

# 2014 Update: Solar and Geothermal Designs for Commercial Buildings

*PGIcorp* Richard Pandolfi  
*geothermal comfort systems of L.I.*

(516) 840-9121 [www.pgicorp.info](http://www.pgicorp.info) or [www.geothermal-longisland.com](http://www.geothermal-longisland.com)

*In Partners with:*

Jean Pierre Clejan  
IGSHPA, NABCEP



# *PGIcorp*

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## *Optimization of Building Envelope (In order of Priority)*

- Installation/Air filtration
- LED/Compact Florescent
- Appliances/water Heaters
- Geothermal
- Solar PV

# Typical Installation Pictures

3 Ton geo with hybrid air source  
heat pump water heater



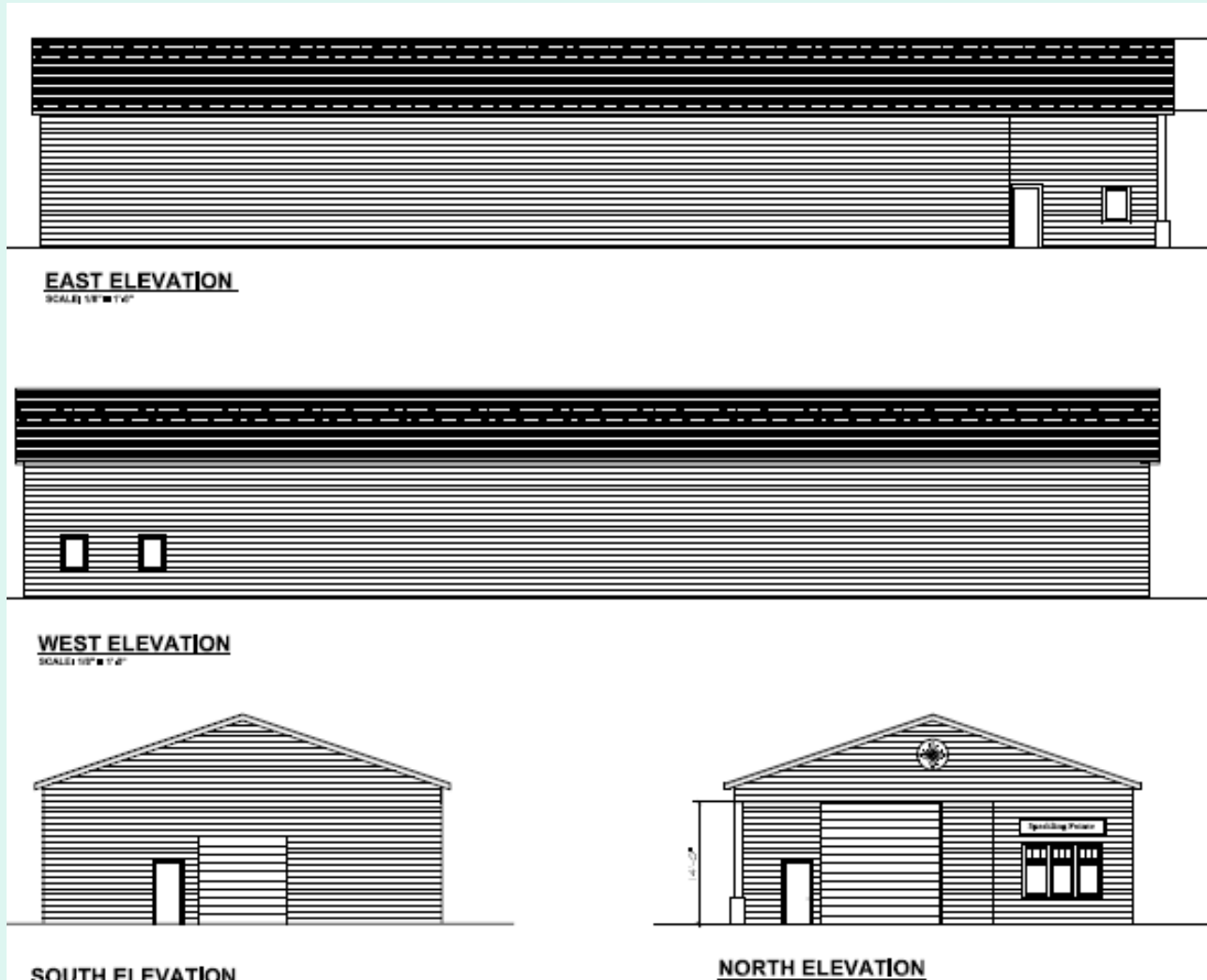
Water to Water



Radiant Intergraded  
Flow System



# Case Study 1 –Zero energy warehouse



Sparkling Pointe Warehouse

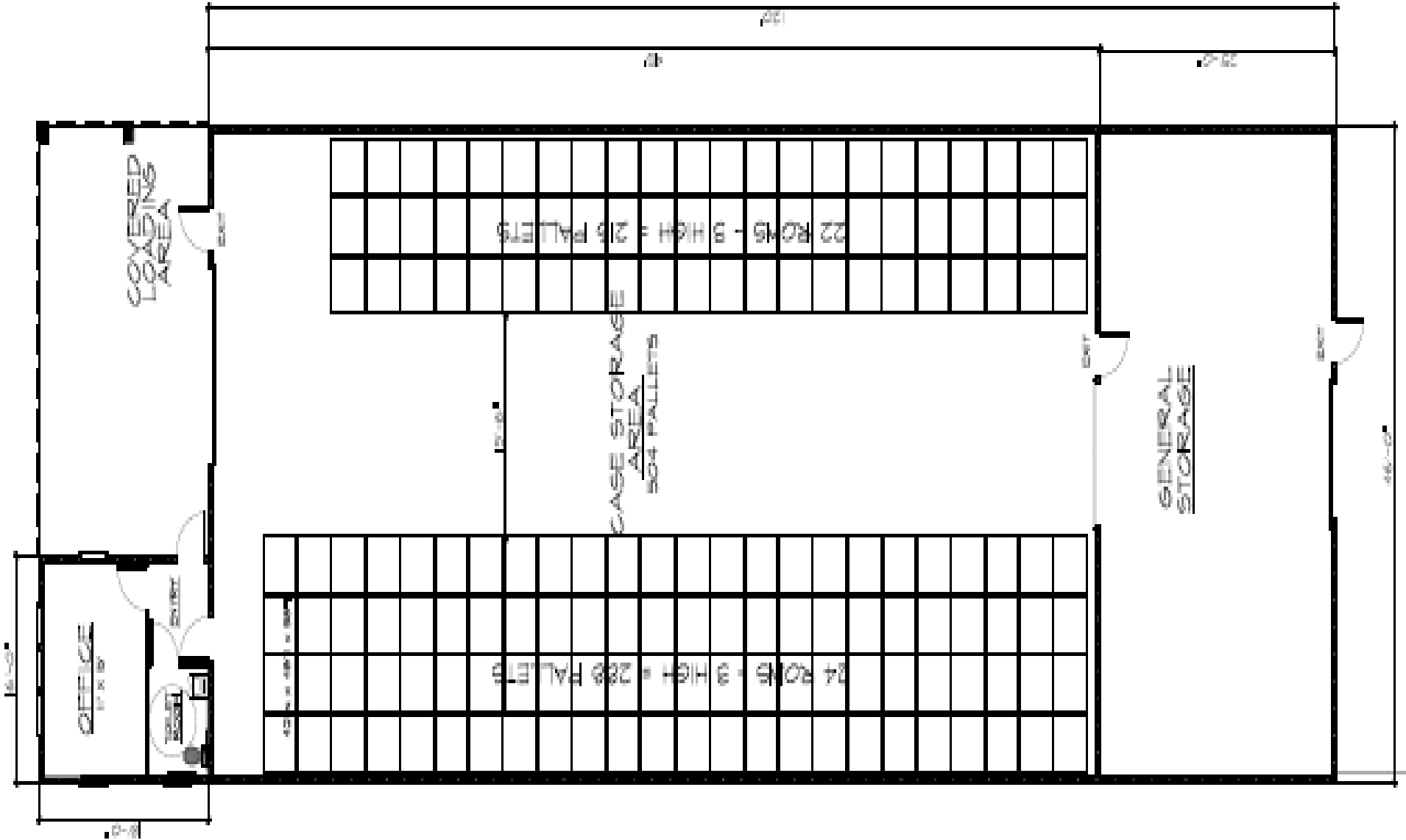
# Case Study 1 – aerial view



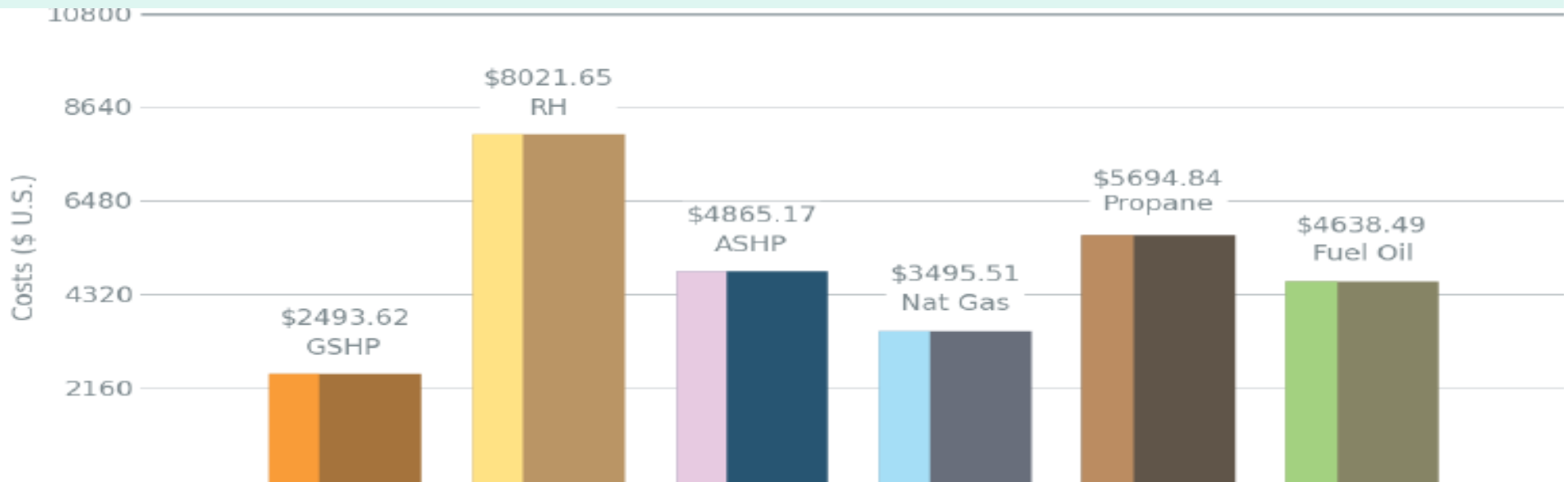
# Case Study 1 – Wine warehouse

- 6,000 square foot ranch warehouse / wine storage with office, well-insulated (spray foam, isolated slab)
- Very large roof area relative to enclosed volume
- Super high-efficiency open-loop geothermal HVAC system – heat pumps located above office, with AHUs
- No fossil fuel at site – cost to bring in natural gas would have exceed differential cost between geo and conventional

# Case Study 1 – Floor Plan



# Case Study 1 – Geothermal Load Calc



System Type	Heating	Cooling	Total	vs. GSHP
Ground Source Heat Pump (GSHP)	\$2,046.65	\$446.97	\$2,493.62	—
RH	\$7,320.79	\$700.86	\$8,021.65	\$5,528.03
ASHP	\$4,164.31	\$700.86	\$4,865.17	\$2,371.55
Nat Gas	\$2,794.65	\$700.86	\$3,495.51	\$1,001.89
Propane	\$4,993.98	\$700.86	\$5,694.84	\$3,201.22
Fuel Oil	\$3,937.63	\$700.86	\$4,638.49	\$2,144.87



# Case Study 1 – Solar Proposal

**Date Issued:** 2/12/2012  
**Client:** Sparkling Pointe by Samuels & Steelman  
**System Size:** 22,560 Watts

Solar panels system with 25 year power output warranty in anodized aluminum SunFrame racking w/10 year warranty, mounted on standoffs integrated into new shingle roof, internal conduit, high-efficiency inverters with 10 year warranty, web-based monitoring

<b>Retail Cost of System</b>		<b>\$ 114,513</b>	** Designed from plans ** Includes underlying NY sales tax on commercial systems
	<b>Rate</b>		
<b>Federal Tax Credit</b>	-30%	\$ (34,354)	Retail cost times rate with no cap
	<b>Rebate/Watt</b>		
<b>Utility Rebate</b>	\$ (1.75)	\$ (39,480)	Watts times rebate/watt - assigned to GreenLogic This is going down, will go away
	<b>Est. Tax Rate</b>		
<b>Tax Reduction From Depreciation</b>	-35%	\$ (34,068)	Depr. Basis is Retail Cost minus half tax credit/grant. No Cap
	<b>Tax Rate</b>		
<b>Income Tax on Utility Rebate</b>	35%	\$ 13,818	Utility rebate times tax rate
<b>Final Net Cost</b>		<b>\$ 20,430</b>	<b>Out-of-pocket</b> <b>\$ 75,033</b>

## Estimated Savings & Return on Investment:

Electricity Produced	127.5% kWh/W/Yr	28,764 kWh/Yr	
Loss factor for orientation, pitch & shade		-13.4%	Assumes 4/12 roof pitch, no shadows
Net Energy Produced Yr 1		24,910 kWh/Yr	
Lifetime Energy Produced		683,355 kWhs	
<b>Est. Year 1 Savings</b>		<b>\$ 3,487</b>	
<b>Est. Lifetime Energy Savings (30 year life)</b>		<b>\$ 207,206</b>	
<b>Annual Internal Rate of Return on Investment (IRR)</b>		<b>21%</b>	
<b>System Pays for Itself After Year:</b>		<b>5</b>	
<b>Net Effective Cost of Solar Power</b>		<b>\$ 0.03</b>	/kWh
<b>Current Cost of Utility Power (before demand charges)</b>		<b>\$ 0.140</b>	/kWh
<b>Lifetime carbon reduction</b>		<b>1,366,710</b>	Lbs of CO2
<b>Equivalent of co2 reduction as planting</b>		<b>9</b>	Acres of Trees

Assumes commercial demand meter

# Case Study 1 – Doing the crunch

- Geothermal load calc projects annual HVAC consumption of \$2,393 in power, which translates to 11,782KWh at \$0.21/KWh
- Lights/office machines projected to consume 5,000 KWh/year
- Electric forklift, bottle rotators and well pump are projected to consume 8,000 KWh/year
- Total predicted consumption: 24,782 KWh/Year
- PV system projected output is 24,910 KWh/Year
- No demand charges apply to due incredibly low peak demand (<7KW allows for simple usage-based billing like

# Case Study 1 utility bills (partial year)

Client: **Sparkling Pointe**

Historical Electric Usage and Cost From LIPA Bills

Last 2 Years

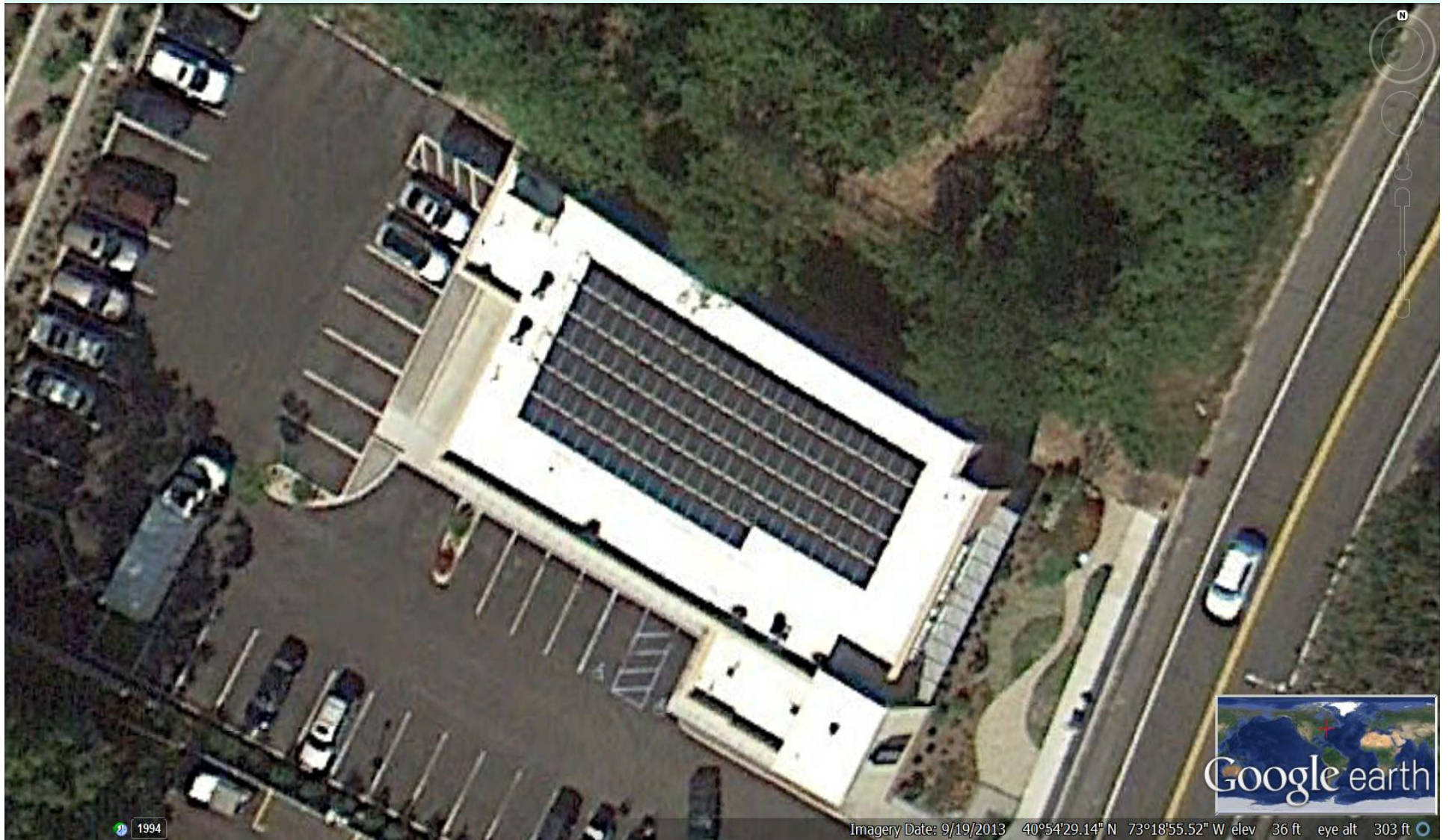
					2013-2014	
Month	Bill Date	Days in Bill	Meter Reading	Meter Read	Usage kWh	LIPA Bill
	<a href="#">3/28/2014</a>	28	94999	-V	646	\$10.50
	<a href="#">2/28/2014</a>	29	95645	ACTUAL	1,111	\$10.88
	<a href="#">1/30/2014</a>	30	94534	ACTUAL	1,140	\$11.25
	<a href="#">12/31/2013</a>	35	93394	ACTUAL	537	\$13.13
	<a href="#">11/26/2013</a>	26	92857	-V	712	\$9.75
	<a href="#">10/31/2013</a>	31	93569	-V	952	\$11.63
	<a href="#">9/30/2013</a>	31	94521	-V	1,306	\$11.63
	<a href="#">8/30/2013</a>	31	95827	-V	1,367	\$11.63
	<a href="#">7/30/2013</a>	32	97194	-V	748	\$12.00
	<a href="#">6/28/2013</a>	29	97942	ACTUAL	16	\$10.88
	<a href="#">5/30/2013</a>	30	97926	-V	1,279	\$11.25
	<b>Total</b>	<b>332</b>			<b>4,206</b>	<b>\$ 125</b>

# Case Study 2 – Near zero energy store



Fort Salonga Bottle Bargains store

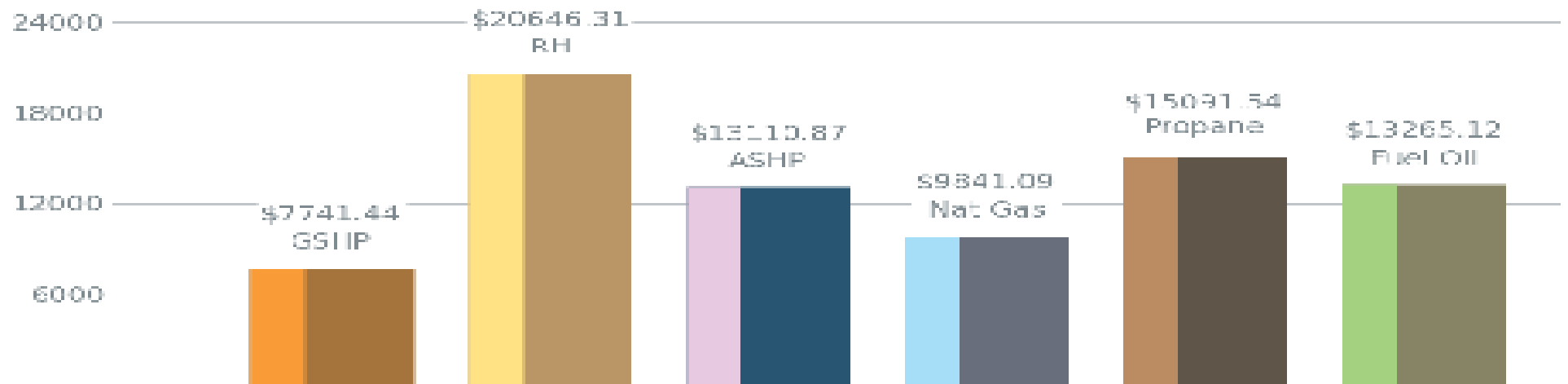
# Case Study 2 – aerial view



## Case Study 2 – Bottle Bargains

- Typically insulated building with open loop geothermal HVAC with staged, super high-efficiency heat pumps
- 42.5KW solar electricity system on new white flat roof
- Annual solar output exceeds geothermal load calculation,  
so there will be no PSEGLI usage associated with HVAC
- Existing (sister) store exists, with conventional systems for purposes of comparison

# Case Study 2 – Geo Load Calculation



System Type	Heating	Cooling	Total	vs. GSHP
Ground Source Heat Pump (GSHP)	<b>\$4,885.99</b>	<b>\$2,855.45</b>	<b>\$7,741.44</b>	—
RH	<b>\$17,476.85</b>	<b>\$3,169.46</b>	<b>\$20,646.31</b>	<b>\$12,904</b>
ASHP	<b>\$9,941.41</b>	<b>\$3,169.46</b>	<b>\$13,110.87</b>	<b>\$5,369.</b>
Nat Gas	<b>\$6,671.63</b>	<b>\$3,169.46</b>	<b>\$9,841.09</b>	<b>\$2,099.</b>
Propane	<b>\$11,922.08</b>	<b>\$3,169.46</b>	<b>\$15,091.54</b>	<b>\$7,350.</b>
Fuel Oil	<b>\$10,095.66</b>	<b>\$3,169.46</b>	<b>\$13,265.12</b>	<b>\$5,523.</b>

## Case Study 2 – Doing the crunch

- Geothermal load calc projects annual HVAC consumption of \$7,741 in power, which translates to 48,312KWh
- PV system projected output is 48,782KWh/Year
- Annual PV Output > HVAC consumption, so store is heated and cooled without buying power
- Client will have to pay for PSEGLI meter and demand charges, plus partial usage (for lights/computers/phones/displays)



## Case Study 2 – Optimization

- Spray foam could have been used under roof (to improve R-Value) – limited by client and architect's aesthetic concerns
- PV system could have been slightly bigger – there was more available roof space. This would have helped offset consumption of lights, etc. Limited by client's budget.
- Tower on South side of building could have been eliminated or moved to North, creating more usable roof space. However, tower is part of client look & feel and needs to be on South (street side) of building

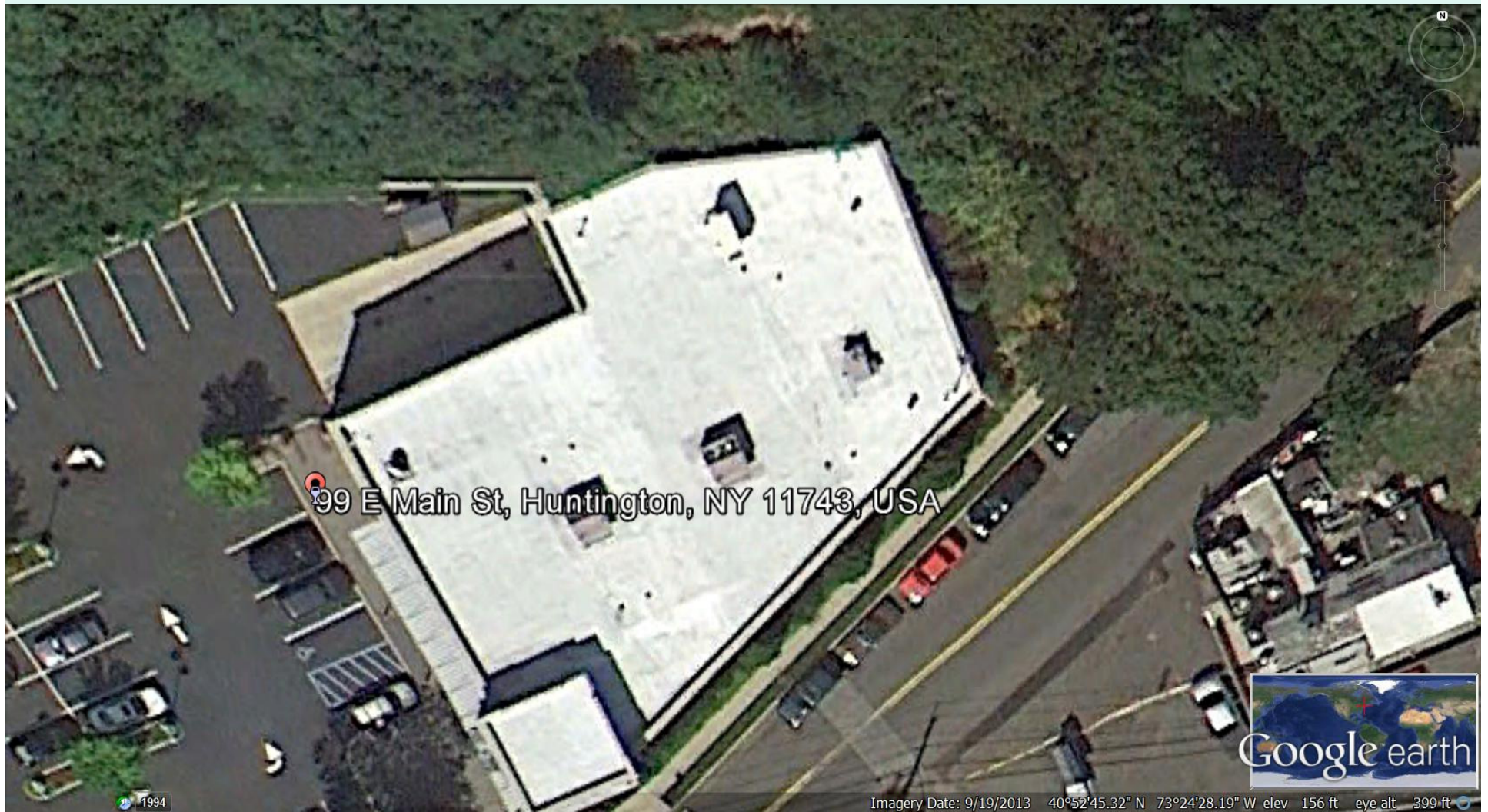
# Case Study 2 – First year utility bill

FORT SALONGA - ALL ELECTRIC					
2013-2014					
Bill Date	Days in Bill	Usage kWh	Recorded Demand	Billed Demand	LIPA Bill
<a href="#">2/25/2014</a>	29	9,840	28	28	\$1,942.89
<a href="#">1/27/2014</a>	37	11,280	31	31	\$2,166.53
<a href="#">12/21/2013</a>	30	9,040	29	29	\$1,543.58
<a href="#">11/21/2013</a>	28	5,760	29.5	29.5	\$1,036.07
<a href="#">10/24/2013</a>	30	6,400	32	32	\$1,194.10
<a href="#">9/24/2013</a>	28	5,360	32	32	\$1,262.17
<a href="#">8/27/2013</a>	28	5,440	31	31	\$1,224.13
<a href="#">7/30/2013</a>	39	7,920	32	32	\$1,716.68
<a href="#">6/21/2013</a>	28	4,000	29.5	29.5	\$933.62
<a href="#">5/24/2013</a>	30	3,040	27	27	\$734.45
<a href="#">4/24/2013</a>	30	3,040	26.5	26.5	\$745.92
<a href="#">3/25/2013</a>	26	6,080	29	29	\$1,247.22
<b>Total</b>	<b>363</b>	<b>77,200</b>			<b>\$ 15,747</b>
					<b>213</b>

# Case Study 2 conventional sister utility bills

ELECTRICITY ONLY			Demand months	ratchet in BOLD	
2013-2014					
Bill Date	Days in Bill	Usage kWh	Recorded Demand	Billed Demand	LIPA Bill
<a href="#">2/3/2014</a>	27	8,960	<b>32</b>	<b>46.5</b>	\$1,894.77
<a href="#">1/7/2014</a>	39	13,040	<b>45</b>	<b>46.5</b>	\$2,495.72
<a href="#">11/29/2013</a>	25	9,360	<b>40</b>	<b>46.5</b>	\$1,612.17
<a href="#">11/4/2013</a>	34	14,960	55	55	\$2,467.12
<a href="#">10/1/2013</a>	27	13,760	62.5	62.5	\$2,933.88
<a href="#">9/4/2013</a>	34	18,800	59	59	\$3,788.48
<a href="#">8/1/2013</a>	27	17,040	66.5	66.5	\$3,276.77
<a href="#">7/5/2013</a>	32	17,280	65	65	\$3,435.63
<a href="#">6/3/2013</a>	31	14,400	57	57	\$2,643.91
<a href="#">5/3/2013</a>	34	12,880	<b>40</b>	<b>46</b>	\$2,378.45
<a href="#">3/30/2013</a>	25	9,680	<b>38.5</b>	<b>46</b>	\$1,951.50
<a href="#">3/5/2013</a>	32	11,920	<b>36</b>	<b>46</b>	\$2,245.65
<b>Electricity</b>	<b>367</b>	<b>162,080</b>			<b>\$ 31,124</b>
<b>Natural Gas</b>					<b>\$ 2,028</b>
		Total: Electricity & Natural Gas			<b>\$ 33,152</b>
		Near zero energy store:			<b>\$ 15,747</b>
		Annual Savings on utilities			<b>\$ 17,405</b>

# Case Study 2 – sister store aerial view



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