



**VERMONT ENERGY**  
INVESTMENT CORPORATION

# **Solid-State Solutions for Municipal Lighting**

*What You'll Need to Know*

*Chad Bulman*

*Midwest Energy Efficiency Alliance*

*[cbulman@mwalliance.org](mailto:cbulman@mwalliance.org)*

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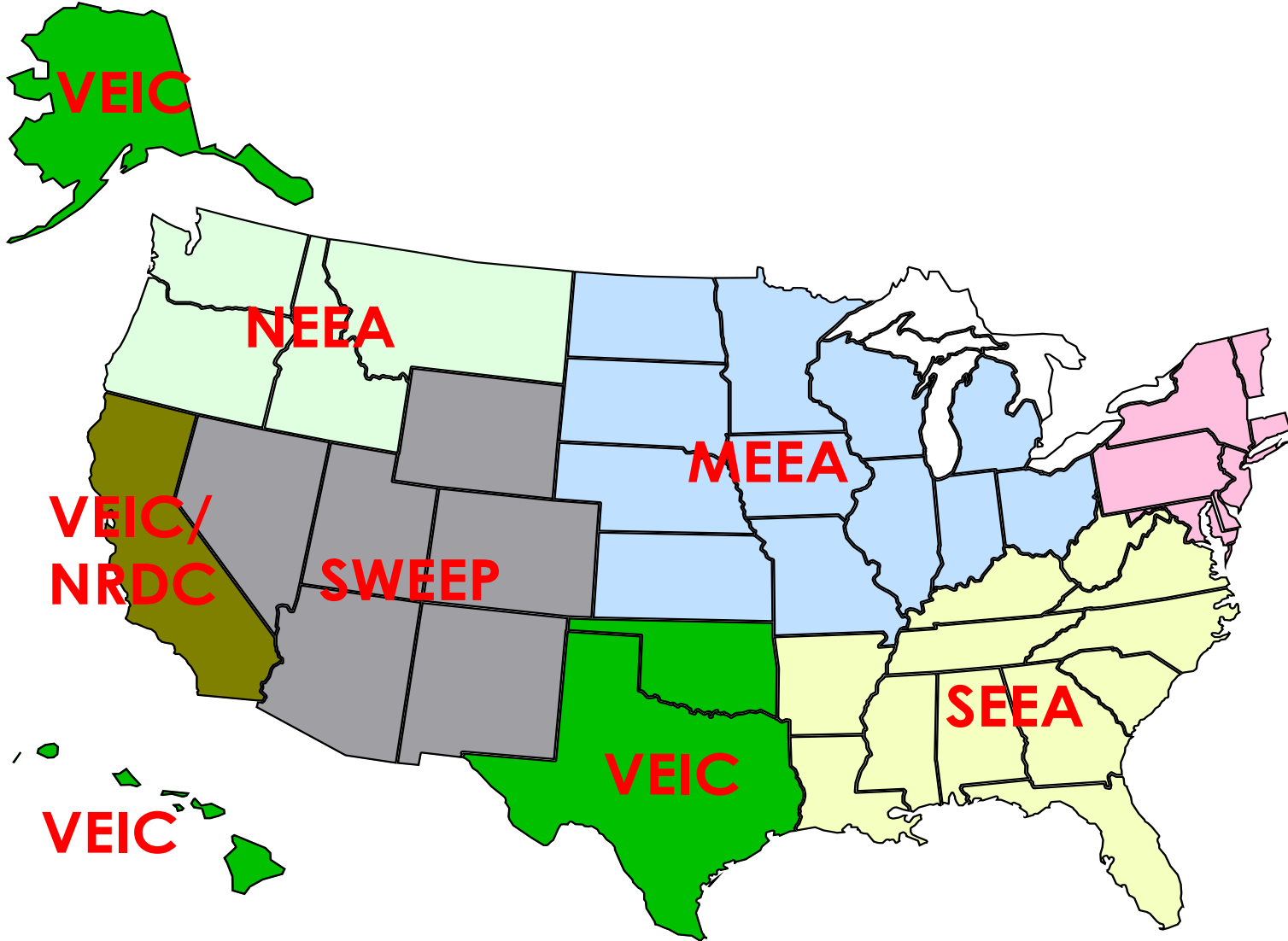


# Webinar Overview

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- Who we are and what we're doing
- SSL primer
- SSL benefits and pitfalls
- How to prepare a successful SSL project
- Upcoming meetings and events
- Resources
- Q&A

# Who we are: Team 4



**ACEEE, NRDC: National Support**

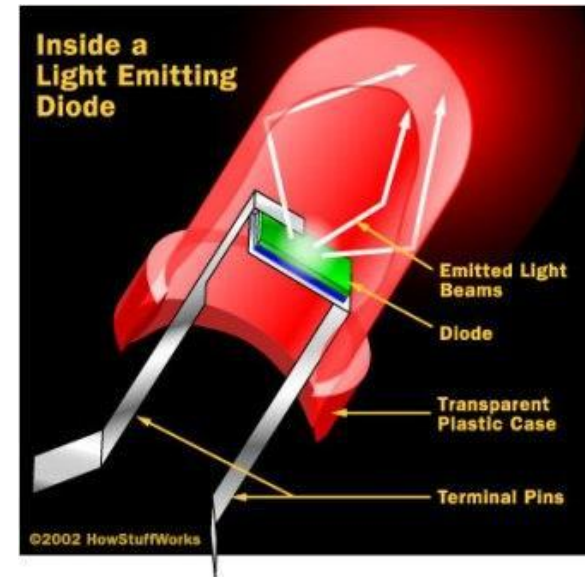
# Team 4 Role: Provide Assistance to ARRA Recipients

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- Energy Efficiency Retrofit Programs
- Evaluation, Measurement, and Verification
- Building Energy Codes
- Community Energy Planning
- Transportation
- Renewable

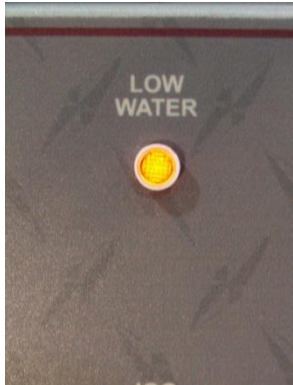
# Solid-State Lighting 101

- Most SSL based on light-emitting diodes (LEDs)
- Not a new technology
- LED brightness, color, and lifetime have been improving over the years
- Key benefit: energy savings
- In recent years, cost-effective general illumination with LEDs has become feasible
  - Energy savings of around 50% for street lighting now common



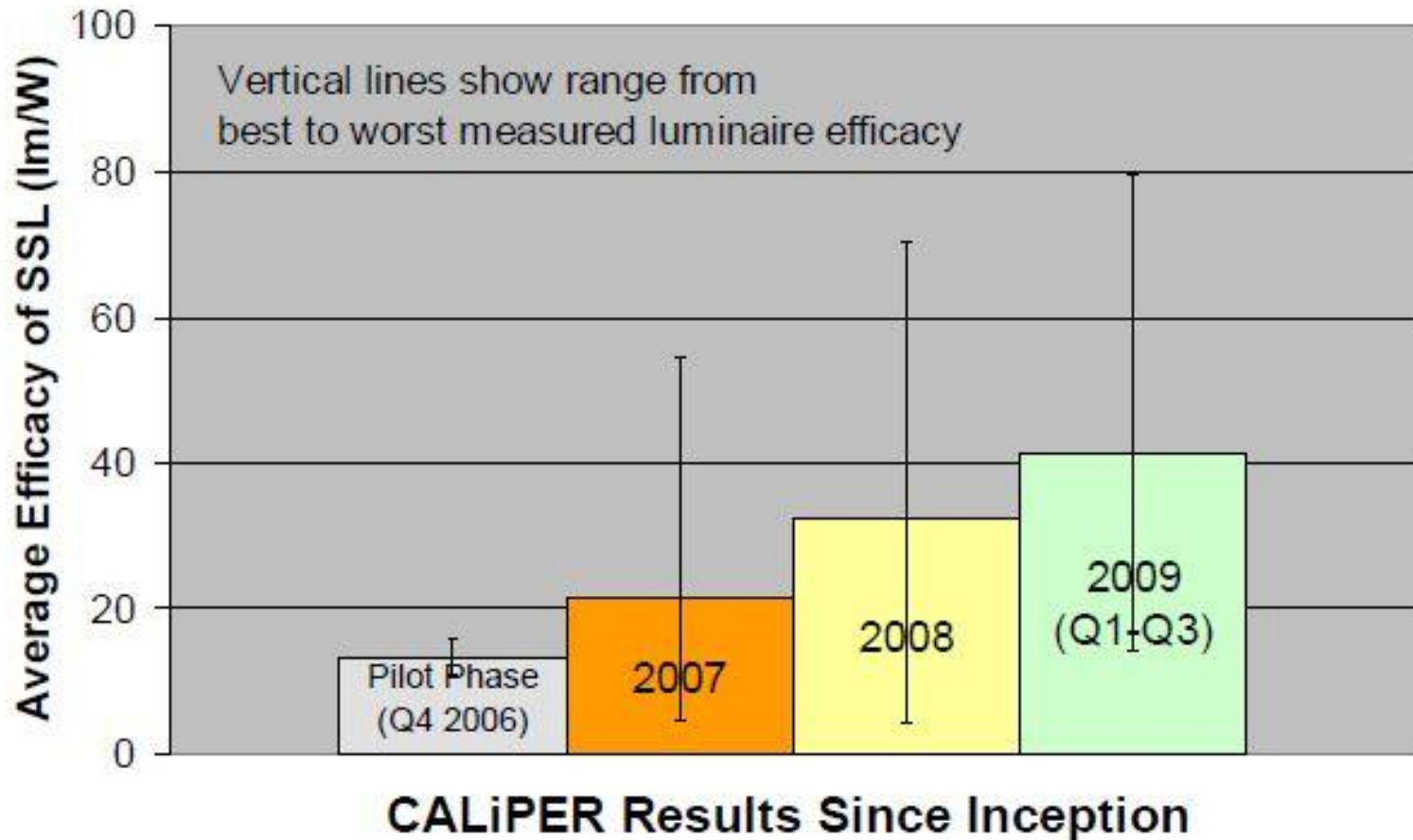
# Solid-State Lighting 101

- Technology has been evolving over time...
  - Initially: Indicator lights
  - Then: niche lighting (effect lighting, holiday lights, traffic signals)
  - Now: General Illumination
  - Tomorrow: Better general illumination, residential market, OLEDs



# Solid-State Lighting 101

SSL Performance is improving day by day  
(Product cycle is around six months)



# Solid-State Lighting 101

- Other benefits
  - Uniformity
  - Controls integration
  - Color rendering and security
  - Night vision
  - Less light pollution
  - Very long life
  - Instant on/off, rapid restrike



FDR Expressway, NYC

Photo: Ryan Pyle



TJ Maxx Parking Lot, NH

Photo: BetaLED



# SSL for Municipalities

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- SSL still not ready for some applications and markets
- However, municipalities are in good position for adoption of SSL
- Why?
  - Tight budgets
  - ARRA funding available
  - Utility and State incentives
  - High maintenance costs
  - Aging infrastructure
  - Sustainability planning
  - Many municipal applications ripe for SSL (streets, parking)

# So Why Aren't We All Making the Switch?

- Price Point
- Is it too early?
- What if product underperforms?
- What if our residents hate it?
- What if I get burned?



# Caveat Emptor

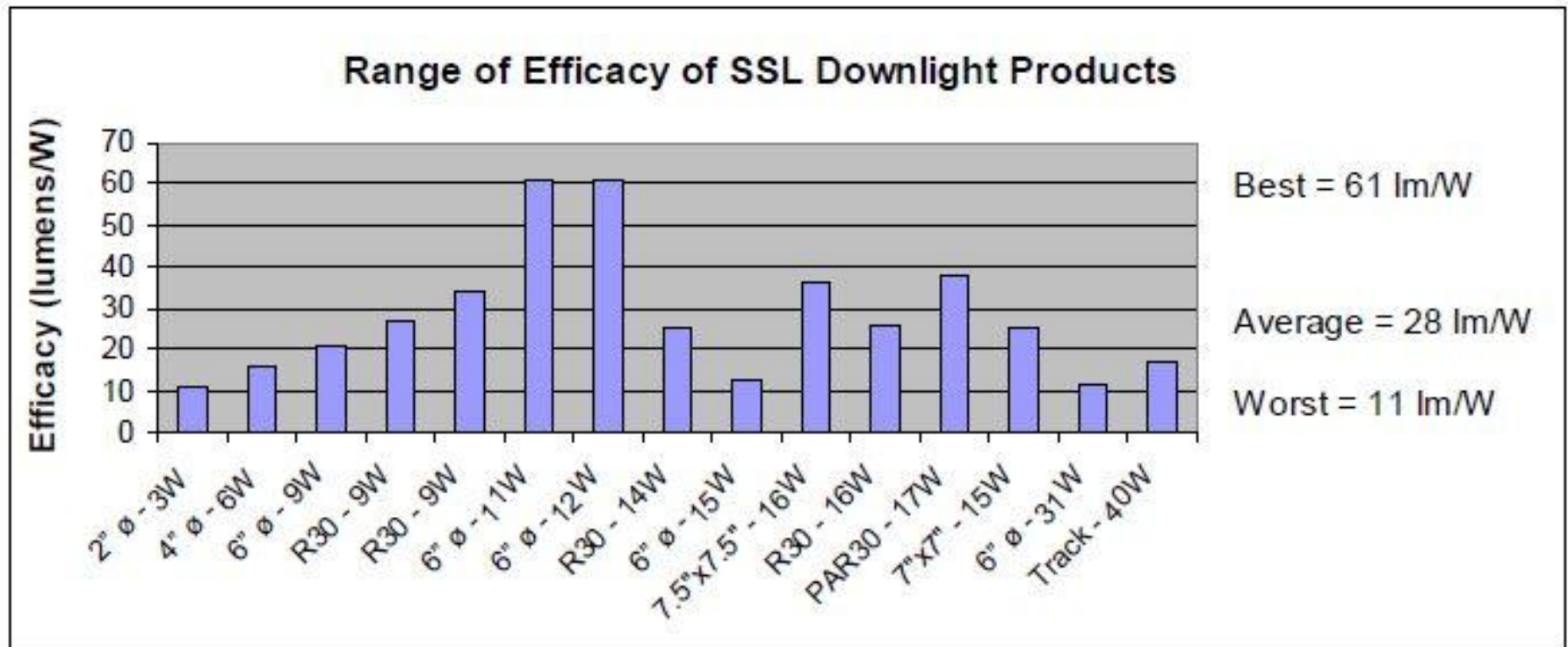
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- Still significant risk for municipalities who don't do their homework
  - Not all LED fixtures are created equal
  - Manufacturers' and vendors' rose-tinted glasses
  - Need to educate community and gain its enthusiasm



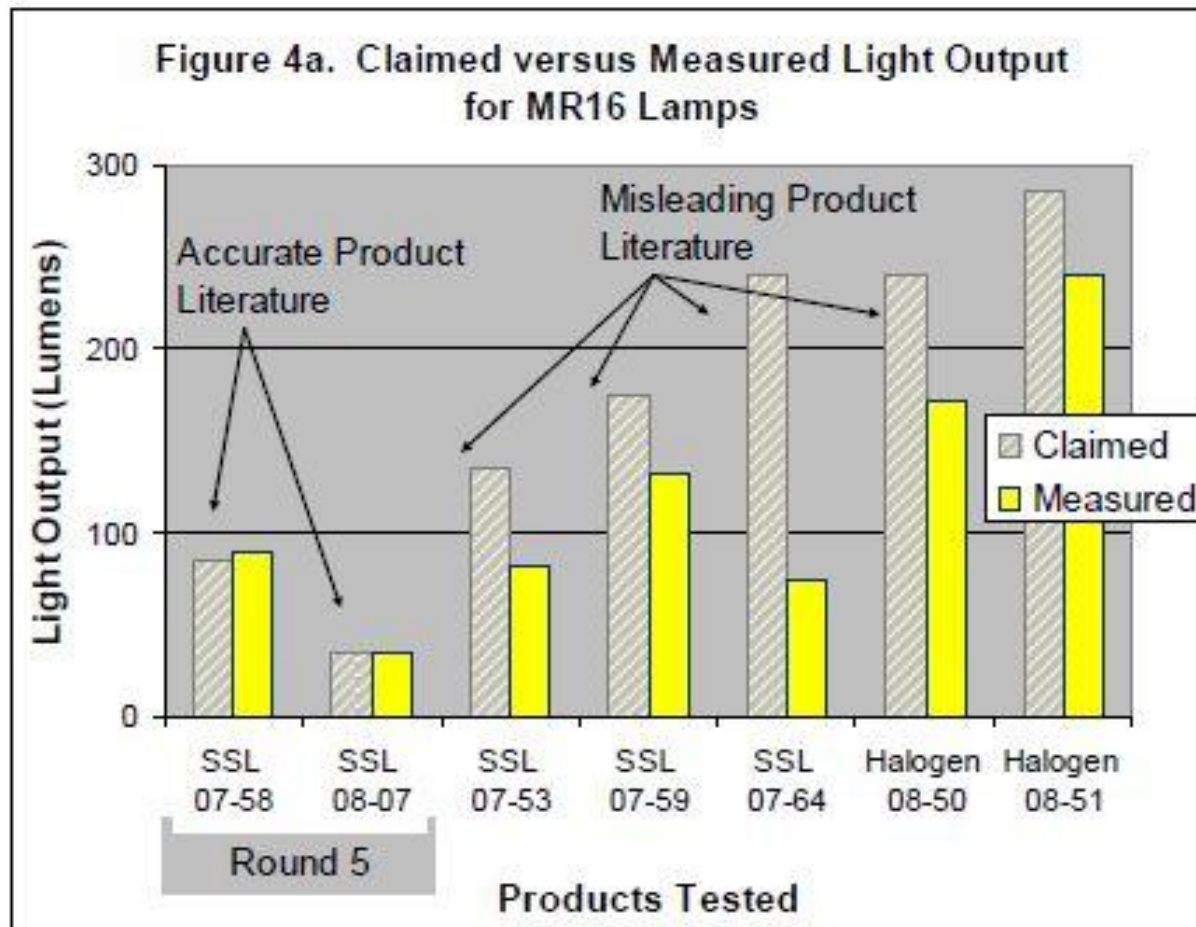
# Caveat Emptor

Product performance with SSL not a known quantity as with traditional lighting



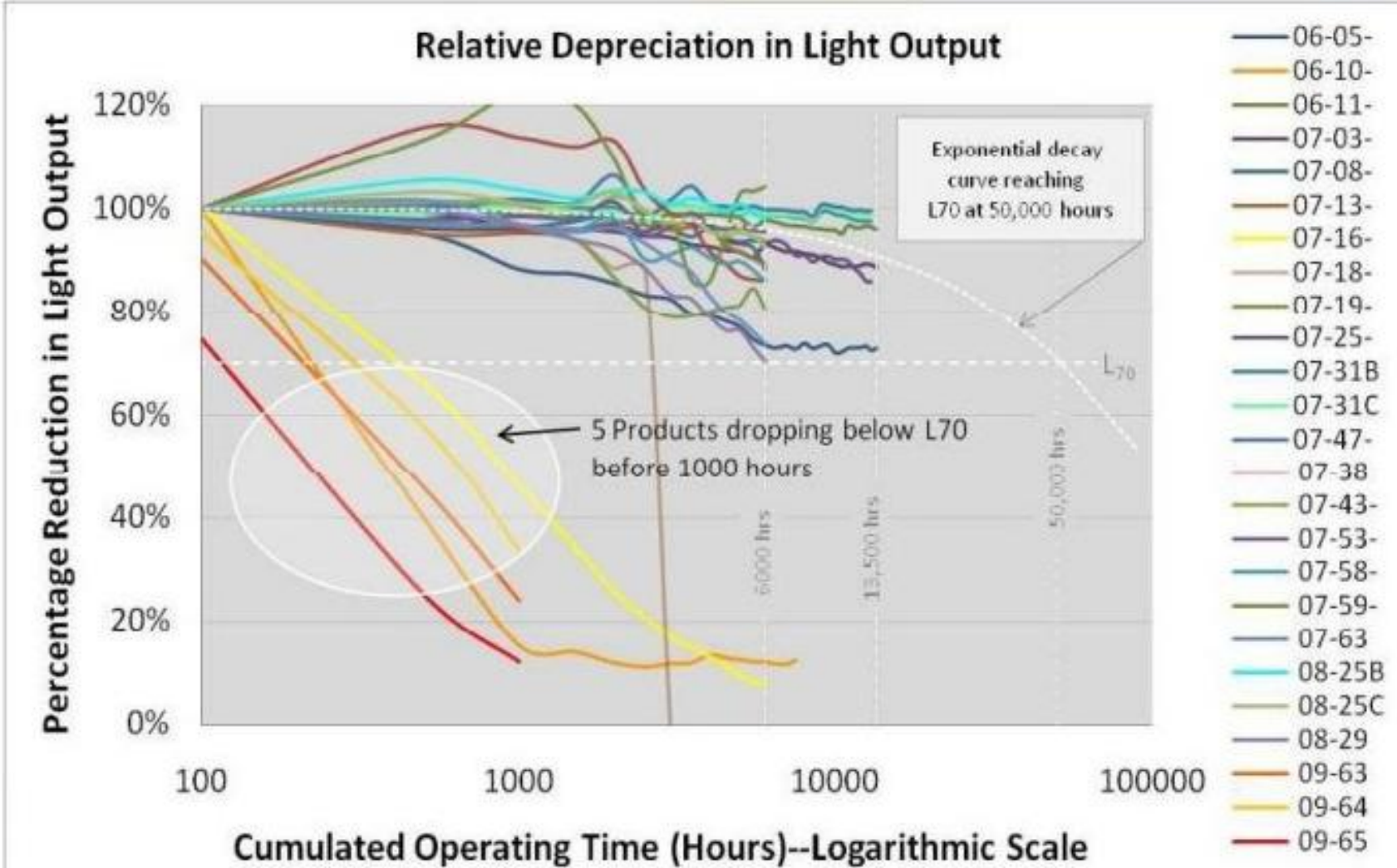
# Caveat Emptor

Beware overstated performance claims  
(SSL not only tech facing this issue)



# Caveat Emptor

Long life not always guaranteed...



# Independent Lab Testing of SSL Products

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- Don't take manufacturers at their word!
- Collect cutsheets, yes, but verify claims
- Independent testing, the only way to be certain
  
- Cautionary tale – Chicago lighting retrofit
  - LED installation meant to last well over 10 years
  - LEDs typically considered at end of life when light output has decreased by 30%
  - This case: Light output dropped by 10% in just *five months*

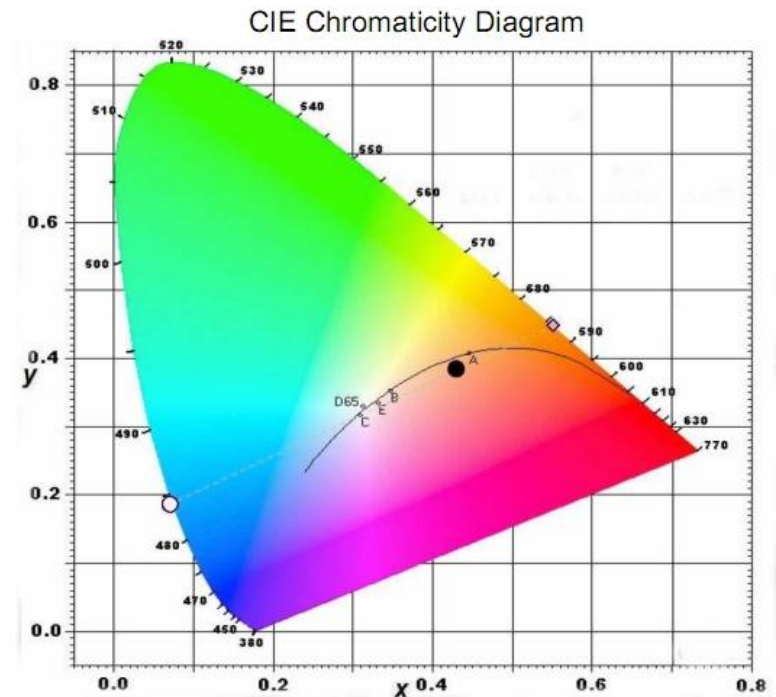
# Independent Lab Testing of SSL Products

- LM-79 Report provides key detail on:
  - Color of light: Correlated Color Temperature (CCT), Color Rendering Index (CRI)
  - Light Output – Total lumens, Zonal lumens
  - Electrical/Efficiency Aspects – volts, amps, watts, efficacy (lumens/watt), off-state power
  - Beam angle – width of light footprint
  - Qualified Test Labs
    - [www1.eere.energy.gov/buildings/ssl/test\\_labs.html](http://www1.eere.energy.gov/buildings/ssl/test_labs.html)



# Independent Lab Testing of SSL Products

- Color temperature (CCT)
  - Warm, golden light: 2700-3300 range
  - Cooler, bluish light: 4500-6000 range
  - SSL has higher efficacy at higher CCT, but this is not what the general public is used to
- Color rendering index (CRI)
  - Sunlight, incandescent: 100
  - CFL: 82
  - Metal Halide: 70
  - HPS/Mercury vapor: 20
  - SSL: Generally high (80+)



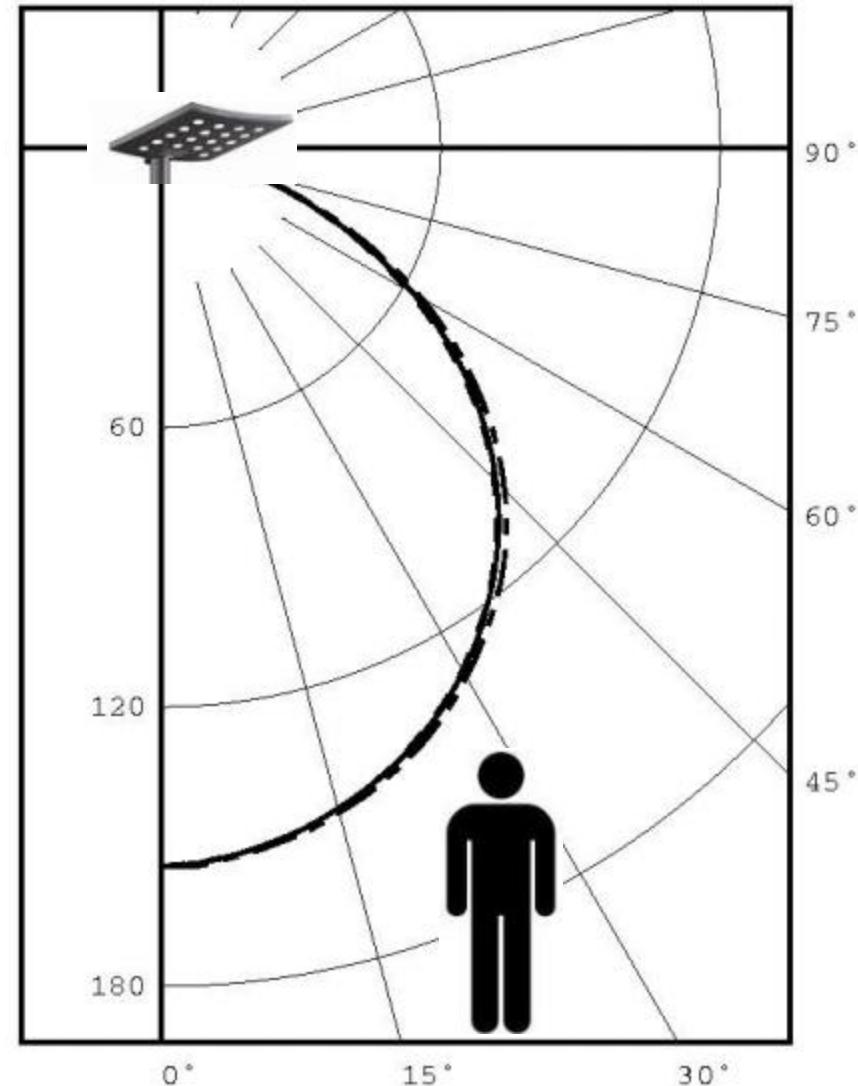
# Light Distribution

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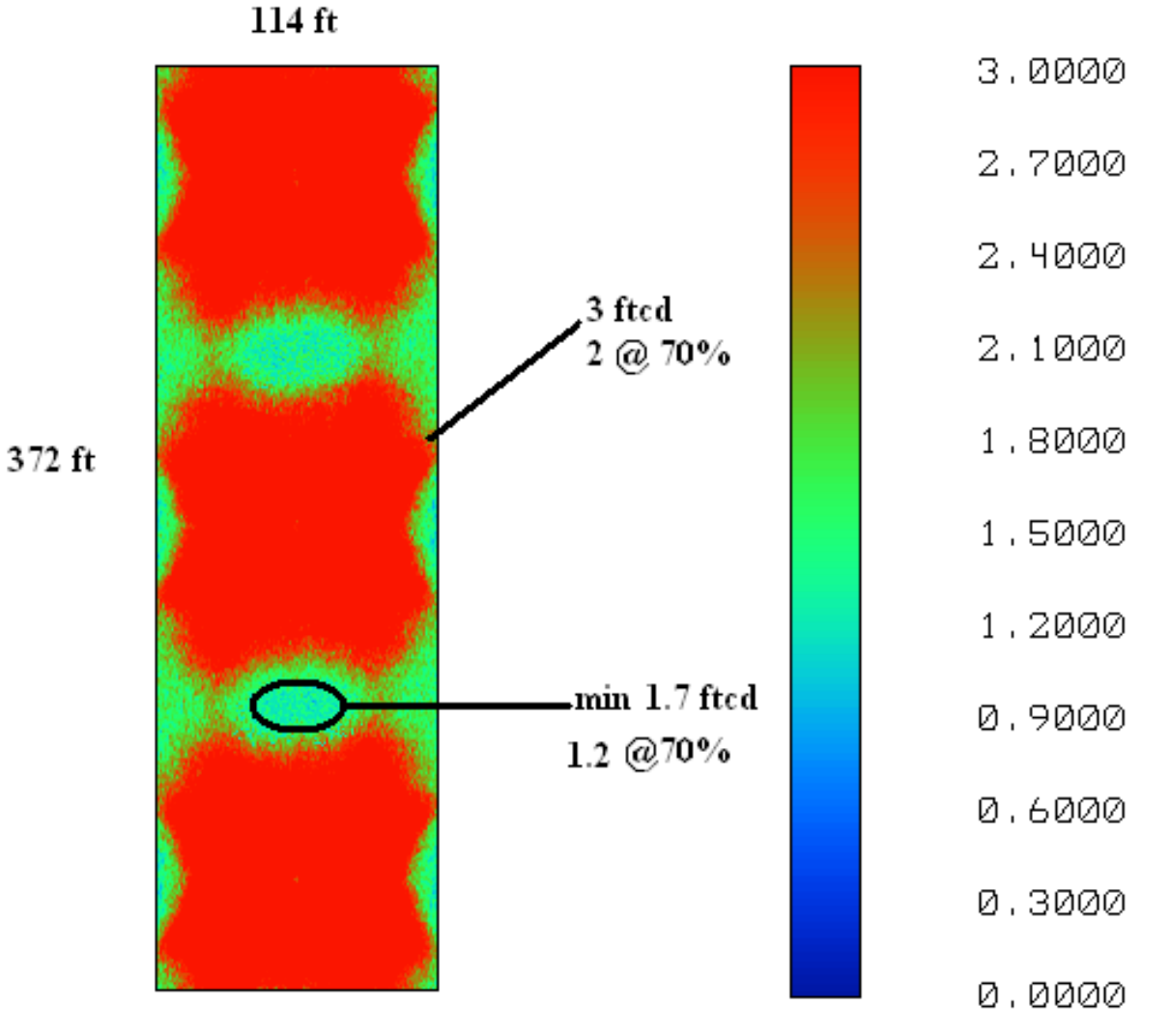
- Beam angle
  - Important consideration in predicting what light distribution will look like
  - Bear in mind that existing pole heights and spacings were not designed with SSL in mind
  - Luckily, SSL's directional nature makes for flexible light distribution patterns
  - Greater uniformity means few 'hot spots' and shadows

# Light Distribution

- At Deg = 0, we have center beam candle power (CBCP)
- To determine beam angle, find spot where candelas = 0.5 X CBCP
- Then, double this number
- This is your useful light



# Footcandle modeling



# Independent Lab Testing of SSL Products

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- Final notes on the LM-79 test
  - No standardized reporting format
  - Some tests may or may not include additional data
  - Product families may be lumped together

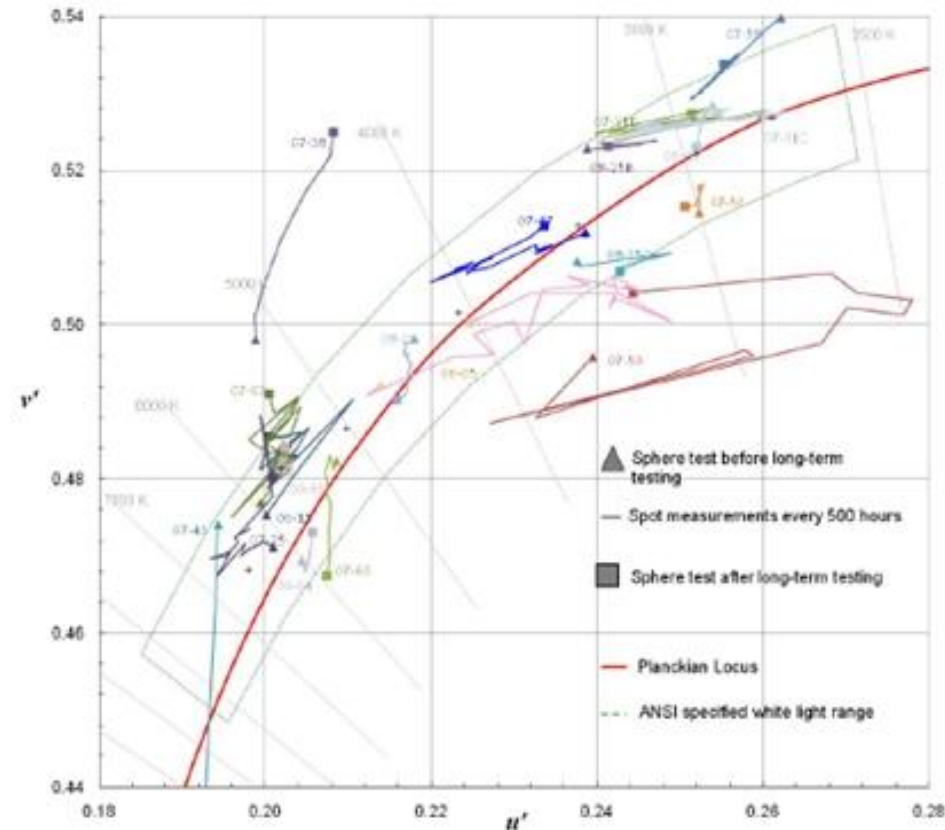
# Independent Lab Testing of SSL Products

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- LM-80 Report provides key detail on:
  - Lumen maintenance – how well the luminaire maintains its initial light levels
  - Color shift – changes in the color of the light over time
  - Though the LM-80 does test over a long period of time (6,000+ hours), its results aren't meant to be extrapolated to predict fixture life
  - TM-21 in development...

# Independent Lab Testing of SSL Products

- LM-80 Test
  - Color shift a negative effect and should be evaluated
  - See how test conditions relate to your expected lighting scenario
    - Ambient temperature
    - Current levels



# Independent Lab Testing of SSL Products

- I don't know how to interpret these lab tests!
  - Educate yourself (DOE fact sheet), or get technical assistance (DOE Tech. Assist. or lighting consultant)
  - Can't do this? Call their bluff and *ask anyway*
  - References from other municipalities
    - Have they done this before and how did it go?





# Return on Investment

- Payback Period answers, “How long will it take me to make up the additional cost of an SSL fixture through energy savings?”
- Need to consider all costs, not just price tag
- Fixture price, Maintenance, Incentives, Annual Usage, Product Life
- Payback Period
  - 0-2 years, no brainer
  - 3-7 years, sound investment
  - 8-10 years, think on it
  - 10+ years, let’s hold off



# Other things to consider...

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- Product warranty? 5 years becoming the standard. Parts/Labor/Both covered?
- Whose LEDs are you using? Are they a known, reputable manufacturer?
- BUG rating? Dark Sky compliant?
- Power Factor?
- Pole height and spacing suitable?
- UL listing or other qualifications

# Other things to consider...

- Light Loss Factors
  - Average ambient temperature
  - Current levels
  - Weather effects
  - Dirt depreciation
- Maintenance concerns
  - SSL offers a reduced maintenance schedule
  - Two maintenance staff + cherry-picker = not cheap
  - Are reduced maintenance needs a good thing for you?



# User Perceptions of SSL are Key

- Chicago SSL installation
  - Residents were not informed of LED retrofit prior to the fact, were not explained benefits, and were not offered chance to offer their opinion
  - Result? LED installation was removed!
  - Make sure your residents know what to expect



# Safety and Security

- Ensuring minimum light levels are met
  - Know your lighting ordinances or standards (e.g., IESNA RP-8)
  - Computer modeling of footcandle measurements let you know
  - For best results use lab test data, not manufacturer claims
  - Be aware that minimum light levels must be maintained over the FULL LIFE of the fixture
    - Are we still cutting the mustard at  $L_{70}$ ?
    - And, by the way, how will we know when we're at the end of the fixture's life?

# Adaptive Controls

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- Something to consider, though may be better to take 'baby steps' initially
  - Can help squeeze additional energy savings out of your lighting
  - Does introduce additional costs, but these days controls are have less of an effect on payback
  - Residents may appreciate it!

# Beyond LED lighting

Be aware that LED fixtures may not be your only (or best) option for next-gen lighting

- Induction lighting
- Plasma lighting
- Ceramic Metal Halide



# No Shortage of Upcoming SSL Events

- Upcoming Webinars
  - 3-Day series of SSL webinars from NEEP on evaluating SSL test reports, August 10-12
  - Lessons Learned from Energy Efficiency Lighting Programs, August 25
    - [http://www1.eere.energy.gov/wip/webinar\\_20100825.html](http://www1.eere.energy.gov/wip/webinar_20100825.html)
  - Testing Times - Standards and Measurement Requirements for LEDs and Luminaires, LEDs Magazine, August 25





# No Shortage of Upcoming SSL Events

- Upcoming workshops/meetings
  - “Introduction to Solid-State Lighting: A Market in Motion” August 15, Dallas
  - DOE Municipal Solid-State First Annual Meeting, September 29, Huntington Beach, CA
  - LEDiscovery, September 22, Toronto
  - SSL Summit 2010, September 14-15, New York
  - Many annual SSL conferences (e.g., DOE, Lightfair, ArchLED)



# Resources



Energy Efficiency &  
Renewable Energy

- Look to the U.S. Department of Energy as a key *FREE* resource
  - GATEWAY Demonstrations
  - SSL Quality Advocates
  - CALiPER
  - L Prize
  - Next Generation Luminaires & Lighting for Tomorrow
  - DOE SSL Forums: <http://sslforum.pnl.gov/>
  - DOE SSL Fact Sheets
    - <http://www1.eere.energy.gov/buildings/ssl/factsheets.html>

# Resources

- Some Additional Programs & Resources
  - Evaluating LED Street Lighting Solutions Webcast
    - [http://www1.eere.energy.gov/buildings/ssl/consortium-update\\_webinar.html](http://www1.eere.energy.gov/buildings/ssl/consortium-update_webinar.html)
  - ENERGY STAR
  - DesignLights Consortium
  - Publications (LEDs Magazine)
  - eNewsletters
  - Blogs: LightNOW, CrossLight



# Online Resources: Solution Center

Solution Center 2.0 live now: <http://wip.energy.gov/solutioncenter>

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

## Solution Center

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Technical Assistance Services

The Solution Center is the home for Energy Efficiency and Conservation Block Grant (EECBG) Program and State Energy Program (SEP) technical assistance resources. The goal of the Solution Center is to help eligible grantees and sub-grantees develop and implement successful energy efficiency and conservation projects and programs that meet the conditions and guidelines of the EECBG and SEP programs. Please spend some time exploring this page and take full advantage of the resources available.

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**Activities**

The Solution Center has gathered best practices, tools, sample projects, and other related resources for all eligible EECBG and SEP activities. Find resources for your projects via the maps below or the menu on the left-hand side of this page.

EECBG Activities | SEP Activities

Residential and Commercial Building Energy Audits

Financial

Development of an Energy Efficiency and Conservation Strategy

Material Conservation Programs

Reduction and Capture of Methane and Greenhouse Gases

Energy Efficiency Retrofits

Energy Distribution Technologies

Renewable Energy Technologies on Site

SEP Program Guidance

EECBG Program Guidance

Resources include: best practices, templates, webinars, project map, events calendar, TAP blog

# Online Resources: TAC

Technical Assistance Center live now: <https://tac.eecleanenergy.org/>

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Version 1.0.7

Make a request for direct technical assistance here  
or call 1-877-EERE-TAP (1-877-337-3827)

# Provider Network Resources

<p>State and Local Capacity Building</p>	<ul style="list-style-type: none"> <li>• Trainings</li> <li>• Workshops</li> <li>• Peer-to-peer matching</li> </ul>
<p>Technical</p>	<ul style="list-style-type: none"> <li>• Renewable energy siting and development</li> <li>• Review of technical specs for RFPs</li> <li>• Strategic planning, energy management, and conservation strategies</li> <li>• Green building technologies</li> <li>• Building codes</li> </ul>
<p>Program Design and Implementation</p>	<ul style="list-style-type: none"> <li>• Policy and program development</li> <li>• Coordinating rate-payer funded dollars with ARRA projects and programs</li> <li>• Sustainable community and building design</li> <li>• State and regional EE and RE assessments and planning</li> <li>• EE and RE portfolio program design elements</li> </ul>
<p>Financial</p>	<p>Program design support and guidance on financing mechanisms such as:</p> <ul style="list-style-type: none"> <li>• Revolving loan funds (RLFs)</li> <li>• Property-assessed clean energy (PACE)</li> <li>• Loan loss reserves and enhanced credit mechanisms</li> </ul>
<p>Performance Contracting</p>	<ul style="list-style-type: none"> <li>• Designing and implementing a performance contract</li> <li>• Leveraging private investment</li> <li>• Reducing institutional barriers</li> <li>• Tracking and comparing programs</li> </ul>

# Questions?

## CONTACT INFO

**Chad Bulman:** [cbulman@mwalliance.org](mailto:cbulman@mwalliance.org); (312)-784-7275

**VEIC:** Dan Quinlan, [dquinlan@veic.org](mailto:dquinlan@veic.org), 802-488-7677 (**Team 4 Lead**)

**MEEA:** Wendy Jaehn, [wjaehn@mwalliance.org](mailto:wjaehn@mwalliance.org), 312-784-7272

**NEEP:** Ed Londergan, [elondergan@neep.org](mailto:elondergan@neep.org), 781-860-9177

**NEEA:** Dave Kresta, [dkresta@nwalliance.org](mailto:dkresta@nwalliance.org), 503-827-8416

**SWEEP:** Curtis Framel, [cframel@swenergy.org](mailto:cframel@swenergy.org), 303-447-0078

**SEEA:** Ben Taube, [ben@seealliance.org](mailto:ben@seealliance.org), 404-931-1518

**ACEEE:** Eric Mackres, [emackres@aceee.org](mailto:emackres@aceee.org), 202-507-4038

**NRDC:** Lara Ettenson, [lettenson@nrdc.org](mailto:lettenson@nrdc.org), 415-875-6100

**EFG:** Richard Faesy, [rfaesy@energyfuturesgroup.com](mailto:rfaesy@energyfuturesgroup.com), 802-482-5001