

Lighting Measures for Energy Conservation in Government Facilities

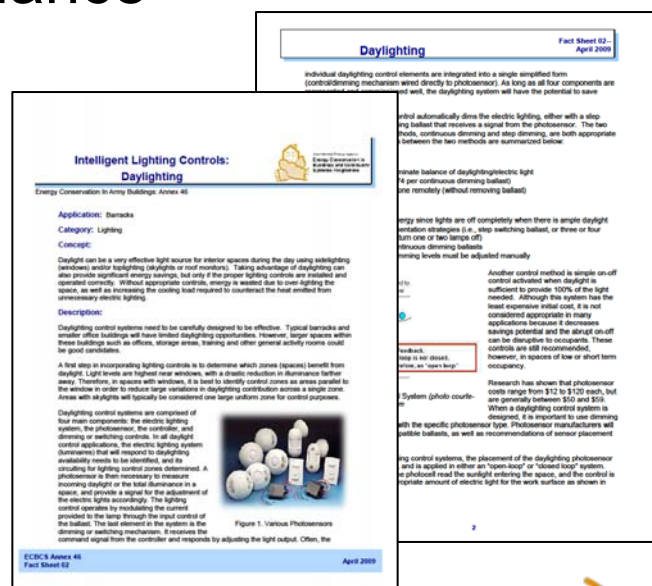
Annex 46 Lighting Templates....and other good information

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Templates for Lighting Efficiency (Annex 46)

- ▶ Templates developed for specific lighting opportunities
- ▶ Focused initially on Barracks applicable to other facilities
- ▶ From relatively simple retrofits to more complex issues
- ▶ Include energy savings calculation guidance
- ▶ Provide practical application guidance
- ▶ Five topics covered:
 - Incandescent to CFL retrofits
 - Occupancy Sensors
 - Daylighting control
 - Exterior lighting control
 - Retrofitting to correct light levels



Project Basics For Effective Lighting

▶ Application

- Match light level and task needs – maximum efficiency not always best
- Match controls to space function

▶ “Quality” and user acceptance

- Lighting quality should be maintained to promote productivity and work environment
- Users need to be able to accept changes

change prompts attention - good and bad!

▶ Cost-effectiveness

- Simple tool for initial screening
- More involved tools for specific application methods



Exterior Applications: Parking/Street/Facade

▶ Current issues

- Older Mercury Vapor and Incandescent technology
- Over-lighted spaces and surfaces
- Security concerns

▶ Appropriate Technologies/Applications

- High Pressure Sodium (HPS) – efficient/poor color
- Metal Halide (MH) good color and efficiency (pulse start!)
- LED – the current hot technology
 - Good exterior application – likes the cold
 - Long life – but does not last forever (~25K – 100K hours)



Control is a key to optimum energy savings....

Template: Exterior Lighting Control

Going beyond the photocell or time clock.....

- ▶ Start with photocell or time clock control....then consider:
- ▶ Photocell (dawn to dusk) + time clock for after closing
- ▶ Occupancy sensing where (technology) appropriate
 - ▶ Switching
 - ▶ Dimming
- ▶ Address safety concerns –
Light **quantity** is **not** the sole metric of safety and security



General Interior Applications: Older Technology

▶ Current issues

- Incandescent lamps still in use (and needed)
- Older T12 (and T8) lamps
- Non-electronic ballasts



▶ Appropriate Technologies

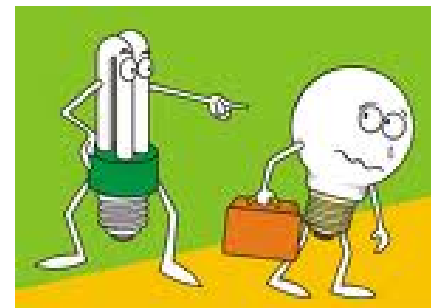
- Compact Fluorescent (CFL) pin and screw-based
 - Good Incandescent retrofit
 - May not be best for specialty spotlighting tasks
- Linear Fluorescent – T8, T5 and electronic ballast
- MH (pulse start) good higher ceiling application
- What about LEDs?
 - Good small task application
 - Not quite ready for general overhead lighting



Template: Incandescent to CFL Retrofits

Common retrofit....”been doing it for years”....but....

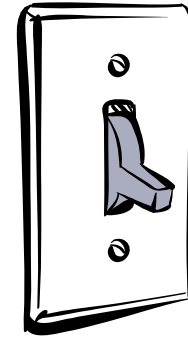
- ▶ Color – wide variety in CFL technology compared to Inc.
- ▶ Output/intensity – CFL is not a point source!
 - May not be effective for highlighting (hard to focus a beam)
 - Still need to check output compared to incandescent
- ▶ Hardwired vs. screw-in. Initial cost vs. “takeback” loss
- ▶ Environmental issues beyond simple incandescent
 - Mercury
 - Additional components/mass
- ▶ Excessive Heat – degrades performance
 - Avoid enclosed recessed applications
 - Check manufacturer's listed applications



General Interior Applications: Manual Switching

- ▶ Current issues
 - Manual switches
 - Lack of area control
- ▶ Appropriate Technologies
 - Occupancy based control
 - Passive Infrared (field-of-view sensing)
 - Ultrasonic (“sees” around objects)
 - Timeclock systems
- ▶ Application Issues

The technology is not one size fits all....



Template: Effective Occupancy Sensor Control

Occupancy sensing....but with a focus on “effective”

▶ The right technology

- Infrared – “sees motion” – not as good with obstructions
- Ultrasonic – “feels motion” – will sense everywhere
- Hybrid for better control
- Auto-on vs. Manual-on

▶ The right location/installation

- Check area limit
- Watch obstructions and occupant patterns

▶ Maximize energy savings settings

- Sensitivity and coverage
- Time-out setting



General Interior Applications: Daylight Control

▶ Current issues

- Skylights/Sidelighting with no control
- Prime daylight spaces with no skylights

▶ Appropriate Technologies

- Step and continuous dimming controls
 - Need to match with dimmable lighting (Fluorescent)
- On-Off control (less effective)
 - Need to consider effect of on-off (warm-up of MH/ HPS)
- Linear Fluorescent – T8, T5 and electronic ballast
- Consider integration of occupancy sensor control

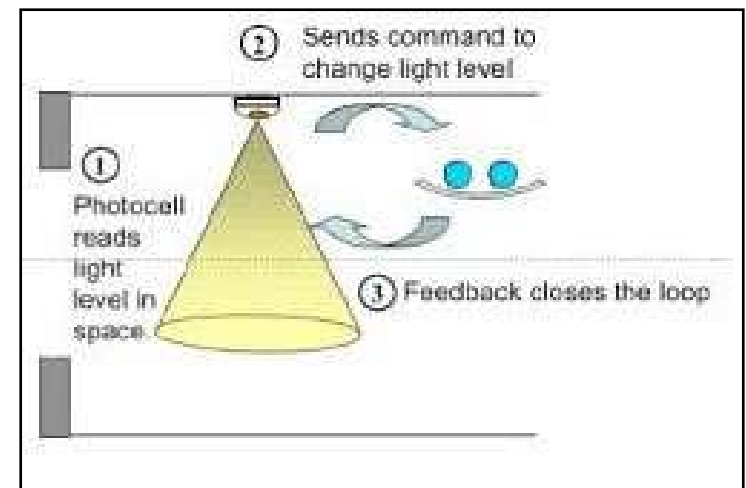
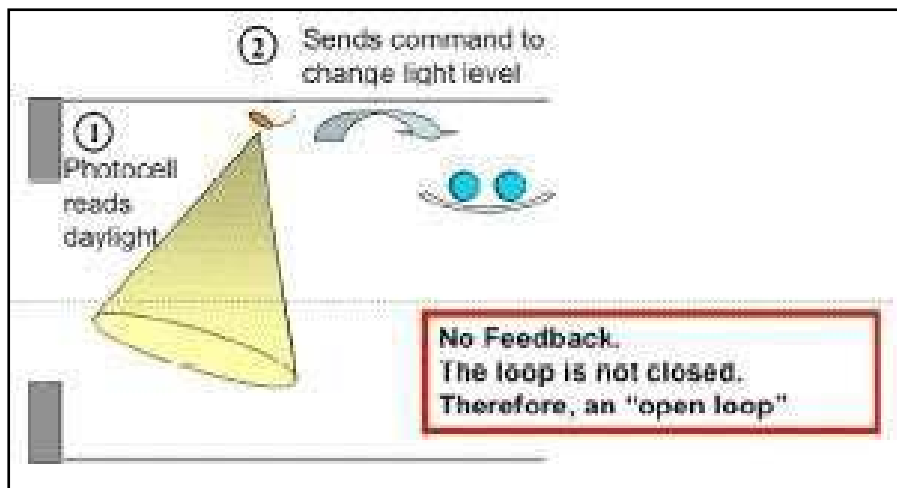


The Sun can look real simple.....Daylighting control is not....

Template: Effective (Intelligent) Daylighting

Daylighting design issues:

- ▶ Continuous vs. Step dimming
- ▶ Open vs. Closed loop control



- ▶ Individual space design elements:
 - window size and location
 - Building orientation
 - Window type

General Interior Applications: Overlighted Spaces

“We have over time, overlighted everything in America”

Howard Brandston

▶ Current issues

- Standard (old) practice
- Hard to retrofit and/or not dead yet!

▶ Application Technologies

- Replace older T12 (and T8) systems and adjust levels
 - May not be able to effectively retrofit just lamps/ballasts - may need complete fixture replacement
- Replace standard with low factor ballasts
 - Consider cost-effectiveness. May be better to replace system
- Complete new system – maximum savings but consider cost

Plan carefully for effective easy transition.....

Template: Retrofitting to Correct Light Levels

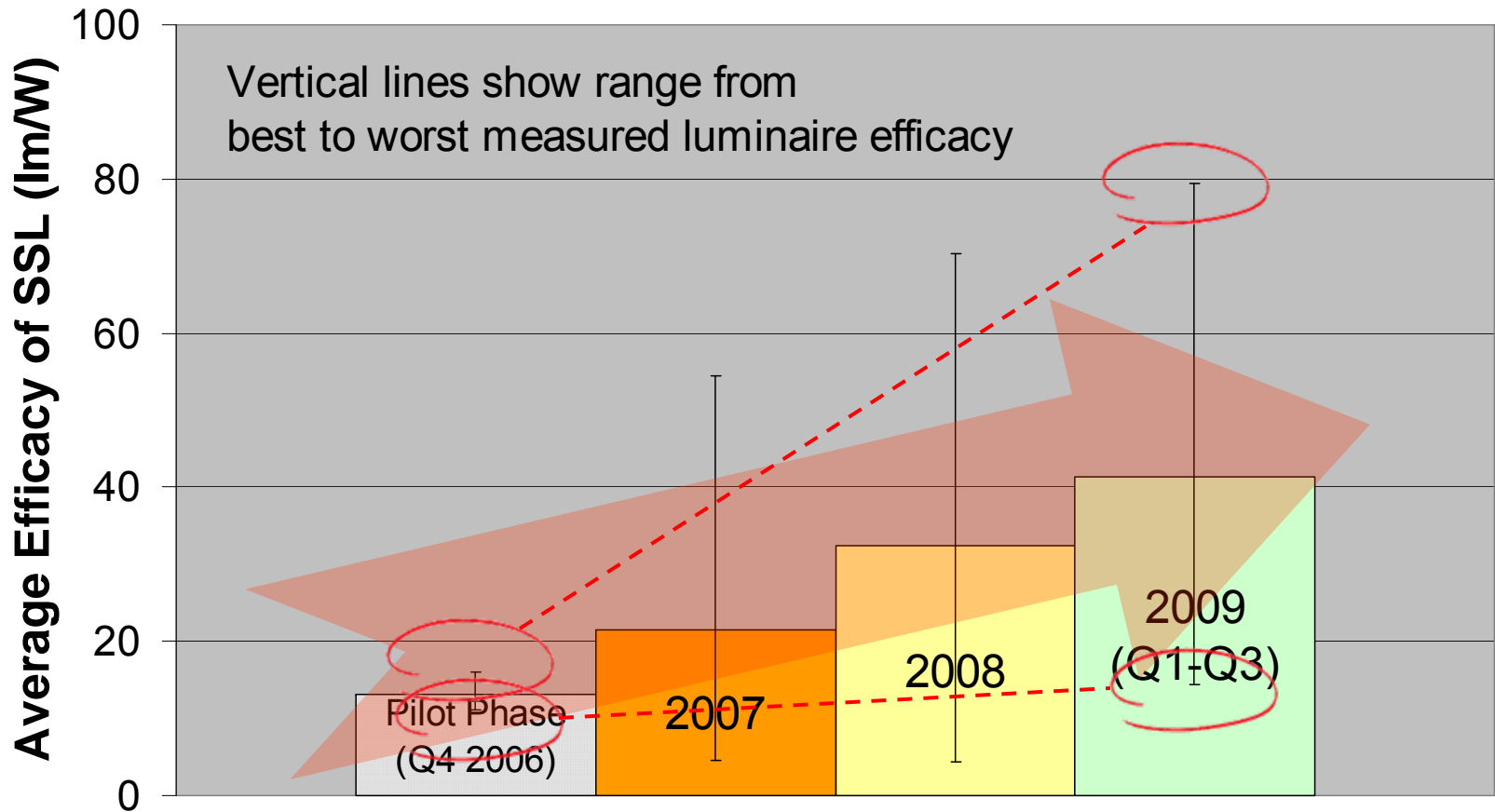
- ▶ Identify lighting needs based on space type and function
 - IES recommendations (www.iesna.org)
 - Organizational guidelines
- ▶ Follow measurement protocols for verifying light levels
 - Average illuminance
 - Min-to-max or uniformity
- ▶ Develop retrofit strategies – user acceptance planning
 - “don’t take my light away” - avoid de-lamping
 - Provide “new, better lighting” that “meets guidelines”
 - Consider “stealth” retrofitting – off hours or days

A few words about LEDs (Solid State Lighting)...

Fundamental differences from other technologies

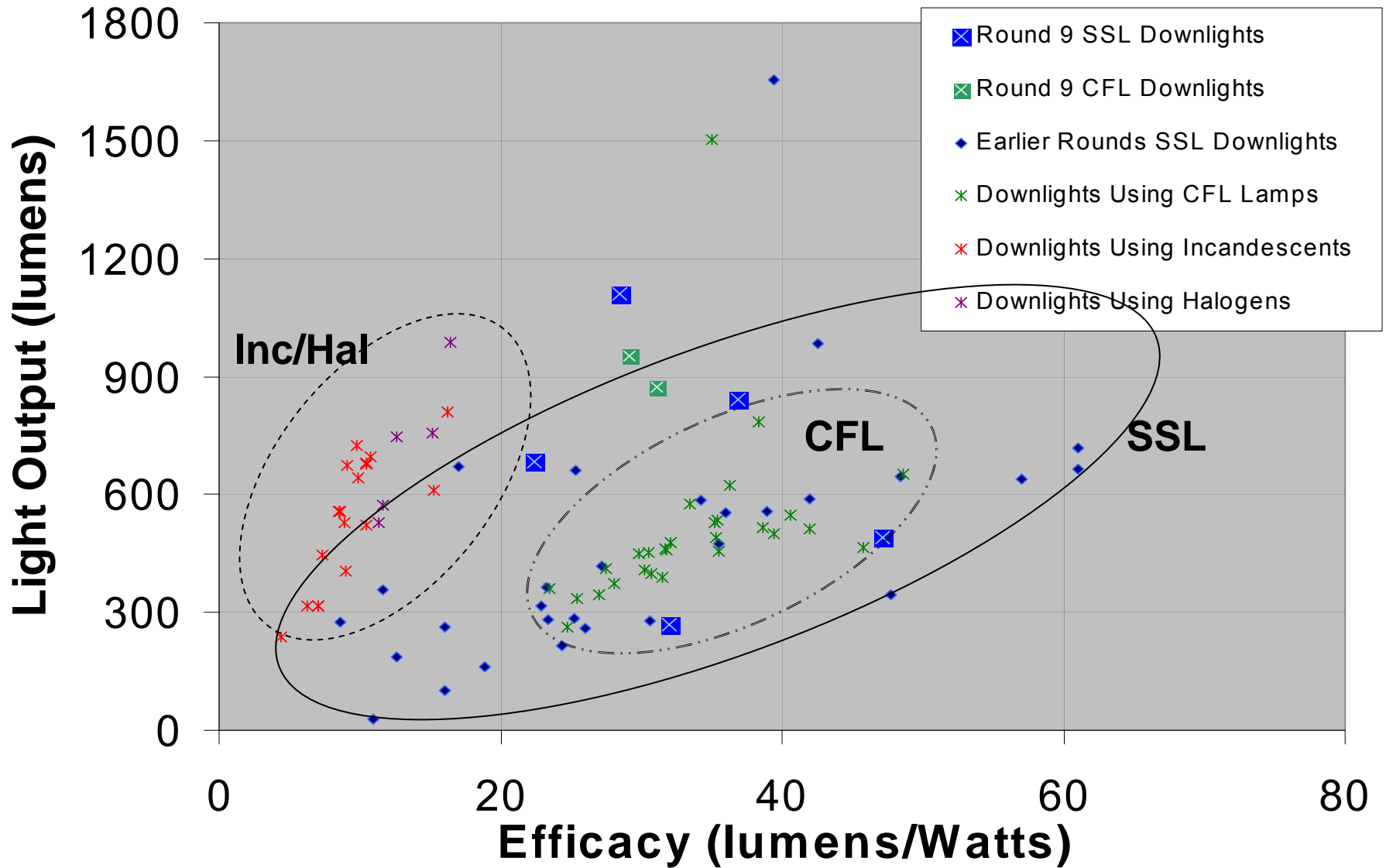
- ▶ **Small format** – good luminaire design flexibility
- ▶ **Multiple colors** - good color design flexibility
....but must define “white light” (CFL experience)
- ▶ **No filament to break** – potentially very long life
....but technology is relatively young – not enough history yet
- ▶ **Heat Sensitivity** – degrade in performance with excessive heat and do not radiate heat
- ▶ **High efficacy potential**
....key word is “potential” – currently around FL/CFL efficacy

Overall LED (SSL) Efficacy Progress



CALiPER Results Since Inception

Recessed Downlights - Capability Summary



Key SSL Performance Observations

Observations from DOE program testing (CALiPER):

- ▶ LED 2'x2' ceiling products are available that can compete admirably with 2'x2' FL luminaires – but check higher output
- ▶ LED 4' linear replacement lamps tested do not meet the light output and efficacies seen in 4' T8 fluorescent lamps
- ▶ LED downlights can now meet/exceed the output capability of most INC/HAL lamps and holding their own with CFL
- ▶ LED MR/PAR reflector products provide better efficacy than incandescents - but often lower in output and beam intensity
- ▶ LED Parking structure and wallpack products are able to match standard technology performance with same or better efficacy
- ▶ LED Technology is new (and different) - comparison information can be inconsistent (and wrong!)

LED comparison data must be carefully evaluated

www.ssl.energy.gov

▶ Questions?