



# Smart Lighting

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**SolarOne<sup>®</sup> Solutions, LLC**

Ilze Greene, Sales & Marketing Director

February 7, 2008

# Who Left the Lights On?

SolarOne®  
Lighting



# Agenda

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- The Company
  - The Market
  - The Products
  - The Distribution
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# The Company

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# SolarOne Lighting: Experience

SolarOne™  
acquires Solar  
Dynamics  
assets



Work with  
LED Lighting  
starts

Eastern CT

Lightfair Int'l  
award



35%!

Announce MPT



Shoe Box



Harvester  
Sales



1st Lights  
Fielded

Relocate  
to MA



SEED  
Award



Announce  
mc<sup>2</sup>  
technology



Babson,  
Sandia

\$\$\$

PE Invest



HADCO

Bethel Woods

2/03 5/03 7/03 10/03 5/04 6/04 7/04 8/04 3/05 4/05 9/05 1/06 5/06 9/06 2/07 7/07 12/07



# The Market

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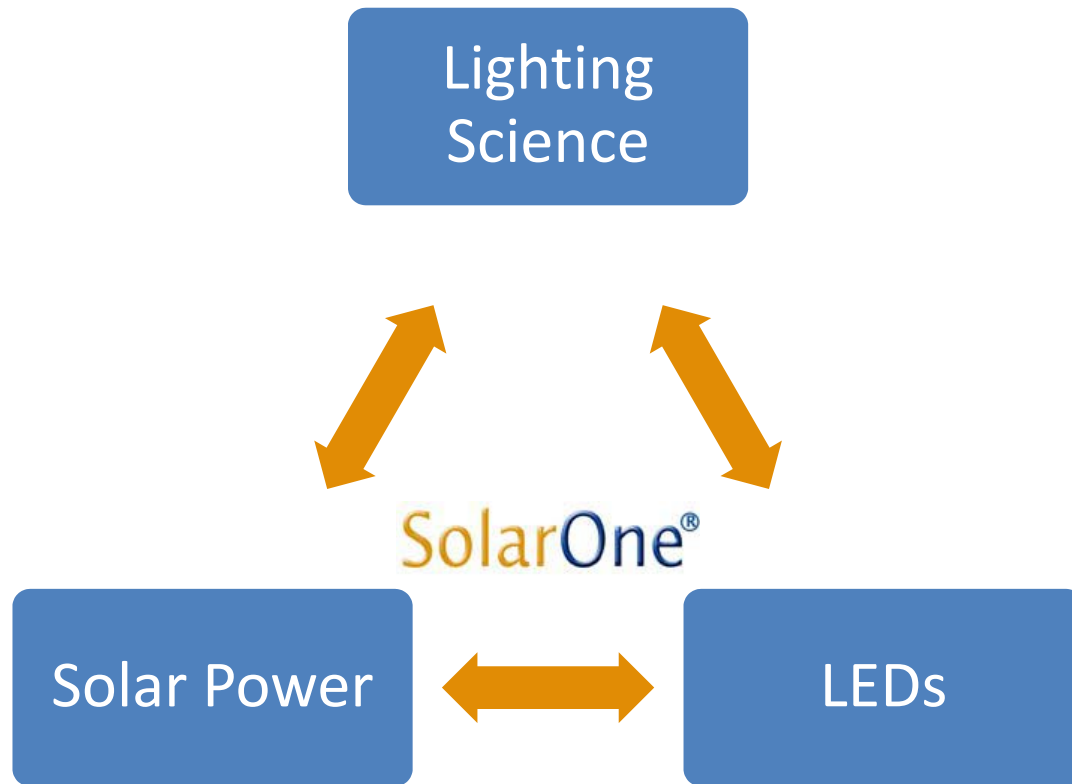
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# Outdoor Lighting Market



- Global lighting fixture and lamp industry is \$40 billion market
  - \$10.5 billion - North American market for light fixtures
  - \$3.0 billion – U.S. outdoor light fixture sales in 2006
- Off-grid (solar) lighting segment is estimated to exceed \$100 million in 2007 and expected to reach \$1 billion by 2011 – *(Source Strategies Unlimited)*
  - 30%+ CAGR -- Off-grid lighting segment revenues through 2011
  - 70%+ -- Growth of high power, white LEDs used in pathway/area lighting (unit sales)
- THIS IS BEFORE CONSIDERING “JUST OFF-GRID” OPPORTUNITIES

# The Technologies





# Lighting Research



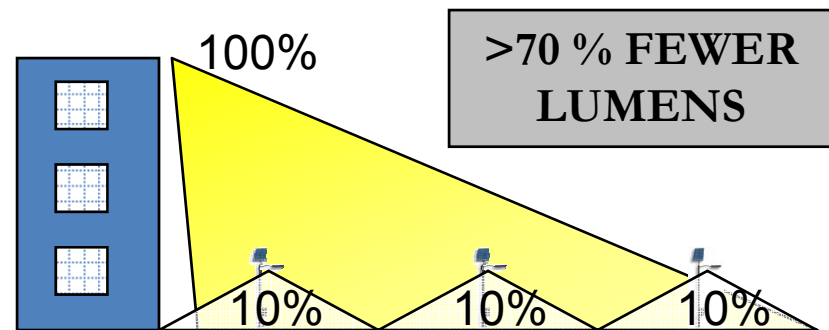
- Significant changes in what is perceived as “good” lighting
  - Uniformity versus brightness
  - White light versus more light
  - Impact of lighting on our health and others

# The Promise of Solar Powered General Illumination



Distributed Light Sources – [reduced  $1/r^2$  losses]

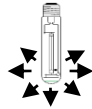
- **Easily** sited
- **Rapidly** installed (no trenching)
- **Immune** to power outages
- **No** electric bills
- **Avoided** Greenhouse Gas Emissions



# More Foot-Candles Where You Need Them

- Lamp Utilization

HID:  
100 lm/W

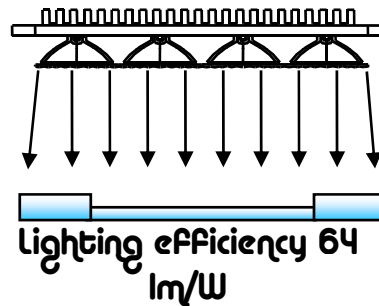
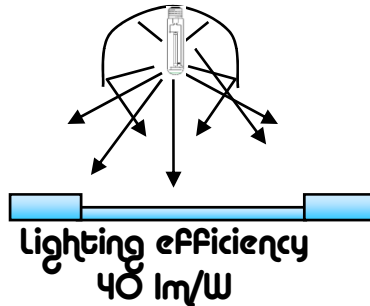


LED:  
80 lm/W



Source: Lumiled Devices

40%  
Utilization  
Efficiency

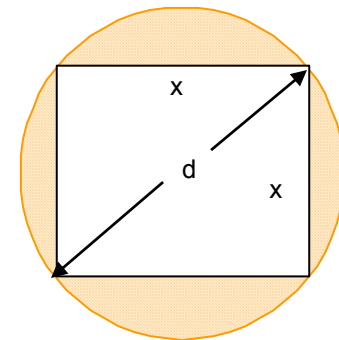


80%  
Utilization  
Efficiency

- Light Placement

Up to 57 % FEWER  
LUMENS

$\% \text{ excess light} = (\sqrt{2}-1) = 57\%$



# The Product

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# The Harvester

## Features

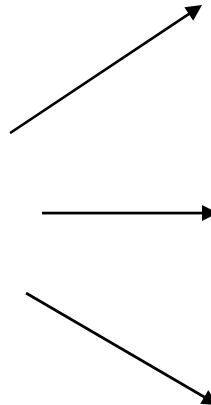
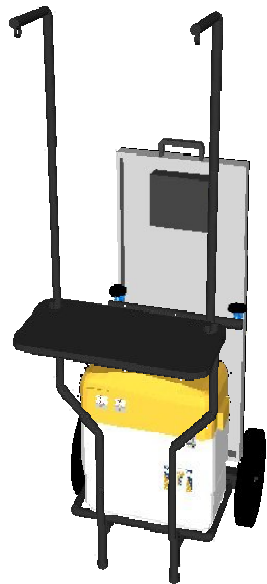
- Mobile
- Solar Powered
- Rugged
- Reliable
- Plug & Play
- Versatile

## Benefits

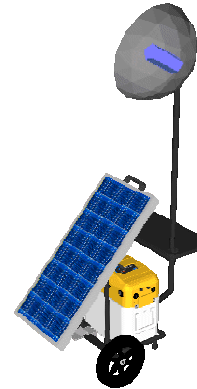
- Rapidly deploys where needed
- Increase charge rate (with manual tracking)
- Silent – difficult to detect, reduced stress-levels
- Fuel Independent
- Easy to use
- Power for many applications

# Patented product platform that evolves

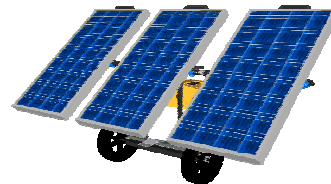
**THE HARVESTER™**  
SOLAR-ELECTRIC GENERATOR



Security



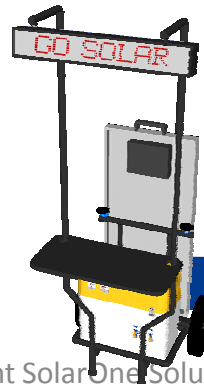
Communications  
Surveillance



Expandable



Lighting

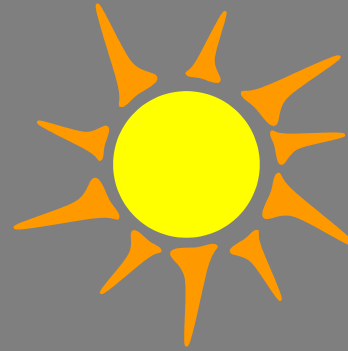


Signage

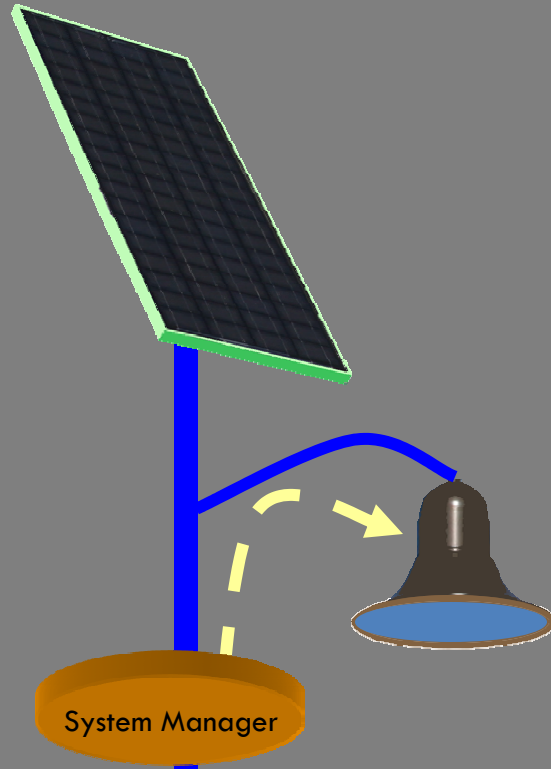


Water Purification

During daylight hours sunshine on the solar panel creates electricity



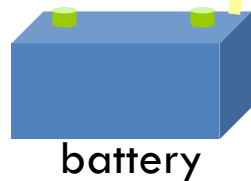
**THE BASICS OF  
HOW IT WORKS**



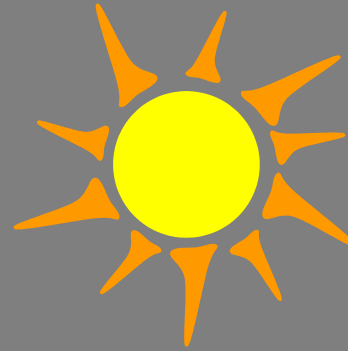
As the sun goes down, the panel stops generating electricity

**The System Manger Controls Current Flow to charge the battery**

**After dark the system manager draws electricity stored in the battery to power the light**

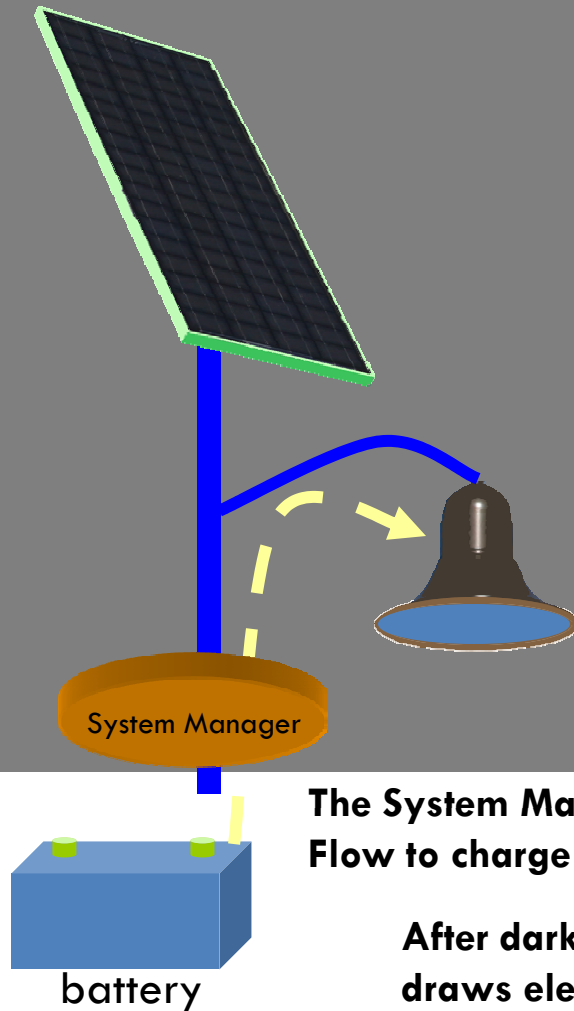


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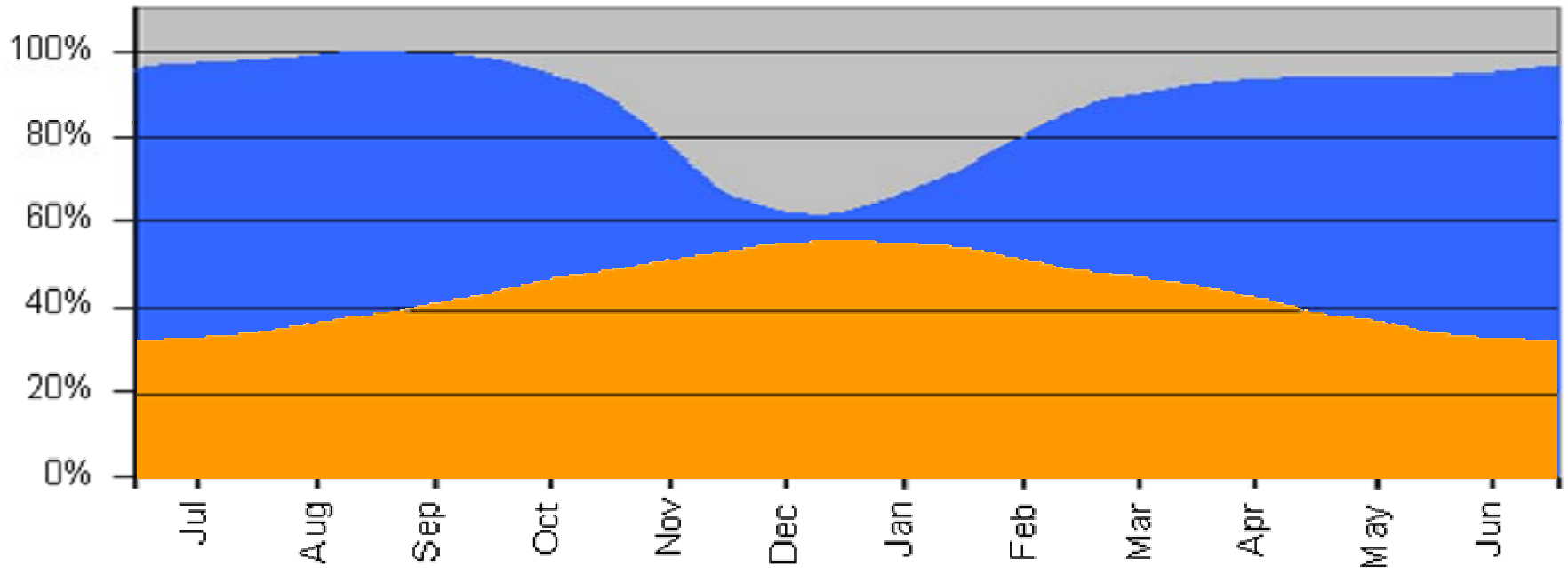
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# The Fundamental Challenge for Solar Lighting: Winter

- The solar energy resource for solar lighting is abundant in summer, but diminishes as the weather changes. A minimum is reached, on average at the winter solstice in late December.
- The need for light, conversely increases as the length of night grows during winter, always *peaking* on the winter solstice, the longest night of the year.



# Technology



- System Manager
- Lamps
- Solar Panels
- Batteries

# System Manager



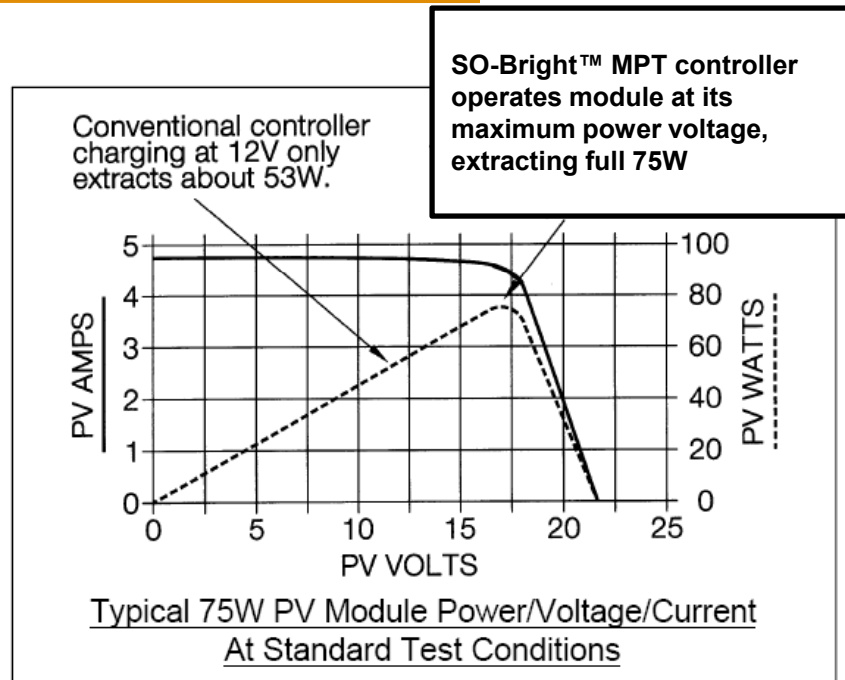
Unlike conventional lighting, Solar Lighting limits the amount of energy you can gather and access. SolarOne's System Manager maximizes the usefulness of that energy

- Charge Control with Max Power Tracking
  - SolarOne's approach to charging results in 30% more efficiency – translating to more performance from the same components
- Remote Control Diagnostics
- Snow Coverage Protection
- User Programmable Lighting Profiles-Deliver the most light when you need it most
- Extended Run Time

# Maximum Power Point Tracking - MPT

- A solar charge controller looks at the output of the panels, and compares it to the battery voltage. It then figures out what is the absolute best power that the panel can put out. It takes this and converts it to the best voltage to get maximum current into the battery.
- Example: University of Michigan

University of Michigan Example	With Maximum Power Tracking (MPT)		
	2006	2007	2007
Lumens	1140	1200	1200
Hours of Peak Lighting	4	9	14
Hours of Off-Peak Lighting	11.5	6.5	1.5
Total Hours of Lighting	15.5	15.5	15.5

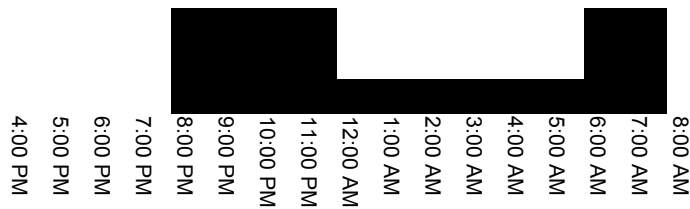


# Lighting Profiles

## Seasonality



21-Mar



21-Jun



21-Sep



21-Dec

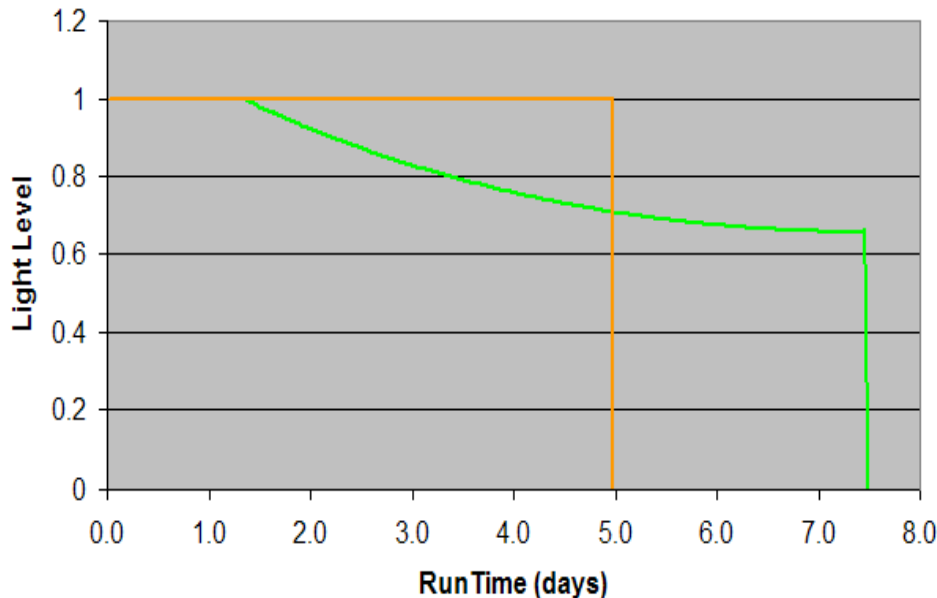


6 Hours of Peak Lighting and up to 8.5 hours of Dim (30%) Lighting  
City: Columbus, Ohio

# System Manager: Run Time Extension (RTE)



**Runtime Extension Example**  
Illumination vs Time



Light levels automatically adjust moderately to extend battery low/no sun “run time”



- Std solar or battery lighting system
- SO-Bright with 50% RTE

# System Manager



- Maximizes your solar investment by providing greater energy collection and more efficient energy use
- Minimizes Maintenance through remote diagnostics and the elimination of the need for clocks and photo-sensors
- Protects the system from outages through runtime extension and snow coverage protection

# Technology



- System Manager
- Lamps
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# LEDs

<b>Feature</b>	<b>Benefit</b>
<b>Solid State - No Filament, Glass or Ballast</b>	<b>Lower Maintenance Costs</b>
<b>High Efficacy - Lumens per Watt = 70</b>	<b>Uses Little Energy</b>
<b>Digitally Controlled</b>	<b>System Can Reduce Battery Drain Through Dimming</b>
<b>Light is Highly Directional</b>	<b>High Efficiency with Low Light Trespass &amp; Pollution</b>
<b>Long Life (100K Hours Absolute, 50K Hours Recommended)</b>	<b>Lower Maintenance Costs</b>
<b>5900 Kelvin Color Temp</b>	<b>Appears Brighter Than Rated and Maximizes Color Rendition</b>

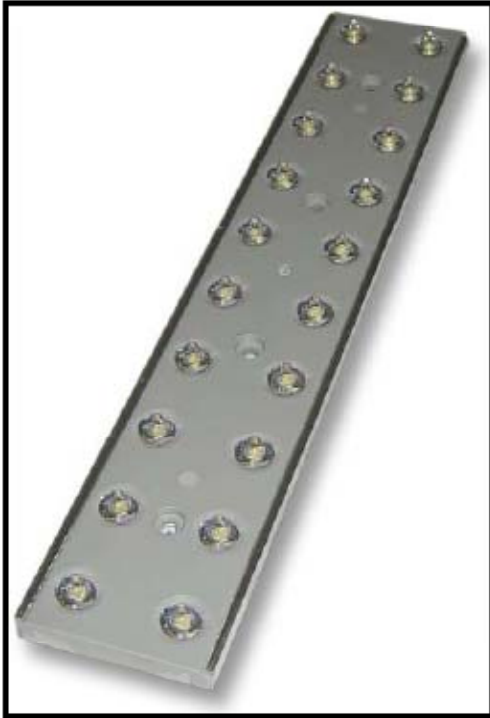
# HL 600 Lamps



Used in Multiples of one to four  
Example: HL1800 = 3 Lamps

- Luminous Efficiency: 70 Lumens per Watt
- Watts per Lamp: ~ 8.5
- 12V DC
- Color Rendering Index (CRI) >80
- Color Temperature 5900K
- Type 5 Distribution
- 24 Individual LEDs per Lamp – 3 Strings
- String Outage Compensation
- Lens: Pattern 12 Clear Acrylic
- Individual Lamp IES File is Available

# HL 750 Lamps



Used in Multiples of one to four  
Example: HL2250 = 3 Lamps

- Luminous Efficiency: 70 Lumens per Watt
- Watts per Lamp: ~ 10
- 12V DC
- Color Rendering Index (CRI) >80
- Color Temperature 5900K
- Type 5 or Type 3 Distribution
- 20 Individual LEDs per Lamp – 2 Strings
- String Outage Compensation
- Individual Lamp IES File is Available

# Impact of Higher Lumens

- Providing more lumens (and using more watts) results in the following
  - Higher Panel Costs
  - Larger Panel Structures
  - More Battery Capacity Cost with Larger, Unsightly Enclosures

# Outdoor Lighting Market



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# SO-Bright Panels

- SO-Bright Technology packages for Hadco use SunPower panels and others.



# Mounting

- For Pendant Style fixtures the panel can be mounted at the top of the pole or on banner arms



- Post Top Lights require banner arms



# Recommended Positioning

- Panels should be positioned to face due South\* (+/- 10 degrees)
- The angle of the panel should be the latitude +15 degrees to maximize efficiency in winter
- Panels can be mounted horizontally with up to 40% efficiency loss
- Partly shaded areas can be addressed



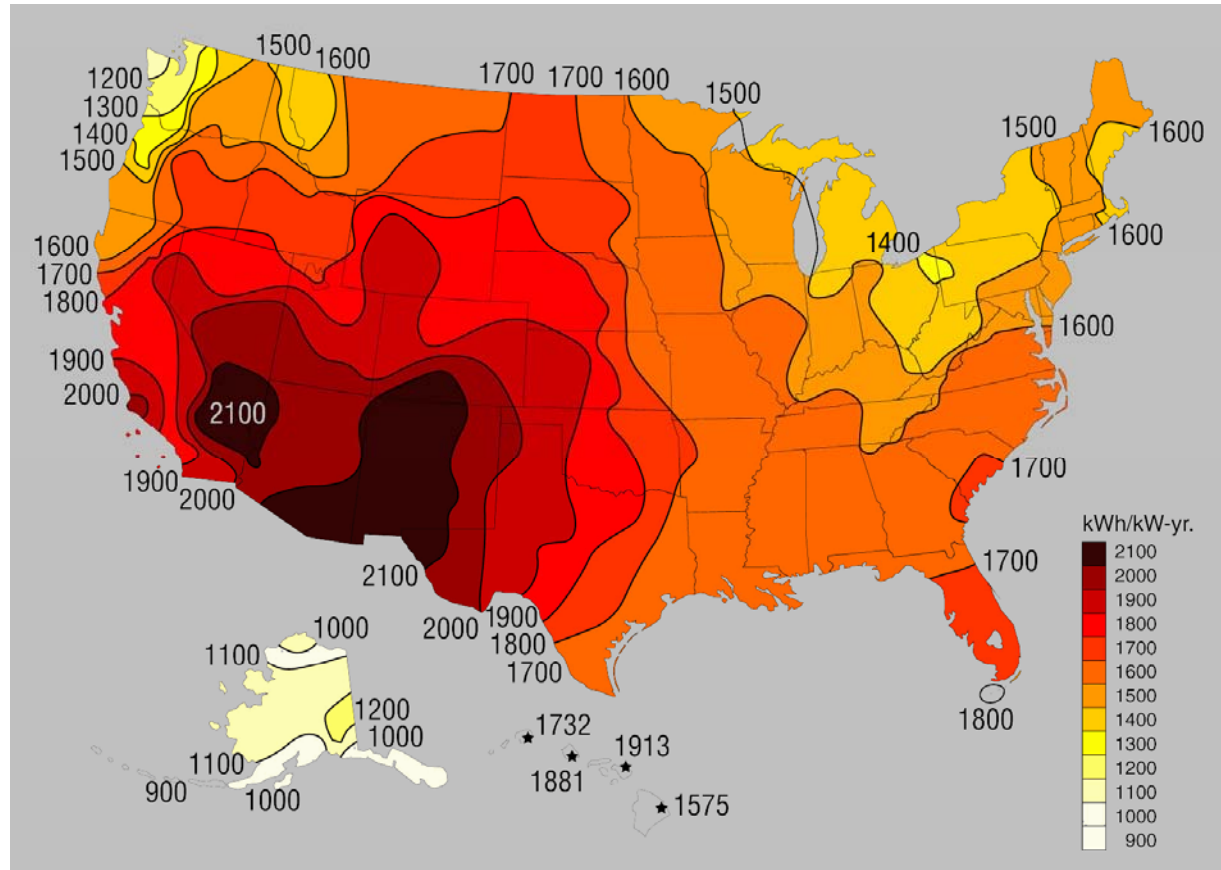
Quotes assume clear access to the southern sky and angle as prescribed unless otherwise noted.

\*Northern Hemisphere

# Solar Resource


The Solar Resource  
is determined  
by:

- Geographic Location, Latitude
- Weather



# Technology



- System Manager
  - Lamps
  - Solar Panels
  - Batteries
- 

# Batteries

- Deep Cycle AGM (Absorbed Glass Batteries ) Lead Acid Batteries
  - Spill Proof
  - Maintenance Free
  - Most Environmentally Sound
  - High Recycle Rate and Recycle Availability
  - 5-6 Expected Replacement
- Gel Batteries
  - Spec'd by some competitors
  - We have seen issues in colder climates
- Weather
  - Cold Weather Negatively Impacts Capacity but Not Battery Life (Our Quotes take this into account)
  - Extreme Heat Can Negatively Impact Battery Life, White Enclosures Recommended
- Sizing
  - Undersized systems (not enough storage capacity) not only increases the opportunity for failure, but also negatively impacts battery life RECOMMENDED STORAGE: 5 DAYS IN THE SOUTH/10 DAYS IN THE NORTH

# Poles

- Solar Lighting Systems have inherently higher EPA requirements
- Standard Pole selection is 5" Diameter
- Standard Pole is Straight
  - Mounting Panels & Slip over fixtures on Tapered Poles can be problematic
  - Bolt on fixtures and side-pole mount can be used with tapered poles

# Fixtures



# SolarOne Advantage



- LED Photometrics
- Energy Collection (MPT)
- Energy Management (SO-Bright™)

# Project Needs

What we need to know to recommend a system

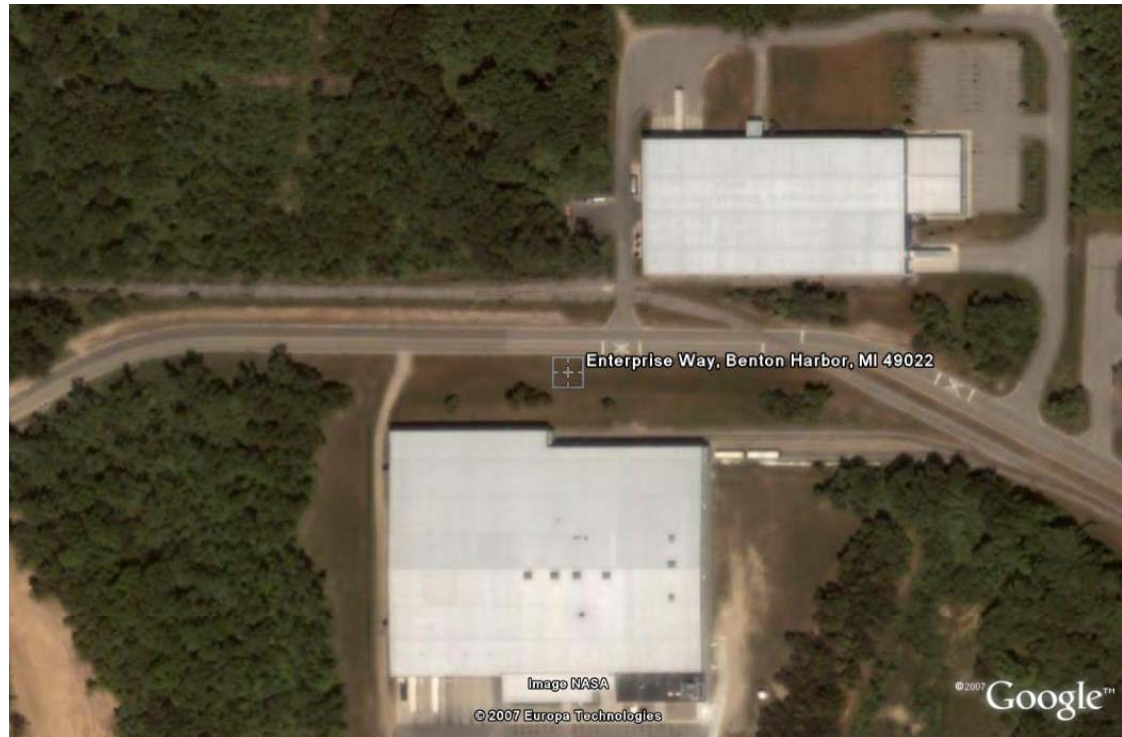


- Application – Parking Lot, Pathway, Bike Trail...
- Dimensions of area to be lit
- Light Level Requirements in Foot Candles
- Is there ambient lighting?
- Hours of Lighting Required. Can the application a combination of peak and off-peak levels? Do the lights have to be on all night?
- Seasonal considerations. For Example: Lights only needed during summer tourist season
- Geographic location of the project (Different cities in a single state can have different solar resources)
- Will panels have clear access to the southern sky? (+/- 10%)
- Other considerations – Need for lighting when the grid is down, obstacles to trenching, “green” mandates



# Site Considerations

- Shade
- Rock
- Wetlands
- Other



# Justifying the Purchase



- The biggest drivers in favor of a solar lighting solution are installation costs and inability to connect to the grid
- Other factors include LEED certification, Grants, Rebates/Credits, Reduced Energy Costs and Perception
- Maintenance and Security can be significant factors as well



# Distribution

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# Renewables or Lighting?



- Lighting Sales
  - Photometrics
  - Local ordinances
  - Integration with other contractors
  - Mature Relationships
  - Established Jargon

# Lighting Representatives



- National Presence
- Established Distribution
- Trusted Relationships

# Wrap Up



- Questions
- Action Items