greenBeach,inc.

CALIFORNIA STATE UNIVERSITY, LONG BEACH

Sustainable Building & LEED

Exposition Transit Project Phase 2

Team Members:

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Problem Statement 1: LEED 2009 vs LEED v4 Assessment

Part 1:

Based on available Project Documents, the Expo Light Rail Line project will qualify for the following LEED version 2009 credits:

Development Density and Community Connectivity (Nearby destinations: 3rd Street Promena Downtown Santa Monica, Santa Monica City Hall, Santa Monica High School, Santa Monica P Santa Monica Place Shopping Center)

Alternative Transportation- Public Transportation Access (Transit Connections: Metro Los Angeles bus lines 20, 33, 534, 704, 720, 733, 920 and Santa Monica Big Blue Bus lines 1, 2, 3, Rapid, 4, 5, 7, 7- Rapid, 8, 9, 10)

Water Efficient Landscaping (Using native vegetation that reduces the amount of water need for landscape. Refer to answer to problem statement #4)

Optimize Energy Performance (energy savings of approximately 16%- refer to answer to problem statement #5)

Water Use Reduction (refer to answer to problem statement #4)

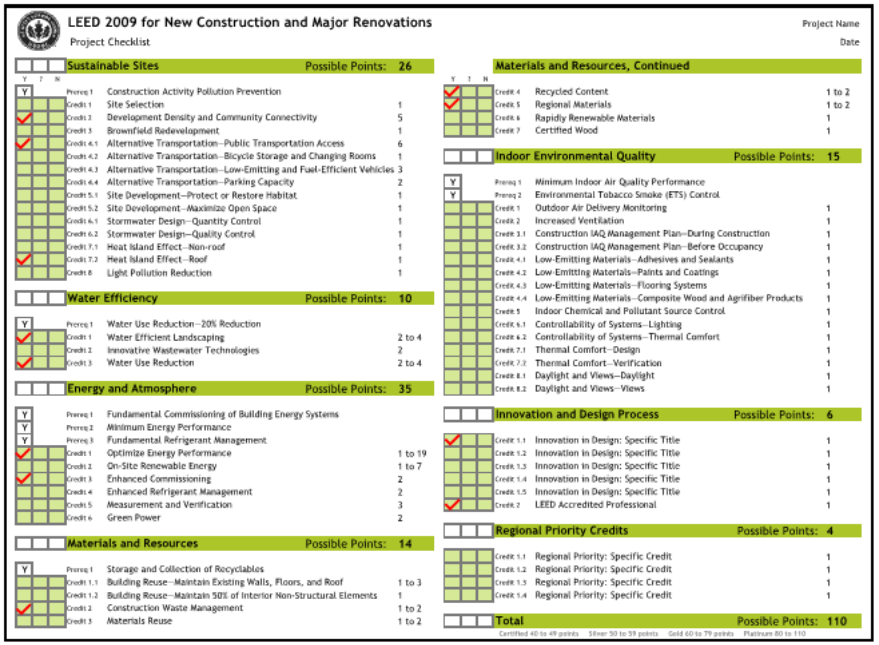
Enhanced Commissioning (is achievable)

Construction Waste Management (A CWM plan will be put in place)

Recycled Content (fly ash)

Regional Materials (within 500 mile material sourcing radius)

LEED Accredited Professional



LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name

Date

Sustainable Sites	Possible Points: 26
Prereq 1 Construction Activity Pollution Prevention	
Credit 1 Site Selection	1
Credit 3 Development Density and Community Connectivity	5
Credit 5 Brownfield Redevelopment	1
Credit 6.1 Alternative Transportation--Public Transportation Access	6
Credit 6.2 Alternative Transportation--Bicycle Storage and Changing Rooms	1
Credit 6.3 Alternative Transportation--Low-Emitting and Fuel-Efficient Vehicles	3
Credit 6.4 Alternative Transportation--Parking Capacity	2
Credit 5.1 Site Development--Protect or Restore Habitat	1
Credit 5.2 Site Development--Maximize Open Space	1
Credit 6.1 Stormwater Design--Quantity Control	1
Credit 6.2 Stormwater Design--Quality Control	1
Credit 7.1 Heat Island Effect--Non-roof	1
Credit 7.2 Heat Island Effect--Roof	1
Credit 8 Light Pollution Reduction	1

Water Efficiency	Possible Points: 10
Prereq 1 Water Use Reduction--20% Reduction	
Credit 1 Water Efficient Landscaping	2 to 4
Credit 2 Innovative Wastewater Technologies	2
Credit 3 Water Use Reduction	2 to 4

Energy and Atmosphere	Possible Points: 35
Prereq 1 Fundamental Commissioning of Building Energy Systems	
Prereq 2 Minimum Energy Performance	
Prereq 3 Fundamental Refrigerant Management	
Credit 1 Optimize Energy Performance	1 to 19
Credit 2 On-Site Renewable Energy	1 to 7
Credit 3 Enhanced Commissioning	2
Credit 4 Enhanced Refrigerant Management	2
Credit 5 Measurement and Verification	3
Credit 6 Green Power	2

Materials and Resources	Possible Points: 14
Prereq 1 Storage and Collection of Recyclables	
Credit 1.1 Building Reuse--Maintain Existing Walls, Floors, and Roof	1 to 3
Credit 1.2 Building Reuse--Maintain 50% of Interior Non-Structural Elements	1
Credit 2 Construction Waste Management	1 to 2
Credit 3 Materials Reuse	1 to 2

Materials and Resources, Continued	
Credit 4 Recycled Content	1 to 2
Credit 5 Regional Materials	1 to 2
Credit 6 Rapidly Renewable Materials	1
Credit 7 Certified Wood	1

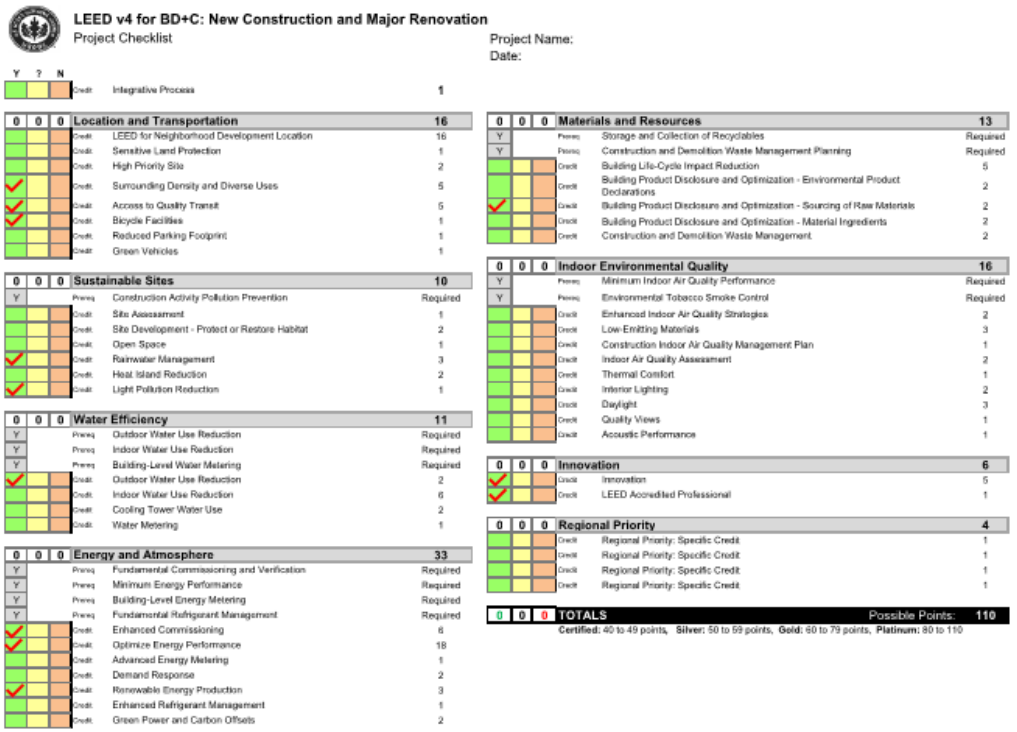
Indoor Environmental Quality	Possible Points: 15
Prereq 1 Minimum Indoor Air Quality Performance	
Prereq 2 Environmental Tobacco Smoke (ETS) Control	
Credit 1 Outdoor Air Delivery Monitoring	1
Credit 2 Increased Ventilation	1
Credit 3.1 Construction IAQ Management Plan--During Construction	1
Credit 3.2 Construction IAQ Management Plan--Before Occupancy	1
Credit 4.1 Low-Emitting Materials--Adhesives and Sealants	1
Credit 4.2 Low-Emitting Materials--Paints and Coatings	1
Credit 4.3 Low-Emitting Materials--Flooring Systems	1
Credit 4.4 Low-Emitting Materials--Composite Wood and Agrifiber Products	1
Credit 5 Indoor Chemical and Pollutant Source Control	1
Credit 6.1 Controllability of Systems--Lighting	1
Credit 6.2 Controllability of Systems--Thermal Comfort	1
Credit 7.1 Thermal Comfort--Design	1
Credit 7.2 Thermal Comfort--Verification	1
Credit 8.1 Daylight and Views--Daylight	1
Credit 8.2 Daylight and Views--Views	1

Innovation and Design Process	Possible Points: 6
Credit 1.1 Innovation in Design: Specific Title	1
Credit 1.2 Innovation in Design: Specific Title	1
Credit 1.3 Innovation in Design: Specific Title	1
Credit 1.4 Innovation in Design: Specific Title	1
Credit 1.5 Innovation in Design: Specific Title	1
Credit 2 LEED Accredited Professional	1

Regional Priority Credits	Possible Points: 4
Credit 1.1 Regional Priority: Specific Credit	1
Credit 1.2 Regional Priority: Specific Credit	1
Credit 1.3 Regional Priority: Specific Credit	1
Credit 1.4 Regional Priority: Specific Credit	1

Total	Possible Points: 110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110



LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name:

Date:

Y	?	N			
			Credit	Integrative Process	1

0	0	0	Location and Transportation	16
			Credit LEED for Neighborhood Development Location	16
			Credit Sensitive Land Protection	1
			Credit High Priority Site	2
✓			Credit Surrounding Density and Diverse Uses	5
✓			Credit Access to Quality Transit	5
✓			Credit Bicycle Facilities	1
			Credit Reduced Parking Footprint	1
			Credit Green Vehicles	1

0	0	0	Sustainable Sites	10
Y			Prereq Construction Activity Pollution Prevention	Required
			Credit Site Assessment	1
			Credit Site Development - Protect or Restore Habitat	2
			Credit Open Space	1
✓			Credit Rainwater Management	3
			Credit Heat Island Reduction	2
✓			Credit Light Pollution Reduction	1

0	0	0	Water Efficiency	11
Y			Prereq Outdoor Water Use Reduction	Required
Y			Prereq Indoor Water Use Reduction	Required
Y			Prereq Building-Level Water Metering	Required
✓			Credit Outdoor Water Use Reduction	2
			Credit Indoor Water Use Reduction	6
			Credit Cooling Tower Water Use	2
			Credit Water Metering	1

0	0	0	Energy and Atmosphere	33
Y			Prereq Fundamental Commissioning and Verification	Required
Y			Prereq Minimum Energy Performance	Required
Y			Prereq Building-Level Energy Metering	Required
Y			Prereq Fundamental Refrigerant Management	Required
✓			Credit Enhanced Commissioning	6
✓			Credit Optimize Energy Performance	18
			Credit Advanced Energy Metering	1
			Credit Demand Response	2
✓			Credit Renewable Energy Production	3
			Credit Enhanced Refrigerant Management	1
			Credit Green Power and Carbon Offsets	2

0	0	0	Materials and Resources	13
Y			Prereq Storage and Collection of Recyclables	Required
Y			Prereq Construction and Demolition Waste Management Planning	Required
			Credit Building Life-Cycle Impact Reduction	5
			Credit Building Product Disclosure and Optimization - Environmental Product Declarations	2
✓			Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
			Credit Building Product Disclosure and Optimization - Material Ingredients	2
			Credit Construction and Demolition Waste Management	2

0	0	0	Indoor Environmental Quality	16
Y			Prereq Minimum Indoor Air Quality Performance	Required
Y			Prereq Environmental Tobacco Smoke Control	Required
			Credit Enhanced Indoor Air Quality Strategies	2
			Credit Low-Emitting Materials	3
			Credit Construction Indoor Air Quality Management Plan	1
			Credit Indoor Air Quality Assessment	2
			Credit Thermal Comfort	1
			Credit Interior Lighting	2
			Credit Daylight	3
			Credit Quality Views	1
			Credit Acoustic Performance	1

0	0	0	Innovation	6
✓			Credit Innovation	5
✓			Credit LEED Accredited Professional	1

0	0	0	Regional Priority	4
			Credit Regional Priority: Specific Credit	1
			Credit Regional Priority: Specific Credit	1
			Credit Regional Priority: Specific Credit	1
			Credit Regional Priority: Specific Credit	1

0	0	0	TOTALS	Possible Points: 110

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

The project will also qualify for the following LEED v4 credits:

Surrounding Density and Diverse Uses (Nearby destinations: 3rd Street Promenade, Downtown Santa Monica, Santa Monica City Hall, Santa Monica High School, Santa Monica Pier, Santa Monica Place Shopping Center)

Access to Quality Transit (Transit Connections: Metro Los Angeles bus lines 20, 33, 534, 704, 720, 733, 920 and Santa Monica Big Blue Bus lines 1, 2, 3, 3- Rapid, 4, 5, 7, 7- Rapid, 8, 9, 10)

Bicycle Facilities (Bicycle Storage within 200 yards walking distance of commuter rail station)

Rainwater Management (refer to answer to problem statement #4)

Light Pollution Reduction (Neoprene gasket prevents light leak)

Outdoor Water Use Reduction (refer to answer to problem statement #4, both prerequisite and credit)

Enhanced Commissioning (is achievable)

Optimize Energy Performance (energy savings of approximately 16%- refer to answer to problem statement #5)

Renewable Energy Production (based on a $12,240 calculated savings, as compared to the annual energy cost of $78,540)

Building Product Disclosure and Optimization- Sourcing of Raw Materials (Products sourced within 100 miles of the project site- worth 200% of their base contributing cost)

Innovation (ID Credit One- Refer to answer to problem statement #4)

LEED Accredited Professionals

Part 2:

LEED V4 Materials & Resources Changes from LEED 2009:

-Storage and Collection of Recyclables:
Materials that require dedicated storage now include batteries, mercury-containing lamps, and e-waste; project teams may choose two of the three. For retail projects, the required number of waste streams with dedicated storage has increased from three to four.
Pros: The storage of batteries, mercury-containing lamps, and electronic waste is put in place in order to better assure that damage and exposure to toxins is minimized. Safe storage and closely-managed recycling practices prevent these materials from causing any harm to their surrounding environment.
Cons: The disadvantages to establishing separate storage for batteries, mercury-containing lamps, and e-waste involve the extra costs and materials that would go into setting up and maintaining the infrastructure that is required to manage these products safely. Furthermore, the addition of separate waste-steams can have damaging effects on the soil, vegetation, and air quality of the site.
-Construction and Demolition Waste Management Plan:
The creation of a CWM plan is a new requirement.
Pros: The development of a construction waste management plan is helpful in ensuring optimal waste management efficiency in a project. Determining the materials that can or cannot be reused, where they will go, how they will get there, and how they will be disposed of is required in order to minimize travel costs and maximize material usage.
Cons: A possible disadvantage to establishing a waste management plan beforehand would be the additional time and cost that goes into putting together an extensive strategy that otherwise could be used towards materials, maintenance, etc…
-Building Life-Cycle Impact Reduction:
1. Building reuse is a combination of two LEED 2009 credits: MR Credit Building Reuse—Maintain Walls, Floor and MR Credit Roof and Building Reuse—Maintain Interior Nonstructural Elements.
2. MR Credit Building Life-Cycle Impact Reduction, Option 3. Materials reuse may incorporate both structural and nonstructural elements as long as they are not double-counted in MR Credit Building Product Disclosure and Optimization—Sourcing of Raw Materials, Option 2, Leadership Extraction Practices.
Pros: The reuse of both structural and nonstructural materials help in salvaging the existing design and essence of a building. This particular credit is intended for the maintenance of historical building, in that they may protect the historic and significance behind their structure.
Cons: Although historic buildings aim to enrich the communities in which they were built, the reuse of its materials could possibly downplay its original aesthetic attraction. Often times, the older the building, the more renovations and new material need to be added in order to preserve the dignity of the structure. The reuse of old materials may not always be the best option.
-Building Product Disclosure and Optimization- Environmental Product Declarations:
This is a new credit. Some materials excluded from MR Credits in the past may now be included, such as mechanical fixtures, fittings, and rough-in materials that are considered nonmotorized MEP components.
Pros: When manufacturers offer total disclosure of product information, customers have the option of purchasing the product based on the effects it has on the environment. When product information is not given, most buyers will not take the initiative to learn about their bought materials. When the public is made more aware, a new-found sense of responsibility is put upon the consumers to make economically friendly choices, which in turn limits the use of harmful chemicals and promotes green chemistry.
Cons: Manufacturers may find that a disadvantage to disclosing product chemical information is the addition cost that it takes to supply the information.
-Building Product Disclosure and Optimization- Sourcing of Raw Materials:
Multiple Criteria from the following LEED 2009 credits have been combined into this credit. Except as noted, the criteria are unchanged from LEED 2009. Other criteria are now incorporated into other MR credits, such as Building Life-Cycle Impact Reduction and Building Product Disclosure and Optimization- Environmental Product Declarations.

1. MR Credit Resource Reuse. Materials that are reused on-site are no longer required to be repurposed.
2. MR Credit Recycled Content. The requirements for recycled content have not changed; however, this criterion is now combined with other criteria in a single option.
3. MR Credits Regional Materials. The 500-mile (805-km) radius requirement was decreased to 100 miles (160 km). The definition of regional has been expanded to include the distribution and purchase location and now includes all points of manufacture.
4. MR Credit Rapidly Renewable Materials. Biobased materials are no longer defined by the harvest cycle of the raw materials; instead, products must meet the Sustainable Agriculture Standard to count toward this credit.

Pros: When materials are reused and, in turn, no longer required to be repurposed, buildings and communities are more likely encouraged to extract the most use out of the materials they are using, therefore driving down the unnecessary cost transportation, manufacturing, etc. By decreasing the required sourcing radius of a project, buildings are now utilizing local sourcing services, which encourages place-based material solutions and regional environmental/economic sustainability. Because the production of many bio-based materials can be considered harmful to the environment, it is beneficial for these materials to be regulated by the Sustainable Agriculture Standard, and used only when specified.
Cons: There may be some disadvantages to the changes that were made in this section. When materials are reused, instead of being repurposed, the particular material no longer has the potential to be used towards something of relatively greater use. By decreasing a project's sourcing radius, the building may no longer has the access to the materials that are necessary to maintain that environment/community. Lastly, the restriction of certain bio-based materials may mean that a costlier/ less-effective alternative must be used.
- Building Product Disclosure and Optimization- Material Ingredients:
This is a new credit.
Pros: This additional credit was intended to limit the manufacturing of harmful products/chemicals and encourage safer alternatives to be used instead. When these chemicals are no longer being ordered/used, manufacturers are forced to create products that are healthier, which in turn, spurs the development of a new generation of materials. Manufacturers who practice disclosing the chemical contents of their products are catering to a consumer-base that are better able to make more informed decisions about their purchase.
Cons: A disadvantage to developing a healthier material market is that competing manufacturers who are less able adapt to customer demand may be pushed out of business, which creates joblessness and eliminates of competition. The more businesses that are

competing to cater to customer demand, the more likely innovative products will appear on the market.

- Furniture and Medical Furnishings:

1. Air testing protocols for Option 2 have been updated to reflect leadership standards.
2. Requirements in Option 3 has been modified to reflect changes to related Materials and Resources credits.

Pros: The impact furniture and other medical furnishings have on the environment is often overlooked. By requiring restricted material use and awareness, this credit ensures that businesses and homes will be improving their air and living quality, as well as will be reducing environmental damage.

Cons: Hospitals and businesses may find that by buying/using certain materials, they may be compromising the desired ambiance of the building that is important in healthcare service. They may also be spending more money for alternative materials that may cost more to make/buy/install.

- Design for Flexibility:

There is no longer a minimum requirement for interstitial space.

Pros: When there are no requirements as to how much interstitial space maybe be used, buildings (most specifically hospitals) have the opportunity to utilize the entire space to their advantage, which reduces lifecycle cost and gives tenants/employees the freedom to customize their working/living space as they desire.

Cons: The more mechanical equipment that is stored in the interstitial space, the costlier it is to maintain these systems due to increases in energy and space use.

-Construction and Demolition Waste Management:

1. A compliance option has been added for total project waste reduction per gross floor area of the project.
2. Multiple material streams must be diverted to earn the credit for waste diversion (Option 1).
3. ADC has been specifically excluded from diversion calculations. In LEED 2009, it was allowed to count as diverted waste.
4. Waste-to-energy may count as a diversion method if the facility meets European Union requirements for waste management and emissions into air, soil, surface water, and groundwater.

Pros: By diverting a certain percentage of waste streams and/or by reducing their waste per gross floor area, buildings are limiting their wastefulness and increasing their sustainable material use.

Cons: Communities and businesses may be compromising the basic function of their building/business when they are forced to find alternative and potentially costlier materials in order to fulfill this requirement.

Part 3:

Based on the above analysis and the available Project Documents that were supplied, we recommend that the Expo Light Rail Line Project should register and comply with the LEED v4 Rating System and will achieve the LEED “Certified” certification, as it just barely achieves the minimum points required for the certification (40 points total), whereas the project under the LEED 2009 Rating System did not achieve any certification.

Problem Statement 2: Life Cycle Sustainability

Part 1 Annual Energy Use

One of the most critical sustainable strategies involves energy reduction. The realiability of energy on non-renewable energy sources such as oil, coal and natural gas emphasizes the importance of finding way to minimize energy demand or using other renawable sources such photovoltaic solar panels and wind turbines. Green Beach Inc. has performed a life cycle analysis pinpointing the cost and benefits that may be incured when light fixtures to be installed on the Exposition Line at the Colorado-4th St.

		Problem Statement 2 : Life Cycle Sustainability						
		Part 1: Annual Energy Use						
Fixture	**Manufacturer**	**Model/Length**	**Quantity**	**Watts**	**HR/Day**	**Day/Year**	**Watt-Hours**	**Annual Energy Usage (kWh)**
X-6A	Primus Lighting	ALX2-RLR-WL-T8 - 36"	64	25	24	365	14,016,000	14,016.00
X-6B	Primus Lighting	ALX2-RLR-WL-T8 - 48"	0	32	24	365	0	0.00
X-6C	Primus Lighting	ALX2-RLR-WL-T8 -60"	144	40	24	365	50,457,600	50,457.60
					Total Annual Energy Usage per year (kWh)			64,473.60
					Total Annual Energy Cost per year (12.74¢/kWh)			$8,213.94
Fixture	**Manufacturer**	**Model/Length**	**Quantity**	**Watts**	**HR/Day**	**Day/Year**	**Watt-Hours**	**Annual Energy Usage (kWh)**
LED alternate - X-6A	Lithonia Lighting	XWLED4 - 36"	64	17.7	24	365	9,923,328	9,923.33
LED alternate - X-6B	Lithonia Lighting	XWLED4 - 48"	0	23.63	24	365	0	0.00
LED alternate - X-6C	Lithonia Lighting	XWLED4 - 60"	144	29.5	24	365	37,212,480	37,212.48
						Total Annual Energy Usage (kWh)		47,135.81
					Total Annual Energy Cost per year (12.74¢/kWh)			$6,005.10
						Annual Energy Savings (kWh)		17,337.79
						Total Annual Energy Savings		$2,208.83

After performing a quantity take-off of the specificed light fixtures to be installed, a comparison was made to identifty the possible energy savings that could be achieved by installing LED lights in place of the fluorescent lights. We found it feasible to save 17, 338 kWh savings each year. This in turn amounts to an annual dollar savings of $2,208.23. Initially, it is evident that LED fixtures benfit both the environment and the owner. These benefits can only grow if all fluorescent lights are selected for each phase of the Exposition Line.

Part 2 & 3 Life Cycle Analysis

Along with product selection, Green Beach performed a life cycle analysis on the factors affected by subcontractor selection. Contractor bids included FOY Group McKinstry and Cochran. The aspects analyzed inclued initial construction cost, average yearly maintenance costs to be incured over the next ten years and the yearly energy savings that accompined the alternate LED light fixture selection.

Specified Light Fixture Installation

Construction

Fixture	QTY.	Unit Price	Ext. Price	Unit Price	Ext. Price	Unit Price	Ext. Price
X-6A	64	$188.00	$12,032.00	$194.00	$12,416.00	$213.00	$13,632.00
X-6B	0	$213.00	$0.00	$220.00	$0.00	$242.00	$0.00
X-6C	144	$234.00	$33,696.00	$241.00	$34,704.00	$252.00	$36,288.00
Material Cost			**$45,728.00**		**$47,120.00**		**$49,920.00**
Construction Fee		12.00%	$5,487.36	15.00%	$7,068.00	13.50%	$6,739.20
Design Fee		6.00%	$2,743.68	10.00%	$706.80	$2,500.00	$2,500.00
		Construction Cost	**$99,687.04**	**Construction Cost**	**$102,014.80**	**Construction Cost**	**$109,079.20**

Maintenance

Replacement Period (YRS) (25,000 Lamp Life HRS/8,760 HR/YR)	2.85						
# of time replaced over 10 Years	3.504						
Fixture Replacement Cost Over Ten Years (Fixtures *.3.504)	728.832	$125.00	$91,104.00	$113.00	$82,358.02	$133.00	$96,934.66
Trip Charges	3.504	$125.00	$438.00	$113.00	$395.95	$133.00	$466.03
		Subtotal	$91,542.00	**Subtotal**	**$82,753.97**	**Subtotal**	$97,400.69
Overhead		10.00%	$9,154.20	Included	0	8.00%	$7,792.06
Profit		5.00%	$4,577.10	Included	0	5.50%	$5,357.04
		Maintenance Cost	$105,273.30	**Maintenance Cost**	$82,753.97	**Maintenance Cost**	$110,549.78
		Avg. Yearly Cost	$10,527.33	**Avg. Yearly Cost**	$8,275.40	**Avg. Yearly Cost**	$11,054.98

Alternate LED Light Fixtures

Construction

Fixture	QTY.	Unit Price	Ext. Price	Unit Price	Ext. Price	Unit Price	Ext. Price
X-6A Alternate	64	$298.00	$19,072.00	$307.00	$19,648.00	$338.00	$21,632.00
X-6B Alternate	0	$315.00	$0.00	$325.00	$0.00	$357.52	$0.00
X-6C Alternate	144	$388.00	$55,872.00	$400.00	$57,600.00	$388.00	$55,872.00
Material Cost			$74,944.00		$77,248.00		$77,504.00
Construction Fee		12.00%	$8,993.28	15.00%	$11,587.20	13.50%	$10,463.04
Design Fee		6.00%	$4,496.64	10.00%	$7,724.80	$2,500	$2,500.00
		Construction Cost	$163,377.92	**Construction Cost**	$173,808.00	**Construction Cost**	$167,971.04

Maintenance

Replacement Period (YRS) (50,000 Lamp Life HRS/8,760HR/YR)	5.7						
# of Times Replaced Over 10 years	1.75						
Fixture Replacement Cost Replaced Over Ten Years (Fixtures *1.75)	364	$145.00	$ 52,780.00	$113.00	$41,132.00	$172.00	$62,608.00
Trip Charges	1.75	$145.00	$ 253.75	$113.00	$197.75	$172.00	$301.00
		Subtotal	$ 53,033.75	**Subtotal**	$41,329.75	**Subtotal**	$62,909.00
Overhead		10.00%	$5,303.38	Included	0	8.00%	$5,032.72
Profit		5%	$2,651.69	Included	0	5.50%	$3,460.00
		Maintenance Cost	$60,988.81	**Maintenance Cost**	$41,329.75	**Maintenance Cost**	$71,401.72
		Avg. Yearly Cost	$6,098.88	**Avg. Yearly Cost**	$4,132.98	**Avg. Yearly Cost**	$7,140.17

Initial construction cost is alway a major factor in product selection. However, by planning ahead and forecasting potential benefits down the line can help decision makers make better selections that far produce superior advantages in the future.

After reviewing each subcontractor's cost we were able to identify a net present value that can be achieved 10 years down the line.

Specified Light Fixtures

Life Cycle Investment Years	10
Construction Cost	$99,687.04
First Year Energy Savings	$0.00
Annual Maintenance Cost Per Year (Avg.) (-) 1 Year Warranty Period (Maintenacne Cost *0.9)	$9,474.60
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$99,687.04	0	0	-$99,687.04	-$99,687.04
1	0	0.00	-9,474.60	-$9,474.60	-$9,474.60
2	0	0.00	-9,948.33	-$9,948.33	-$9,948.33
3	0	0.00	-10,445.74	-$10,445.74	-$10,445.74
4	0	0.00	-10,968.03	-$10,968.03	-$10,968.03
5	0	0.00	-11,516.43	-$11,516.43	-$11,516.43
6	0	0.00	-12,092.25	-$12,092.25	-$12,092.25
7	0	0.00	-12,696.87	-$12,696.87	-$12,696.87
8	0	0.00	-13,331.71	-$13,331.71	-$13,331.71
9	0	0.00	-13,998.29	-$13,998.29	-$13,998.29
10	0	0.00	-14,698.21	-$14,698.21	**-$14,698.21**

Alternate LED Fixtures

Life Cycle Investment Years	10
Construction Cost	$163,377.92
First Year Energy Savings	$2,208.83
Annual Maintenance Cost Per Year (Avg.) (-) 1 Year Warranty Period (Maintenacne Cost *0.9)	$6,098.88
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$163,377.92	0	0	-$163,377.92	-$163,377.92
1	0	2,208.83	-6,098.88	-$3,890.05	-$3,890.05
2	0	2,319.28	-6,403.83	-$4,084.55	-$4,084.55
3	0	2,557.00	-6,724.02	-$4,167.01	-$4,167.01
4	0	2,960.05	-7,060.22	-$4,100.17	-$4,100.17
5	0	3,597.96	-7,413.23	-$3,815.27	-$3,815.27
6	0	4,592.01	-7,783.89	-$3,191.88	-$3,191.88
7	0	6,153.73	-8,173.08	-$2,019.35	-$2,019.35
8	0	8,658.92	-8,581.74	$77.18	$77.18
9	0	12,793.16	-9,010.83	$3,782.34	$3,782.34
10	0	19,846.40	-9,461.37	$10,385.03	**$10,385.03**

The o

Specified Light Fixtures

Life Cycle Investment Years	10
Construction Cost	$102,014.80
First Year Energy Savings	$0.00
Annual Maintenance Cost Per Year (Avg.) (-) 3 Year Warranty Period (Maintenacne Cost *0.7)	$8,275.40
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$102,014.80	0	0	-$102,014.80	-$102,014.80
1	0	0.00	-8,275.40	-$8,275.40	-$8,275.40
2	0	0.00	-8,689.17	-$8,689.17	-$8,689.17
3	0	0.00	-9,123.62	-$9,123.62	-$9,123.62
4	0	0.00	-9,579.81	-$9,579.81	-$9,579.81
5	0	0.00	-10,058.80	-$10,058.80	-$10,058.80
6	0	0.00	-10,561.74	-$10,561.74	-$10,561.74
7	0	0.00	-11,089.82	-$11,089.82	-$11,089.82
8	0	0.00	-11,644.31	-$11,644.31	-$11,644.31
9	0	0.00	-12,226.53	-$12,226.53	-$12,226.53
10	0	0.00	-12,837.86	-$12,837.86	**-$12,837.86**

Alternate LED Fixtures

Life Cycle Investment Years	10
Construction Cost	$173,808.00
First Year Energy Savings	$2,208.83
Annual Maintenance Cost Per Year (Avg.) (-) 3 Year Warranty Period (Maintenacne Cost *0.7)	$2,893.08
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$173,808.00	0	0	-$173,808.00	-$173,808.00
1	0	2,208.83	-2,893.08	-$684.25	-$684.25
2	0	2,319.28	-3,037.74	-$718.46	-$718.46
3	0	2,557.00	-3,189.62	-$632.62	-$632.62
4	0	2,960.05	-3,349.10	-$389.05	-$389.05
5	0	3,597.96	-3,516.56	$81.40	$81.40
6	0	4,592.01	-3,692.39	$899.62	$899.62
7	0	6,153.73	-3,877.01	$2,276.72	$2,276.72
8	0	8,658.92	-4,070.86	$4,588.06	$4,588.06
9	0	12,793.16	-4,274.40	$8,518.76	$8,518.76
10	0	19,846.40	-4,488.12	$15,358.28	**$15,358.28**

Mckinstry produced the highest overall present value so they are the optimum choice to represent the best value to the owner when installing alternate LED light Lamps.

Life Cycle Investment Years	10
Construction Cost	$109,079.20
First Year Energy Savings	$0.00
Annual Maintenance Cost Per Year (Avg.) (-) 1 Year Warranty Period (Maintenacne Cost *0.9)	$9,949.48
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

Specified Light Fixtures

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$109,079.20	0	0	-$109,079.20	-$109,079.20
1	0	0.00	-9,949.48	-$9,949.48	-$9,949.48
2	0	0.00	-10,446.95	-$10,446.95	-$10,446.95
3	0	0.00	-10,969.30	-$10,969.30	-$10,969.30
4	0	0.00	-11,517.77	-$11,517.77	-$11,517.77
5	0	0.00	-12,093.66	-$12,093.66	-$12,093.66
6	0	0.00	-12,698.34	-$12,698.34	-$12,698.34
7	0	0.00	-13,333.26	-$13,333.26	-$13,333.26
8	0	0.00	-13,999.92	-$13,999.92	-$13,999.92
9	0	0.00	-14,699.91	-$14,699.91	-$14,699.91
10	0	0.00	-15,434.91	-$15,434.91	**-$15,434.91**

Life Cycle Investment Years	10
Construction Cost	$167,971.04
First Year Energy Savings	$2,208.83
Annual Maintenance Cost Per Year (Avg.) (-) 1 Year Warranty Period (Maintenacne Cost *0.9)	$6,426.15
Maintenance Escalation Rate	3.00%
Energy Escalation Rate	5.00%
Discount Rate	15.00%

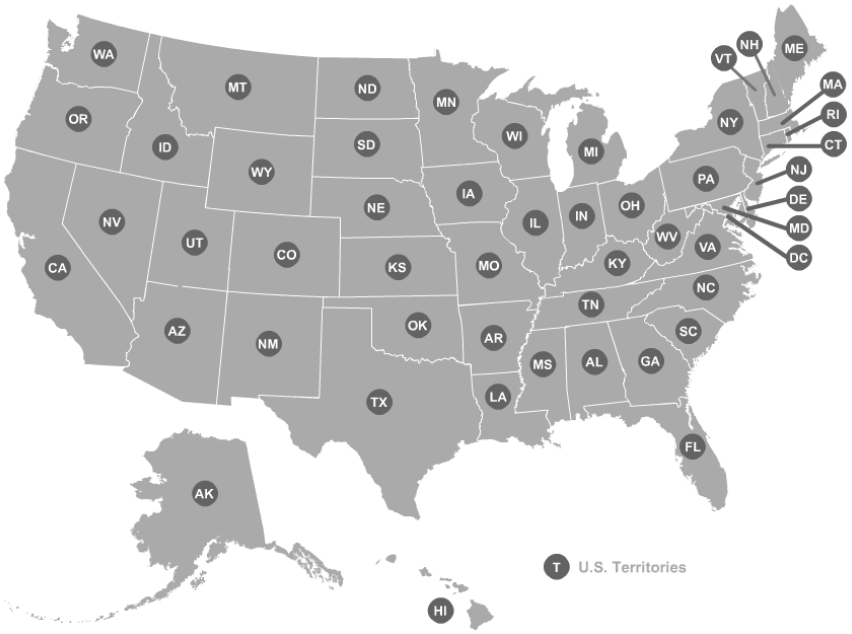
Alternate LED Fixtures

Year	Install Cost	Energy Savings	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$167,971.04	0	0	-$167,971.04	-$167,971.04
1	0	2,208.83	-6,426.15	-$4,217.32	-$4,217.32
2	0	2,319.28	-6,747.46	-$4,428.19	-$4,428.19
3	0	2,557.00	-7,084.84	-$4,527.83	-$4,527.83
4	0	2,960.05	-7,439.08	-$4,479.03	-$4,479.03
5	0	3,597.96	-7,811.03	-$4,213.07	-$4,213.07
6	0	4,592.01	-8,201.58	-$3,609.57	-$3,609.57
7	0	6,153.73	-8,611.66	-$2,457.93	-$2,457.93
8	0	8,658.92	-9,042.24	-$383.33	-$383.33
9	0	12,793.16	-9,494.36	$3,298.81	$3,298.81
10	0	19,846.40	-9,969.07	$9,877.32	**$9,877.32**

Part: 4 Incentives and Rebates

Incentives & Rebates

There are many available incentives and rebates to assist developers, builders, or people who are interested in more efficient technology. A good resource to discover a multitude of benefits of going more efficient is a site called DSIRE I have attached the link below for reference. Every state has incentives as shown on this map from desire below. All you have to do is click on a state and it will give you long list of viable incentives.



One incentive that really caught my attention was PG&E is providing 0% loans for energy efficiency projects pursued by their non-residential customers. Financing is available to fund many technologies, including lighting, HVAC, electric motors, LED street lights, refrigeration, food service equipment and water pumps. Projects may be eligible for financing if it qualifies for a rebate or incentive through a PG&E program, including Customized Retrofit Incentives, certain PG&E third-party programs, the LED Street Light Program or certain product rebate programs.

Loan funds must be used to purchase and install qualifying energy-efficient equipment. Customers may use a contractor or self-install the equipment. PG&E will inspect the facility before the old equipment is removed, and again after the new products are operating.

Loan terms and monthly payment amounts are determined based on the equipment's estimated monthly savings. Business customers may qualify for loans between $5,000 and $100,000, with loan periods of up to 60 months. Government agencies may qualify for loans between $5,000 and $250,000 per PG&E meter, with loan periods of up to 120 months.

Problem Statement 3

Concrete Carbon Footprint

Question #1

Concrete Take-off totals

Name	Cubic Yards
Platform Footings at Grade Stations	185.84
Platform Walls at Grade Stations	141.56
Sidewalk Footings at Grade	10.88
Sidewalk Walls at Grade Stations	20.16
TC &C Footings	20.15
TC &C Walls	27
Colorado / 4th St Station	91.3
Total Before Waste factor:	496.89
1.07	531.6723
Total CY:	**531.6723**

Question #2

1. Assuminng not including formwork or labor
2. Assumption that all concrete elements are 4000psi

White Castle Concrete

Option's

Type	Cost $	Amount CY	Total Cost $
4000 1"	64	532	34048
4000 3/8"	71	532	37772
6000 1"	87.64	532	46624.48
6000 3/8"	88.22	532	46933.04

WHITE CASTLE CONCRETE

Slip Diamond Ready mix

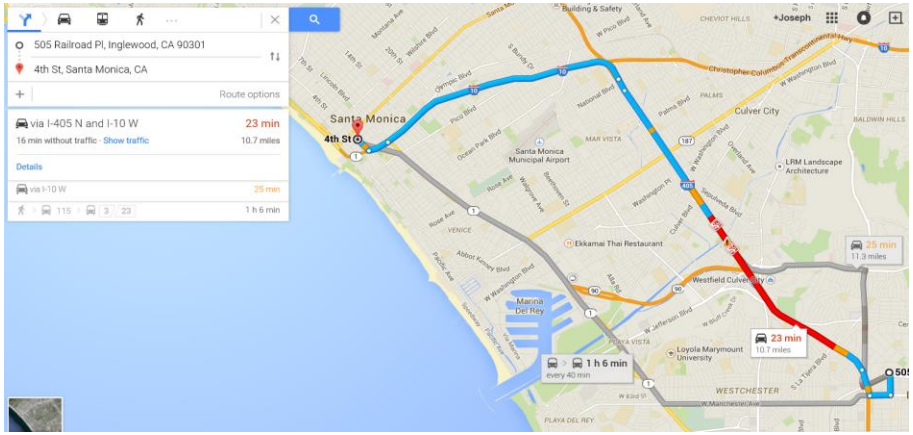
Type	Cost $	Amount CY	Total Cost $
6000 -1" Rock	80	532	42560
6000 - 3/8" Rock	86.5	532	46018
4000 - 1" Rock	73.5	532	39102
4000 - 3/8" Rock	79	532	42028

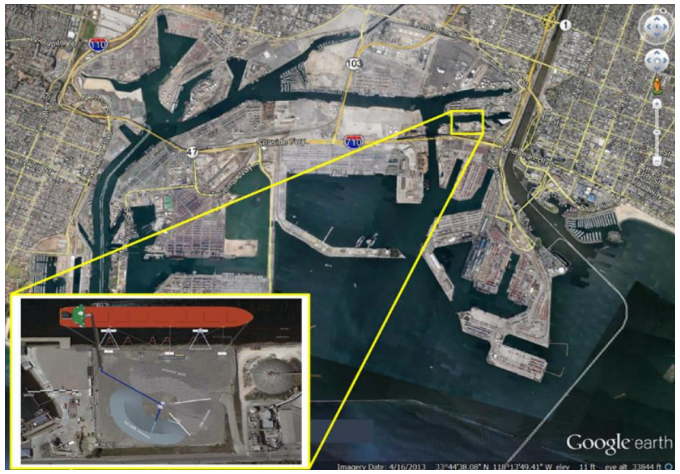
SLIP DIAMOND READY MIX

Questions #3

Assuming from Pomona Haul location
Assuing it comes from the port of long beach
Assuming we are using a 10 wheeler dump truck for transportation MPG is 1-5 so I used 2.5
Assuming Plant Location is: 505 railroad place, Inglewood, CA

Whit Castle (Product Locations)





Type	Location	Distance	MPG	Gallons	Places/ Batch's	Total Gallons
Cement	Cemex Inglewood Plant	0				
Fly Ash F	Headwaters Resources	47	2.5	18.8	11	206.8
Coarse Aggregate 57	Polaris Minerals Corp.	24	2.5	9.6	11	105.6
Fine Aggregate	Polaris Minerals Corp.	24	2.5	9.6	11	105.6
					Total :	**418**

Transportation to Pour	Location	Distance	MPG	Gallons	# Trucks	Total Gallons
To LA site (Concrete)	Los Angeles	10	3.2	32	54	1728
						1728

Total Number of Galons	2146
Pounds of CO2	19
Total Pounds of carbon dioxide	40774
Total Carbon dioxied in tons	**40.774**

Total tunage of CO2 Cost	**1630.96**

Assuming we are using a 10 wheeler dump truck for transportation MPG is 1-5 so I used 2.5
Assuming using same Fly Ash provider and location is at the port of long beach
Assuming Plant Location is: West LA assuing it within 10 miles

City Park Concrete (Product Locations)

Type	Location	Distance	MPG	Gallons	Places/Batchs	Total Gallons
Cement	Cal Portland CP Ontario CA	0				
Fly Ash F	Headwaters Resources	47	2.5	18.8	11	206.8
Coarse Aggregate 57	Vulcan, San Gabriel Valley	20.7	2.5	8.28	11	91.08
Fine Aggregate	Vulcan, San Gabriel Valley	20.7	2.5	8.28	11	91.08
						388.96

Name

Transportation to Pour	Location		Distance	MPG	Gallons	# Trucks	Gallons
To LA site (Concrete)	Los Angeles		10	3.2	32	112	3584
							3584

Figure 2. Extraction and Manufacturing Location of Fly Ash Concrete

Total Number of Gallons	3972.96
Pounds of CO2	19
Total Pounds of carbon dioxide	75486.24
Total Carbon dioxied in tons	**75.48624**

Total tunage of CO2 Cost	3019.4496

I recommend using White Castle Concrete do economical and enviromental reasons.

Assuming 18 pounds of CO2 is produce per gallon of gasoline burned.
Assuming that we are counting there and back so mileage is doubled.

Part 2: Local vs. Out of town Labor

Question #1

Location of workers	# Workers	Distance	Trips	Miles
Los angeles, CA	2	16	22	704
Riverside, CA	3	70	22	4620
Oceanside, CA	2	93	22	4092
			Total Miles:	9416

Total miles driven by workers	MPG	Total Gallons	CO2 / Gallon
9416	20	470.8	18
	Total pounds of CO2:		**26.1555556**

Assuming 18 pounds of CO2 is produce per gallon of gasoline burned.
Assuming that we are counting there and back so mileage is doubled.

Question #2

Location of workers	# Workers	Distance	Trips	Miles
Los angeles, CA	2	15	22	660

Riverside, CA	3	15	22	990
Oceanside, CA	2	15	22	660
			Total Miles:	2310

Total miles driven by workers	MPG	Total Gallons	CO2 / Gallon
2310	20	115.5	18
	Total pounds of CO2:		**6.41666667**

If the works lived 15 miles away 20 pounds of CO2 will not be Produced.

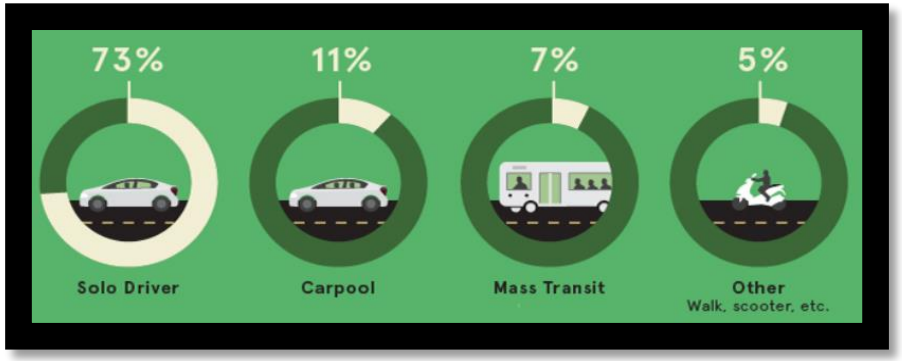
Assuming 18 pounds of CO2 is produce per gallon of gasoline burned.
Assuming that we are counting there and back so mileage is doubled.

Question #2

Location of workers	# Workers	Distance	Trips	Miles
Los angeles, CA	1	15	22	330
Riverside, CA	1	15	22	330
Oceanside, CA	1	15	22	330
			Total Miles:	990

Total miles driven by workers	MPG	Total Gallons	CO2 / Gallon
990	20	49.5	18
	Total pounds of CO2:		**2.75**

If the workers carpoled together than there would be a even larger reduction of 23 pounds.



Problem Statement #4 – Water Collection & Usage

1. Using the Estimated Total Water Use Calculation (ETWU) we were able to estimate how much water the Exposition Line at Colorado & 4th St. will actually use. The formula goes as follows.

   Annual gallons per hydrozone = ET_o x plant factor x 0.62 x hydrozone area / 0.71

   ETWU = $(ET_o)(.62)\{(.5 \times HA)/IE) + SLA\}$

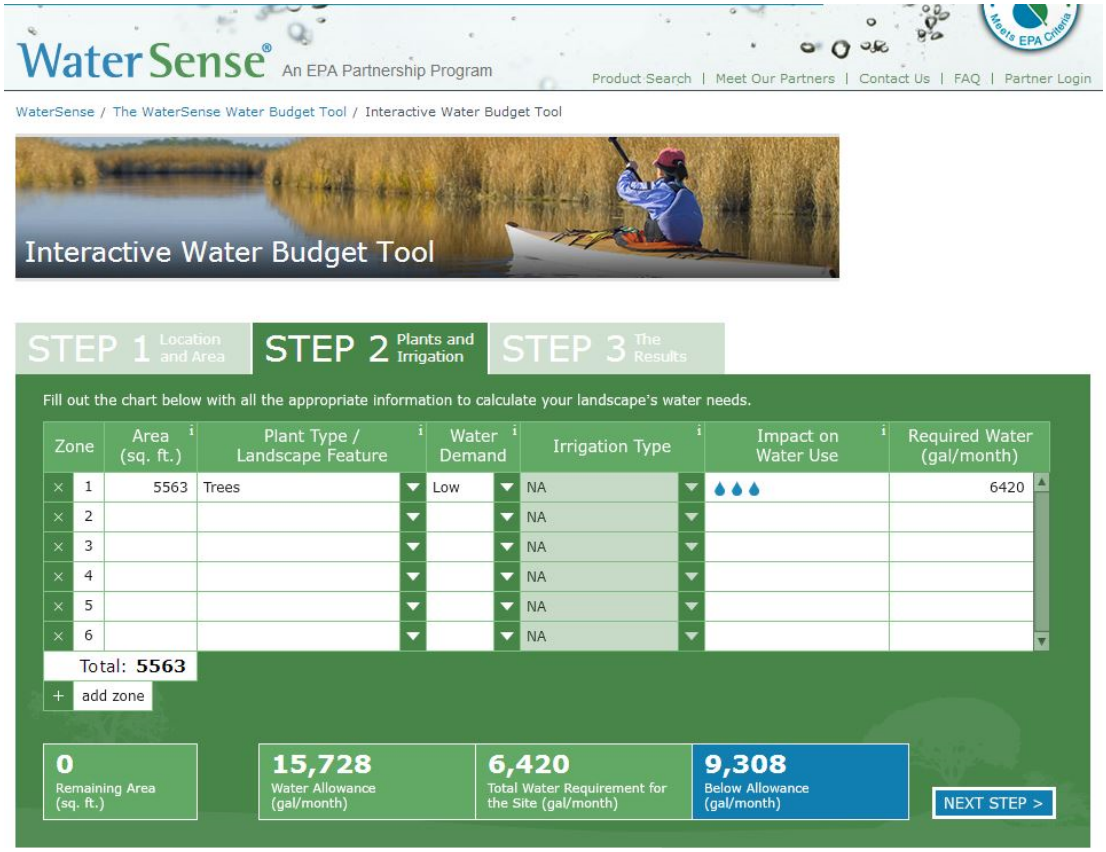
   Where:
   - The plant factor = .5
   - ETWU = Estimated Total Water Use per year (gallons)
   - ET_o = Reference Evapotranspiration (inches)
   - HA = Hydrozone Areas (low, medium, high water use areas in sqft)
   - The 0.62 multiplier converts inches per year to gallons per square foot per year.
   - Irrigation efficiency is said to be 71%, the minimum efficiency set forth by the city of Santa Monica Office of Sustainability & the Environment.

   ETWU = (44.22 in)(.62){(.5 x 5563 sq.ft.)/.71) + 0}

   = 107,406.64 (estimated gallons/year) or 8,950 (gallons/month based off Santa Monica's fresh weather throughout the year)

MONTHS	Average Temp. (Santa Monica, CA)	Average High Temp. (Santa Monica, CA)	Average Precipitation (Santa Monica, CA)	Project Water Usage in Santa Monica, CA (TOTAL)
January	56.7 °F	65.1 °F	3.4 inches	8950 (gallons)
February	56.8 °F	65.3 °F	3.3 inches	8950 (gallons)
March	5.3 °F	65.8 °F	2.6 inches	8950 (gallons)
April	58.9 °F	65.6 °F	0.7 inches	8950 (gallons)
May	62.2 °F	68.5 °F	0.2 inches	8950 (gallons)
June	65.3 °F	70.9 °F	0.1 inches	8950 (gallons)
July	68.8 °F	74.9 °F	0.3 inches	8950 (gallons)
August	69.3 °F	**75.9 °F**	0.1 inches	8950 (gallons)
September	68.2 °F	75.1 °F	0.2 inches	8950 (gallons)
October	65.1 °F	72.8 °F	0.8 inches	8950 (gallons)
November	60.2 °F	69.4 °F	1.2 inches	8950 (gallons)
December	55.9 °F	**65 °F**	2.0 inches	8950 (gallons)

"Hottest" Temp. Coolest Temp.



2. In order to reduce potable water usage, implementing a cistern to the project for the purpose of collecting rain water to reuse in landscape irrigation is a great way to not only save money but also a great practice to implement in all projects to come. By referencing back to part 1, we can see that we would need a cistern with an estimated capacity amount of roughly 107,400 gallons. Using a cistern of this capacity would also satisfy the need of landscape irrigation for the entire year without requiring supplemental water at any point during the year.

3.

a. When considering that the only available area for the cistern would be underneath the bike module "C" area (North end of the station) and given a parameter of 33'x26'x10' to place the cistern (considering the 1' thick slabs/walls), we would maximize the opportunity of catching rain water and reusing it for landscape irrigation by using a cistern as big as the project would allow us. In this case we know the total cubic foot is 8580. We also know that 7.48 gallons = 1 cubic foot. With this being said, we would use a cast-in-place concrete cistern with a max capacity of 64,178.4 gallons.

Capacity (gallons)	Length	Width	Height
64,178.4 gallons	33'	26'	10'

b. Based on the fact that only 59.7% (64,178.4 gallons out of 107,406.64) will be covered in the cistern, the amount of supplemental water required by the project (if evenly distributed throughout the year) would roughly be 3,602.35 gallons per month.

Problem Statement 5: On-Site Renewable Energy

Part 1: Solar Panel Design -

	FLOOR AREA	UOM
TOS Booth & Toilet Roof	**186**	SF
C/S Building	**433**	SF

1.1 Quantity of Panels to Offset 8% of TOS Booth & C/S Building & 1.2 Best Value

Assumptions:

Standard Test Conditions to Evaluate Output Energy
Annual Average Solar Radiation **6.1 kWh/m²- day**
Default Performance Ratio **0.75**

Hours of Operation / Day*:

*REFERENCE:http://media.metro.net/riding_metro/bus_overview/images/806.pdf

Sunday through Thursday (5 AM - 12: 30 AM)	**Friday & Saturday (5 AM - 2 AM)**
19.5	21
40.5	Hours/Week
52	Weeks/Year
2106	**Hours/Year**

PROPOSED STANDARD DESIGN - TOS BOOTH & C/S BUILDING

TOS Booth	**Proposed Design Demand**	*Assumptions:*	
186	kBtu/ft²- year	2106	Hours/Year
SF		186	SF
Space Heating	20.06		
Space Cooling	93.11		
Indoor Fans	188.61		
Lighting	59.53		
Receptable	86.33		
TOTAL	**447.64**	**51,376.43**	
	kBtu/ft²- year	**kWh**	

C/S BUILDING TOTALS	**Proposed Design Demand**	*Assumptions:*	
433	kBtu/ft²- year	2106	Hours/Year
SF		433	SF
TOTAL	**240.00**	**64,124.09**	
	kBtu/sq.ft.-yr	**kWh**	

TOTAL Proposed Energy Design
115,500.52
kWh

PANEL DESIGN - TOS BOOTH & C/S BUILDING

Annual Average Solar Radiation	**206.85 kWh/ft²- year**

Panel	Length (in)	Width (in)
Sunpower X21-345	61.4	41.20
Sunmodule Plus SW275 Mono	65.94	37.44
Grape Solar GS-Start-100W	40.16	26.37

Panel	Solar Radiation kWh/ft²- year	Efficiency Factor	Performance Factor	Energy Output kWh/ft²- year
Sunpower X21-345	206.85	21.50%	0.75	44.47
Sunmodule Plus SW275 Mono	206.85	13.88%	0.75	28.71
Grape Solar GS-Start-100W	206.85	16.40%	0.75	33.92

PANEL SELECTION - TOS BOOTH & C/S BUILDING (CONTINUED)

TOS Booth

Panel	Cost	Area of Panel (ft^2)	Panels Allowed (EA)	Panel Coverage (ft^2)	Annual Contribution (kWh)	Total Cost	Dollars per kWh
Sunpower X21-345	$465	17.57	6.00	105.40	**4,687.51**	**$2,790.00**	**$0.5952**
Sunmodule Plus SW275 Mono	$450	17.14	6.00	102.87	**2,953.33**	$2,700.00	$0.9142
Grape Solar GS-Start-100W	$150	7.35	25.00	183.86	**6,236.98**	$3,750.00	$0.6013

C/S Building

Panel	Cost	Area of Panel (ft^2)	Panels Allowed (EA)	Panel Coverage (ft^2)	Annual Contribution (kWh)	Total Cost	Dollars per kWh
Sunpower X21-345	$465	17.57	17.00	298.64	**13,281.27**	**$7,905.00**	**$0.5952**
Sunmodule Plus SW275 Mono	$450	17.14	16.00	274.31	**7,875.55**	$7,200.00	$0.9142
Grape Solar GS-Start-100W	$150	7.35	38.00	279.46	**9,480.21**	$5,700.00	$0.6013

TABLE 5.1

TOS Booth

Panel	Annual Contribution (kWh)	Total Cost	Dollars per kWh
Sunpower X21-345	**4,687.51**	**$2,790.00**	**$0.5952**
Sunmodule Plus SW275 Mono	**2,953.33**	$2,700.00	$0.9142
Grape Solar GS-Start-100W	**6,236.98**	$3,750.00	$0.6013

C/S Building

Panel	Annual Contribution (kWh)	Total Cost	Dollars per kWh
Sunpower X21-345	**13,281.27**	**$7,905.00**	**$0.5952**
Sunmodule Plus SW275 Mono	**7,875.55**	$7,200.00	$0.9142
Grape Solar GS-Start-100W	**9,480.21**	$5,700.00	$0.6013

TOTAL Proposed Panel Energy Contribution
17,968.77
kWh

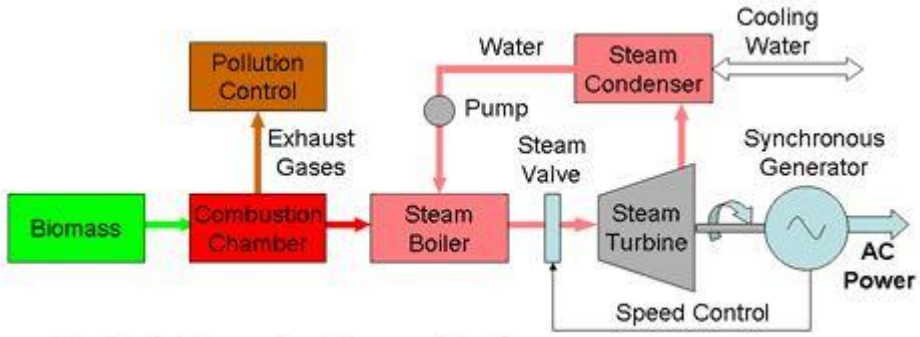
TOTAL RENEWABLE ENERGY OFFSET
15.56%

Per the obtained results from table 5.1, the panel design proposal will generate 15.6% in annual energy savings. By comparing the dollars spent to the amount of energy generated, and considering available roof area, the best value selection for renewable energy contribution is the Sunpower X21-345 panel. At a competitive $0.59 per kWh generated, the Sunpower X21-345 system contributes a combined 17,968 kWh in an operating year for the TOS Booth and C/S Building.

Problem Statement #5 – On-Site Renewable Energy

Part 3 (Alternative Renewable Energy Sources)

Other than traditional photovoltaic panels, an alternative renewable energy source that many of us tend to overlook is Biofuel-based electrical systems. Biomass is an energy that is produced to burn as fuel for the purpose of generating electricity. It uses solar energy captured by photosynthesis for electrical power generation. One advantage of using biofuels is that they are renewable energy resources which ultimately do NOT contribute to global warming. In example, a generating plant fuelled by biomass uses conventional steam turbine electricity generating plant as used in coal fired power stations with modifications to the combustion chamber and fuel handling systems to handle the bulkier fuel as demonstrated in the AC power diagram below. California is known to be a rich in energy generating landscapes and using this type of energy to produce things such as power for AC units can be extremely beneficial to all end users.



Electricity Generation Powered by Biomass

4 ACRES

Tota Area of Parcel 174,240 ft²

Initial

Use: Sunpower X21-345			17.57 sq ft (ea)
Quantity	9,918	EA	Panels
Price (EA)	$465	EA	
Total Cost	**$4,612,089**	**Energy Escalation Assumption**	**5%**
Energy Savings (kWh) Year 1	36,041,003	**$0.1274 per kWh - Electricity Local - Los Angeles**	

Year	Install Cost	Energy Savings in Dollars	Maintenance	Total Annual Cash Flow	Present Value Total Annual
0	-$4,612,089.43	$4,591,623.83	-$138,362.68	$117,897.07	$117,897.07
1	0	$4,821,205.02	-$142,513.56	$4,963,718.58	$4,963,718.58
2	0	$5,062,265.27	-$146,788.97	$5,209,054.24	$5,209,054.24
3	0	$5,315,378.53	-$151,192.64	$5,466,571.17	$5,466,571.17
4	0	$5,581,147.46	-$155,728.42	$5,736,875.88	$5,736,875.88
5	0	$5,860,204.83	-$160,400.27	$6,020,605.10	$6,020,605.10
6	0	$6,153,215.07	-$165,212.28	$6,318,427.35	$6,318,427.35
7	0	$6,460,875.83	-$170,168.65	$6,631,044.47	$6,631,044.47
8	0	$6,783,919.62	-$175,273.71	$6,959,193.32	$6,959,193.32
9	0	$7,123,115.60	-$180,531.92	$7,303,647.52	$7,303,647.52
10	0	$7,479,271.38	-$185,947.88	$7,665,219.25	$7,665,219.25

NET INCOME	**$62,392,253.97**

Panel	Solar Radiation kWh/ft²- year	Efficiency Factor	Performance Factor	Energy Output kWh/ft²- year
Sunpower X21-345	206.85	21.50%	0.75	44.47

The Exposition Transit Project: Phase 2

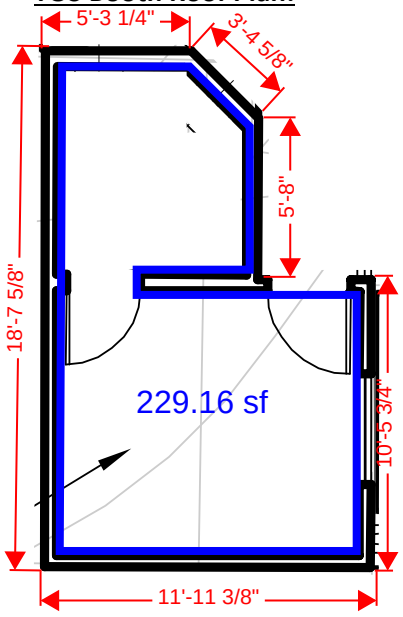
The City of Santa Monica:

Zoning Ordinance Standards for the Installation of Solar Energy Systems

SMMC 9.04.10.02.220: Solar Energy Design Standards

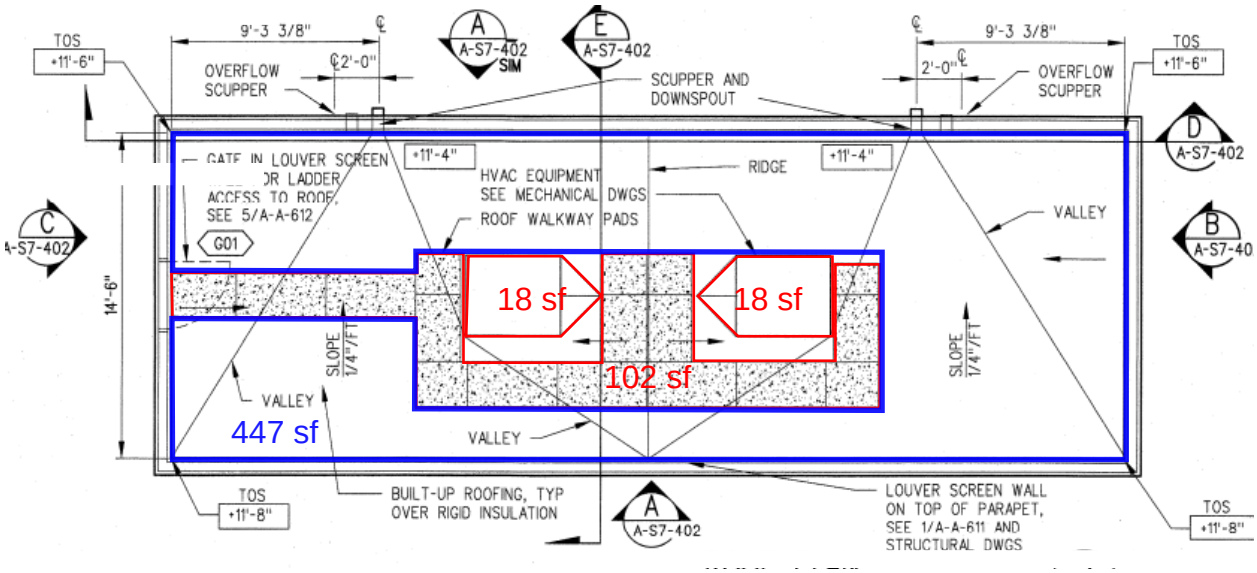
Santa Monica Fire Department
SOLAR PHOTOVOLTAIC INSTALLATION GUIDELINE

TOS Booth Roof Plan:



The following exhibit includes open roof space available for Solar Panels

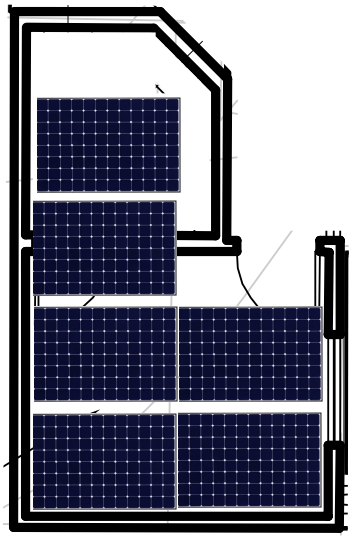
C/S Building Roof Plan:



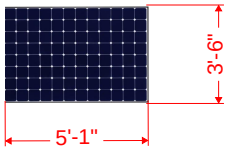
The following exhibit includes open roof space available for Solar Panels

The Exposition Transit Project: Phase 2

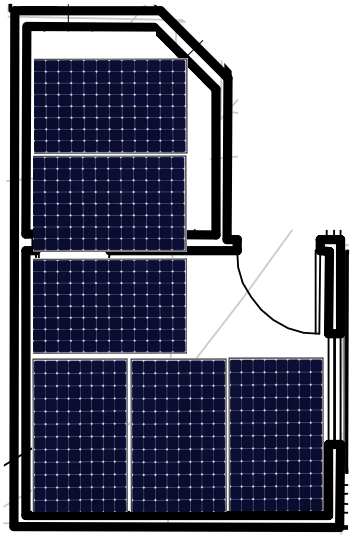
TOS Booth Roof Plan:



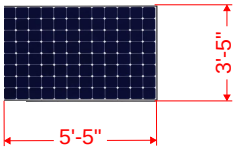
Manufacture: Sunpower
Solar Panels: X21-345 Model



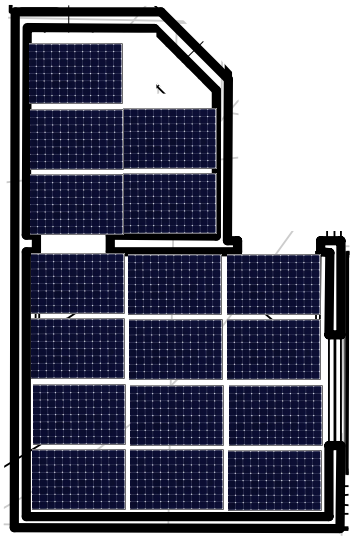
TOS Booth Roof Plan:



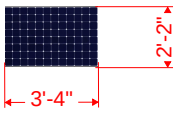
Manufacture: Sunmodule Plus
Solar Panels: X21-345 Model



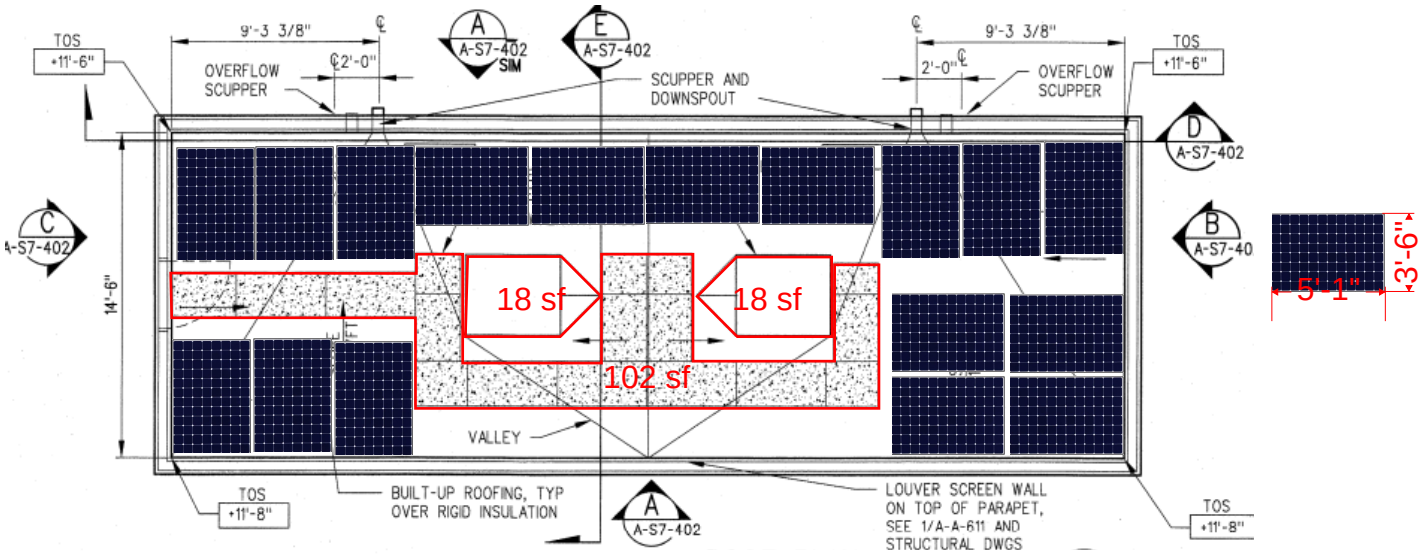
TOS Booth Roof Plan:



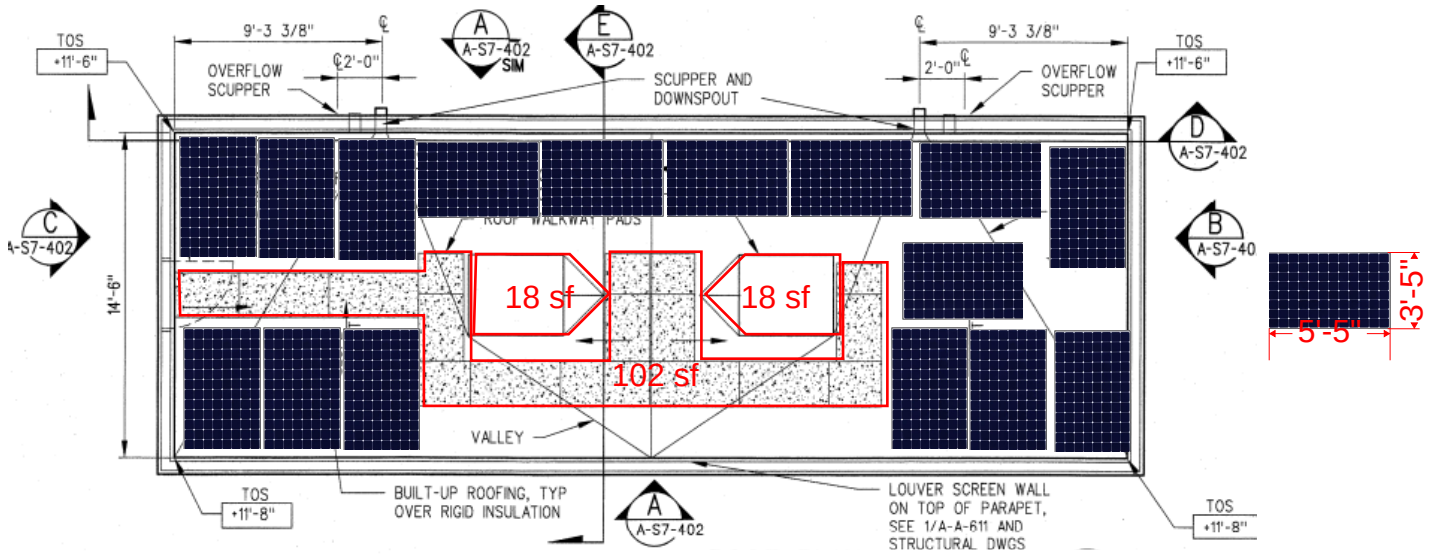
Manufacture: Grape Solar
Solar Panels: GS-Start-100W Model



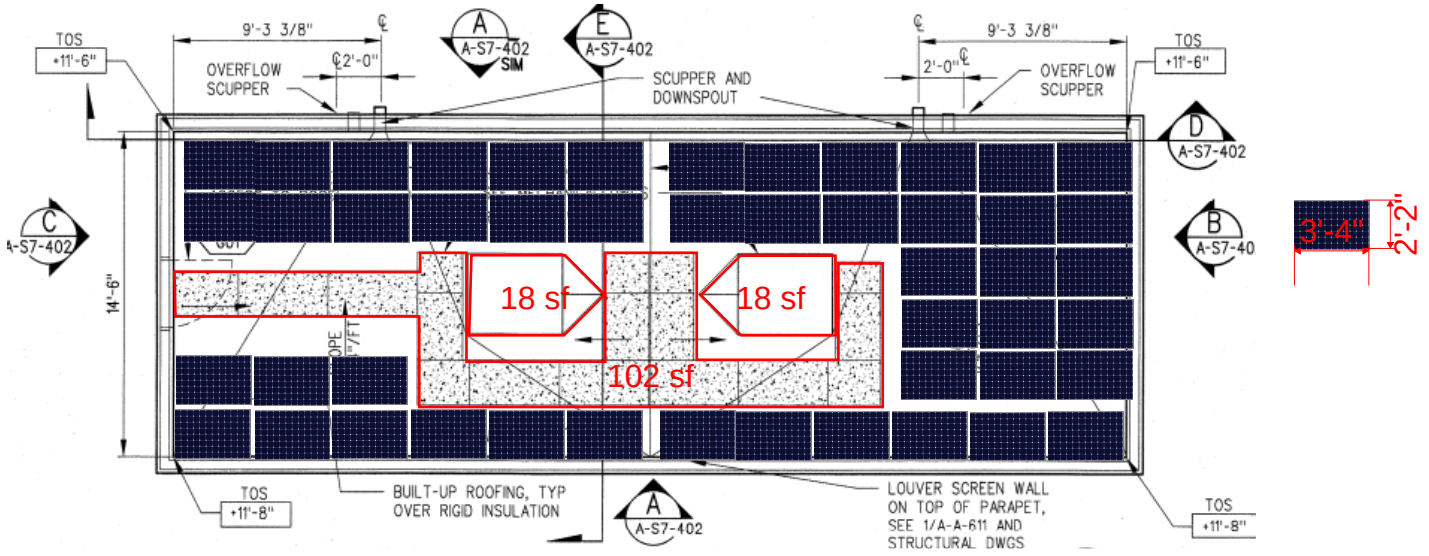
C/S Building Roof Plan: Sunpower X21-345 Model



C/S Building Roof Plan: Sunmodule Plus SW275 M(



C/S Building Roof Plan: Grape Solar GS-Start-100W Model



Addendum 1: Expo Daily Ridership

The combined ridership on the two phases is expected to reach 64,000 a day by 2030.						
Based on Estimated riders per						
# of Riders Per Day	Distance	Total Miles Per day				
64,000	16	1024000				
Average Miles Per Gallon : Based on what was given in the Problem statement: 20 MPG						
Total Miles	MPG	Gallons Saved (PER Day)				
1024000	20	**51200**				

In the 21st century membership and participation programs must focus on creating radical new value instead of on membership. By prioritizing value creation and placing less emphasis on membership. Instead of a one-size-fits-all membership, I propose we have a system that works and operates with many different people and is very easy to use. I think the key is to developed a transportation app like uber that will allow its gets to see how much it will cost them to go from destination to destination only charging them for the distance that they went on the train not just one fair gets your any ware on the route. This at the same time will encourage people to join because it fun and interactive.