Smart Lighting

SolarOne® Solutions, LLC
Ilze Greene, Sales & Marketing Director
February 7, 2008
Who Left the Lights On?
Agenda

• The Company
• The Market
• The Products
• The Distribution
The Company
SolarOne Lighting: Experience

- SolarOne™ acquires Solar Dynamics assets
- Work with LED Lighting starts
- Eastern CT
- Lightfair Int’l award
- Announce MPT
- Shoe Box
- Harvester Sales
- 1st Lights Fielded
- Relocate to MA
- SEED Award
- Announce mc² technology
- Babson, Sandia
- $$$ PE Invest
- HADCO
- Bethel Woods

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March 2007
The Market
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

Solar One Lighting

Solar Power ↔ LEDs

Lighting Science
• 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

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

Distributed Light Sources – [reduced 1/r² losses]

> 70% FEWER LUMENS
More Foot-Candles Where You Need Them

- **Lamp Utilization**
  - **HID:** 100 lm/W
  - **LED:** 80 lm/W

40% Utilization Efficiency

80% Utilization Efficiency

- **Light Placement**

Up to 57% FEWER LUMENS

\[ \% \text{ excess light} = \left( \frac{\pi}{2} - 1 \right) \approx 57\% \]
The Product
## The Harvester

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>Rapidly deploys where needed</td>
</tr>
<tr>
<td>Solar Powered</td>
<td>Increase charge rate (with manual tracking)</td>
</tr>
<tr>
<td>Rugged</td>
<td>Silent – difficult to detect, reduced stress-levels</td>
</tr>
<tr>
<td>Reliable</td>
<td>Fuel Independent</td>
</tr>
<tr>
<td>Plug &amp; Play</td>
<td>Easy to use</td>
</tr>
<tr>
<td>Versatile</td>
<td>Power for many applications</td>
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</tbody>
</table>
Patented product platform that evolves
During daylight hours sunshine on the solar panel creates electricity.

As the sun goes down, the panel stops generating electricity.

The System Manager 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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As the sun goes down, the panel stops generating electricity.

The System Manager Controls Current Flow to charge the battery. After dark the system manager draws electricity stored in the battery to power the light.
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

<table>
<thead>
<tr>
<th>University of Michigan Example</th>
<th>With More Efficient Lamps</th>
<th>With Maximum Power Tracking (MPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2007</td>
<td>2007</td>
</tr>
<tr>
<td>Lumens</td>
<td>1140</td>
<td>1200</td>
</tr>
<tr>
<td>Hours of Peak Lighting</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Hours of Off-Peak Lighting</td>
<td>11.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Total Hours of Lighting</td>
<td>15.5</td>
<td>15.5</td>
</tr>
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</table>

SO-Bright™ MPT controller operates module at its maximum power voltage, extracting full 75W.

Conventional controller charging at 12V only extracts about 53W.

Typical 75W PV Module Power/Voltage/Current At Standard Test Conditions

Lumens: 1140, 1200, 1200
Hours of Peak Lighting: 4, 9, 14
Hours of Off-Peak Lighting: 11.5, 6.3, 1.5
Total Hours of Lighting: 15.5, 15.5, 15.5

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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)

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

Runtime Extension Example
Illumination vs Time

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

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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

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Technology

- System Manager
- Lamps
- Solar Panels
- Batteries
## LEDs

<table>
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<tr>
<th>Feature</th>
<th>Benefit</th>
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<tr>
<td>Solid State - No Filament, Glass or Ballast</td>
<td>Lower Maintenance Costs</td>
</tr>
<tr>
<td>High Efficacy - Lumens per Watt = 70</td>
<td>Uses Little Energy</td>
</tr>
<tr>
<td>Digitally Controlled</td>
<td>System Can Reduce Battery Drain Through Dimming</td>
</tr>
<tr>
<td>Light is Highly Directional</td>
<td>High Efficiency with Low Light Trespass &amp; Pollution</td>
</tr>
<tr>
<td>Long Life (100K Hours Absolute, 50K Hours Recommended)</td>
<td>Lower Maintenance Costs</td>
</tr>
<tr>
<td>5900 Kelvin Color Temp</td>
<td>Appears Brighter Than Rated and Maximizes Color Rendition</td>
</tr>
</tbody>
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HL 600 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

Used in Multiples of one to four
Example: HL1800 = 3 Lamps
HL 750 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

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

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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

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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

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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

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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
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