



Swimming Pool Energy Audits - Energy Savings for Homes with Pools

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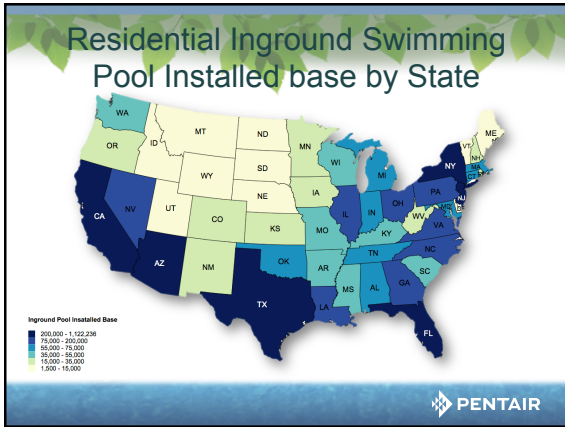
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Pentair Aquatic Systems

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A National View of Pool Energy Use

- \$1.1-1.6 billion spent per year in energy
- 9 to 14 billion kWh per year for pumps
- 36 to 63 million therms per year, heating
- CO2 emissions =10 million tons per year
- Use the equivalent of 24 medium sized (500 MW) power plants
- Emissions of 1.3 million cars

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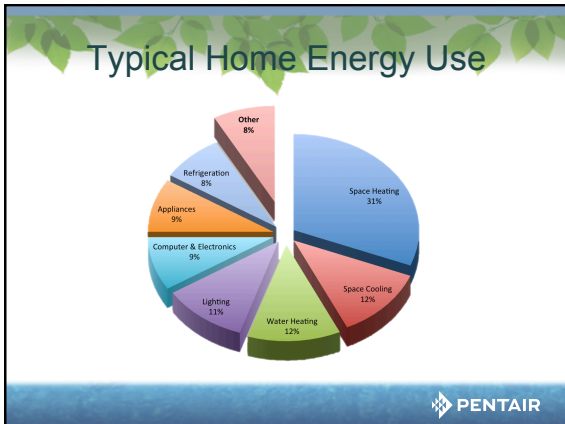


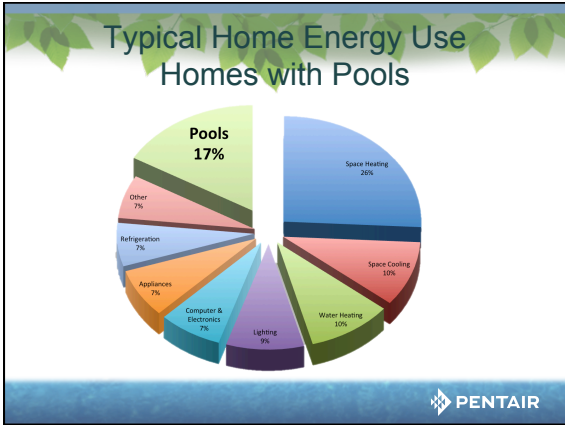
Estimated Residential Inground Pools

Table 1: 2007 estimated residential inground pools by state.

State	Inground Pools	State	Inground Pools
California	1,122,236	Arkansas	43,659
Florida	757,016	South Carolina	41,811
Texas	458,196	Washington	39,479
Arizona	299,251	Wisconsin	39,447
New York	255,494	West Virginia	37,078
New Jersey	203,774	Oregon	35,761
Pennsylvania	138,661	New Hampshire	32,283
Georgia	126,861	New Mexico	27,806
Ohio	116,241	Colorado	24,738
Louisiana	95,263	Kansas	24,677
North Carolina	86,363	Minnesota	23,068
Illinois	84,771	Iowa	21,973
Nevada	77,978	Rhode Island	20,113
Virginia	76,253	Maine	18,638
Michigan	69,901	Delaware	17,767
Connecticut	68,820	Utah	13,070
Maryland	68,036	Idaho	12,722
Alabama	67,922	Nebraska	11,907
Indiana	65,921	Vermont	9,720
Massachusetts	61,790	Wyoming	9,662
Tennessee	58,941	Montana	9,398
Oklahoma	57,181	South Dakota	5,634
Kentucky	47,564	North Dakota	5,303
Mississippi	42,372	District of Columbia	1,532
Missouri	40,576		

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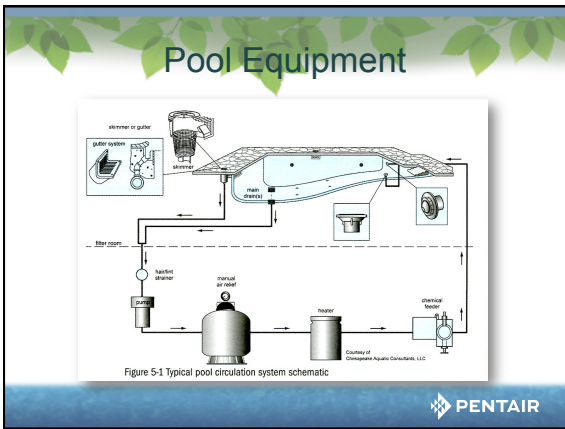
Pool Retrofits Are Good Investments

Home Savings from upgrading 2,500 ft² single story home to Energy Star Levels

City	Climate Zone	Swimming Pool	Energy Star Home
Phoenix	3	\$390	\$509
Los Angeles	4	\$633	\$529
Orlando/Tampa	2	\$621	\$679
Islip (NY)	11	\$454	\$686
San Antonio	4	\$491	\$704

*National Resources Defense Council (NRDC) Synergies in Swimming Pool Efficiency – March 24, 2008

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- ### Where Pools Use Energy
- Filtration of water
 - Pools sweeps or cleaners
 - Pool heating
 - Pool lighting
 - Water features
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- ### Energy Savings Technologies for Pools
- Variable speed pumps
 - PV powered Variable speed pumps
 - Efficient heaters, Solar, HP, Gas
 - Better controls and schedule
 - Pools covers
 - LED lights
 - Better designed plumbing
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Typical residential pool energy usage

- Typical National Pools
- Filter Pumps draw 1,500 - 2,500 watts
- Run 4.5 - 24 hrs/day Ave.- 6 hrs /day
- 3,800 kWh/year
- Cleaners 1,200-1500 watts 3.5 hrs/day
- Filtration and cleaning can exceed 5,300 kWh/ year





Bringing it all together

RETROFIT CASE STUDY



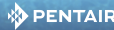
Retrofit Case Study

- Northern California
- 20,000 gallon pool, built 2002
- Tiered Utility Rates \$.12 - \$.40/kWh


Retrofit Case Study, Before

- 1 ½-horsepower standard pool pump (for filtration and solar heating)
- Sweep-style pool cleaner with a ¾-hp booster pump
- 2-hp waterfall pump one
- 500 watt incandescent light



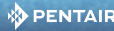
Retrofit Case Study, Summer, No Solar

- Old pump, 6 hrs/day run time
- Pump, 2,092 w X 6 hrs/day = 12.5 kWh/day
- Cleaner, 1,372 w x 2.5 hrs/day = 3.4 kWh/day
- **Total energy 15.9 kWh/day**
- New pump, 10 hrs/day run time
- Pump = 221 w X 7 hrs/day = 1.6 kWh/day
- Pump & cleaner, 650 w @ 3 hrs/day = 2 kWh/day
- **Retrofit total energy = 3.6 kwh/day**
- **Savings = 15.9 – 3.6 = 12.3 kWh/day**




Retrofit Case Study, Before

- The original single-speed pump ran an average of 6 -7.5 hours/day @ about 2100 watts for filtration and heating.
- The pool cleaner's booster pump, which ran for about 2.5 hours/day, @ an additional 1372 watts.
- Combined, these two pumps were using an average of 15 kWh per day.




Retrofit Case Study, After

- Variable-speed pump (for filtration, solar heating and pool cleaner)
- 2nd variable-speed pump for waterfall
- LED lighting



Retrofit Case Study

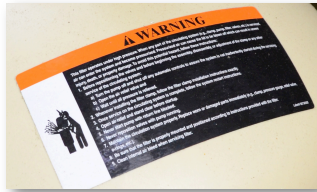
FILTER PUMP OPERATING COST COMPARISON				
Function	Old pumps		New variable-speed pump	
	summer	winter	summer	winter
filtration	2092 watts 6 hours per day 12.6 kWh \$153 per month	2092 watts 4 hours per day 8.4 kWh \$102 per month	221 watts 6 hours per day 1.3 kWh \$16 per month	221 watts 3 hours per day 0.66 kWh \$8 per month
	(year round) 1372 watts 2.5 hours per day 3.4 kWh \$42 per month		(year round) 650 watts 3 hours per day 2.0 kWh \$24 per month	



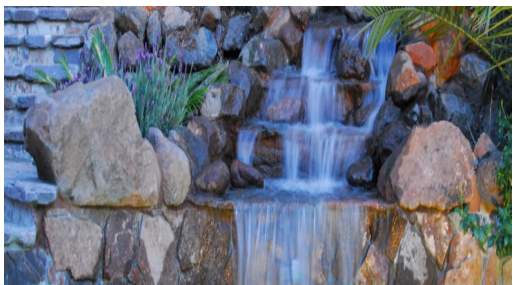

Pool Equipment




BE Safe !!

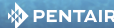



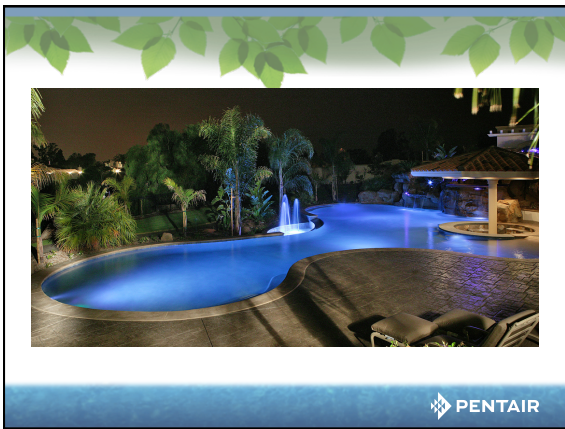
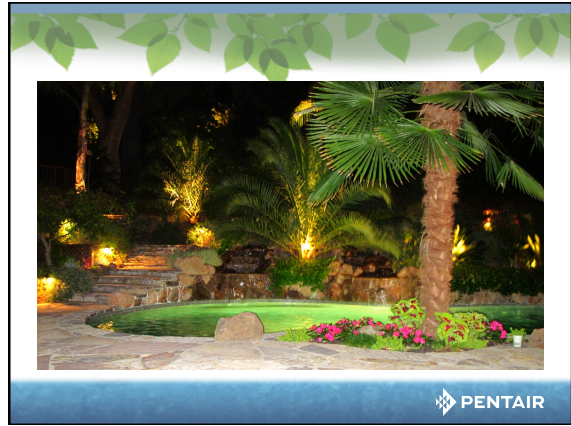
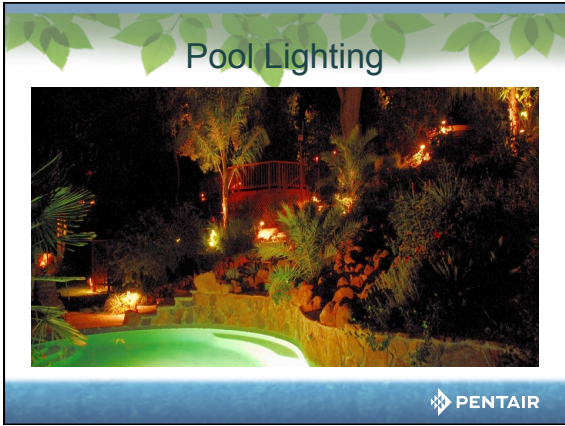

Water Feature

Water Feature Retrofit Case Study

WATERFALL PUMP OPERATING COST COMPARISON		
	Old single-speed pump	New variable-speed pump
waterfall	2418 watts \$0.97 per hour	905 watts – high flow setting \$0.36 per hour
		351 watts – medium flow setting \$0.14 per hour
		187 watts – low flow setting \$0.07 per hour





Pool Lighting

- Incandescent = 500 watts
- LED = 45-70 watts, multiple themes
- LED's last substantially longer



500 watts




70 watts

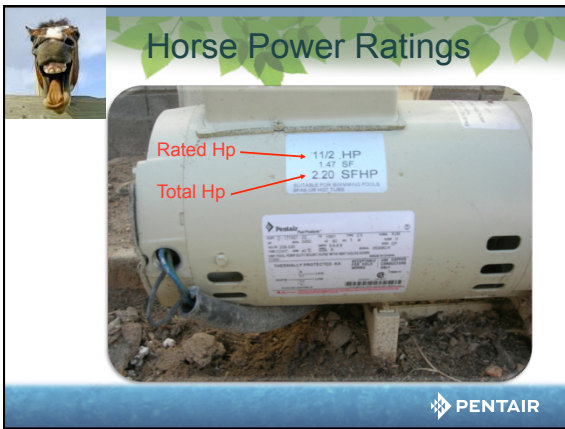
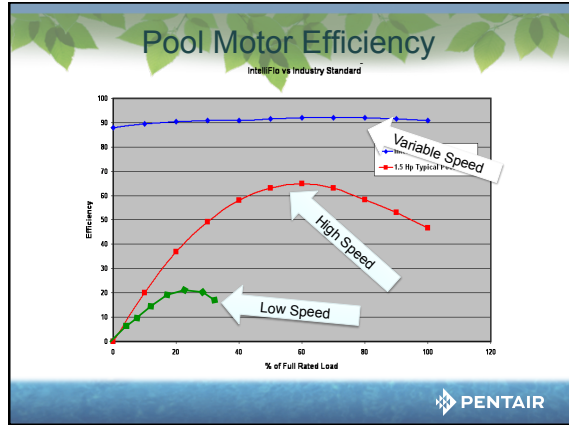
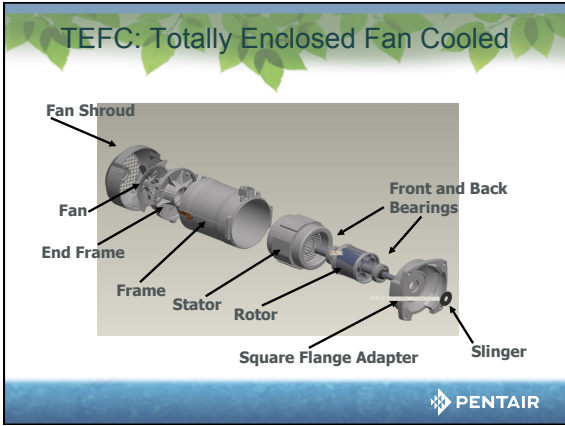
Technology efficiency

POOL PUMP MOTORS

Induction Motor Efficiency

Motor Type	Efficiency Range (%)
Split Phase	25% - 45%
Capacitor Start Induction Run	40% - 55%
Permanent Split Capacitor	45% - 60%
Capacitor Start Capacitor Run	55% - 75%
ECM - (Variable Speed)	89% - 92%





1 Hp ≠ 746 Watts

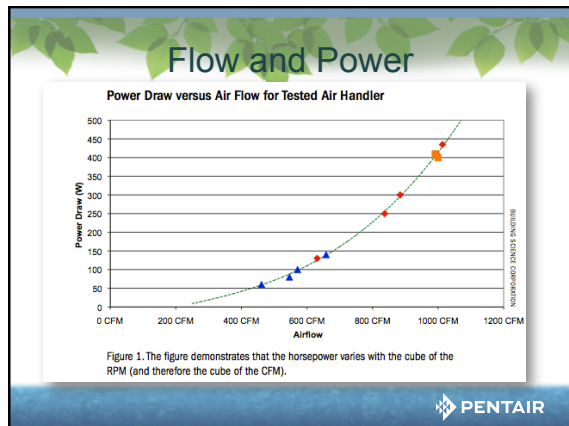
Pool Pump Hp	Traditional	Variable Speed
1/2 Hp	1200 W	150 W ↕ 400 W
3/4 Hp	1400 W	
1 Hp	1600 W	
1 1/2 Hp	1900 W	
2 Hp	2300 W	
3 Hp	2800 W	

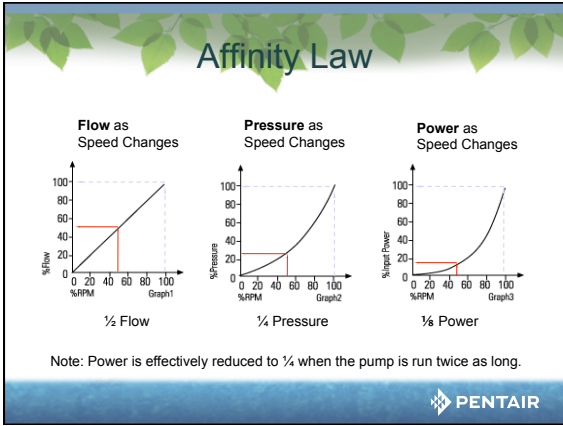
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How savings are achieved

AFFINITY LAW & PRESSURE

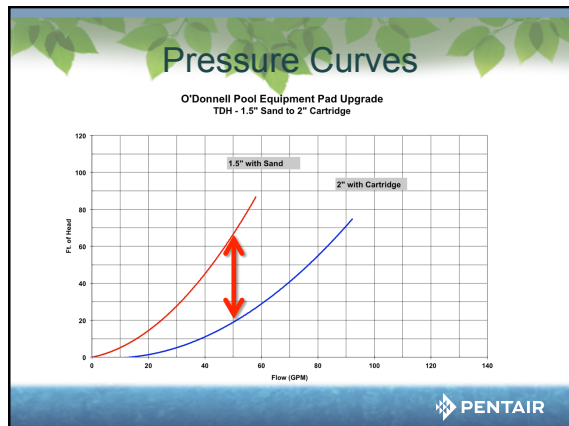
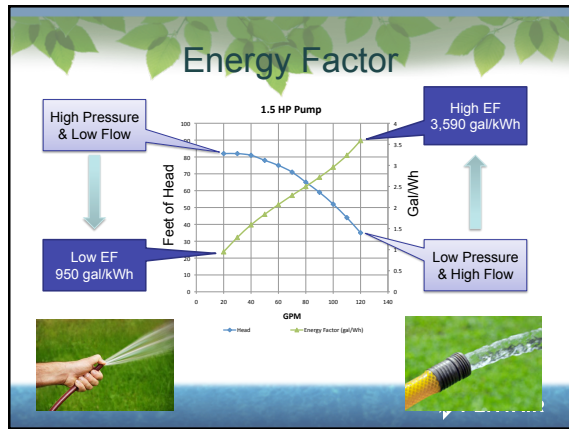
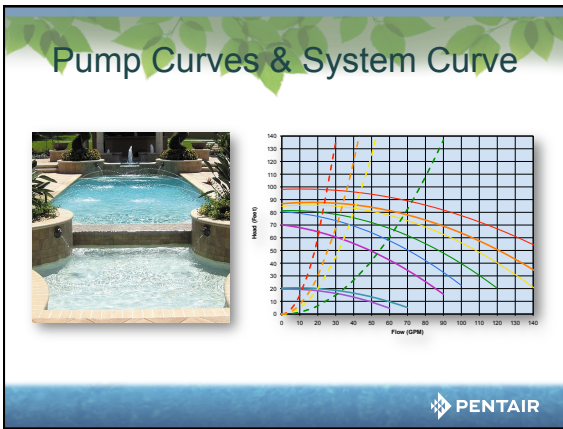
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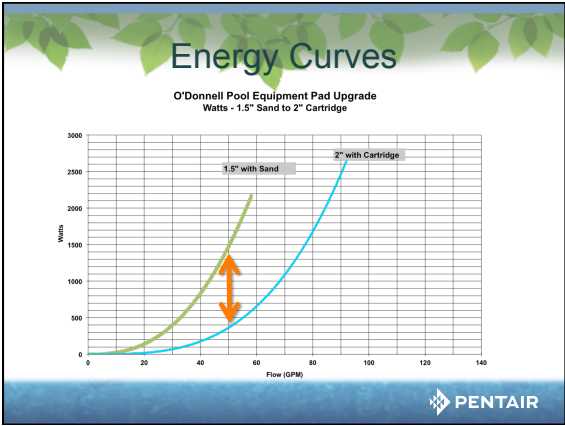




Affinity Law

Speed (rpm)	Flow (gpm)	Power (W)
3450	66	2000
3000	55	1157
2400	44	593
1800	33	250
1200	22	74
600	11	9
0	0	0





Results From PG&E's Pool Pump Trailer

Pacific Gas and Electric Company

Pump	Flow Rate (GPM)	Hours /day	Hours /year	Power (kW)	Energy (kWh /year)	Energy Cost (\$/ year)
Single Speed 3/4 HP	60	6.9	2535	1.20	3042	\$913
Two Speed 2 HP - High	73	5.7	2083	2.03	4229	\$1,269
Two Speed 2 HP - Low	33	12.6	4609	0.51	2350	\$705
Variable Speed	33	12.6	4609	0.18	830	\$249

Assumes 25,000 gallon pool, 1 turnover per day, \$0.30/kWh.

It is not complicated

ENERGY AUDIT TOOLS

The Difference Between kW & kWh

- Kilowatts (kW): An "Instantaneous" measure, ...example, 20 mph "right now"
- Kilowatt hours (kWh): A "Quantity" ...example, 12,000 miles "over time"

Calculating Cost

Watts (kW) x Time (hrs/day) x Cost (\$/kWh)

- 2.0 kW x 8 hrs/day x \$.15/kWh = **\$2.40 / day**
- \$2.40/day x 30 days/month = **\$72.96 / month**
- \$72.96 / month x 12 months/yr = **\$875.52 / year**

Case Study – 18,000 Gallon Pool

AVG Energy Efficient pump	Watts	GPM	Hours
1/2	1220 W	66	4.54
3/4	1525	73	4.10
1	1700	80	3.75
1.5	2000	87	3.45
2	2200	91	3.29
3	2800	98	3.06
VS @30gpm	150	30	10


Variable Speed vs. 1.5 Hp EE

One turnover per day example

18,000 gallon pool –

1.5 hp 2000 W---**87 gpm**
 18,000g / **87gpm** / 60 min = 3.45 hours
 3.45hrs X 2.0 kW = **6.9kWh**

Variable Speed at **30 gpm**
 18,000 / **30 gpm** / 60 min = 10 hours
 10hrs x 0.150 kW = **1.5kWh**



Variable Speed vs. 1.5 Hp EE

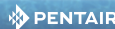
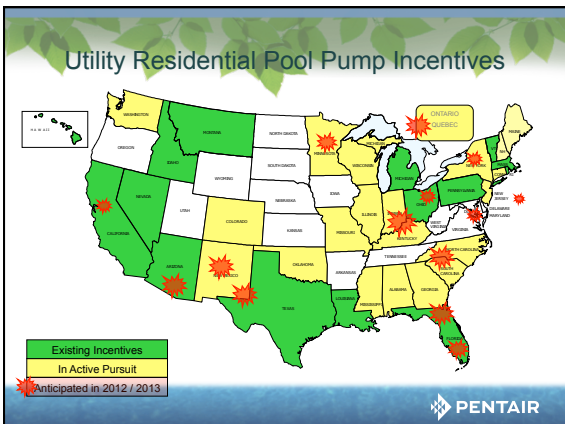
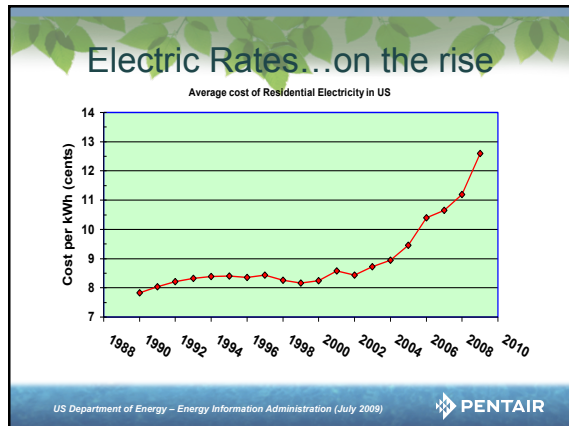
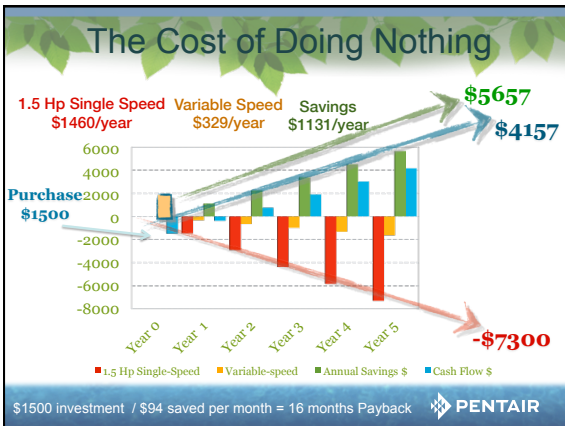
1.5 Hp 2000 W - 87 gpm
 3.45hrs X 2.0kW X \$.25 X 365 = \$629

8hrs X 2.0 kW X \$.25 X 365 = \$1460 \$122/month
 12hrs X 2.0kW X \$.25 X 365 = \$2190
 24hrs X 2.0kW X \$.25 X 365 = \$4380

Variable Speed at 30 gpm 150 W
 10hrs x .150 kW X \$.25 X 365 = \$137


24hrs X .150 kW X \$.25 X 365 = \$329 \$27/month

Variable Speed Saves \$95 per month-\$1131 per year

Now let's look at the Audit Software for iPad & Android

ENERGY AUDIT TOOL



Audit

Home Customer Pool Pumps Lights Report

Pool

Pool Volume: 27000 Gallons

Operational Days Per Year: 180 Days

TDH Factors

Cleaner?

Pipe Size (suction): 2 inches

Pipe Size (return): 2 inches

Filter Type: Sand Cartridge D.E.

Filter Pressure: 8 PSI

Head Loss Characteristic: Medium

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Audit

Home Customer Pool Pumps Lights Report

Target Turns: 1.0 Turns Per Day

Current Pump

Pump: Brand, Model, Speed Type, HP, sf, utp

HP Override: 1.5 HP

Speed Type: Single Speed

sf Override: [Slider]

Power: 2068 WATTS

Flow: 78.1 GPM

Hours Per Day: 8.0 Hours

New Pump

Pump: Brand, Model, Speed Type, HP, sf, utp

HP Override: 1.5 HP

Speed Type: Variable Speed

sf Override: [Slider]

Power: 990 WATTS

Flow: 68 GPM

Hours Per Day: 2.0 Hours

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Energy Savings for Your Pool

Energy Price: \$22.4 /kWh
 1234 Street Test
 Energy City, WA 98101
 (206) 555-1234
 www.pentair.com

Customer Information

Pool Size: 27000 Gallons
 Filter Pressure: 8 PSI

Current Pump Model: Pentair Intelli-Speed
 450 WATTS

Estimated Annual Energy Savings: \$1,234.56

Current Pump Energy Usage: 100 kWh
 New Pump Energy Usage: 10 kWh

Energy Consumption (kWh)

1000 800 600 400 200 0

Current Pump

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Thank You

Questions?

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