

•Introduction

- Personal and Building Intro

•Building Background

- Building Size, Location, and Type
- Current Budget and Schedule
- Areas for Improvement/Client Influence

•Analysis 1: Solyndra Solar Panel Implementation

- Installation location
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 - Hallway Motion Sensor
 - Motion Sensor PTAC

•Conclusion

- Final Schedule and Budget
- Final Decisions (What and What Not to Proceed With)
- Q/A



Thesis by: Josh Raphael
Architectural Engineering
Construction Management

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Building Background

Location - 655 White Horse Pike, Absecon, NJ

Mixed Separate Use Group – R-1 Residential/ A-3 Assembly

Construction Type – V-B

Addition Area

- First Floor (A-3): 4,912 ft²
- First Floor (R-1): 6,475 ft²
- Second Floor (R-1): 7,984 ft²
- Third Floor (R-1): 7,984 ft²

Total initial Cost - \$4 Million

Date of Construction – March 2009 – April 2010

Owner – Renuka Hospitality, LLC

General Contractor – DRK Associates

Architect – Harry S. Harper Architects



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Cost Breakdown		
	Cost	Cost/SF
Total Project Cost	\$4,000,000	\$146
Total Hotel Cost	\$3,373,344	\$124
Total Pool Cost	\$340,000	\$12.53
Design Cost	\$25,000	\$0.92
Systems		
Mechanical	\$257,432	\$9.42
Electrical	\$367,000	\$13.42
Plumbing	\$280,037	\$10.24
Structural Steel	\$95,000	\$3.47
Fire Suppression	\$65,000	\$2.38
Concrete (Site+Building)	\$200,000	\$7.31
Building Masonry	\$70,000	\$2.56
Square Footage Cost		
Total Building Area		27355 SF
Total Building Perimeter		493 LF
Story Height		10 FT
Interpolated RS Means Value		\$160.44 Cost/SF
Total Project Cost		\$4,388,836
Means Cost Adjustment & Breakdown		
Adjustment for Story Height	Add	\$1.60 Cost/FT
Adjustment for Perimeter	Add	\$4.60 Cost/100FT
Location Factor		1.05
Final RS Means SF Cost		\$171.34 Cost/ST
Total Project Cost		\$4,686,892

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Current Budget & Schedule

•Schedule Summary

•Project Duration – 13 Months

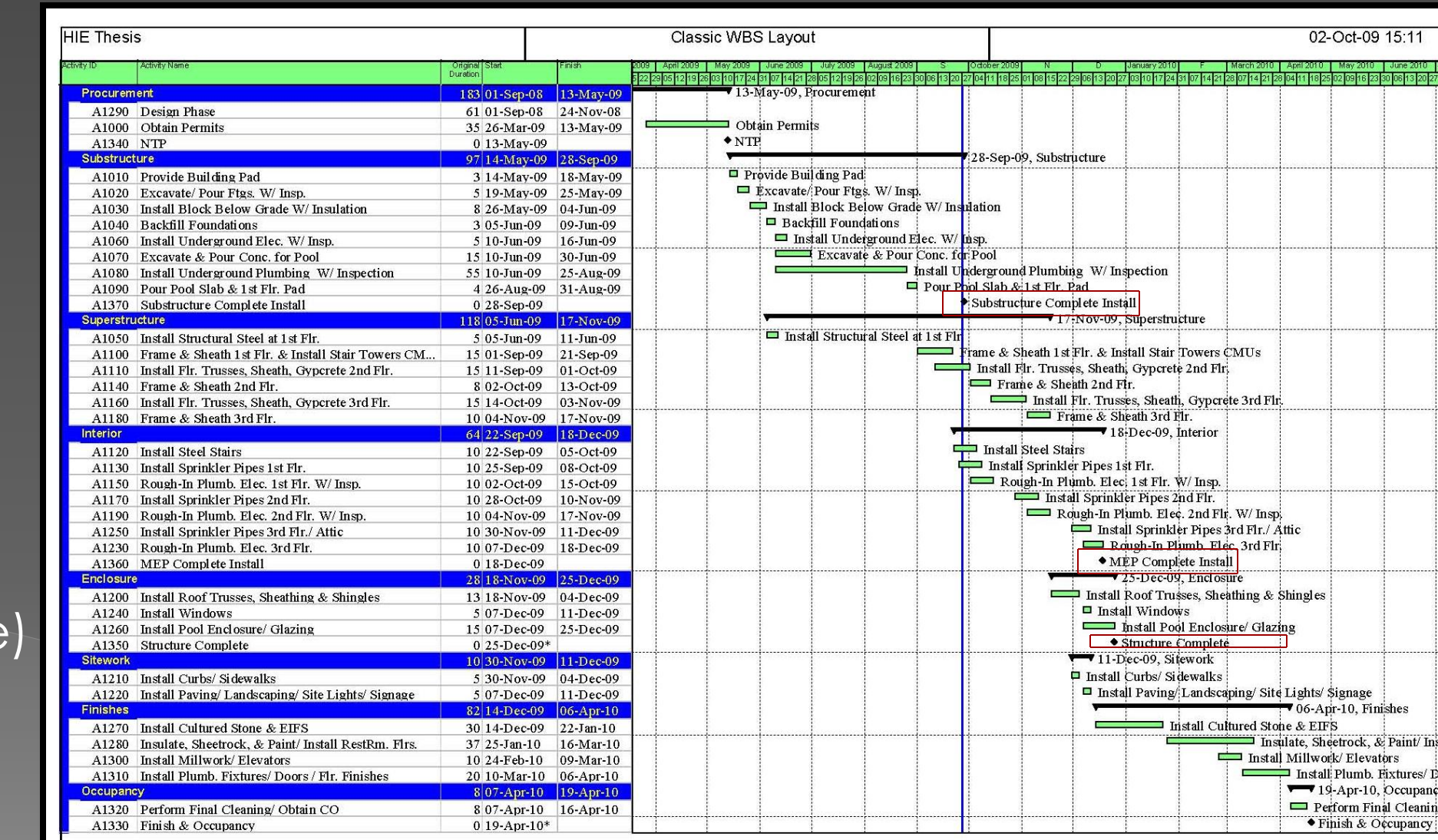
•Milestones

1. Substructure Complete
2. MEP Installation Complete
3. Building Structure Complete

•Cost Summary

- Approximate Project Cost – \$4 Million (Owner Estimate)
- Approximate Project Cost - \$4.7 Million (Square Ft Estimate)

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Areas for Improvement/Client Influence

•Issues

•Guest Waste Energy

1. Bathroom Night lighting
2. Lighting, Heating, & Cooling During Vacancy

•Heating & Cooling Loss from Stud Wall Construction

•Lack of Energy Efficiency Efforts

•Solutions

1. Solyndra Solar Panel Installation
2. SIP Panel Implementation
3. BAS Systems



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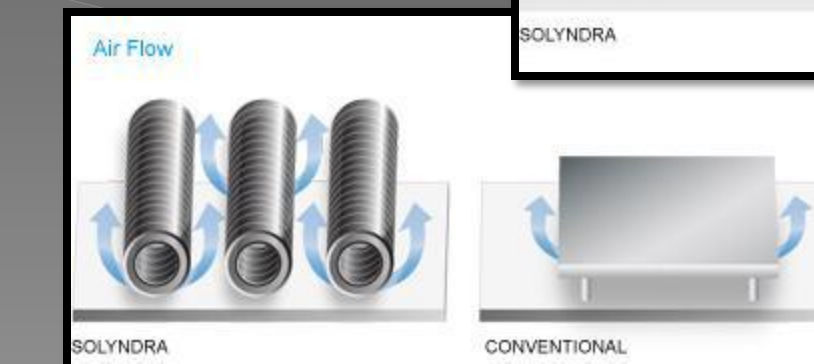
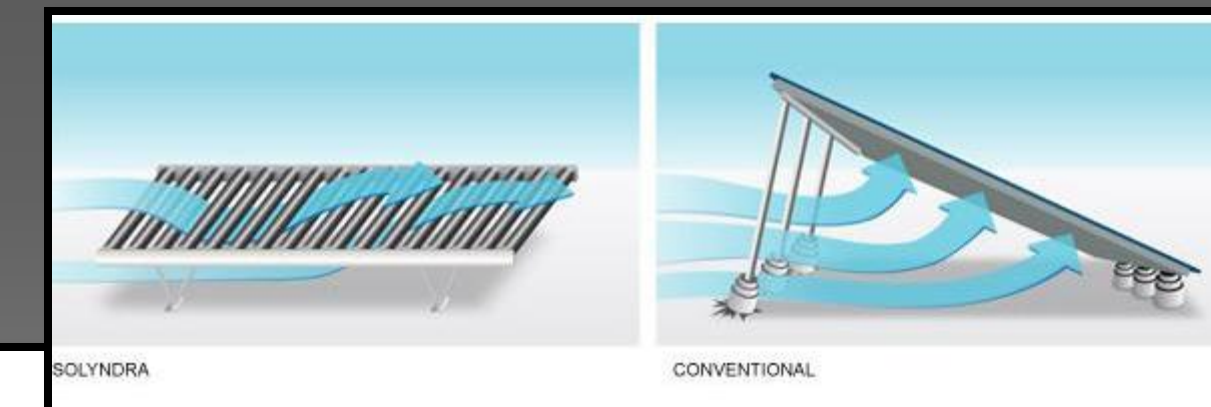
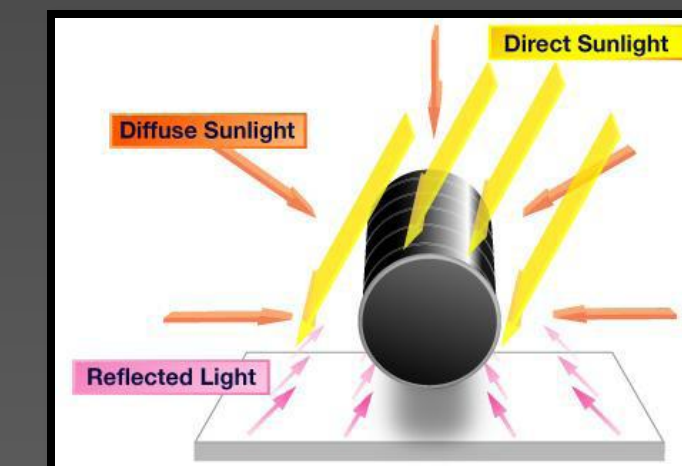
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About Solyndra Solar Panels

- Cylindrical PV Tubes – 360° Absorption (Direct, Diffuse, & Reflected Sunlight)
- Most Efficient Solar Technology
- Air Flow
 - Withstand Wind Up to 130mph (Absecon < 120mph)
 - Prevents Panel Overheating
- Quick & Easy Installation – No need to mount
- Greater Rooftop Coverage



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Installation Location

•**Location** – South East Facing Roofs of Both the New & Existing Buildings (Green Shading)

Panel Size & Layout

•**Panel Size** – 6' x 3.5'

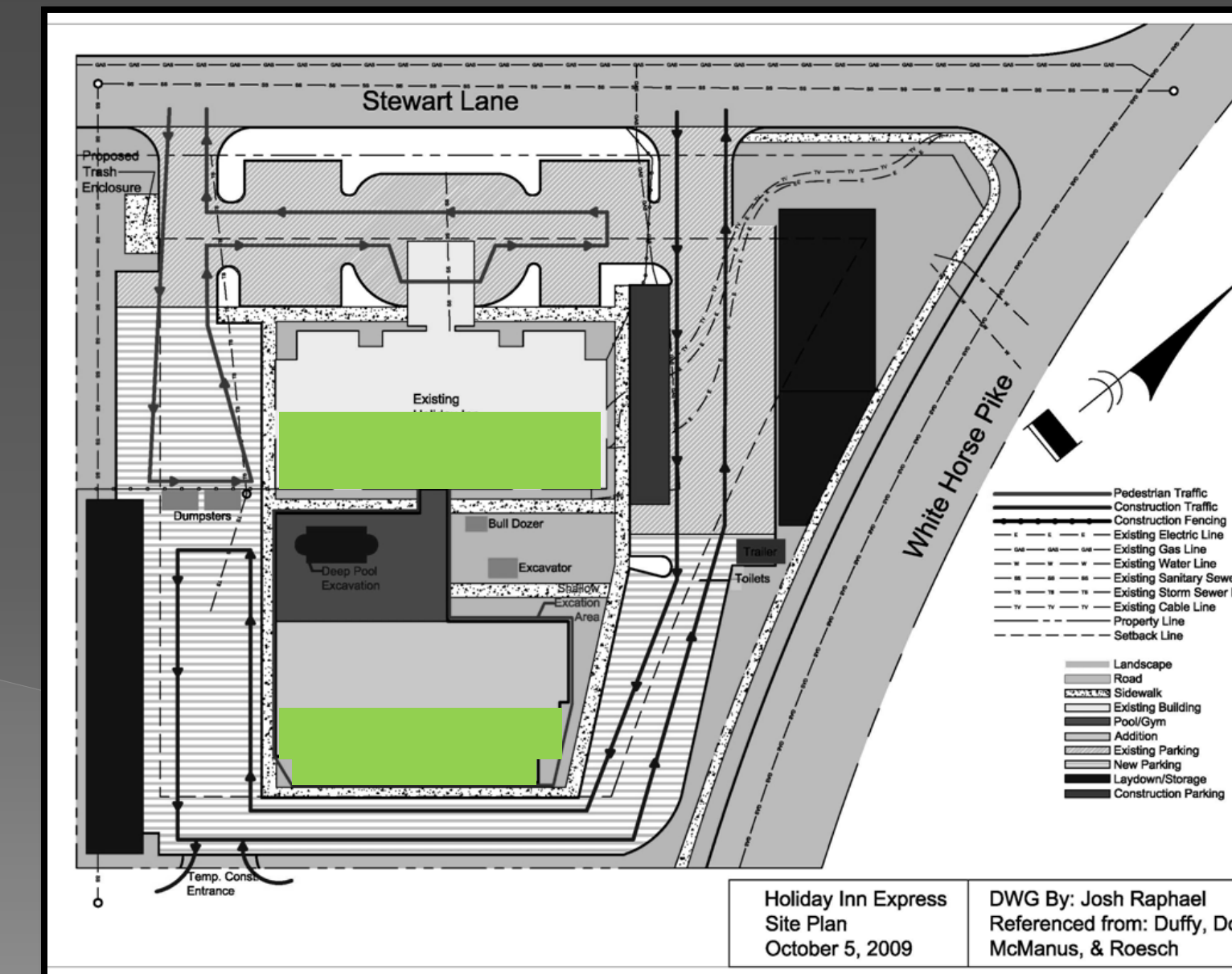
•**Panel Power** – 191Wp Standard Test Conditions (Irradiance of 1000 W/m², air mass 1.5, and cell temperature of 25°C)

•**Available Roof Area** – 11760 ft²

•**Panel Count** – 500 Panels

•**System Power** – 95.5 kW Power

Additional Information



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Schedule & labor Analysis

- Labor Rate** – 10 Panels/Hr, Using a 3 Man Crew
- Installation Duration** – 6.25 Days
- Schedule Adjustment**
 - Panel Installation Proceeding Roof Installment
 - Installation simultaneous with site work

Cost Analysis

- Panel Material/Installation Cost** – \$5.42/W
- Rebates**
 - Federal** - Investment Tax Credit(ITC) 30% of the Entire Energy System
 - State** – Eliminates NJ State Tax of 7%
- Final Cost per Watt** - \$4.13/W
- Final System Cost** – \$394,041

Additional Information

Description	Cost
Solyndra Solar Panels (500)	\$517,610
Labor	
Combiner Boxes	
Wiring	
Monitoring System	\$6,500
100 kW Inverter (w/ 10 yr warranty)	\$51,215
Permitting	\$5,000
7% NJ State Tax	\$40,623
Total System Cost	\$620,948
System Cost per Watt	\$6.50
Incentives	Savings
Federal Investment Tax Credit (30%)	\$186,284
NJ Solar System Tax Exemption	\$40,623
New Total System Cost	\$394,041
New System Cost per Watt	\$4.13

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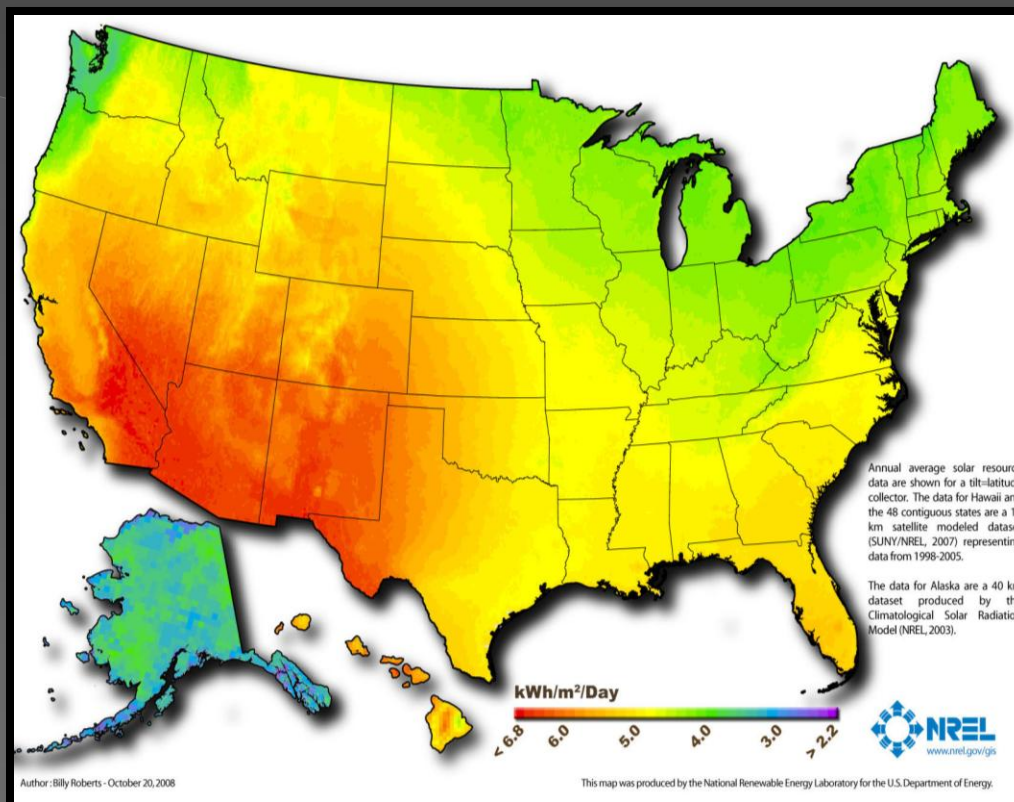
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Energy Savings Analysis: Electrical Breadth

- Average Solar Radiation – 4.67 kWh/m²/day
- Absecon Electricity Cost – 13 ¢/kWh
- Future Carbon Tax – Increased energy cost \$0.1027 – \$0.1137 /kWh
- Carbon Footprint – Savings of 170,007 lbs of CO₂/yr
- Energy Savings – 118,886 kWh
- Cost Savings
 - No Carbon Tax - \$15,455/yr
 - With Carbon Tax - \$28,533/yr

Payback

- Payback Period
 - No Carbon Tax – 25.5 years
 - With Carbon Tax – 13.8 Years

Additional Information

Location	Atlantic City, NJ
Array Tilt (6/12 slope)	26.6°
Array Azimuth (SE)	45°
Avg. Solar Radiation	4.67
Electricity Cost	13 ¢/kWh
DC Power Rating	95.5 kW
AC Power Rating	73.5 kW
Annual AC Energy Produced (kWh)	118,886 kWh
Annual Energy Savings (\$)	\$15,455.18
Savings (lbs of CO₂/yr)	170,007

With Future Carbon Tax	
Electricity Cost	24 ¢/kWh
Annual AC Energy Produced (kWh)	118,886 kWh
Annual Energy Savings (\$)	\$28,532.64
Savings (lbs of CO₂/yr)	170,007

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•Analysis 3: BAS Systems and Wireless Controls

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ANALYSIS 2: STRUCTURAL INSULATED PANELS



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•Building Background

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About SIP Panels

- **Structurally Sound** – Stronger & Straighter
- **R – Value** – R 24.7 compared to R19
- **Prefabrication** – Lower on Site Labor Cost
- **Labor** – 50-70% Faster

SIP Application

- **Exterior Wall** - 6" SIP Panel vs. 2 x 6" Stud Construction
- **Location** – 1st, 2nd, & 3rd Floor Addition Exterior Walls
- **Exterior Wall Area** – 15,274 ft²

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SIP vs. Stick Built

•Material Cost

- Initial Cost of SIP Panels - \$60,188
- Budget Increase - \$14,690, about 33% more expensive than Stick Built

•Schedule & Labor Analysis

- Current Framing Duration – 26 Days (All 3 Floors)
- New Framing Duration – 17 Days (All 3 Floors)
- Estimated Schedule Reduction – 50%, 4 Days/Floor
- Schedule Reduction – 3 Days/Floor (Learning Curve)
- Total Reduction – 9 Days

Description	2" x 6" Stick Built	Quantity	Total Cost	6 1/2" SIP Panels	Quantity	Total Cost
Material	\$520/M.B.F.	21.84 M.B.F.	\$11,357	\$3.30/SF	15,274 SF	\$50,404
R-19 Insulation	\$0.52/SF	15,274 SF	\$7,943			
3/8" Plywood	\$0.40/SF	30,548 SF	\$12,220			
Labor	\$640/M.B.F.	21.84 M.B.F.	\$13,978	\$0.64/SF	15,274 SF	\$9,784
Total Cost			\$45,498			\$60,188

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Energy Efficiency Analysis: Mechanical Breadth

•Leakage

- 2 x 6" (Poor Leakage) – 857 MBTU, 251,101 kWh
- 2 x 6" (Avg. Leakage) – 678 MBTU, 198,654 kWh
- SIP Panel – 297 MBTU, 87,021 kWh

•Energy Cost Absecon, NJ

- 2 x 6" (Poor Leakage) – \$32,643
- 2 x 6" (Avg. Leakage) – \$25,825
- SIP Panel – \$11,313
- Savings (Avg. Leakage)- \$14,512/yr

Payback

- Payback Period – 1-2 years

	Conventional 2 x 6 Construction (Poor leakage)	Conventional 2 x 6 Construction (Average leakage)	6" SIP Construction
Heating (MBTU)	775 MBTU	606 MBTU	257 MBTU
Heating Cost	\$9,525	\$7,448	\$3,306
Cooling (MBTU)	82 MBTU	72 MBTU	40 MBTU
Cooling Cost	\$1,008	\$885	\$492
Total (MBTU)	857 MBTU	678 MBTU	297 MBTU
Total Cost	\$10,533	\$8,333	\$3,798

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ANALYSIS 3: BUILDING AUTOMATED SYSTEMS



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About BAS Systems

- Product Suppliers** – Prolighting, Lutron, Watt Stoppers
- Use** – Eliminate Energy Consumption During Vacancy

BAS System Application

•3 Areas for Implementation

1. Bathroom Nightlight/Motion Sensor Switch



2. Hallway Motion Sensors



3. Motion Sensor PTAC



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Bathroom Nightlight/Motion Sensor Switch

•About

- The switch shuts off energy when vacant
- The switch acts as a low energy nightlight

•Reasons

- 40% of Hotel guest use bathroom as nightlight
- 75% of fixture energy used when operating for more than 2 Hrs (Usually during guest vacancy)

•Initial Cost

- New Switch** – \$38/each, about \$20 more than regular switches
- Cost Increase** - \$980



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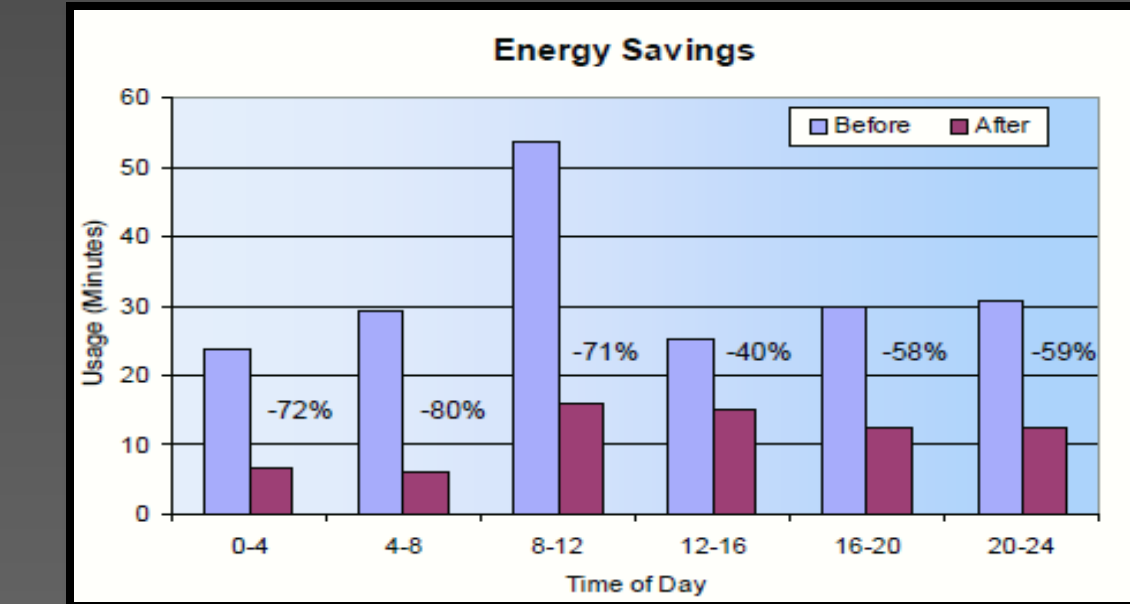
Bathroom Nightlight/Motion Sensor Switch

•Energy Efficiency Analysis: Electrical Breadth

- Bathroom lighting – 3 (100W) Incandescent
- Typical Energy Usage – 190 min/day
- Energy Usage W/ New Switch – 68 min/day
- Daily Use Reduction – 122min/day/unit
- Annual Energy Savings – 16,993 kWh/year
- Annual Cost Savings - \$2,210/year

•Payback

- Payback Period - .5 years



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Hallway Motion Sensor

•About

- RAB LOS2400H Smart Hallway Sensors
- The sensors have a max viewing range of 16' x 80'
- Can control 2400W/sensor of lighting

•Reasons/Application

- Hallway vacancy between 11PM-6AM
- Excessive emergency hallway lighting
- Apply to 2nd & 3rd floor hallways

•Initial Cost

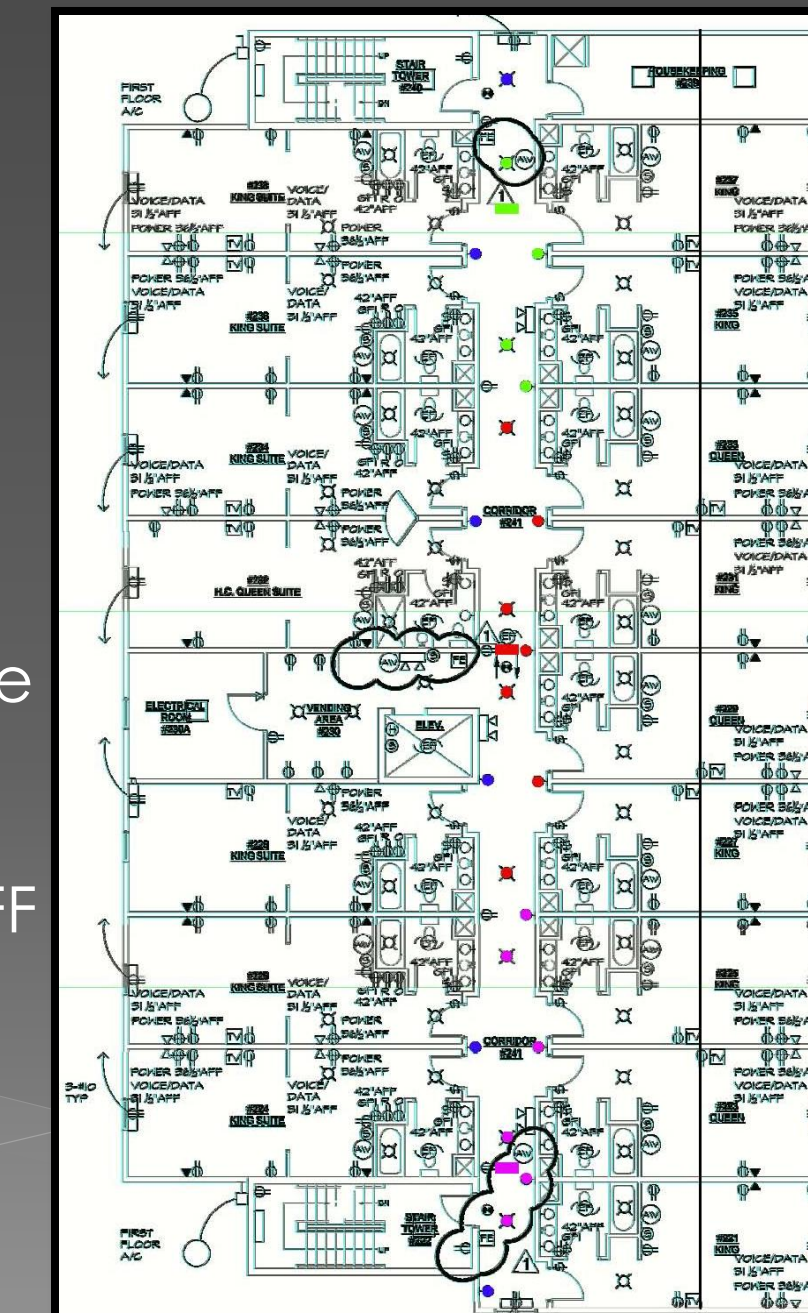
- Sensor Cost – \$139/each, Total of \$834
- Labor Cost – 30\$/each, Total of \$180
- Total Cost - \$1,014

Additional Information

•Design Layout

•3 Sensors/Floor

- Green - controls 4 lights
- Red - controls 7 lights
- Pink - controls 6 lights
- Blue - 6 continuous emergency lights
- Green & pink sensors are offset 46' from center sensor
- Clg. Mounted – 8'-8" AFF



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Hallway Motion Sensor

•Energy Efficiency Analysis: Electrical Breadth

- Hallway lighting – 23 (100W) Incandescent
- Daily Use Reduction –5Hrs/day/floor
- # of Lights on Sensors – 17 Lights
- Energy Consumption
 - Before – 40,296 kWh/year
 - After – 32,850 kWh/year
- Annual Energy Savings – 7,446 kWh/year
- Annual Cost Savings - \$968/year

•Payback

- Payback Period - 1 year



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Motion Sensor PTAC



•About

- Current System** – 9000 BTU Amana PTAC unit
- New System** - 9000 BTU DigiSmart Amana PTAC unit w/ the DigiSmart Motion Sensor
- Typical savings** – 35% on Heating & Cooling

•Reasons

- Reduce Heating & Cooling Loads

•Initial Cost

- PTAC Upgrade Cost** – \$169/each, Total of \$8,291
- Labor Cost** – Negligible

Additional Information

•Energy Efficiency Analysis: Mechanical Breadth

•Original PTAC

- Energy Usage** – 4,400 kWh/year/unit
- Energy Usage** – 215,600 kWh/year
- Energy Cost** – \$28,028/year

•New PTAC

- Energy Usage**– 3,000 kWh/year/unit
- Energy Usage** – 147,000 kWh/year
- Energy Cost** – \$19,110/year

- Annual Energy Savings** – 16,993 kWh/year
- Annual Cost Savings** - \$8,918/year

•Payback

- Payback Period** - 1 year

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•Building Background

- Building Size, Location, and Type
- Current Budget and Schedule
- Areas for Improvement/Client Influence

•Analysis 1: Solyndra Solar Panel Implementation

- Installation location
- Sizing the Panel Layout
- Schedule and Labor Analysis
- Cost Analysis
- Energy Savings Analysis/Payback

•Analysis 2: SIP Panel Implementation

- SIP Application
- SIP vs. Stick Built
 - Material Cost
 - Schedule and Labor Analysis
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•Analysis 3: BAS Systems and Wireless Controls

- BAS System Application
 - Bathroom Nightlight motion Sensor
 - Hallway Motion Sensor
 - Motion Sensor PTAC

•Conclusion

- Final Schedule and Budget
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- Q/A

CONCLUSION: FINAL BUDGET/SCHEDULE ANALYSIS

Outline

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Holiday Inn Express

Final Schedule

•Original Finish Date – April 16,2010

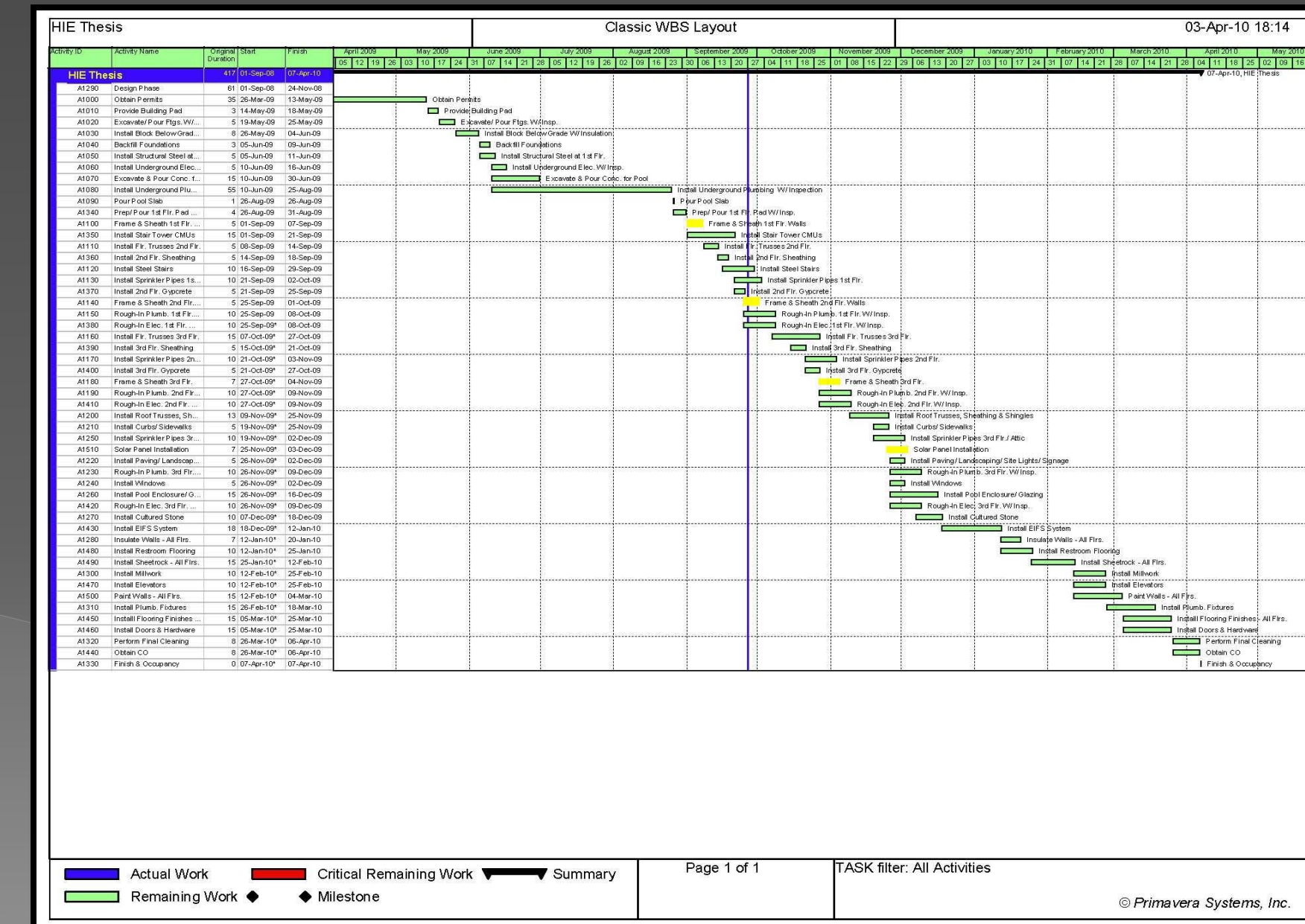
•New Finish Date – April 7, 2010

•Solar Panels – 6.25 day Installation period, doesn't affect overall finish date

•SIP Panel – 3 day Reduction/floor, 9 day overall schedule reduction

•BAS Systems – Negligible

Additional Information



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Holiday Inn Express

Final Budget

- Two final budget analysis were made, with/without solar panels
- The annual savings is 37% less w/o solar panels
- The initial cost is 94% cheaper w/o solar panels

Final Payback

- Payback Period (w/ Solar Panels) – 10 years
- Payback Period (w/o Solar Panels) – 1 year

Additional Information

Analysis	Initial Budget Increase	Energy Savings (kWh/year)	Energy Savings (\$/year)	Energy Savings (lbs of CO ₂ /year)
Solyndra Solar Panels	\$394,041	118,886 kWh	\$15,455	170,007 lbs of CO ₂
6" SIP Panels	\$14,690	111,633 kWh	\$14,512	159,635 lbs of CO ₂
Motion Sensor Nightlight Switch	\$980	16,993 kWh	\$2,210	24,300 lbs of CO ₂
Hallway Occupancy Sensor	\$1,014	7,446 kWh	\$968	10,648 lbs of CO ₂
Motion Sensor PTAC	\$8,291	68,600 kWh	\$8,918	98,098 lbs of CO ₂
Totals w/o Solar Panels	\$24,975	204,672 kWh	\$26,608	292,681 lbs of CO₂
Totals	\$419,016	323,558 kWh	\$42,063	462,688 lbs of CO₂

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Final Decisions

•Solyndra Solar Panels

- Produces about 22% of Entire Building Energy
- Long Payback Period about 26 years
- Almost 10% Increase in Initial Budget
- More Beneficial for Owner to Wait (Carbon Tax, Solar Panel ↓ Cost, & ↑ Efficiency)

•SIP Panels

- Stronger, Quieter, & Straighter
- Easy Installation
- Faster installation, 9 day Schedule Reduction
- 55% More energy Efficient Than Stick Built
- Quick Payback, 1 Year
- Plausible for Owner

•BAS Systems

- Reasonable Reduction in Vacant Energy Consumption
- Cheap Initial Cost
- About \$12,000/year Annual Savings
- Easy Installation
- Quick Payback, 1 year
- Plausible for Owner

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QUESTION?

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