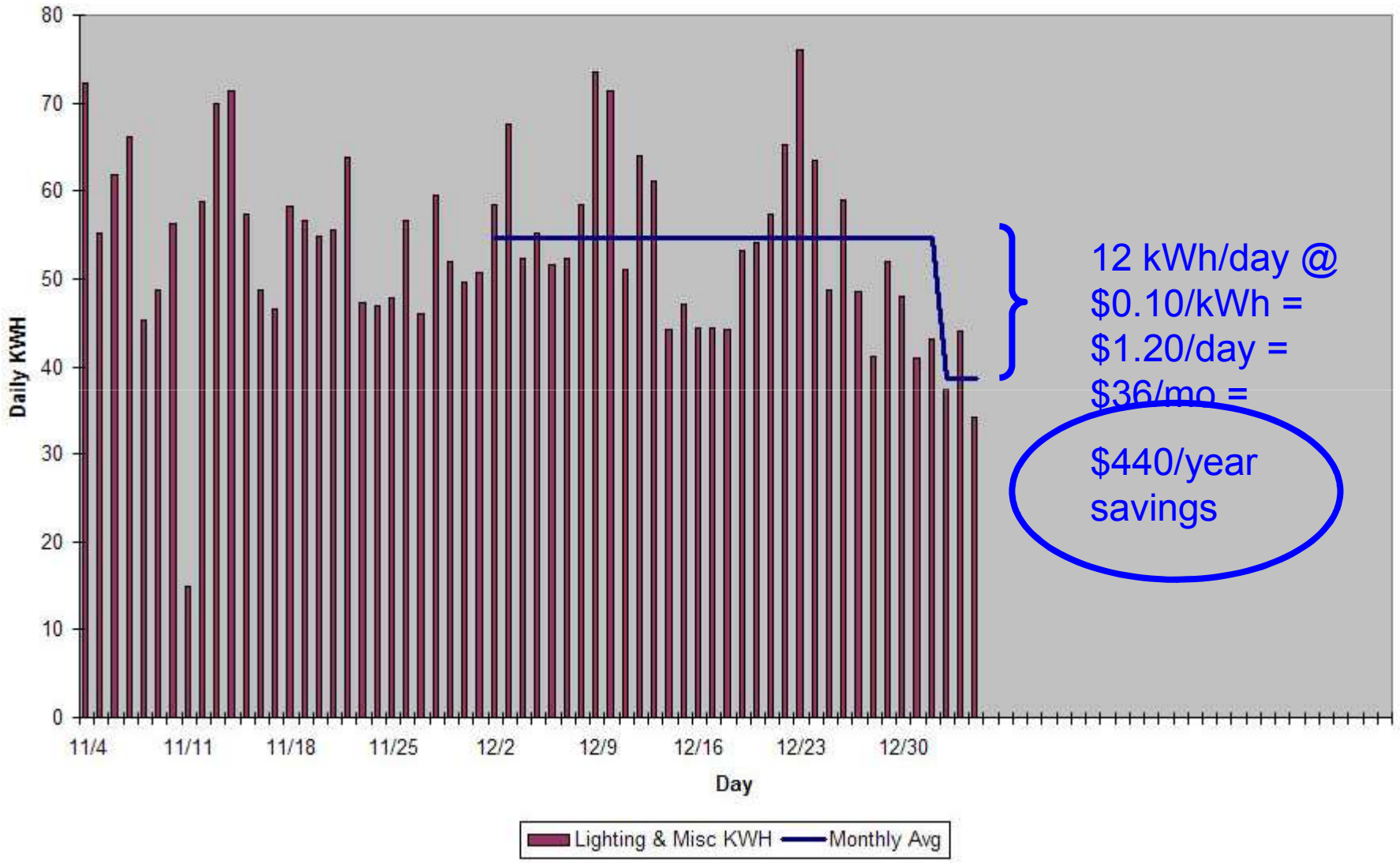
- 10,000 hours
- 500 initial lumens
- 11 watts – replaces incandescent 40 W

Replace every incandescent light bulb with CFL:

- Get it down to everything except oven, refrig, microwave
- Say 'no' to ugly CFL bulbs
- Be careful what you buy – use amalgam technology bulbs for reliability

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Compact Fluorescent Lamps



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Home Automation



HomeVision controller
(http://www.csi3.com/homevis2.htm)

+



Occupancy sensors

+



X10 technology switches

=







✓ Lights, ceiling fans, exhaust fans, entertainment items turned off automatically when nobody is in a room.

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Home Automation
2 Hour Example Log Showing Automatic Turn Off

Kitchen fluorescents, pantry, util room fluorescent & gar hall lights turned Off. 85 Time: 17:02:05 Date: 09/26/11

Family fluorescent lights turned off. 85 Time: 17:02:18 Date: 09/26/11

Playroom lights turned off. 85 Time: 17:10:36 Date: 09/26/11

Bedroom hall lights turned off. John's bedroom and closet lights turned off. John's ceiling fan turned off (between sunrise/sunset). John's/Chris' bath lights and exhaust fan turned off. 85 Time: 17:21:29 Date: 09/26/11

Pantry door opened. 85 Time: 17:31:41 Date: 09/26/11

Zone 2 unoccupied. 85 Time: 17:51:29 Date: 09/26/11

Kitchen fluorescents, pantry, util room fluorescent & gar hall lights turned Off. 85 Time: 17:57:02 Date: 09/26/11

Family fluorescent lights turned off. 85 Time: 18:02:51 Date: 09/26/11

Zone 1 occupied. 85 Time: 18:07:59 Date: 09/26/11

Playroom lights turned off. 85 Time: 18:19:58 Date: 09/26/11

Master bedroom and hall lights turned off. Master bedroom ceiling fan turned off. 85 Time: 18:22:59 Date: 09/26/11

Zone 2 occupied. 85 Time: 18:30:10 Date: 09/26/11

Master bedroom and hall lights turned off. Master bedroom ceiling fan turned off. 85 Time: 18:40:44 Date: 09/26/11

Pantry door opened. 85 Time: 18:44:44 Date: 09/26/11

Master bath lights, ceiling fan, and exhaust fans turned off. 85 Time: 18:54:56 Date: 09/26/11

Zone 3 unoccupied. 85 Time: 19:07:43 Date: 09/26/11

Lighting

Ceiling Fans

Exhaust Fans

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Energy Monitoring – Why?

Reduce costs:

- Lower operating costs:
  a. Instant visualization tool - stimulates usage reduction (i.e., adjust tstats, turn off lights/appliances) – raises consciousness of being more energy frugal.
  b. Provides information needed to adjust maintenance settings.
- Lower maintenance costs - Anticipate repair needs in advance of more catastrophic expenses.

Increase satisfaction:

- Confirm improvements, enhancements, corrective actions were effective.
- Verify advertised equipment performance
- Ensure results occur, surprises don't happen, promised savings materialize.

Enhance decision making:

- Optimize decisions by providing quantitative feedback:
  a. Provides 'base line' to compare future actions to.
  b. Identifies what to work on next – facilitates pareto analysis.
  c. Offers data for informational and analysis purposes – perform ROI analysis.
- Enables questioning of unusual anomalies to identify more opportunities.

Speed up repairs / problem solving:

- Fix specific problems quicker / more accurately.

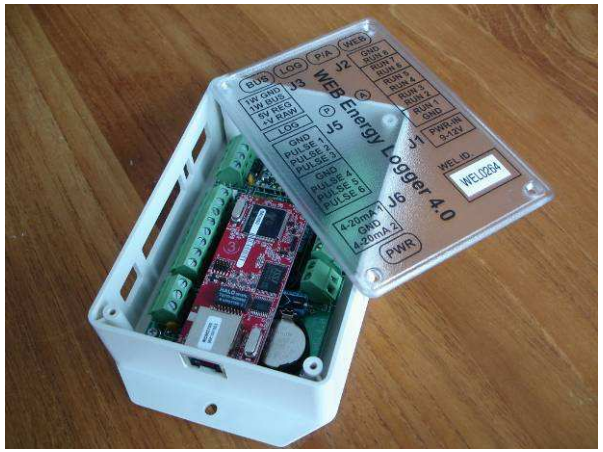
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Energy Monitoring Example

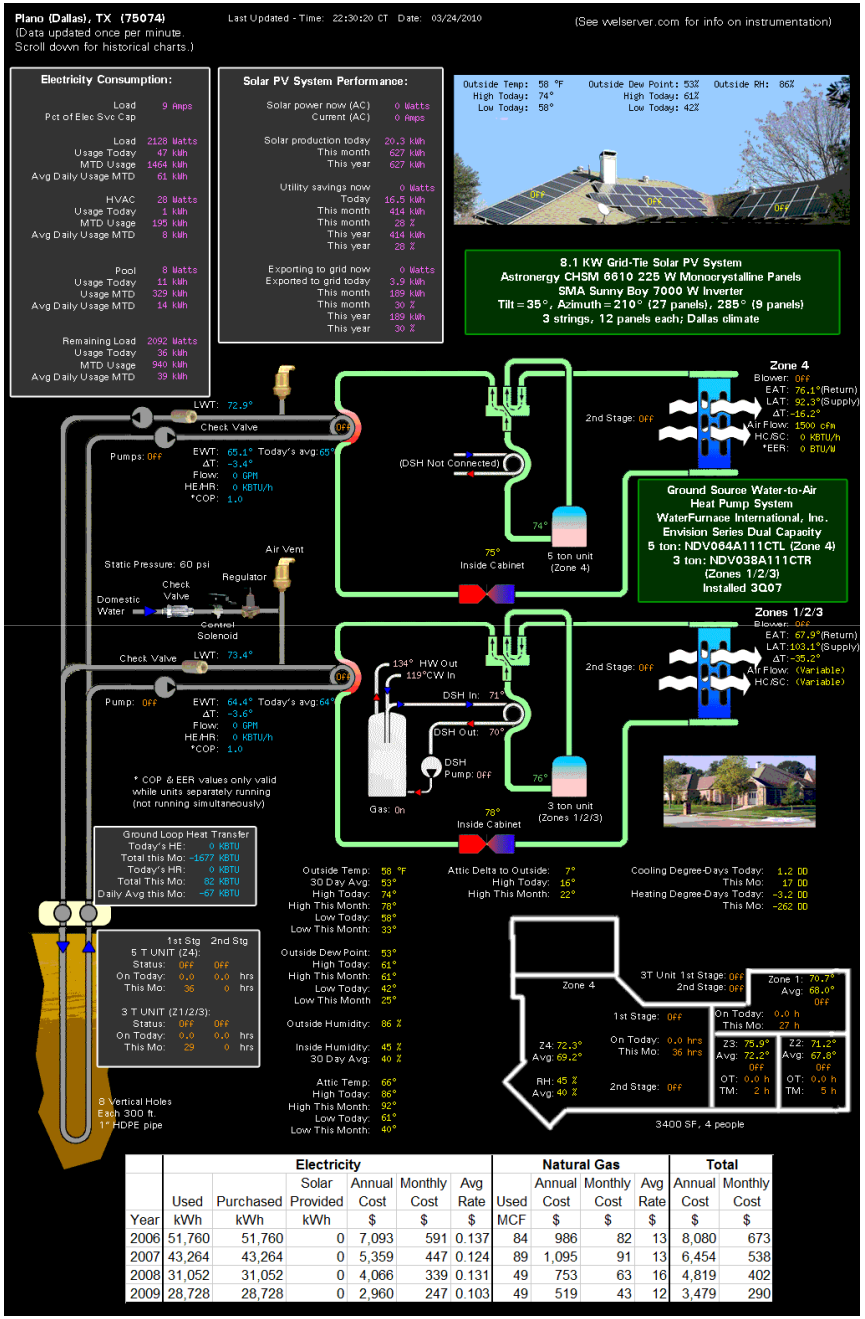
http://welserver.com/WEL0043

Web Energy Logger (WEL)



http://www.welserver.com

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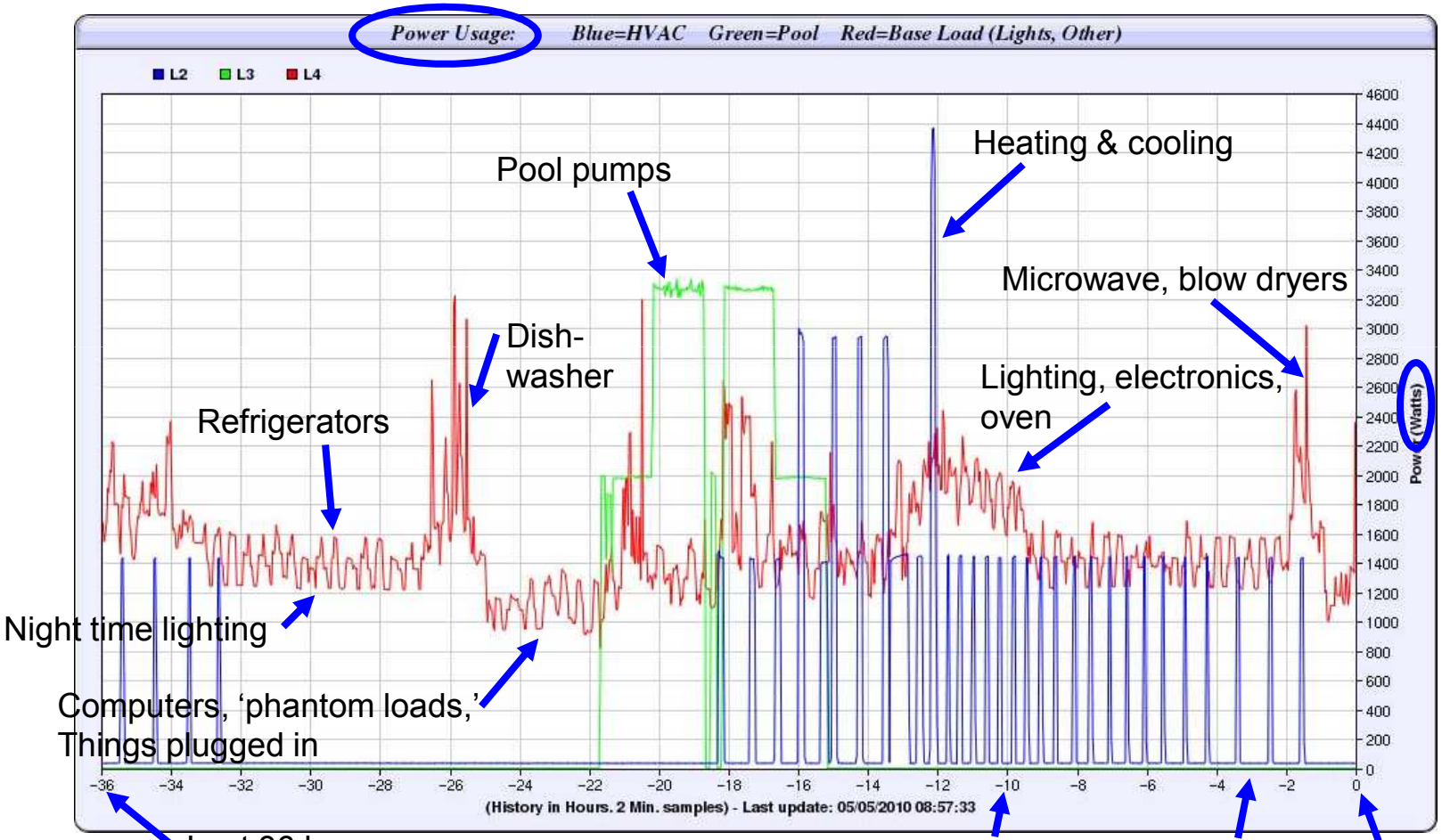
	Electricity						Natural Gas				Total	
	Used	Purchased	Solar Provided	Annual Cost	Monthly Cost	Avg Rate	Used	Annual Cost	Monthly Cost	Avg Rate	Annual Cost	Monthly Cost
Year	kWh	kWh	kWh	$	$	$	MCF	$	$	$	$	$
2006	51,760	51,760	0	7,093	591	0.137	84	986	82	13	8,080	673
2007	43,264	43,264	0	5,359	447	0.124	89	1,095	91	13	6,454	538
2008	31,052	31,052	0	4,066	339	0.131	49	753	63	16	4,819	402
2009	28,728	28,728	0	2,960	247	0.103	49	519	43	12	3,479	290

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Energy Monitoring – Why?

Example – Lower Operating Costs

(Visualization tool to stimulate usage reduction)



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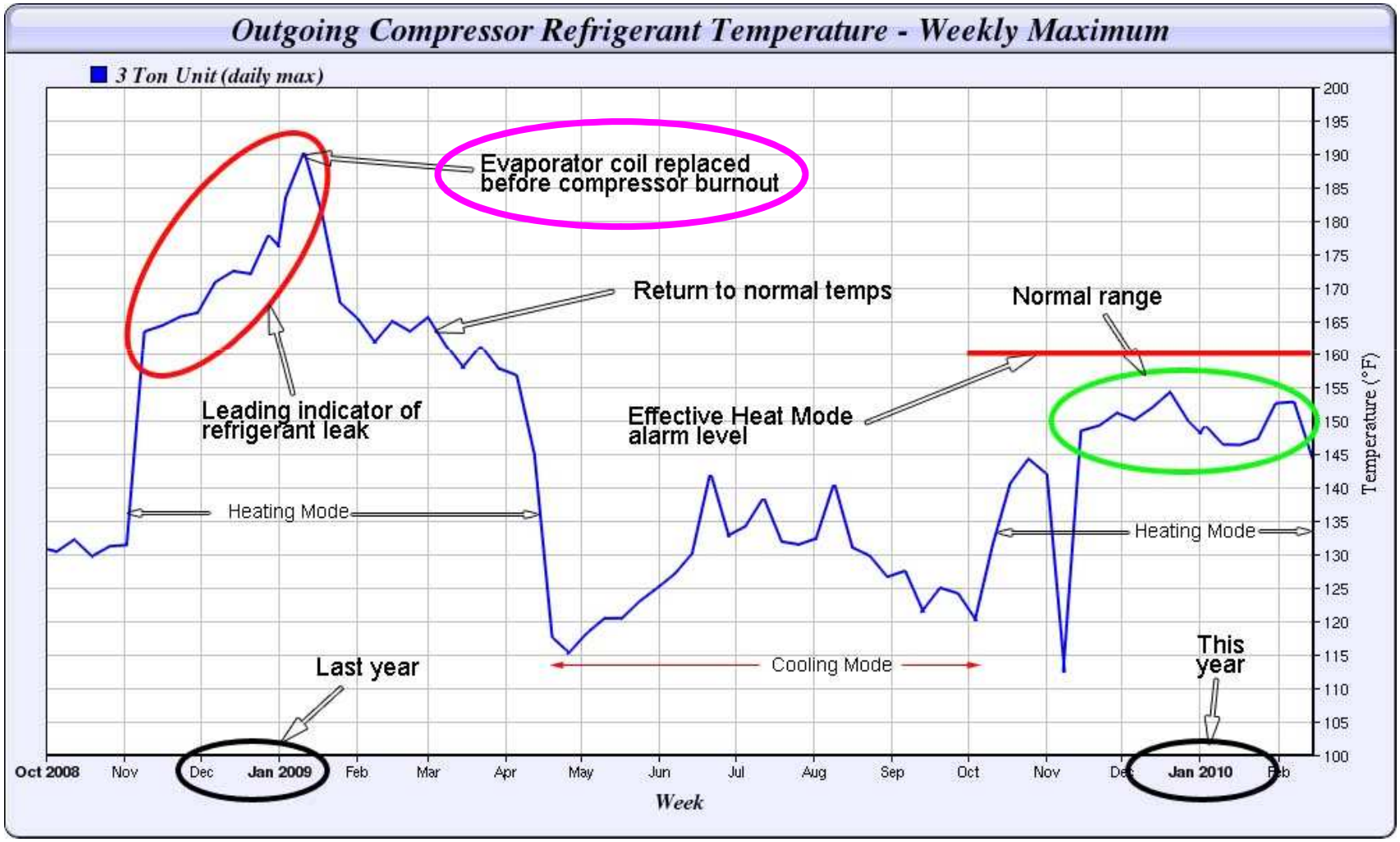
Electronics, TV, cooking, lights

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Energy Monitoring – Why?

Example – Lower Maintenance Costs

(Anticipate repair needs in advance of catastrophic expenses – i.e. heat pump coil replacement)



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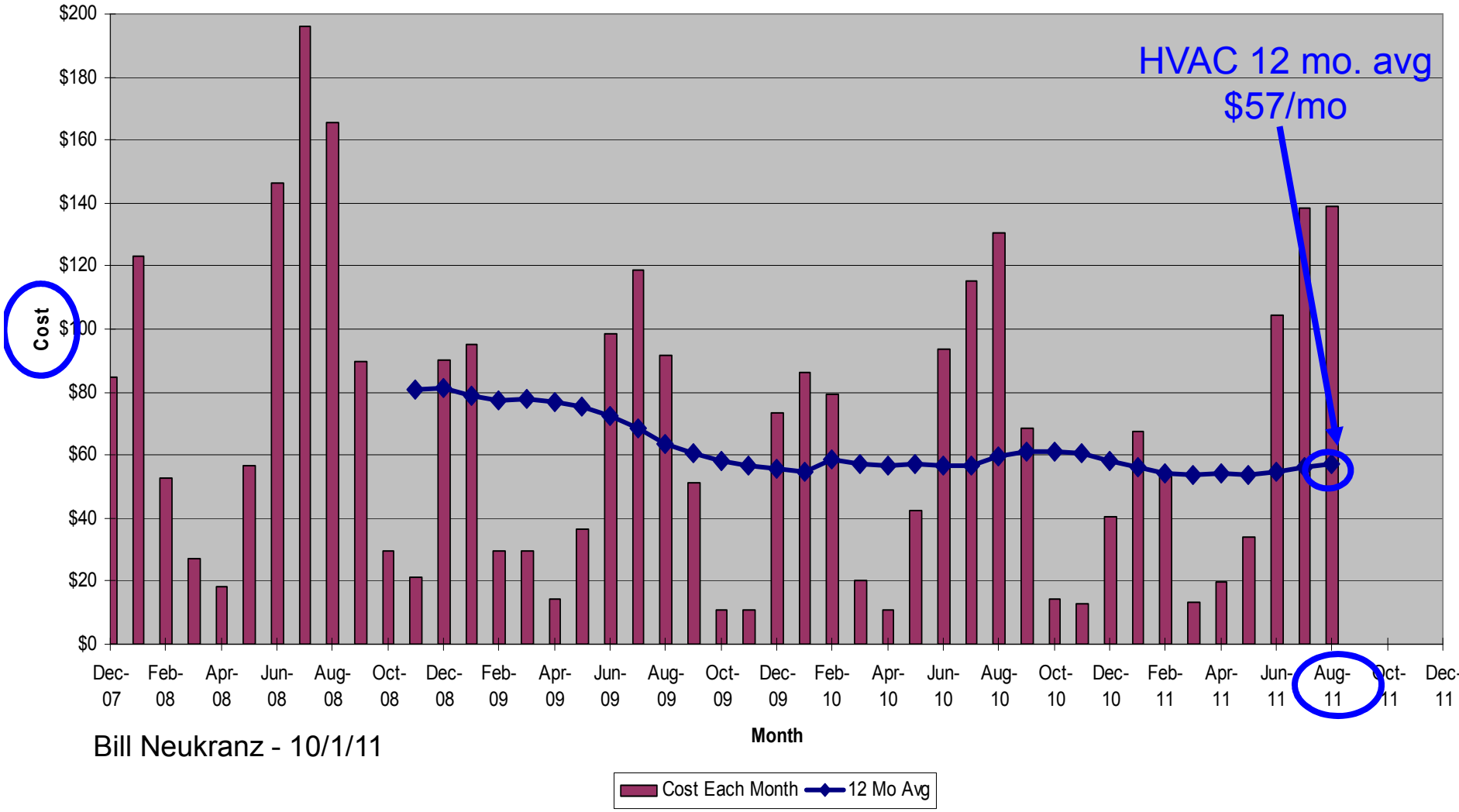
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Energy Monitoring – Why?

Example – Increase Satisfaction

(Confirm improvements, etc. result in real savings - i.e. geothermal HVAC replacement)

HVAC Cost Per Month



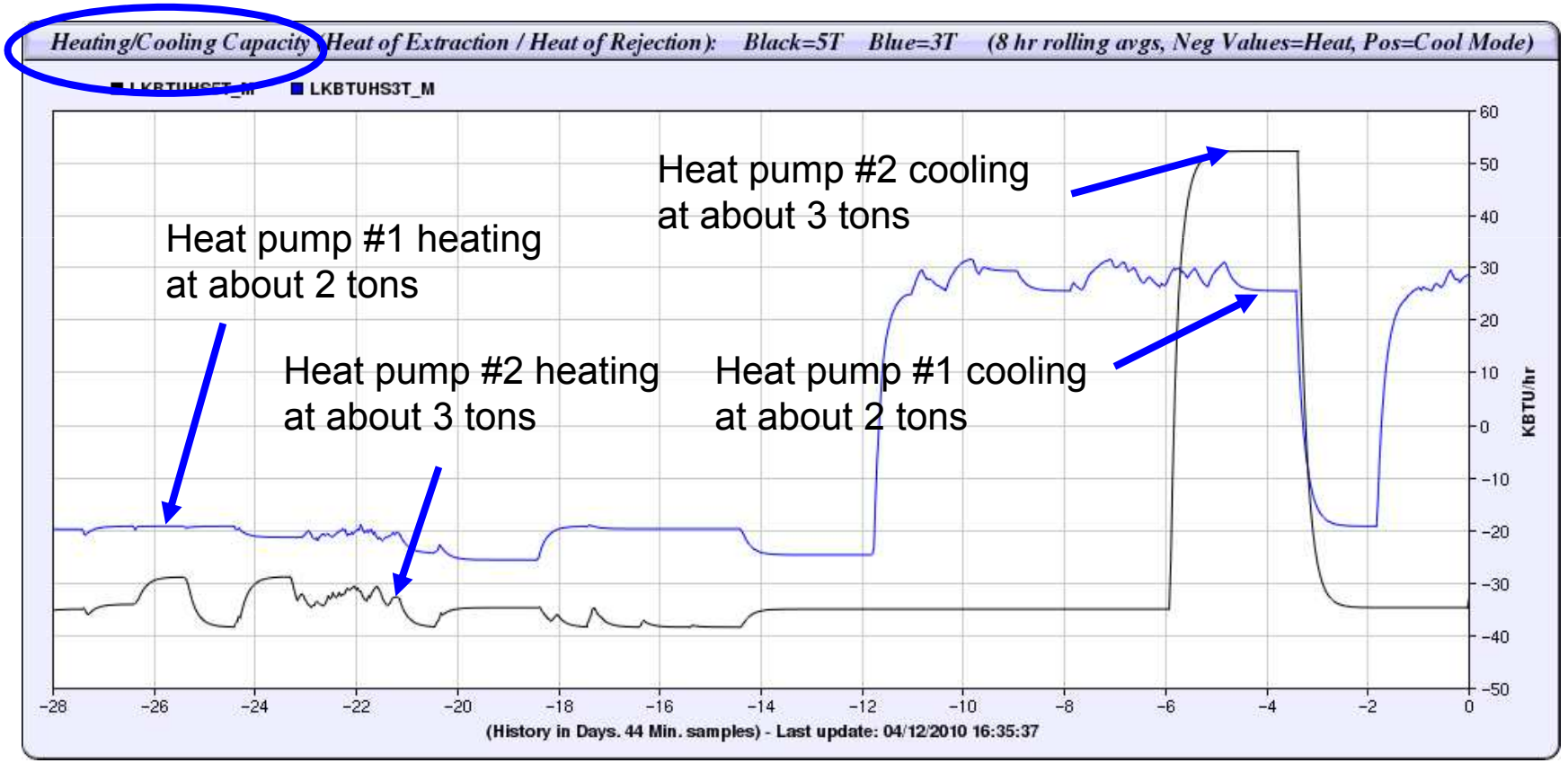
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Energy Monitoring – Why?

Example – Increase Satisfaction

(Verify advertised equipment performance)



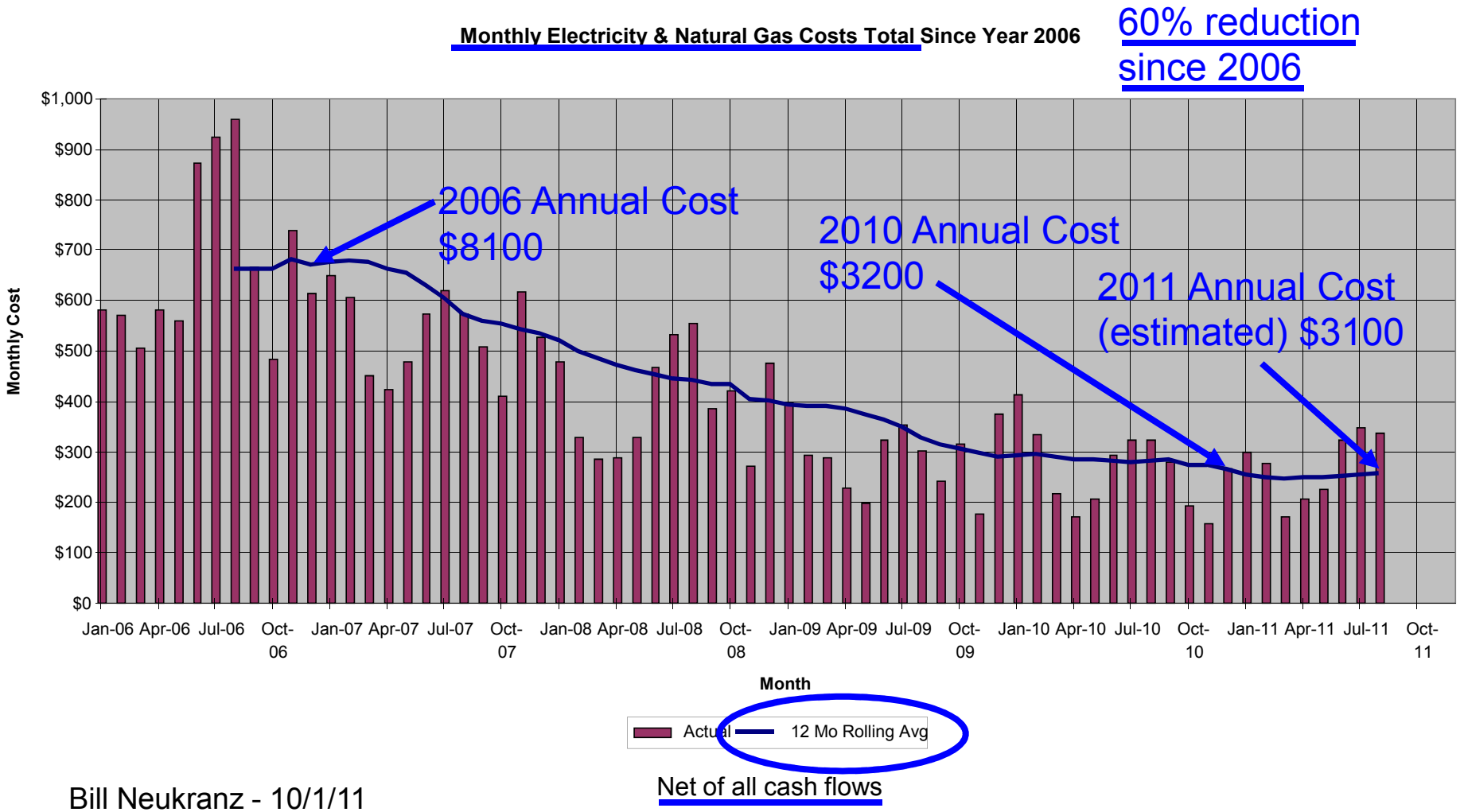
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Energy Monitoring – Why?

Example – Increase Satisfaction

(Ensure results occur, surprises don't happen, promised savings materialize)



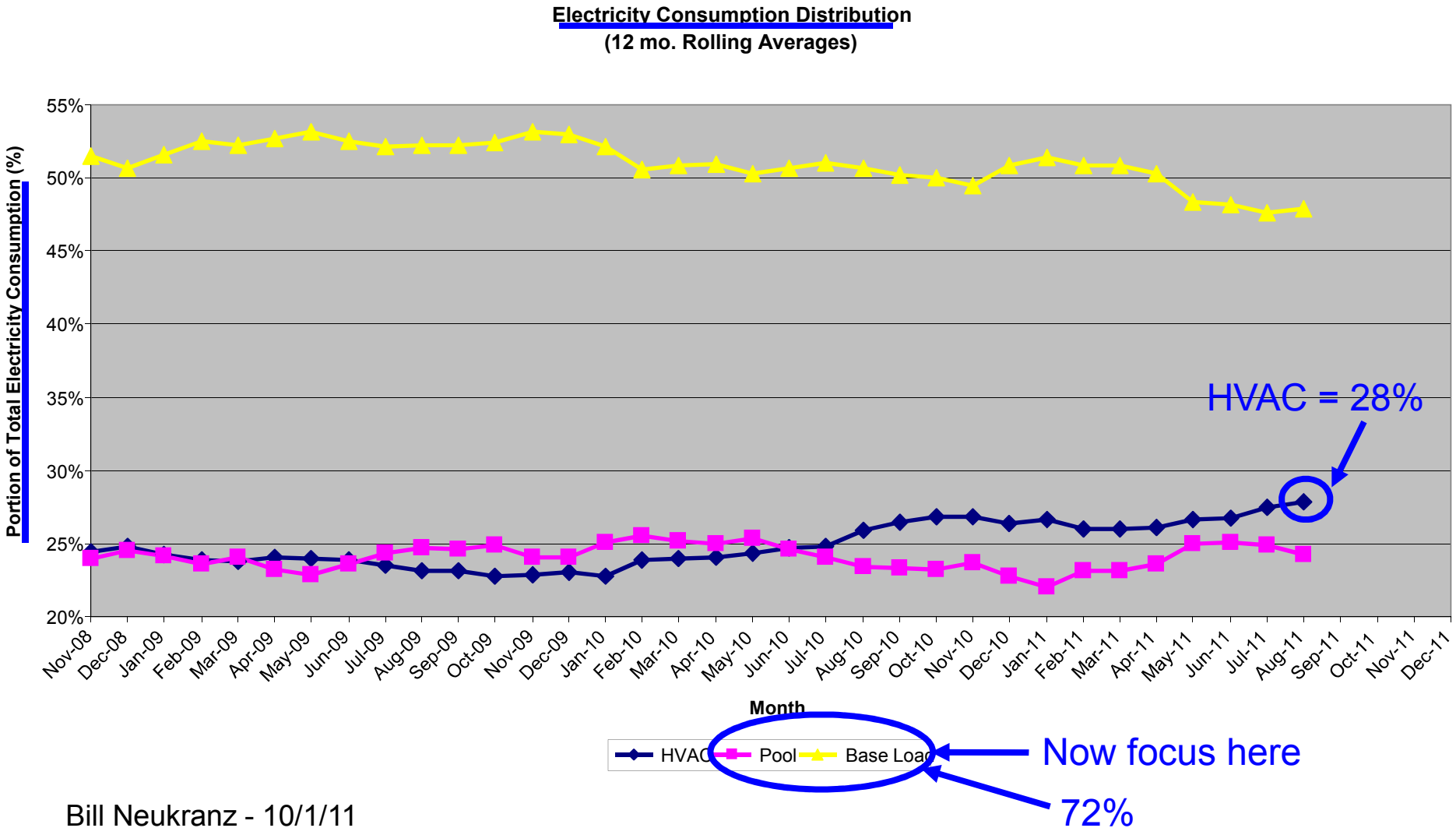
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Energy Monitoring – Why?

Example – Enhance Decision Making

(What to work on next – i.e. pool pumps)



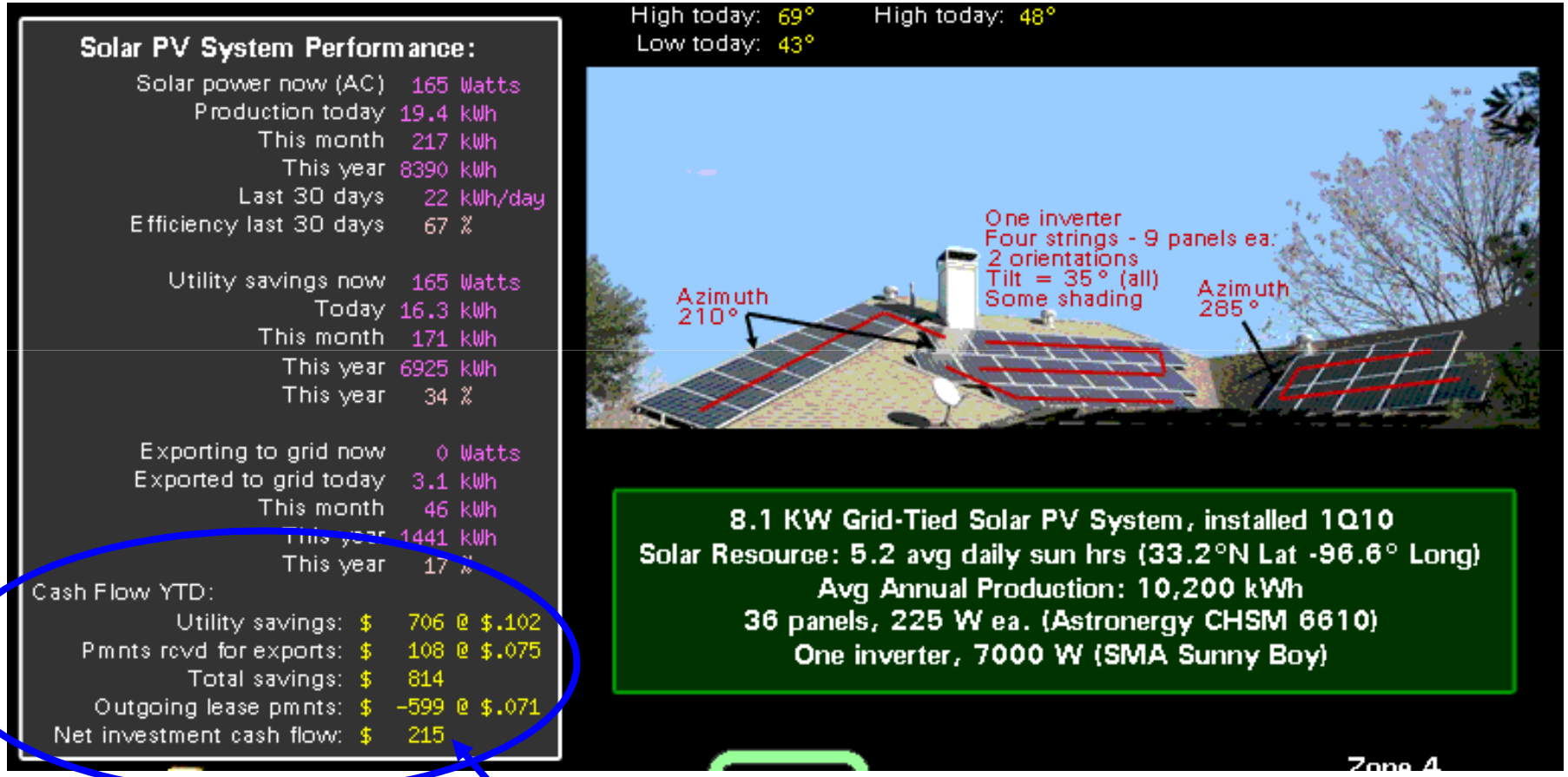
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Energy Monitoring – Why?

Example – Enhance Decision Making

(Perform ROI analysis – i.e. solar PV system)



Approx $23/mo net savings
(positive cash flow)

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Appendix

Ten Steps to Cut Your Energy Costs in Half

Summary

No cost,
or low cost;
small effort



Higher cost;
larger effort

1. **Aggressively manage your electric utility rate**
2. **Replace every incandescent light bulb with CFL**
3. **Change your living style**
4. **Turn stuff off**
5. **(Optional) Understand and measure actual energy consumptions**
6. **Research what your governments and utilities are offering**
7. **Look very hard at heating & cooling the structure – maybe include energy audit**
8. **Replace appliances with Energy Star or lower power versions**
9. **Put in home automation system to save even more**
10. **Put in solar PhotoVoltaic (PV) system to make your own power**

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Appendix

Aggressively Manage Your Electric Utility Rate

AT A GLANCE In the electric-rate game, knowledge is power

How to choose an electricity rate plan

- Make sure you understand your current plan. Is there a penalty for leaving the plan or an advantage to signing a new contract with your existing company?
- Go to www.powertochoose.org to compare pricing plans. Most experts recommend fixed-rate plans for residential customers. Plans range from three months to two or three years, and there is usually a penalty for leaving the plan early.
- Identify a few pricing plans with a term that's right for you, then read the Facts Labels. Look at the average price you will pay based on your monthly electricity use. Then look carefully for any fees or extra costs that could drive up your bill. Are any fees excluded from the price?
- When you have chosen a pricing plan, read the terms of service to make sure you understand the price, fees and payment rules. What are the payment options? What happens when the contract expires? Call the company if you can't find the answers to these questions.
- Click "sign up," which takes you to the provider's website. Sometimes companies charge deposits, so be prepared to walk away and start over if the deposit is too expensive.

How to game the introductory-rate system

Squeezing the most out of introductory variable rates requires diligent work, much like the old 12-CDs-for-a-penny music clubs. This is not for the automatic bill payment crowd. Here's how it can be done:

Know the date of your monthly meter read and put it on your calendar each month. If you can't find it on your bill, call Oncor. This is crucial because some introductory rates end on the date of your next meter read.

Go to www.powertochoose.org and find the cheapest variable rate. The lowest rates (right now as low as 4.5 cents per kilowatt-hour) are likely to be introductory rates that will rise after the first billing cycle.

Read the rules carefully. Some companies raise the rate after your next meter read, even if that's only a few days away. Other companies give you the rate for a full month.

Mark on your calendar the date the offer ends. Find out what your rate will rise to the next month by scouting around the company's website or calling.

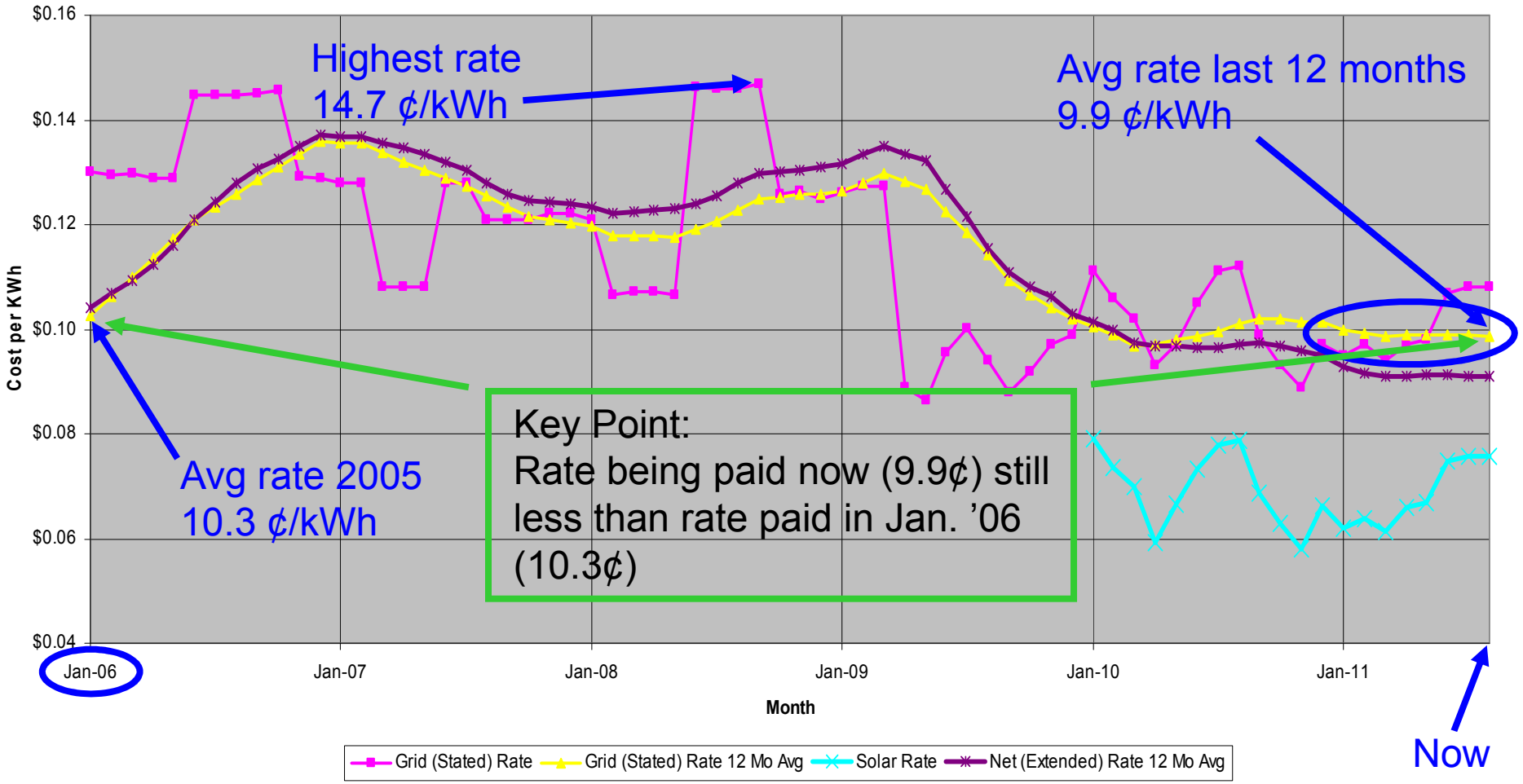
As the end date approaches, shop for another rate. You could try hopping from one introductory rate to another. Or use the introductory rate to try out a new company and, if you like the retailer, switch to its lowest fixed-rate contract after the promotion ends.

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Appendix

Management of Electric Utility Rate – Actual Example

kWh Rates Since Year 2006



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