



Olas Rooker, Travis Damuth, Raz Divani,
 Marco Tadros, Ghaya Berkaoui

Chaska Government Center: Updating the Exterior Lighting



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Design by Olas Rooker, Travis Damuth, Raz Divani,
Marco Tadros, Ghaya Berkaoui

Project Scope



Objective

- Investigate options for updating the outdoor lighting in the parking lots at the Chaska Gov. Center
- Priority on LED bulbs and utilizing solar energy
- Save money on energy
- Long-term financial payoff
- Capital investment.

The project is a collaboration between Carver County and our group of five students with the objective of switching all exterior lights at the Carver County government building.

The project aims to utilize solar radiation as a form of energy to provide light for the parking lots and entryways.

Objective

- Investigate options for updating the outdoor lighting in the parking lots at the Chaska Gov. Center
- Priority on LED bulbs and utilizing solar energy
- Save money on energy
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Annual Utility Bill



ADDRESS CORRESPONDENCE TO:

City of Chaska

Utility Billing
One City Hall Plaza
Chaska, MN 55318-1962

For Billing Information call: (952) 448-9200

Office Hours: 7:30 - 4:30 Mon-Fri

A payment drop box is located in the City Hall parking lot.

For Electric, Water and Sewer Emergencies call: (952) 448-4335

Bill Date: 8/25/15

For Services to: Account No. 0500939050

CARVER CO GOVT CENTER
606 4TH ST ELECTRIC E

Account Summary

Previous Bill Amount:		\$17,144.83
Last Payment Received:	8/07	17,144.83
Previous Balance:		0.00
Total Current Charges:		30,373.29
Sales Tax:		0.00
Amount Now Due		\$30,373.29

**There is a \$10 service charge for returned check or returned bank payment.

Penalty Date: 09/15/2015
After Penalty Date Pay: \$31,891.96

Service Description	Meter Readings		Meter Multiplier	Usage	Current Charges
	8/08/15	7/07/15			
KW Demand Charge Electric	3.897	.000		779.400	9,664.56
LG Large General Service Electric	2178	758	200.000	284000	17,554.04
LG Energy Adjustment Charge	0.010932				3,104.69
RK Reactive Reading Electric	672	244	200.000	85600	0.00
SC Electric Service Charge					50.00

The government building spends hundreds of thousands of dollars on energy bills, so any offset of costs via renewable energy will lead to a relatively quick return on investment.

We anticipate that developing a solar-powered exterior lighting system will be a much better alternative to the current and outdated lights .

Electric Energy Analysis



The average Kwh usage per year = 3,000,000 Kwh



Electric Energy Analysis

Carver County
Electric Energy Analysis - Total 10/27/2015

Current Month September-15

Month	Electricity - Previous Year		
	Demand (kW)	Usage (kWh)	Cost
October-13	720	274,200	\$ 25,043.04
November-13	562	235,800	\$ 21,546.82
December-13	646	288,080	\$ 23,212.55
January-14	651	287,680	\$ 25,627.12
February-14	607	246,640	\$ 22,592.61
March-14	603	234,280	\$ 21,579.05
April-14	581	235,720	\$ 21,227.47
May-14	815	272,680	\$ 29,134.99
June-14	995	314,750	\$ 34,815.07
July-14	953	325,280	\$ 34,361.72
August-14	949	359,640	\$ 36,871.21
September-14	821	287,960	\$ 24,857.71
Totals		3,322,510	\$ 320,689.96

Month	Electricity - Current Year		
	Demand (kW)	Usage (kWh)	Cost
October-14	750	253,160	\$ 23,595.20
November-14	562	238,000	\$ 20,269.80
December-14	633	255,720	\$ 23,502.88
January-15	566	262,320	\$ 23,667.27
February-15	633	222,480	\$ 21,104.75
March-15	553	225,520	\$ 21,251.40
April-15	695	282,200	\$ 25,439.56
May-15	738	258,520	\$ 27,125.12
June-15	745	254,840	\$ 27,391.21
July-15	1,013	388,160	\$ 40,972.82
August-15	856	374,960	\$ 39,516.35
September-15	0	0	\$ -
Totals		3,015,680	\$ 293,886.36



The average Kwh usage per year = 3,000,000 Kwh

Operating schedule times

	A	B	C	D	E
1	Date	Time off	Time on	Total Time off	Total time on
2	9/28/2015	7:09:42	18:59:40	11:48:46	12:11:14
3	9/29/2015	7:10:54	18:57:46	11:45:39	12:14:21
4	9/30/2015	7:12:07	18:55:52	11:42:32	12:17:28
5	10/1/2015	7:13:20	18:53:58	11:39:25	12:20:35
6	10/2/2015	7:14:33	18:52:05	11:36:19	12:23:41
7	10/3/2015	7:15:46	18:50:13	11:33:13	12:26:47
8	10/4/2015	7:17:00	18:48:21	11:30:07	12:29:53
9	10/5/2015	7:18:14	18:46:29	11:27:01	12:32:59
10	10/6/2015	7:19:28	18:44:38	11:23:56	12:36:04
11	10/7/2015	7:20:42	18:42:48	11:20:51	12:39:09
12	10/8/2015	7:21:57	18:40:58	11:17:46	12:42:14
13	10/9/2015	7:23:12	18:39:09	11:14:42	12:45:18
14	10/10/2015	7:24:27	18:37:21	11:11:39	12:48:21
15	10/11/2015	7:25:42	18:35:34	11:08:36	12:51:24
16	10/12/2015	7:26:58	18:33:47	11:05:33	12:54:27
17	10/13/2015	7:28:14	18:32:01	11:02:31	12:57:29
18	10/14/2015	7:29:30	18:30:16	10:59:29	13:00:31
19	10/15/2015	7:30:47	18:28:32	10:56:28	13:03:32
20	10/16/2015	7:32:04	18:26:49	10:53:28	13:06:32
21	10/17/2015	7:33:21	18:25:08	10:50:30	13:09:30
22	10/18/2015	7:34:38	18:23:27	10:47:31	13:12:29
23	10/19/2015	7:35:56	18:21:47	10:44:33	13:15:27
24	10/20/2015	7:37:14	18:20:08	10:41:36	13:18:24
25	10/21/2015	7:38:32	18:18:30	10:38:39	13:21:21
26	10/22/2015	7:39:51	18:16:54	10:35:45	13:24:15
27	10/23/2015	7:41:09	18:15:18	10:32:50	13:27:10
28	10/24/2015	7:42:28	18:13:44	10:29:56	13:30:04
29	10/25/2015	7:43:48	18:12:12	10:27:05	13:32:55
30	10/26/2015	7:45:07	18:10:40		
31					
32					
33				Average time on	12:52:38
34					

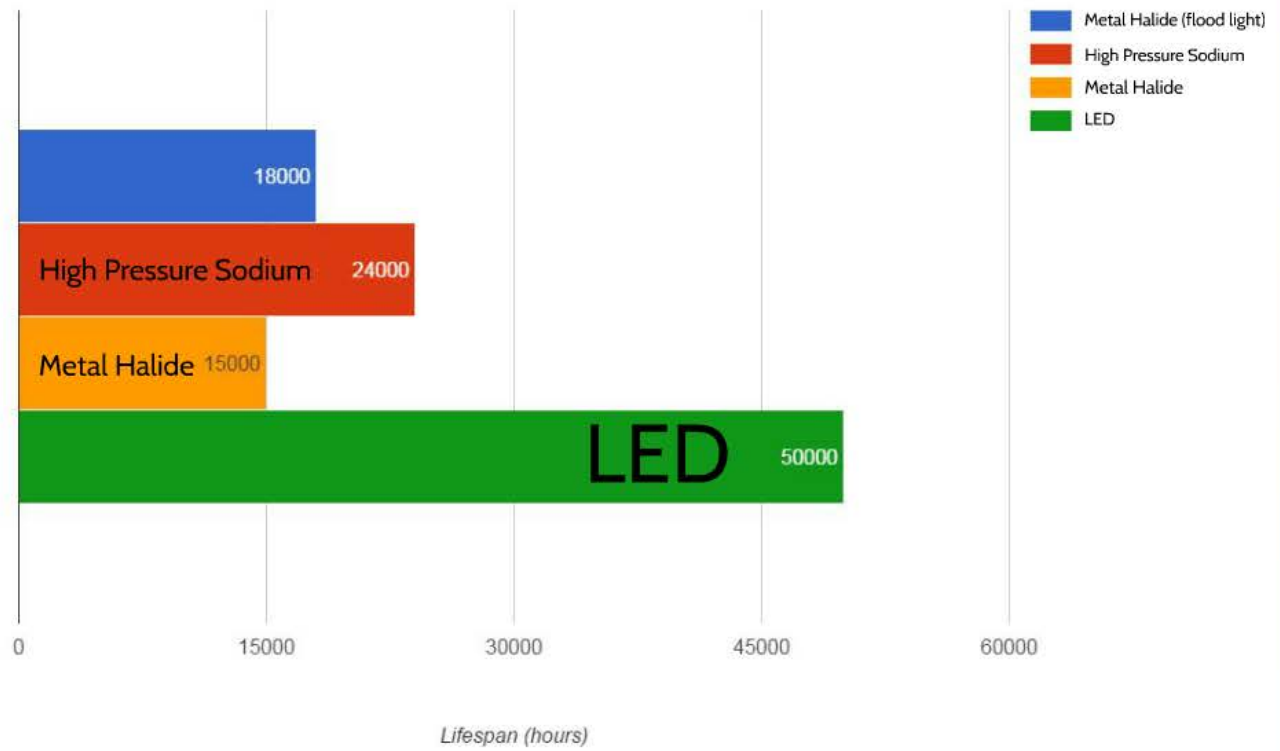
- Average time in October: 13 Hours
- Average time in June: 8 Hours
- Average time in December: 15 Hours

Package 1: Bulb Replacement

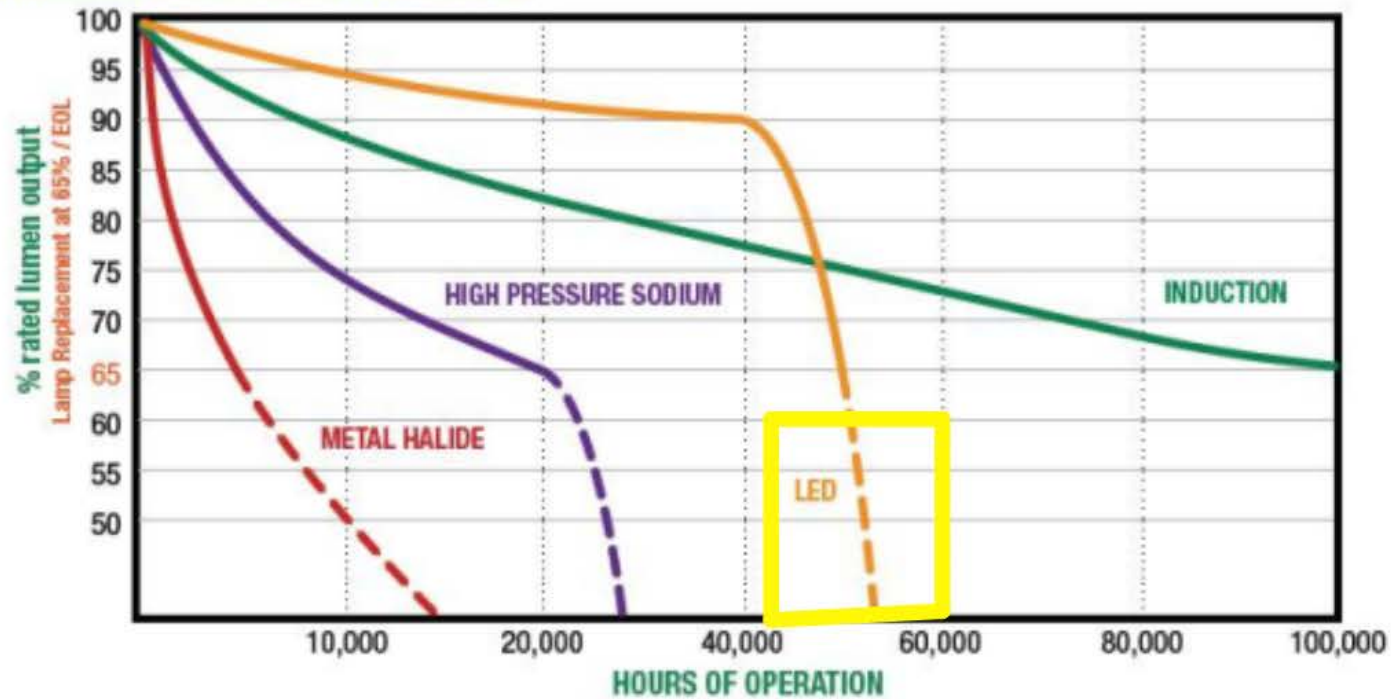
- **Cost and Energy Savings** changing all bulbs to LED
- **Estimated payback time**
- **Pros and Cons**



Light Bulb Comparison



ESTIMATED LUMEN MAINTENANCE



source: bcxenergy.com

LED output is much more constant over lifespan

Energy Savings

Assumptions:

- Off-peak usage
- Higher cost per kWh in summer months (June-September)
- 9.5 hours on during summer, 12 hours on rest of year

Total Current Annual Energy Usage: 84,540 kWh

Total Current Energy Cost: \$4,914.75/year

Annual Energy Usage Converting to LED: 23,140 kWh

Estimated Energy Cost: \$1,345.51

About 73% less energy and cost



Retrofit Cost

- Corresponding LED bulb in current fixtures
- Takes into account all outdoor light fixtures
- Maintain UL safety certification

\$15,352

Current Setup

Energy Cost: \$4,914.75/year

Bulb Cost: \$10.03/year

Total: \$4,925/year

Cost after 5 years: \$24,623.90

Proposed LED System

Energy Cost: \$1,345.51/year

Bulb Cost: \$312.13/year

Total: \$1,657.64/year

Proposed LED System

Retrofit Cost: \$15,352

Total: \$17,009.64

After 5 years: \$23,640.22

Current	LED
\$24,623.90	\$23,640.22

5 Year Cost

Savings after 5 years: \$983.68

10 year savings: \$17,319.36



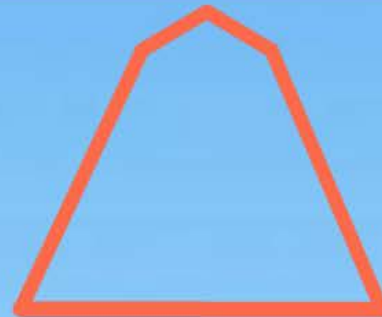
Package 1

Benefits

- Low cost option
- Easy transition
- Less Waste
- Reliable lighting
- No Mercury recycling
- <5 year payback

Drawbacks

- Fixtures remain
- High initial capital needed
- No solar usage



Benefits

- **Low cost option**
- **Easy transition**
- **Less Waste**
- **Reliable lighting**
- **No Mercury recycling**
- **<5 year payback**

1

Drawbacks

- **Fixtures remain**
- **High initial capital needed**
- **No solar usage**

Package 2

Package 2

LED light bulbs
Solar PV Panels to produce 100% of energy

Item	Quantity	Unit Price	Total Price
LED Light Bulbs	100	0.10	10.00
Solar PV Panels	100	100.00	10000.00
Wiring	100	10.00	1000.00
Inverter	1	1000.00	1000.00
Mounting Racks	100	10.00	1000.00
Subtotal			12010.00
Tax			1201.00
Total			13211.00



Area Needed
2218 Sqft area needed
south facing panels
30 degree summer, 60 degree winter

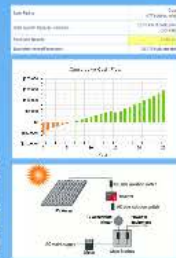


Estimated System Size:

System Size (kW)	10.0
System Size (kW)	10.0
System Size (kW)	10.0

Estimated Cost:

System Cost (\$)	13211.00
System Cost (\$)	13211.00
System Cost (\$)	13211.00



Solar Panels options:

1. Monocrystalline Silicon (Single Silicon)

Efficiency	18-22%
Cost	High
Appearance	Uniform

2. Polycrystalline Silicon (Multi-silicon)

Efficiency	15-18%
Cost	Low
Appearance	Fragmented

3. BIPV (Building Integrated Photovoltaics)

Efficiency	15-18%
Cost	Very High
Appearance	Seamless



Cost Analysis



WE CAN REDUCE ENERGY CONSUMPTION WITH SOLAR PANELS BY 70%.
IN THE FIRST 7 YEARS, ELECTRICITY BILL WILL BE HIGHER THAN PACKAGE 2. BUT IT WILL BE RETURNED AFTER 7 YEARS.

ROOF AREA

ROOF AREA NEEDED: 2218 Sqft
select roof areas near to the parking lots to increase efficiency



Package 2

LED light bulbs

Solar PV Panels to produce 100% of energy



LED TYPE	Wattage	quantity	Quantity*kW	h	kWh/day	kWh/year
LED 8090M	120	1	0.12	12	1.44	525.6
LED 8039M	20	6	0.12	12	1.44	525.6
LED 8090M	120	2	0.24	12	2.88	1051.2
LED 8090M	120	5	0.6	12	7.2	2628
LED 8088M	50	13	0.65	12	7.8	2847
LED 8090M	120	4	0.48	12	5.76	2102.4
LED 8090M	120	11	1.32	12	15.84	5781.6
LED 8055M	30	6	0.18	12	2.16	788.4
LED 8055M	30	1	0.03	12	0.36	131.4
LED 8090M	120	1	0.12	12	1.44	525.6
LED 8088M	50	4	0.2	12	2.4	876
LED 8055M	30	3	0.09	12	1.08	394.2
LED 8055M	30	4	0.12	12	1.44	525.6
LED 8090M	120	2	0.24	12	2.88	1051.2
LED 8090M	120	2	0.24	12	2.88	1051.2
LED 8088M	50	5	0.25	12	3	1095
LED 8055M	30	9	0.27	12	3.24	1182.6
LED 8055M	30	4	0.12	12	1.44	525.6
LED 8039M	20	5	0.1	12	1.2	438
LED 8039M	20	6	0.12	12	1.44	525.6
LED 8090M	120	1	0.12	12	1.44	525.6
		95				25097.4



Solar Panels options:

1. Monocrystalline Silicon (Single Silicon)

OVERVIEW	
Product	Monocrystalline P-Type Silicon Solar Cell
Format ; Diameter	156 mm x 156 mm; 200 mm
Description:	High performance and premium optical quality and appearance cell, suitable for all applications including BIPV. (Efficiency 17.5% - 18.39%).
Electrical contacts	Front side: grid; 3 busbars Back side: 3 busbars

900mm

2. Polycrystalline Silicon (Multi-silicon)

Cell	polycrystalline silicon solar cells 156MM*156MM
No.of cells and connections	36(4*9)
Dimension of module(mm)	1480*670*40
Weight (kg)	12

3. BIPV (Building Integrated Photovoltaics)

Place of Origin: Zhejiang, China (Mainland)	Brand Name: sinosola	Model Number: 90W-200W
Material: Monocrystalline Silicon	Size: 1300*802*8	Number of Cells: 60
Max. Power: 90W-200W	certificate: TUV/IEC/CEC/CE/ISO	



Estimated System Size:

Solar Rating:	Good 4.77 kWh/sq-m/day
Solar System Capacity Required:	22.18 kW of peak power (DC watts)
Roof Area Needed:	2,218 sq-ft
Equivalent Annual Production:	28,779 kWh electricity

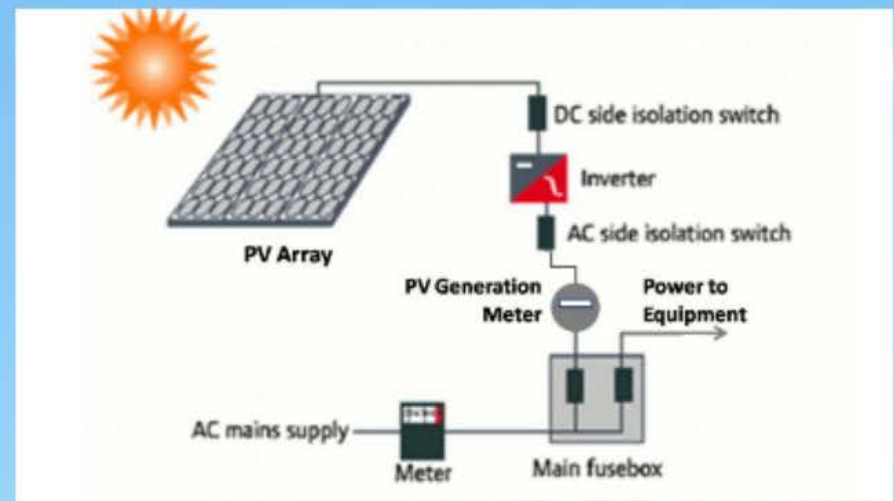
Building Type:	Commercial/Business
State & County:	MN - Carver
Utility:	City of Chaska
Utility Type:	Municipal Utility
Your Average <u>Monthly</u> Electricity Bill: (Assumed rate x average monthly usage)	\$ 374 / Month

Estimated Cost:



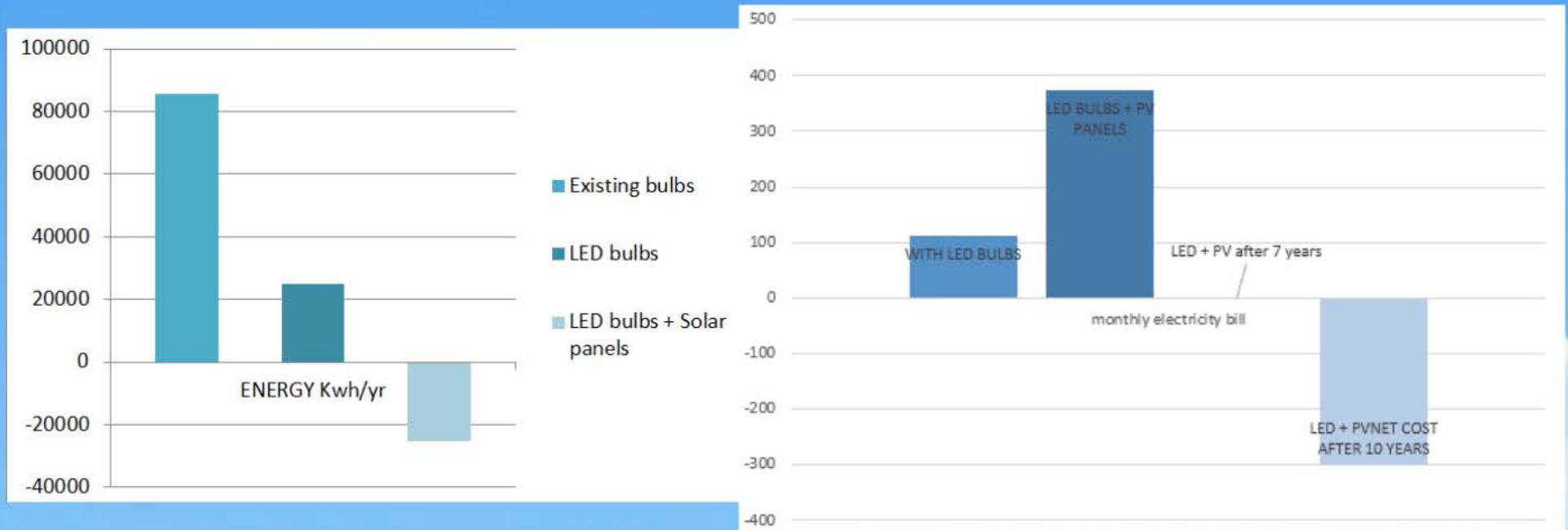
Assumed Installation Gross Cost: "Gross Cost" is the cost <u>before</u> any rebates, incentives, tax credits, etc. are applied. See the Cost Notes, below!	\$77,630 assuming \$3.5 per watt DC
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Federal Tax Credit (30% of Net Cost at Installation) » link	\$ 23,289
Modified Accelerated Cost Recovery System (MACRS) Depreciation (5 yr) » link	YES
ESTIMATED NET COST:	\$ 54,341
Cash & Loan Amounts:	\$ 54,341 Cash \$ 0 Borrowed
Loan Monthly Payment (6.5% apr, 30 years):	\$ 0



<http://estimator.solar-estimate.org/>

Cost Analysis



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ROOF AREA

ROOF AREA NEEDED: 2218 Sqft

select roof areas near to the parking lots to increase efficiency



Area Needed

2218 Sqft area needed

south facing panels

30 degree summer, 60 degree winter



Package 2

Benefits

- Give off no pollution
- Cost effective
- become less dependent on the worlds fossil fuel supplies

Drawbacks

- Initial cost of solar cells
- Pollution affects efficiency



Package 3

Project 3

THIS BREAKDOWN INCLUDES:

- THE INITIAL LIGHT BULB CHANGES IN PROJECT ONE
- THE SOLAR PANEL ARRAYS OF PROJECT TWO
- THEN REPLACEMENT OF ALL OLD FIXTURES WITH 'NEW' ENERGY SAVING FIXTURES



OVERALL COST TO CHANGE ALL FIXTURES



+ TO REPLACE ALL FIXTURES WILL NEED AN INITIAL OF FRONT COST OF APPROXIMATELY **\$50,000**

POST LIGHTS

LED Street / Parking Lot Light with 280 watts, 28,000-30,000 Lumens



"BRIGHT" FOR LONGER

Year	Original Lumens	Original Lumens	Original Lumens	Original Lumens	Original Lumens	Original Lumens	Original Lumens	Original Lumens	Original Lumens
1	10000	10000	10000	10000	10000	10000	10000	10000	10000
2	10000	10000	10000	10000	10000	10000	10000	10000	10000
3	10000	10000	10000	10000	10000	10000	10000	10000	10000
4	10000	10000	10000	10000	10000	10000	10000	10000	10000
5	10000	10000	10000	10000	10000	10000	10000	10000	10000
6	10000	10000	10000	10000	10000	10000	10000	10000	10000
7	10000	10000	10000	10000	10000	10000	10000	10000	10000
8	10000	10000	10000	10000	10000	10000	10000	10000	10000
9	10000	10000	10000	10000	10000	10000	10000	10000	10000
10	10000	10000	10000	10000	10000	10000	10000	10000	10000

- + THROUGH THE LIFE SPAN OF THE ORIGINAL LIGHT BULBS, THE LUMENS "BRIGHTNESS" DECREASES 60% COMPARED TO ITS INITIAL OUTPUT.
- + THESE NEW LIGHTS HAVE A SUSTAINED LUMEN LIFE SPAN CAPABLE OF OUT LASTING APPROXIMATELY THE SAME LUMENS FOR A LONGER TIME.

RETURN ON INVESTMENT

- + THE AVERAGE KW USAGE FOR THE PAST YEARS ARE 84536.27 KW/Y. THIS ACCRUED A COST OF \$4914.75 PER YEAR. YOU WOULD HAVE SAVED APPROXIMATELY \$3500.00 EACH YEAR FROM SIMPLY REPLACING THE FIXTURES.
- + THE EXPECTED ROI OF FIXTURE REPLACEMENT WILL TAKE APPROXIMATELY 30 YEARS JUST FROM THE SAVING PER WATT USED.
- + SAVINGS AFTER 50 YEARS, \$74,711.87



Project 3

THIS BREAKDOWN
INCLUDES:

+THE INITIAL LIGHT BULB
CHANGES IN PROJECT ONE

+THE SOLAR PANEL
ARRAYS OF PROJECT TWO

+THEN REPLACEMENT OF
ALL OLD FIXTURES WITH
NEW ENERGY SAVING
FIXTURES



OVERALL COST TO CHANGE ALL FIXTURES



+ TO REPLACE ALL
FIXTURES WILL
NEED AN INITIAL OF
FRONT COST OF
APPROXIMATELY
\$50,000

ENERGY SAVINGS

+ WITH THE FIXTURES BEING REPLACED THERE WILL BE ADDITIONAL SAVINGS OF APPROXIMATELY 70 % OF YOUR OVERALL WATTAGE USED, COMPARED TO THE OLD FIXTURES. RECOUPING APPROXIMATELY 40 % OF YOUR MONTHLY ENERGY BILL STRICTLY FROM NEW FIXTURES.



THERE IS AN INITIAL COST INCURED BY REPLACING ALL EXISTING FIXTURES

+ OVER TIME THE 70% SAVINGS PER KWATT WILL SUPPLEMENT THE INITIAL COST

Eg. 1 Kw $\xrightarrow{\text{Cost}}$ \$1
1 Kw $\xrightarrow{\text{Now Costs}}$ \$0.30



POLICY RESTRICTIONS

THE REPLACEMENT FIXTURES
WE CHOSE A NECESSARY TO
ABIDE BY THE FACILITIES
REGULATIONS ALLOWING FOR
THE CORRECT BRIGHTNESS IN
AREAS SUCH AS THE YARD
AND JAIL.



"BRIGHT" FOR LONGER

Lamp Wattage	Lumen Output		Power Cost	Cost per 100 Lumens*
	(initial)	(maintained)	(per year)	(per year)
Low-Pressure Sodium (LPS)				
18	1800	1800	\$7.20	\$0.57
35	4800	4800	\$14.00	\$0.41
55	8000	8000	\$22.00	\$0.40
90	13500	13500	\$36.00	\$0.39
135	22500	22500	\$54.00	\$0.34
180	33000	33000	\$72.00	\$0.31
High-Pressure Sodium (Clear) (HPS)				
35	2250	1643	\$14.00	\$1.21
50	4000	2920	\$20.00	\$0.97
70	6300	4599	\$28.00	\$0.87
100	9500	6935	\$40.00	\$0.83
150	16000	11680	\$60.00	\$0.73
200	22000	16060	\$80.00	\$0.71
250	29000	21170	\$100.00	\$0.67
310	37000	27010	\$124.00	\$0.66
350	46500	33945	\$140.00	\$0.59
400	50000	36500	\$160.00	\$0.63
430	51500	37595	\$172.00	\$0.66
Standard Metal Halide (MH)				
150	13500	8413	\$60.00	\$1.01
175	15000	9348	\$70.00	\$1.07
250	23000	14333	\$100.00	\$1.00
360	36000	22434	\$144.00	\$0.91
400	40000	24928	\$160.00	\$0.91
1000	110000	67000	\$400.00	\$0.86

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POST LIGHTS

LED Street / Parking Lot Light with 280 watts, 28,000-30,800 Lumens.

Additional Information

PRODUCT TYPE	Street / Parking Lot Light
MANUFACTURER	uSaveLED
MODEL NUMBER	USSL280WILAOK
PRICE	\$859.00
VOLTAGE	90-305VAC
WATTAGE	280
LUMENS	28,000-30,800
LUMENS PER WATT	100-110
LED CHIPSET	Philips LUXEON Rebel ES LEDs
LIGHT DISTRIBUTIONS	120', 30', 60', 90'x100', Type II, Type III-A, Type III-B
BASE TYPE/CONNECTION	Adjustable 90' / Direct Wired
KELVIN (CCT)	3500, 4100, 5000, 5700, 6500
CRI	>78
POWER FACTOR	>0.95
LIFE SPAN (HOURS)	62,000+ (L70)
DIMMABLE	Yes (Add \$50.00)
WATERPROOF	YES (IP66)
CERTIFICATIONS	CE, DLC, RoHS, TUV, UL
LENGTH OF WARRANTY (YEARS)	8yr, 10yr Available (Add 10% to Price)
DIMENSIONS	38.63"x11.82"x4.22"
SUGGESTED REPLACEMENT FOR	1000W Metal Halide Fixture and Bulb
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	72%



Prezi

RECESSED LIGHTING



Additional Information

PRODUCT TYPE	High CRI Downlight Retrofit
MANUFACTURER	Satco
MODEL NUMBER	USDL15WSAT
PRICE	\$42.00
VOLTAGE	120V
WATTAGE	15
LUMENS	1200
LUMENS PER WATT	80
BEAM ANGLE (DEGREES)	90
BASE TYPE/CONNECTION	E26 (Add \$5.00 for GU10 Base)
KELVIN (CCT)	3000
CRI	>90
POWER FACTOR	0.9
LIFE SPAN	35,000+
DIMMABLE	YES
WATERPROOF	Wet Locations OK
CERTIFICATIONS	CSA, Energy Star, ETL, RoHS, UL
LENGTH OF WARRANTY (YEARS)	3
DIMENSIONS	Fits 5" and 6" Recessed Fixtures
SUGGESTED REPLACEMENT FOR	100W Halogen
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	85%



45W LED Architectural Flood Light / Wall Pack, 4,500 lumens

Additional Information

PRODUCT TYPE	Architectural Flood Light / Wall Pack
MANUFACTURER	uSaveLED
MODEL NUMBER	USFLA45WRL
PRICE	\$229.00
VOLTAGE	100-277VAC
WATTAGE	45
LUMENS	4,500
LUMENS PER WATT	100
LED CHIPSET	OSRAM
BEAM ANGLE (DEGREES)	120
BASE TYPE/CONNECTION	Screw-In Knuckle / Direct Wired
KELVIN (CCT)	3000, 4100, 5000, 5700
CRI	>70
POWER FACTOR	>0.95
LIFE SPAN (HOURS)	50,000+
DIMMABLE	YES
WATERPROOF	YES (IP65)
CERTIFICATIONS	CE, cUL Pending, DLC Pending, RoHS
LENGTH OF WARRANTY (YEARS)	5yr
DIMENSIONS	9.34"x7.09"x3.55"
SUGGESTED REPLACEMENT FOR	200W Metal Halide
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	77.5%

Additional Information

PRODUCT TYPE	DLC Approved Stadium Flood Light
MANUFACTURER	uSaveLED
MODEL NUMBER	USFL200WGL-DLC
PRICE	\$655.00
VOLTAGE	12VDC Available, 100-277VAC, 180-528VAC Available (Add 15%)
WATTAGE	200
LUMENS	26,000
LUMENS PER WATT	130
LED CHIPSET	CREE
BEAM ANGLE (DEGREES)	10, 24, 38, 60, 90
KELVIN (CCT)	3000, 4000, 5000, 5700, 6500
CRI	>80
POWER FACTOR	>0.98
LIFE SPAN	80,000+
DIMMABLE	10%-100% Dimming w/ RF Remote (Add \$170.00)
WATERPROOF	YES (IP67)
CERTIFICATIONS	CE, DLC, RoHS, UL Driver
LENGTH OF WARRANTY (YEARS)	5
DIMENSIONS	20.48"x13.78"x3.94"
SUGGESTED REPLACEMENT FOR	750W Metal Halide
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	73.4%



200W DLC,
LED Stadium
Flood Light,
26000
lumens

FLOOD LIGHTS



Additional Information

PRODUCT TYPE	DLC Approved Stadium Flood Light
MANUFACTURER	uSaveLED
MODEL NUMBER	USFL200WGL-DLC
PRICE	\$655.00
VOLTAGE	12VDC Available, 100-277VAC, 180-528VAC Available (Add 15%)
WATTAGE	200
LUMENS	26,000
LUMENS PER WATT	130
LED CHIPSET	CREE
BEAM ANGLE (DEGREES)	10, 24, 38, 60, 90
KELVIN (ICCT)	3000, 4000, 5000, 5700, 6500
CRI	>80
POWER FACTOR	>0.98
LIFE SPAN	80,000+
DIMMABLE	10%-100% Dimming w/ RF Remote (Add \$170.00)
WATERPROOF	YES (IP67)
CERTIFICATIONS	CE, DLC, RoHS, UL Driver
LENGTH OF WARRANTY (YEARS)	5
DIMENSIONS	20.48"x13.78"x3.94"
SUGGESTED REPLACEMENT FOR	750W Metal Halide
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	73.4%

WALL PACKS



150W LED
Architectural
15,000
lumens

Additional Information

PRODUCT TYPE	Architectural Flood Light / Wall Pack
MANUFACTURER	uSaveLED
MODEL NUMBER	USFLA150WRL
PRICE	\$649.00
VOLTAGE	100-277VAC
WATTAGE	150
LUMENS	15,000
LUMENS PER WATT	100
LED CHIPSET	OSRAM
BEAM ANGLE (DEGREES)	120
BASE TYPE/CONNECTION	Knuckle Mount Slip Fitter or U-Bracket Mount Option Available / Direct Wired
KELVIN (CCT)	3000, 4100, 5000, 5700
CRI	>70
POWER FACTOR	>0.95
LIFE SPAN (HOURS)	50,000+
DIMMABLE	YES
WATERPROOF	YES (IP65)
CERTIFICATIONS	CE, cUL, DLC Pending, RoHS, UL
LENGTH OF WARRANTY (YEARS)	5yr
DIMENSIONS	17.01"x12.13"x5.00"
SUGGESTED REPLACEMENT FOR	450W Metal Halide
PERCENT OF WATTAGE SAVED FROM AVERAGE REPLACEMENT*	66.67%

RETURN ON INVESTMENT

- + THE AVERAGE kW USAGE FOR THE PAST YEARS ARE 84536.27 kW/Yr. THIS ACCRUED A COST OF \$4914.75 PER YEAR. YOU WOULD HAVE SAVED APPROXIMATELY \$3500.00 EACH YEAR FROM SIMPLY REPLACING THE FIXTURES.



- + THE EXPECTED ROI OF FIXTURE REPLACEMENT WILL TAKE APPROXIMATELY 30 YEARS JUST FROM THE SAVING PER WATT USED
- + SAVINGS AFTER 50 YEARS, \$74,711.87

Summary

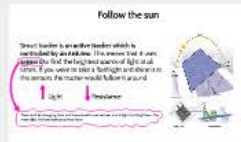
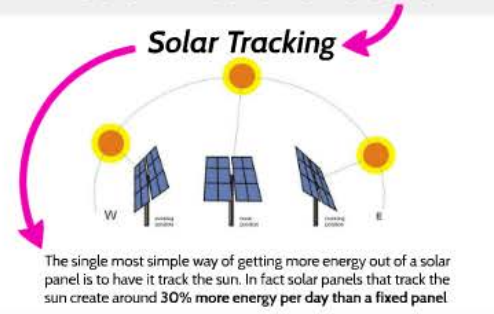
Project Layout

Package 1 = Bulb Replacement (quick fix)

Package 2 = Solar Panels + Package 1
(Long term cost solution + %100 energy savings)

Package 3 = New Fixtures + Package 2

A look into the future



Fixed solar Panels



For the most part our common every day solar cells run at an efficiency of 18-20%, meaning they only convert 18-20% of the energy they receive into electricity. While this is far better than the 3-6% efficiency that most green plants end up with, it doesn't quite meet our power needs. To bring in enough power we either need to improve the efficiency of our panels or find ways of getting more from our current solar panels.

Every panel you see in your day to day life is in a fixed position, most likely facing south at a 45 degree angle. While this approach is extremely simple and meets the needs of most small applications, it isn't producing as much energy as it could be.

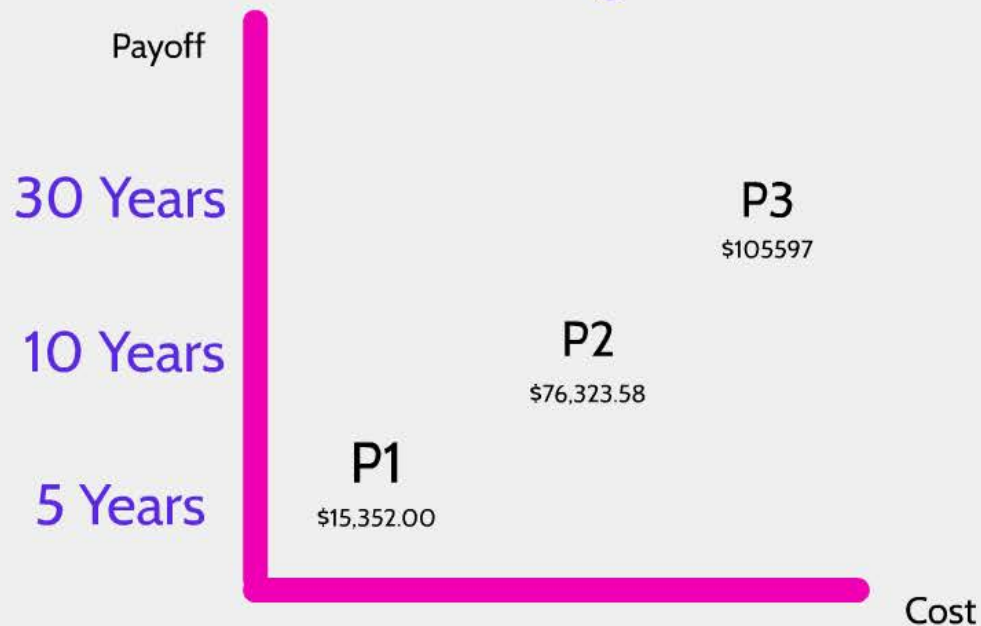
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Fixed solar Panels

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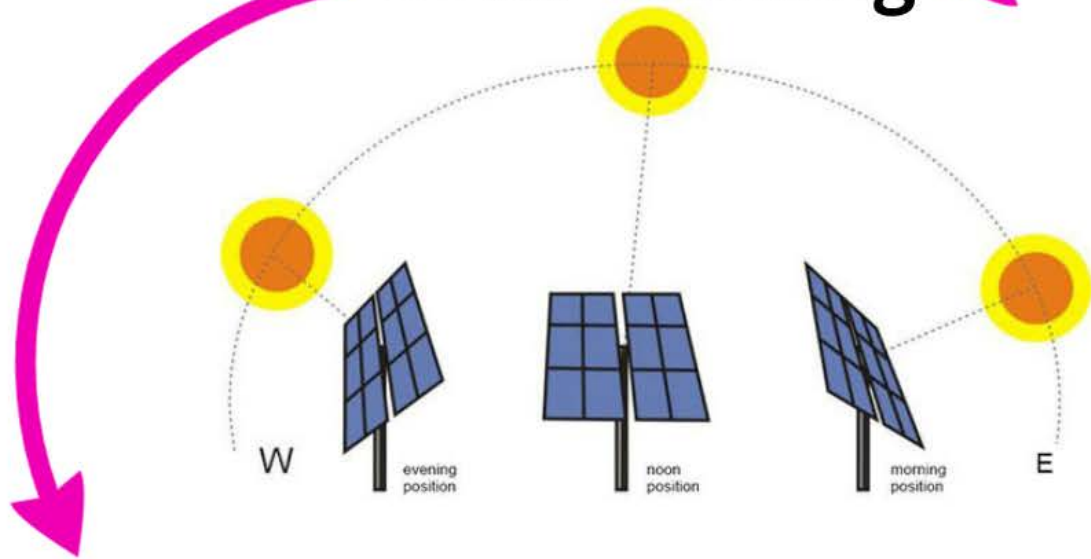


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A look into the future

Solar Tracking



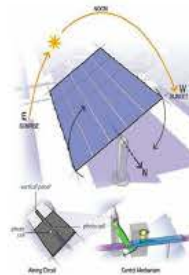
The single most simple way of getting more energy out of a solar panel is to have it track the sun. In fact solar panels that track the sun create around **30% more energy per day** than a fixed panel

Follow the sun

Smart tracker is an active tracker which is controlled by an Arduino. This means that it uses sensors to find the brightest source of light at all times. If you were to take a flashlight and shine it at the sensors the tracker would follow it around.

↑ Light ↓ Resistance

They work by changing their resistance level based on how much light is hitting them. The more light, the less resistance they have.



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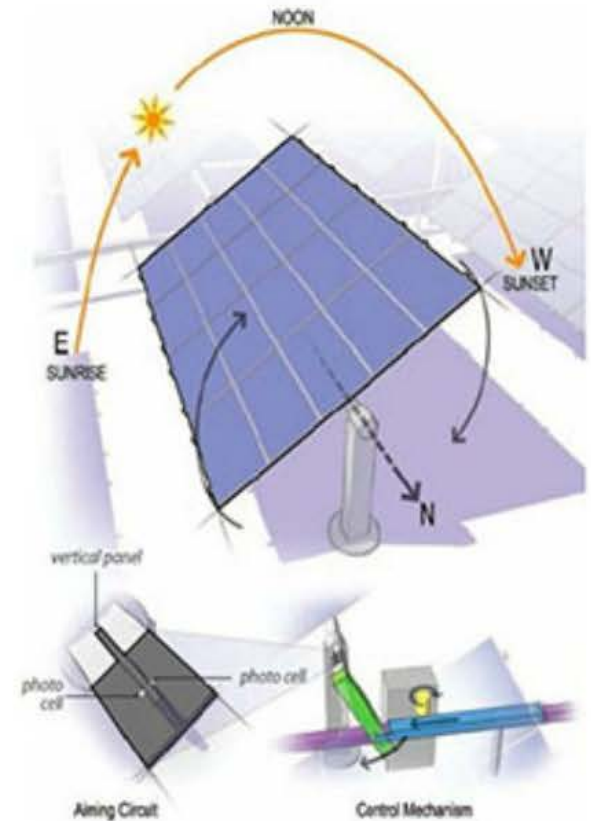


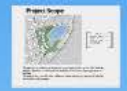
Light



Resistance

They work by changing their resistance level based on how much light is hitting them. The more light, the less resistance they have.





Olas Rooker, Travis Damuth, Raz Divani,
 Marco Tadros, Ghaya Berkaoui

Chaska Government Center: Updating the Exterior Lighting