



Solar Program Review Meeting

Solar-Powered LED Lighting Technology



Presented by:

David Green, Ph.D.
Chairman
Carmanah Technologies Inc.





Carmanah

Leaders in Solar-Powered LED Lighting

**Carmanah Technologies Inc.
Building 4, 203 Harbour Road
Victoria, British Columbia
Canada V8N 4J5**

**Toll-Free: 877.722.8877
Worldwide: 250.380.0052
Fax: 250.380.0062
Web: www.carmanah.com**





Marriage of LEDs and Solar Panels

- Solar panels: solid state devices that turn light into electricity
- LEDs: solid state devices that turn electricity back into light
- Both technologies are about the same age: born for practical purposes in the 1960s.
- These two technologies are uniquely complementary.



The Key Design Issues for Solar-Powered Lighting

- Lack of power
- Robustness (vandalism, elements)
- Longevity (servicing)

Available Power



WORLD DESIGN INSOLATION

SOLAREX

The Natural Source For Electricity™





History of Solar Powered Lighting

- Solar powered lighting has been around since 1970s, but was not adopted quickly
- Large solar panel and battery requirement
- Costly
- Vandalism issues
- Servicing issues



The Advent of HB LEDs

- **Extremely efficient (colored)**
- **Low dc voltage**
- **Long life**
- **Shock and vibration proof**
- **Produce pure colors**
- **Instantaneous, precise on/off**
- **Directional output**





The Beauty of the Relationship

The advent of LEDs has tipped the balance in making solar lighting practical and economical:

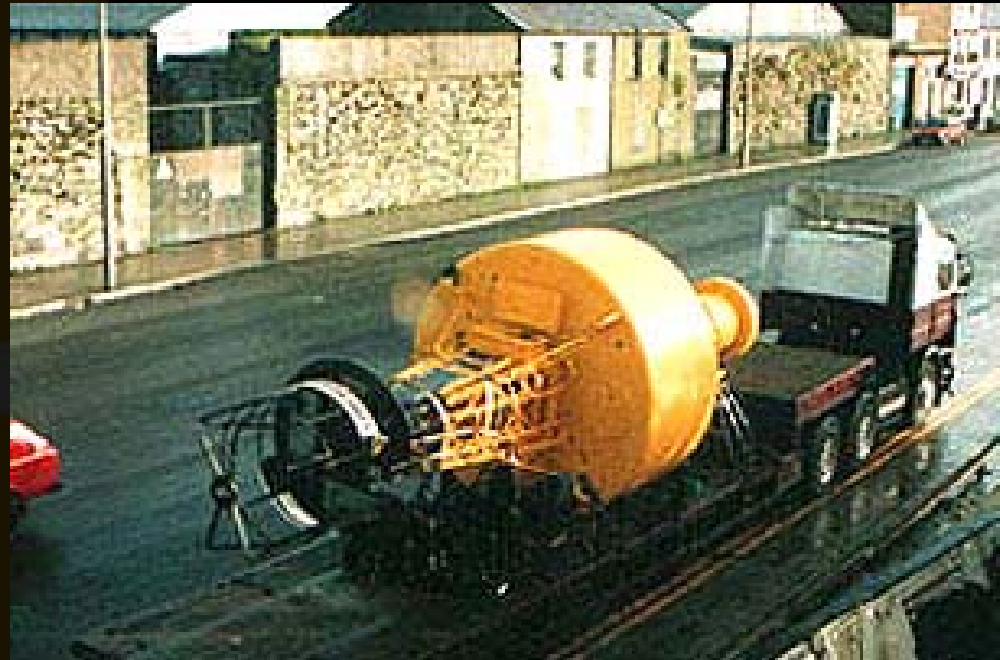
- Reduced energy requirement
- Virtually indestructible
- Last as long as the lighting assemblies



Example: Solar-Powered Navigation Lighting

The most advanced application of solar-powered lighting has been navigation lights.

(Alternative: acetylene!)



US Coast Guard: leading world authority on solar lights

Traditionally: automatic lamp changers, many solar panels, banks of 12 volt batteries housed in large buoys requiring yearly servicing by large vessels.



Elements of a Solar-Powered Navigation Light

- **Solar panel**
- **Battery**
- **Circuit board**
- **Lens**
- **Housing**



LEDs and Solar Panels

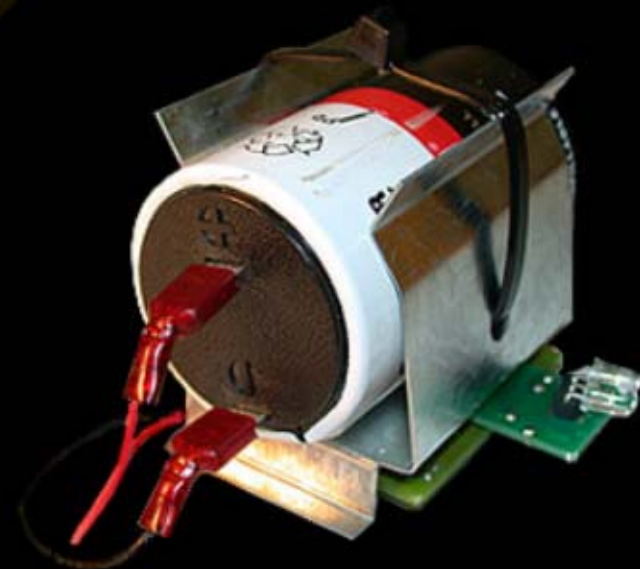
- **Efficiency means solar panel can be reduced in size by a factor of 10**
- **Panel can be incorporated into the light assembly**





LEDs and Batteries

- **Efficiency means battery pack size can be reduced by a factor of 10**
- **Battery voltage can be dropped from 12 volts to 4 volts**
- **Can place batteries in the light assembly**





LEDs and Circuitry

- **LEDs can be controlled precisely with microprocessor both for pulse width modulation**
 - energy conservation
 - dimming
 - flash patterns.
- **dc:dc converters can efficiently run complex LED configurations from low voltage source**



LEDs and Lenses

- LEDs are directional
- don't require colored lens to produce the desired color
- don't require replacement





LEDs and Housings

- LEDs are extremely resistant to shock and vibration
- last as long as the housings
- don't generate much heat
- Can be permanently sealed in the housing

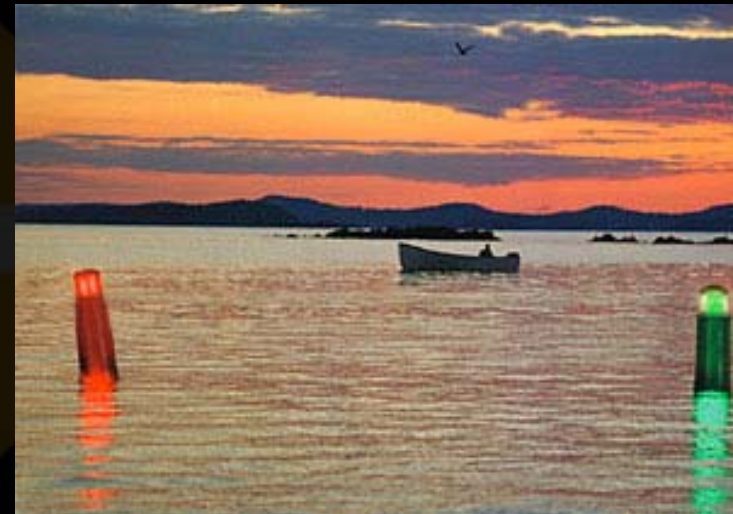




Effect of LEDs on Navigation Lighting

- LEDs have completely revolutionized navigation lighting:
 - Weigh 1/10 as much
 - Last 10 times as long
 - Cost 1/10 as much
 - Reduce buoy size and ship size
 - Eliminate servicing trips by ship

Consequence: any navigational aid can now be lighted.





A Paradigm Shift...

Solar-powered LED lights can be placed anywhere:

- No electricity consumption
- No external wiring
- No dependence on the grid
- Individual power plants for each device
- The ultimate in secure and distributed power





Applications

- Highway
- Aviation
- Transit
- Railway
- Signage
- Remote illumination





LED Status

- Still improving rapidly in performance/cost ratio
- White LEDs for illumination (as opposed to signalling) are only just available
- Performance of LEDs varies





Battery Status

- **Variants of sealed lead acid batteries still are the best choice**
- **Several re-chargeable battery technologies are rapidly advancing**
- **Fuel cell development also offers exciting possibilities for energy storage**





Solar Panel Status

- **No dramatic breakthroughs, but performance/cost ratio is improving**
- **A variety of new technologies offer the possibilities of breakthroughs**
- **PV is gaining acceptance as a mainstream energy source, and will attract more research and development over the coming years**



Status of Solar LED Technology

- All component technologies are continuing to improve
- Stationary outdoor lighting accounts for 8% of all lighting energy consumption
- Outdoor lighting can be expected to convert to solar LED technology.



Summary

With the advent of LEDs, the value proposition for solar lighting has become excellent, considering:

- hard wiring costs
- energy costs
- reliability versus the grid
- maintenance costs
- flexibility
- vandal-resistance

Solar-powered LED lighting will become ubiquitous.

