



# Project 2: Improved Daylighting Performance of Tubular Daylighting

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# Project Overview

- 18 Month R&D Project
- Project Part of the Daylighting Element
  - \$173,282 PIER Funds
  - \$363,718 in Matching Funds
- Project Accelerates Development & Release of New Diffuser Options
- Project Team
  - Solatube International, Inc. (STI)
  - California Lighting Technology Center (CLTC)
  - Southern California Edison (SCE)

# Project Goals and Objectives

- Two Goals

- Develop Commercially-available Direct/Indirect Diffuser Options for use with TDDs
  - Reduce Direct Glare from Diffuser Surface
  - Increase Ceiling Illumination
- Provide Off-the-shelf Daylighting Solution which Supports Current Visual Comfort Trends in Commercial Spaces

- Four Objectives

- Develop conceptual, commercially viable direct/indirect diffuser options for detailed photometric analysis.
- Produce 2-3 commercially-viable diffuser options for prototyping, physical testing, and evaluation (produce a minimum of a 40% uplight component).
- Develop 1 commercially viable product solution & perform detailed photometric testing and develop the photometric data required for launch to the general Public.
- Produce design guidelines to support the application and use diffuser options by architectural and lighting design practitioners.

# Project Timeline (New)



ID	Project 2.0: Improved Daylight Performance of Tubular Daylighting Devices	Q2 07		Q3 07				Q4 07			Q1 08			Q2 08			Q3 08			Q4 08			Q1 09	
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb		
1	2.1 Measure Current Daylight Distribution of Solatube Skylights																							
2	2.2 Design Optical Elements that will Improve Distribution to Achieve Task 2.1																							
3	2.3 Simulate Daylight Distribution Using Ray-tracing Software																							
4	2.4 Evaluate Simulation Results																							
5	2.5 Repeat Tasks 2 through 4 as Necessary																							
6	2.6 Develop Prototype of Final Design																							
7	2.7 Demonstrate Performance of Prototype Diffuser Design																							
8	2.8 Set-up Agreements for Utility ET Demonstrations																							
9	2.9 Reporting																							
10	2.10 Project Level Connectivity																							

# Overview of Solatube Daylighting System



Solatube Daylighting System:  
**The “Daylight Fixture”**

Providing optically-controlled  
daylight to today’s buildings!

# The Tubular Daylighting Device (TDD)

## The TDD Optical System

### • Capture

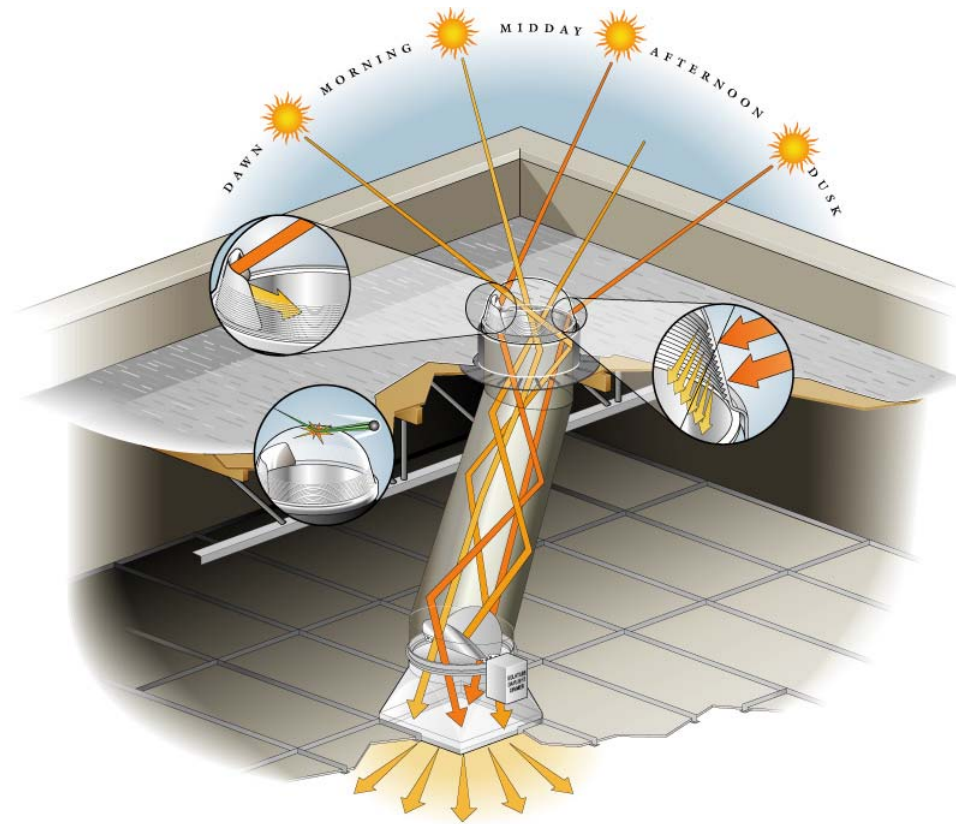
- ✓ Captures light through UV filtering dome with the patented LightTracker™ Reflector.
- ✓ Brighten Up Series also has Raybender Technology, a Fresnel lens built into the dome to redirect low angle light.

### • Transfer

- ✓ Transfers light through Spectralight® Infinity tubing with ultimate specular reflectivity.

### • Deliver

- ✓ Spreads light into the interior with Diffusers, reducing glare and hot spots.
- ✓ Solatube Daylight Dimmer allows the user to control light output.



# Current Activities & Status



## 1. Measure the Current Daylight Distribution of Solatube Skylights (CLTC)

1. Hold Kick-off Meeting and Develop Performance Benchmarks
2. Identify Test Spaces at CLTC and Install Baseline "Light Engine" Products
3. Analyze and characterize the current distribution performance of current Solatube TDDs
4. Develop Base-line 3-D Optical Models of Base-line Light Engine and Calibrate through Physical Testing

## 2. Design Optical Elements that will Improve Distribution (STI)

1. Reflective Diffuser Elements
2. Refractive Diffuser Elements

## 3. Simulate Daylight Distribution Using Ray-tracing (CLTC)

## 4. Evaluate Simulation Results (CLTC)

## 5. Repeat Tasks 2 through 4, as Necessary (STI & CLTC)

## 6. Develop Prototype of Final Design (STI)

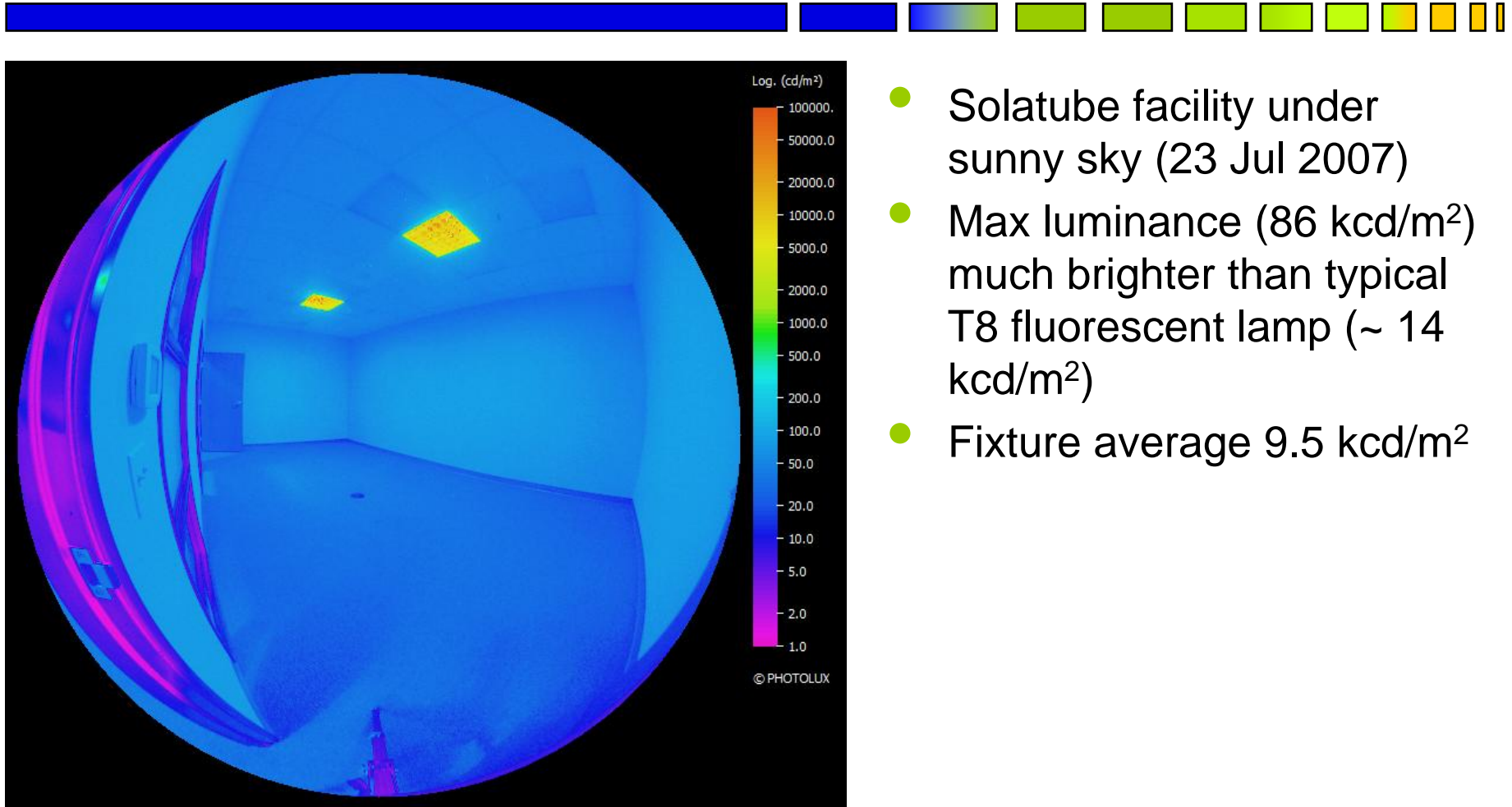
## 7. Demonstrate Performance of Prototype Diffuser Designs (CLTC & STI)

## 8. Initiate Discussions with Utility ET Demonstrations (STI)

## 9. Final Report (All)

## 10. Project-level Market Connections Activities

# Glare measurement (by HDR)



# Project Objectives / Benchmark Criteria

- Performance Goals
  - Desired Spread of Light
    - Cast Light Evenly on Ceiling Plane up to 7-feet from Fixture Center
    - Support Fixture Spacing of 10'-12' on center
  - Acceptable Suspension/Pendant Length
    - Maximum – 18" Maximum
    - Ideal – 6" to 12"
  - Ceiling Contrast Uniformity
    - Measured (Worst Case) – 100:1
    - Lofty Goal – 8:1 for Indirect Light Fixtures
    - Benchmark Criteria - Range of 15:1 to 20:1 for Daylight Source
  - Max Luminous Intensity of Fixture
    - Measured (Worst Case) – 85,000 cd/m<sup>2</sup>
    - Lofty Goal – 12,000 to 15,000 cd/m<sup>2</sup>
    - Benchmark Criteria - Range of 20,000 to 30,000 cd/m<sup>2</sup> for Daylight Source
  - VCP (Visual Comfort Probability) and/or UGR (Universal Glare Rating)
    - Measured (Worst Case) – UGR = 25 (Suitable for Medium Industrial Work)
    - UGR ≤ 19 (CIE Max Recommendation for Office Space)
    - VCP ≥ 70
  - Light Distribution (Up to Four Options Options) Not to Limit “View of Sky”
    - Direct/Indirect – 80% Down light / 20% Up light and 60% Down light / 40% Up light
    - Indirect/Direct – 40% Down light / 60% Up light and 20% Down light / 80% Up light

# Planned Demonstrations

- Demonstration Projects (All Major Utility Markets)
  - CLTC Offices
    - Office of the Future
    - Open Plan Office Spaces
  - SCE CTAC
    - Staff Conference Room (Building #6050)
    - CTAC Daylighting Classroom
  - Solatube Offices
  - Others?

# Input



- Ceiling Contrast Uniformity
  - Range of 15:1 to 20:1 for Daylight Source Acceptable?
- Max Luminous Intensity of Fixture
  - Range of 20,000 to 30,000 cd/m<sup>2</sup> for Daylight Source Acceptable?