Sustainable Communities Program

Non-Res Title 24 Overview

June 11, 2014

Presented by:

"When we try to pick out
anything by itself, we find it hitched
to everything else in the universe."
- John Muir

Outline

1. **Setting the Stage**
2. **Getting More Specific**
3. **Show me an Example**
4. ***Wait: One Thing More …***

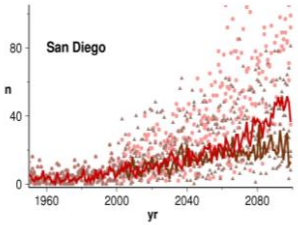
Climate Challenges of the San Diego Region

Courtesy of: Scripps Institution of Oceanography

Dr. David W. Pierce
Division of Climate, Atmospheric Sciences, and Physical Oceanography

Dr. Dan Cayan
US Geological Survey Water Resources Discipline

Climate Summary

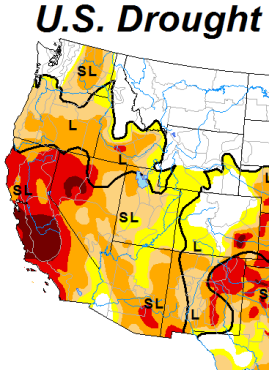


Climate change effects most *at the extremes*

- Heat waves
- Wildfires
- Droughts and floods

Sea level rise:

- *In combination with* natural factors will damage public infrastructure and private property



San Diego water supply faces long-term challenges

- Growing population, shrinking supply, increased other demands

Courtesy of Dr. David W. Pierce from his presentation, “Climate Challenges of the San Diego Region”

Key Dates:

1973

1978

2006

2013

2020

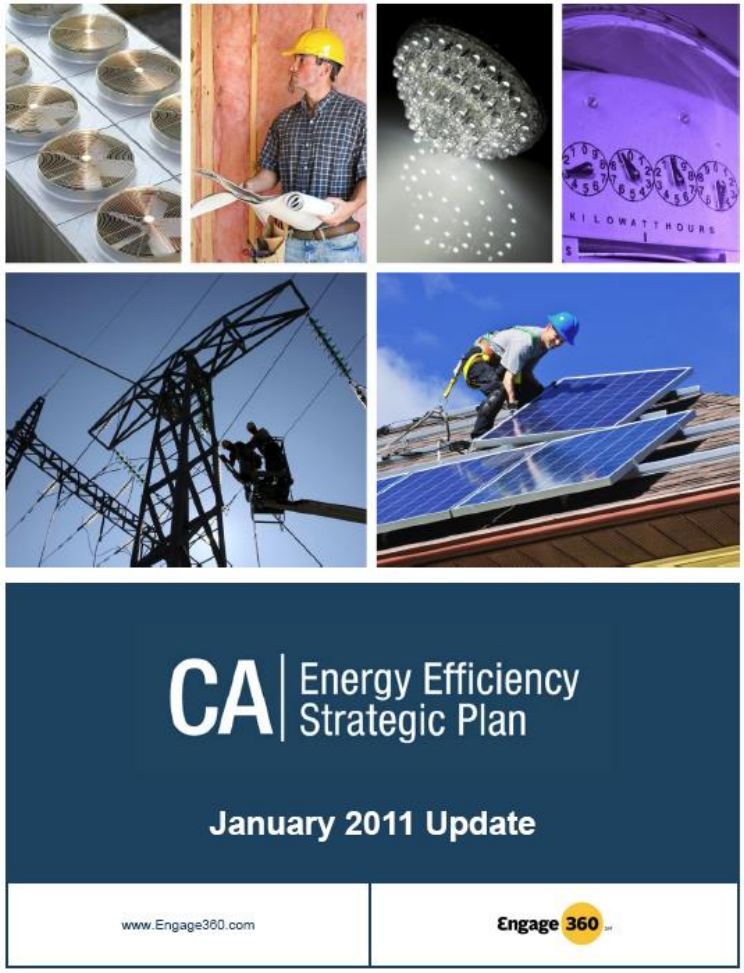
2030

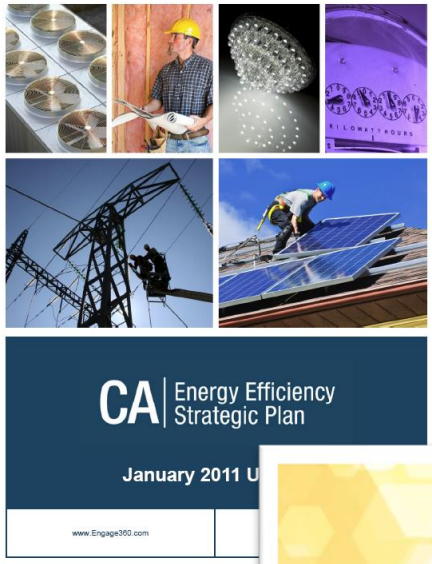
A SUMMARY OF THE FOCUS 2050 STUDY PRESENTED BY **THE SAN DIEGO FOUNDATION**

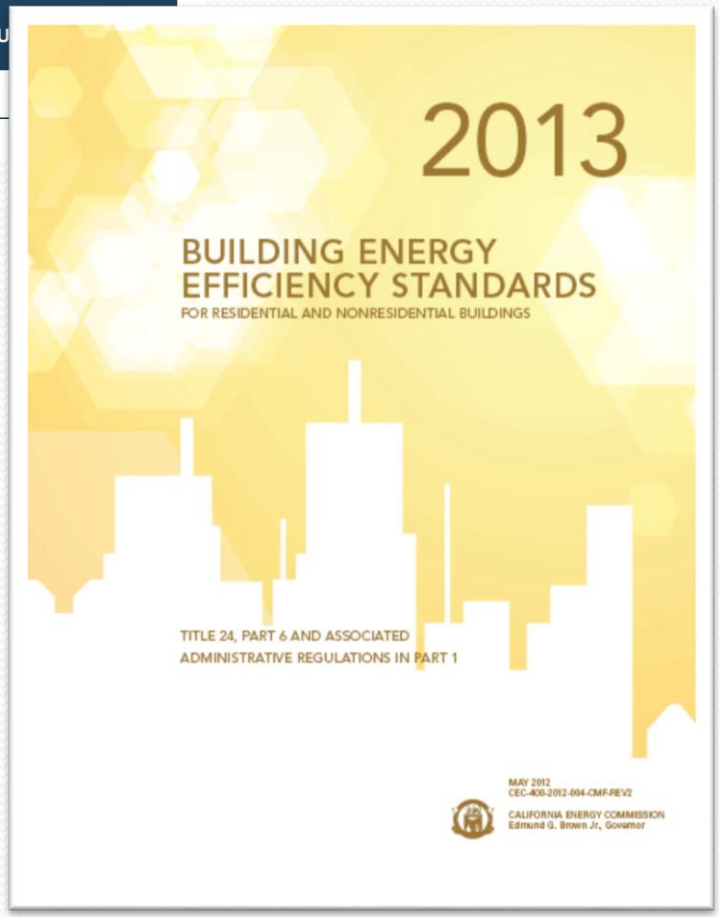
CA: EESP: Energy Action Plan

Loading Order:

1. Energy efficiency
2. Demand Response (DR)
3. Renewable energy resources and distributed generation
4. Cleaner and more efficient fossil fuel generation







- B.E.E.S. aka “Title 24”
- Increasing stringency: 2008/2013/ 2016 …
- Residential: Net Zero **2020**
- Non-Residential: Net Zero **2030**
- *T24-13 Implementation July 1, 2014*

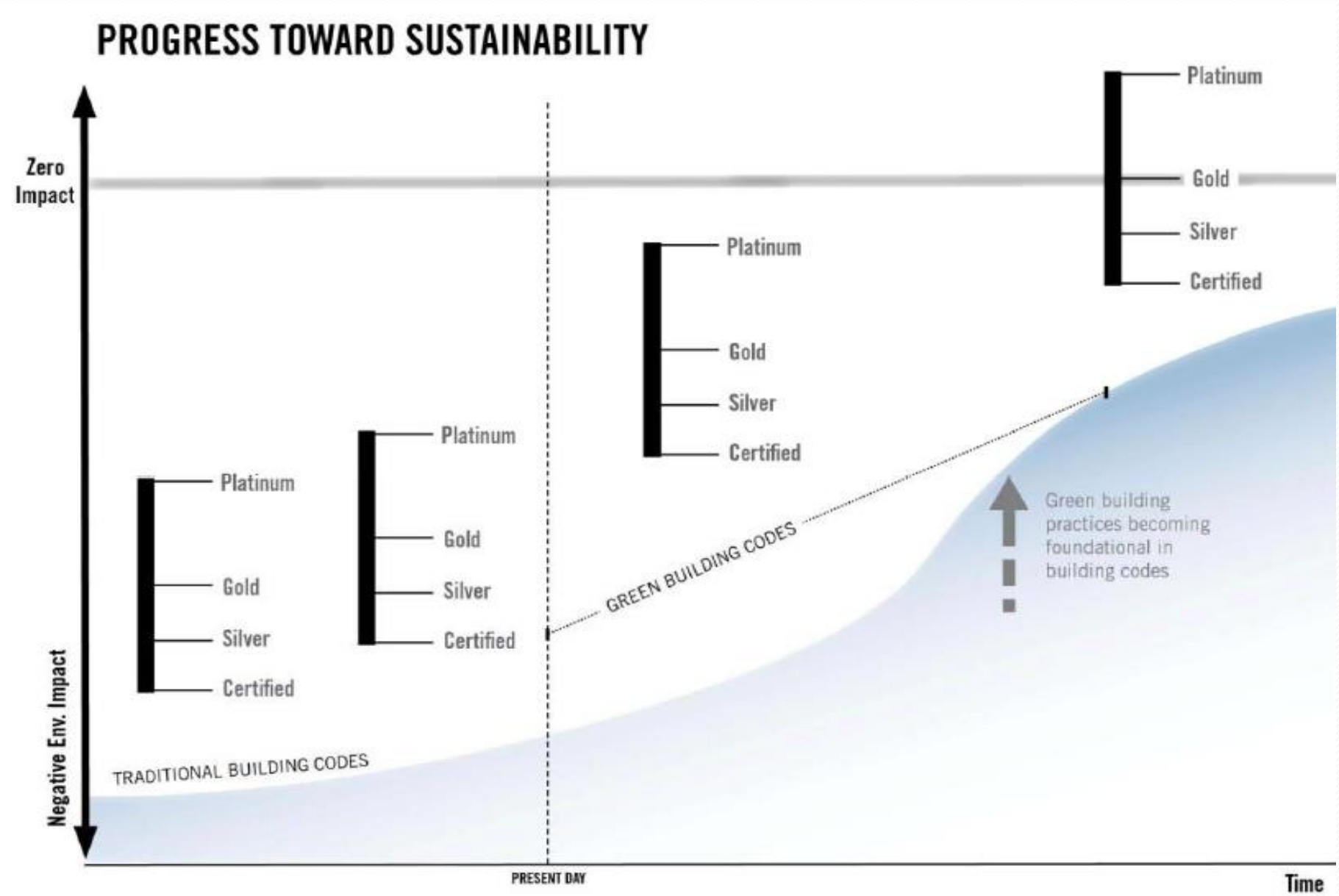
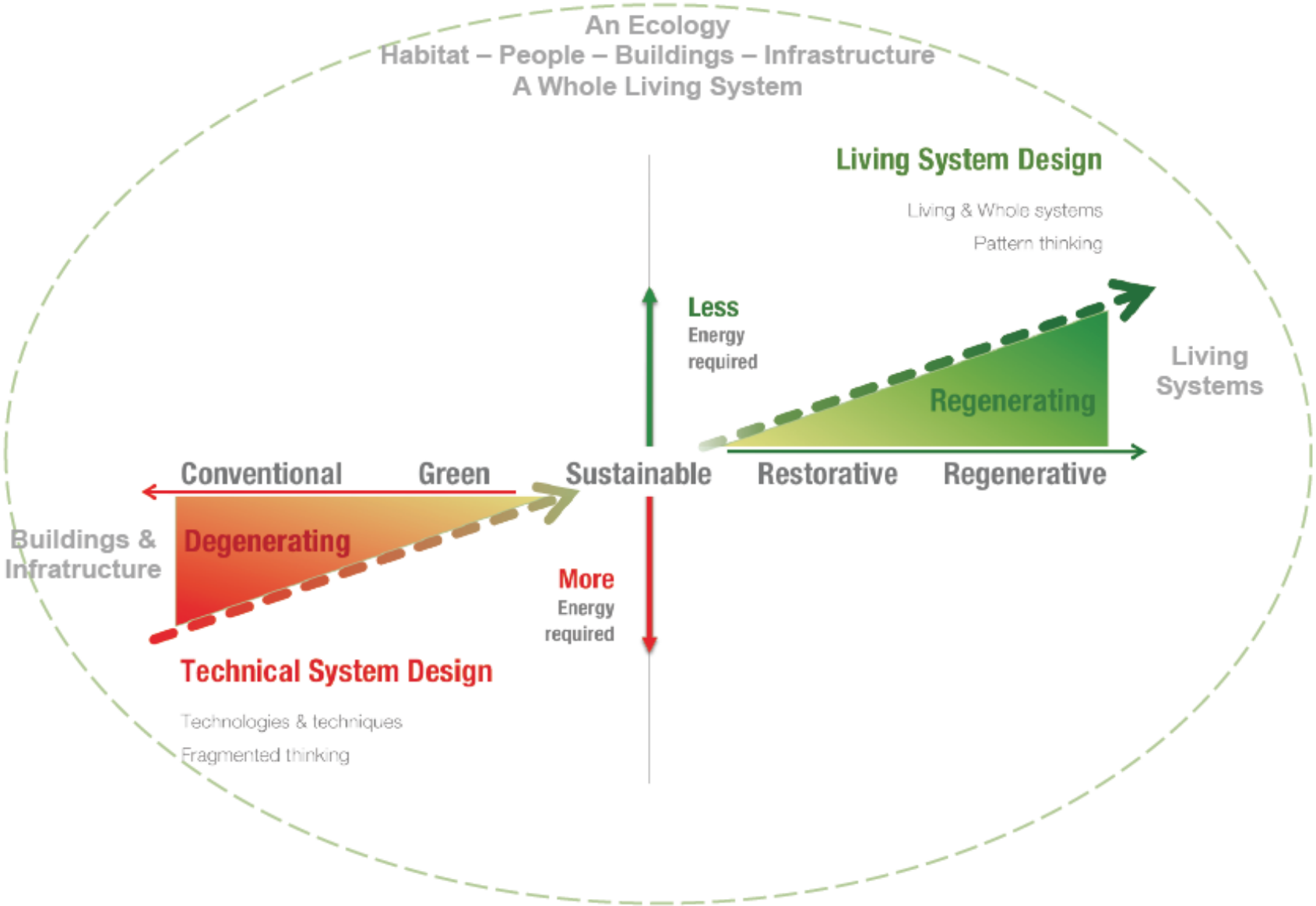


Chart created by: Dan Geiger USGBC-NCC



Trajectory of Ecological Design

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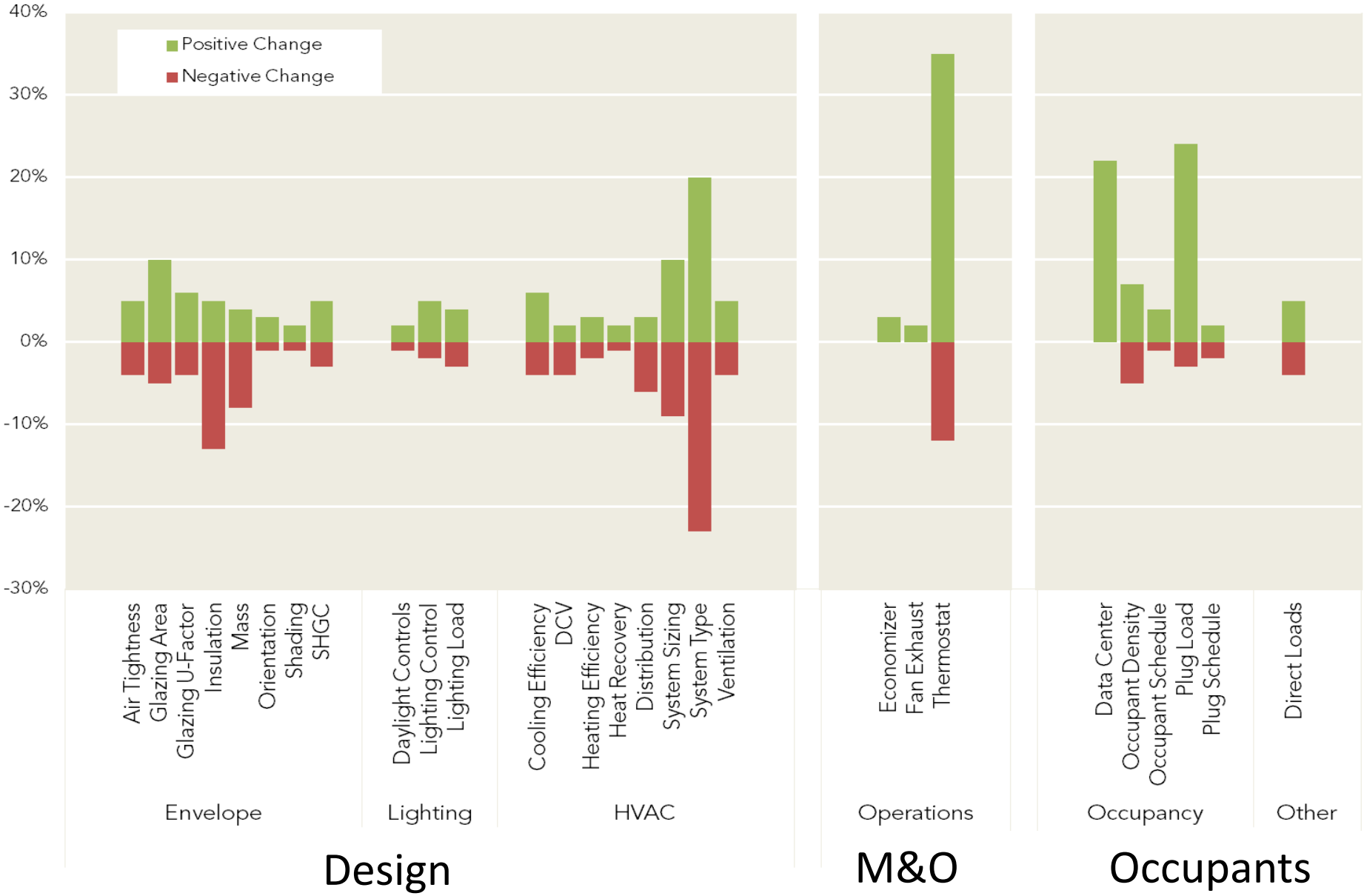
Courtesy of Bill Reed, Integrative Design Collaborative, www.integrativedesign.net

How much energy use is driven by Building Design vs Operations?

Eg: Energy Use: Design through Operations



Outline

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Title 24-2013, Summary of Key Ideas

- Leapfrog from idea, ~~Credit, Prescriptive~~ → Mandatory
- Commissioning, from CALGreen to T24: >10,000 sf
- More Processes regulated: data centers, commercial kitchens and refrigeration, laboratories, parking garages, compressed air, …
- Metering: power distribution, data, end use separation, …
- Early Design Review required: at kickoff, at CD, forms. Size.
- Did we mention **controls**? motion, occupancy, FDD, Plugs, …
- Modeling and documentation: tools, forms, registry
- Architect, HVAC, Lighting, Energy Modeler: new challenges

Basic Organization of Energy Standards
Non-Residential and Residential Buildings

	MANDATORY MEASURES: *REQUIREMENTS* AND	PRESCRIPTIVE METHOD: *GUIDELINES* OR	PERFORMANCE METHOD: *TRADEOFFS*
ENVELOPE			
LIGHTING			
MECHANICAL			
WATER HEATING			

Basic Organization of Non-Res Energy Standards

Non-Res, High Rise Res Hotels/Motels	MANDATORY MEASURES: *REQUIREMENTS* AND	PRESCRIPTIVE METHOD: *GUIDELINES* OR	PERFORMANCE METHOD: *TRADEOFFS*
ENVELOPE			
Conditioned			
Unconditioned Process Spaces			
LIGHTING			
Indoor, Conditioned			
Indoor, Process Spaces			
Unconditioned and parking garages			
Outdoor Lighting			
Signs, Indoor and Outdoor			
MECHANICAL			
Conditioned Spaces			
WATER HEATING			
KEY NEW SECTIONS			
Building Electrical Power			*N/A*
Pool and Spa Systems			*N/A*
Solar Ready Buildings			*N/A*
Covered Processes: Envelope, Ventilation, Process Loads			

TABLE 100.0-A APPLICATION OF STANDARDS

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
General Provisions		100.0, 100.1, 100.2, 110.0, 110.10			
Nonresidential, High-Rise Residential, And Hotels/Motels	General	140.0	140.2	140.1	141.0
	Envelope (conditioned)	110.6, 110.7, 110.8,120.7	140.3		
	Envelope (unconditioned process spaces)	N.A.	140.3(c)		
	HVAC (conditioned)	110.2, 110.5, 120.0-120.5, 120.8	140.4		
	Water Heating	110.3, 120.3, 120.8	140.5		
	Indoor Lighting (conditioned, process spaces)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Indoor Lighting (unconditionedand parking garages)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6	N.A.	
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Building Electrical Power	130.5	N.A.		
	Pool and Spa Systems	110.4, 150.0(p)	N. A.		N. A.
	Solar Ready Buildings	110.10	N.A.		N.A.
Covered Processes[1]	Envelope, Ventilation, Process Loads	110.2, 120.6, 120.8	140.9	140.1	120.6, 140.9
Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0

Mandatory or Tradable?

General	• 100 • 110.0, 110.1
Mandatory	• 110 – most of it • 120, 130, 150
Prescriptive	• 140.2 to 140.9
Performance	• 140.1
Additions & Alterations	• 141 (Mandatory, Prescriptive, Performance)

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Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0

Envelope: Roofs, Walls, and Floors

	MANDATORY	PRESCRIPTIVE (CZ 7 / 10)
ROOFS		
Metal buildings	U=0.098 (R-19 continuous)	U=0.065 / 0.065
Wood Framed & Other	U=0.075 (R-19 in wood frm)	U=0.067 / 0.039
Cool Roof	Varies with slope, "cooler"	Possible U-Factor tradeoff
WALLS		
Metal building	U=0.113 (R-13)	0.113 / 0.061
Metal framed	**0.105 (R-4 rigid+R-21 2x6)**	0.098 / 0.062
Light Mass	0.440	0.440 / 0.170
Heavy Mass	0.690	0.690 / 0.650
Wood framed	0.110 (R-11 in 2x4)	0.110 / 0.059
Spandrel Panels	**0.28 (entire wall avg)**	
FLOORS		
Mass	0.269 or 3" lw conc	0.269 / 0.269
Other Floors	0.071	0.071 / 0.071
AIR BARRIER		Not Reqd / Required

Envelope: Fenestration: Prescriptive

Type	Max U-Factor	Max RSHGC	Min VT
Fixed	0.36	0.25	0.42
Operable	0.46	0.22	0.32
Curtainwall	0.41	0.26	0.46
Doors	0.45	0.23	0.17

- Window Area Prescriptive Maximum:

  40% Window Wall Ratio (WWR)

- Area Weighted Performance Rating:

  e.g. a façade with high VT glass for daylighting and low VT glass is acceptable if the area-weighted VT meets the minimum prescriptive value.

Fenestration: Prescriptive U-value & RSHGC & VT

Window assembly U-factor:

- NFRC 100 rated OR use the default Table 110.6-A value
- < 1,000 sf site built: Nonresidential Appendix NA6 formula *

Window assembly Relative Solar Heat Gain Coefficient (RSHGC):

- NFRC 200 rated OR use the default Table 110.6-B value
- < 1,000 sf site built: Nonresidential Appendix NA6 formula *

Window assembly Visual Light Transmittance (VT):

- NFRC 200 rated OR ASTM E972
- < 1,000 sf site built: Nonresidential Appendix NA6 formula *

** Appendix NA6 formula uses the glass Center Of Glass (COG) value.*

Primary Daylight – Sidelit and Toplit Zones:

Mandatory Controls

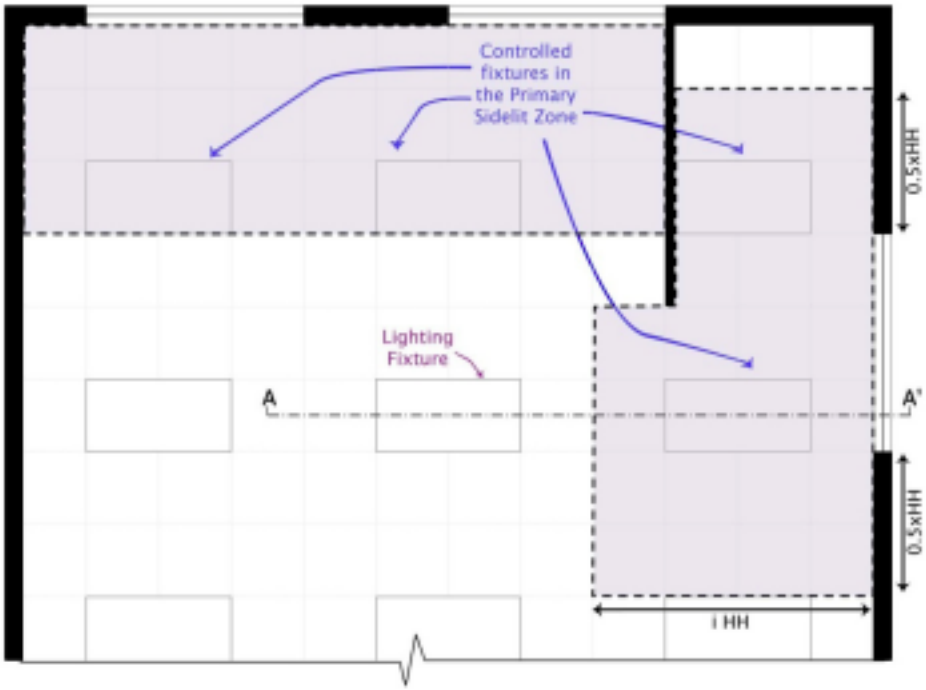


Figure 5-7 – Primary Sidelit Daylit Zone Diagram 1

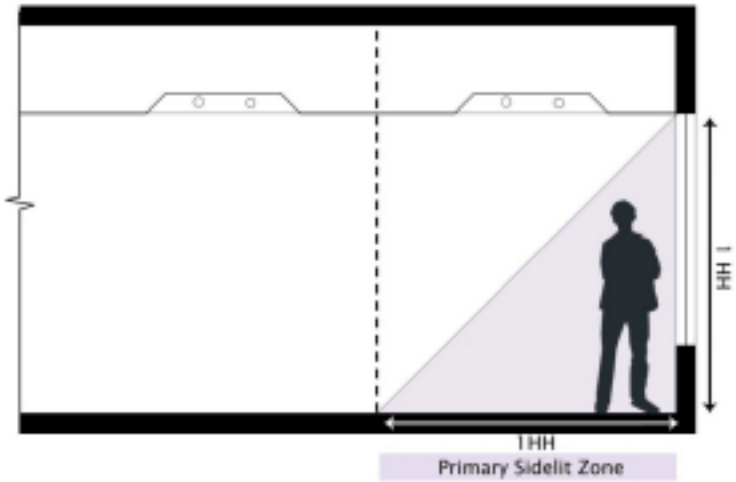


Figure 5-8 – Primary Sidelit Daylit Zone Diagram 2

Secondary Daylit Zones :

Prescriptive Controls

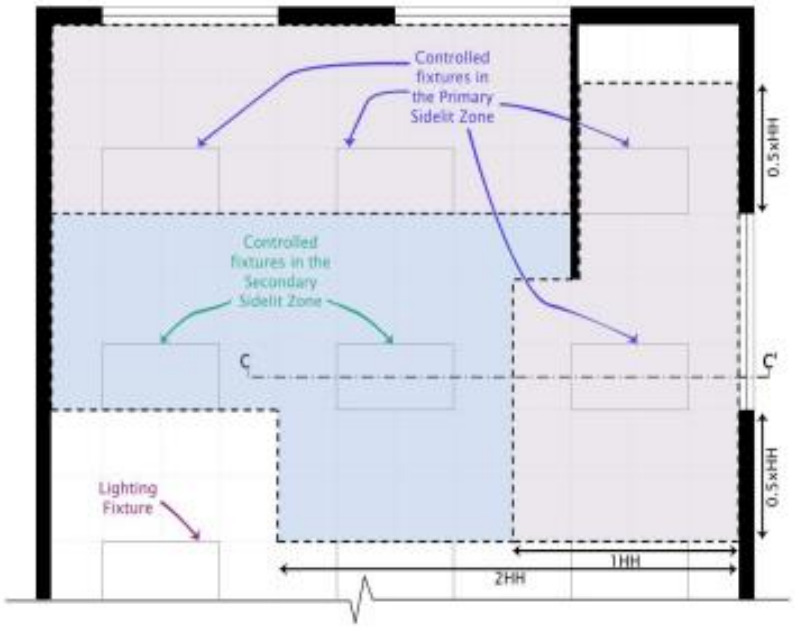


Figure 5-9 – Secondary Sidelit Daylit Zone Diagram 1

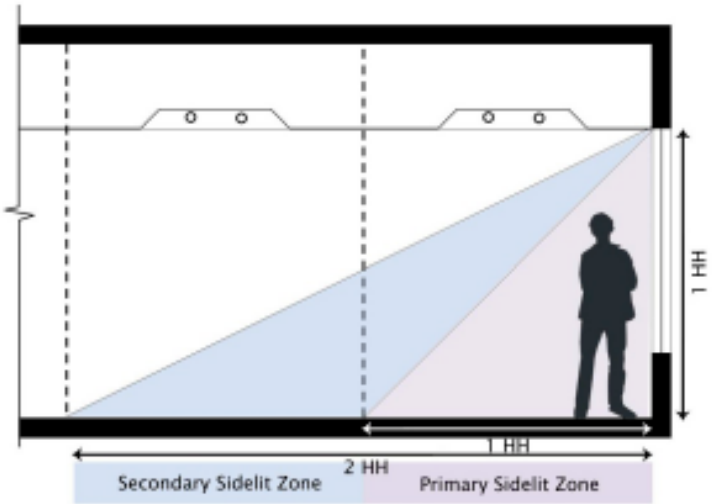
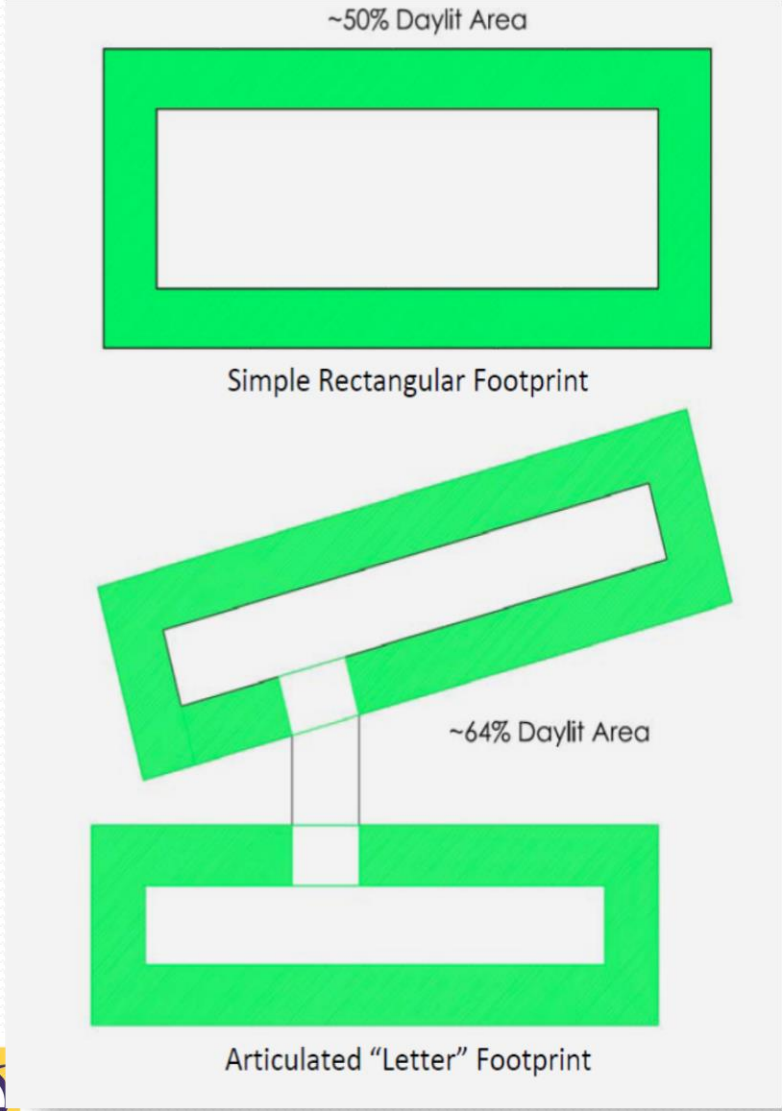
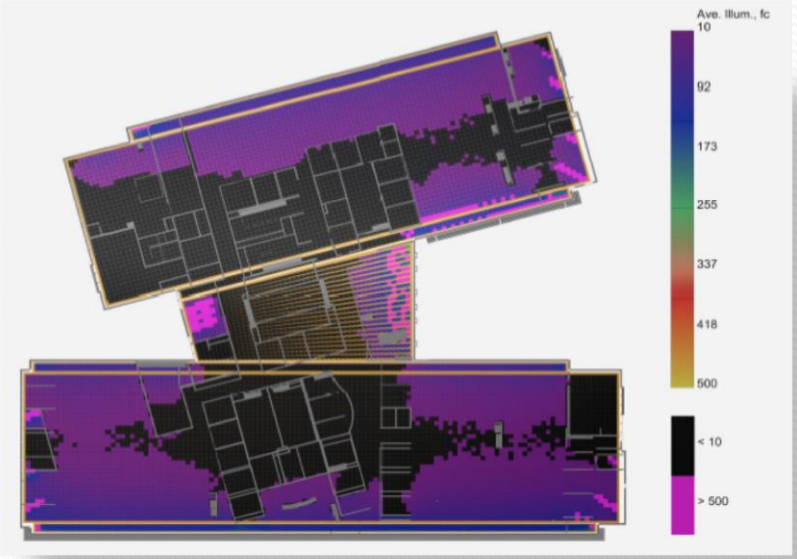


Figure 5-10 – Secondary Sidelit Daylit Zone Diagram 2

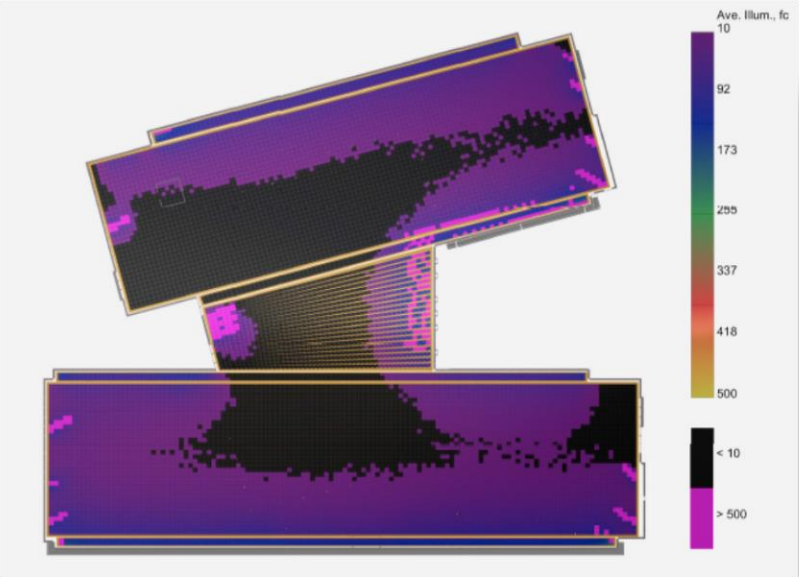
Daylighting Analysis: Examples



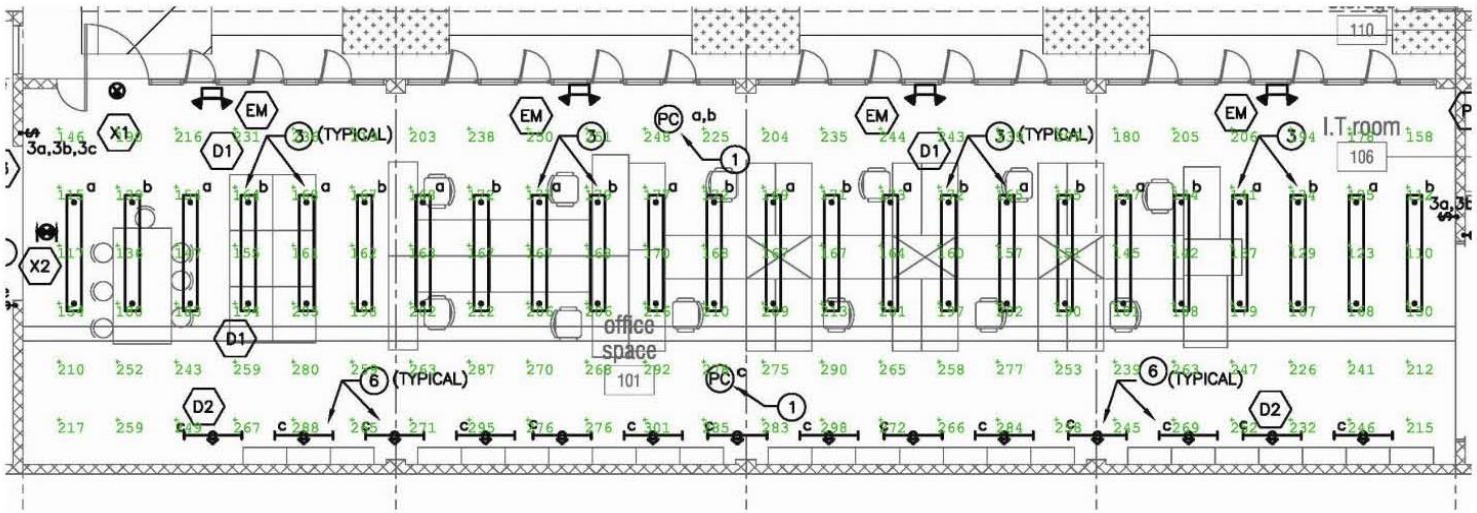
Hard-walled spaces



No interior walls



Daylight, Lighting, and Controls Integration



Workplane Calculation Grid – Interior Lighting Plan

- Identify daylighting zones
- Design fixture layout to complement
- Automatic daylighting controls: required or credits
- Commissioning! And Acceptance Testing …

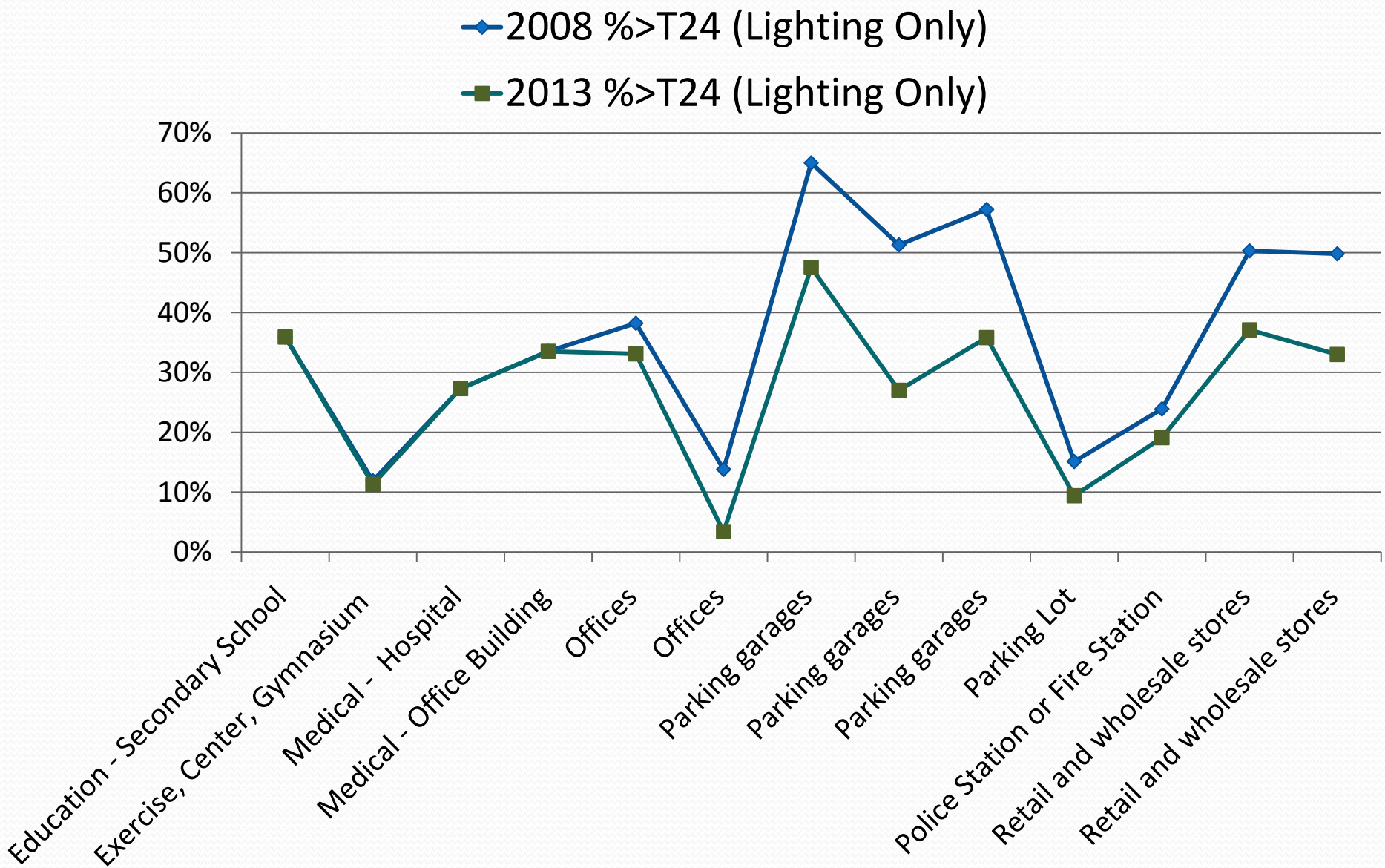
Daylight Benefits

Ultimate Goal – Electric Lighting OFF!

Allowed Lighting Power Density (LPD)

TYPE OF USE (Whole Bldg)	2008 Standards	2013 Standards
Auditoriums	1.5	1.5
Classroom Building	1.1	1.1
Commercial and industrial storage buildings	0.6	0.6
Convention centers	1.2	1.2
Financial institutions	1.1	1.1
General commercial and industrial work buildings		1.0
High bay	1.0	
Low bay	1.0	
Grocery Stores	1.5	1.5
Library	1.3	1.3
Medical buildings and clinics	1.1	1.1
Office buildings	0.85	0.80
Parking Garages	0.30	0.20
Religious facilities	1.6	1.6
Restaurants	1.2	1.2
Schools	1.0	1.0
Theaters	1.3	1.3
All others	0.6	0.6

Graph: Savings By Design: LPD Research



HVAC: getting better! Mandatory:

Higher efficiencies for DX equipment

- < 65,000 Btuh from 13 SEER to 14 SEER (January 1, 2015)
- >=65,000 Btuh<240,000 Btuh 11.7 EER (January 1, 2015)
- More part load control of fans, compressors

Some higher efficiencies for chillers and cooling towers

HVAC: getting better! Prescriptive:

Economizers:

- Prescriptive *was 75,000 Btuh*
- Now down to 54,000 Btuh AND airflow > 1,800 cfm

Units >=6 tons (down from 7.5 tons):

- Fault Detection (FDD) required
- Also added more fan controls

Solar Ready: Mand.

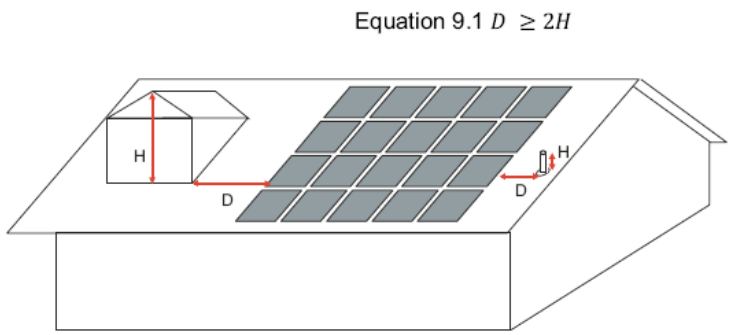
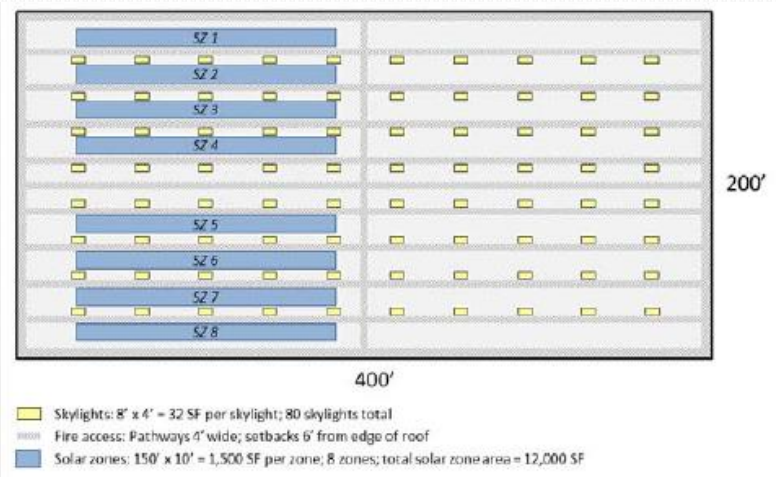


Figure 9.2: Schematic of Allowable Setback from Rooftop Obstructions

Source: California Energy Commission



Applies to:

- NR Bldgs: 1,2,3 stories
- HRR and Hotel/Motel 1-10 stories
- Adds > 2,000 sf

Roof:

- 15% of qualifying roof area
- Flat or south: 110 to 270 degrees
- Subtract skylights
- Usable areas: > 80 sf, >5 ft dimensions
- Free of obstruction
- Carry weight of solar panels

Options:

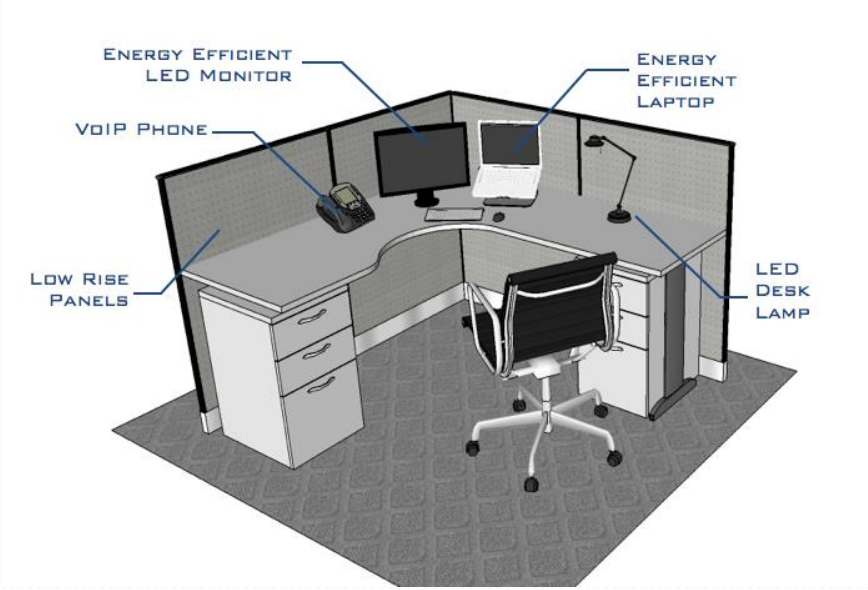
- ½ of solar potential vs 15% net roof
- Locate: covered parking or within 250 ft
- Solar thermal

Impacts:

- Space for inverters and/or water storage

Plug Loads: Controls

- Controlled & Uncontrolled 120V receptacles must be provided in the following types of spaces:
  - Private Office, Open Office Area, Reception Lobby, Conference Room, Kitchenette in Office Spaces, and Copy Room.
- Essentially every other receptacle or a split wired duplex outlet with one controlled & one uncontrolled receptacle.
- Controlled outlets can be operated by a local occupancy sensor or by the EMCS.



Electric Power Distribution Metering: Mandatory

METER Type	<= 50 kVA	50 to 250 kVA	250 to 1,000 kVA	> 1,000 kVA
Instantaneous KW Demand (real time)	Req	Req	Req	Req
Re-settable kWh	Req	Req	Req	Req
Historical KW (Peak Demand)			Req	Req
kWh per rate period				Req

Electric Power Distribution
Separate End Uses: Mandatory

LOAD Type	<= 50 kVA	50 to 250 kVA	250 to 1,000 kVA	> 1,000 kVA
Lighting		Agg	Dis-Agg	Dis-Agg
HVAC Systems		Agg	Dis-Agg	Dis-Agg
Domestic Hot Water		Agg	Agg	Agg
Plug Loads		Agg	Agg	Dis-Agg
Elevators/Escalators		Agg	Agg	Agg
Appliances > 25kVA		Agg	Dis-Agg	Dis-Agg
Load Centers > 25kVA		Agg	Dis-Agg	Dis-Agg
Renewable Source	**Each Group**	**Each Group**	**Each Group**	**Each Group**
Renewable Loads		Agg	Agg	Agg
Charging Stations	Agg	Agg	Agg	Agg

Agg: Aggregated Load **Dis-Agg: Dis-Aggregated Load**

Alterations:
Two Performance Paths

Standard Design for Alterations		
Component	Without HERS existing conditions Verification	With HERS existing conditions Verification
Roof Insulation	Prescriptive	
Wall Insulation	Prescriptive	
Floor Insulation	Prescriptive	
Windows	Alteration Table	Existing Condition
Window Film	Alteration Table	

Alterations: Fenestration

Component	Prescriptive	Fenestration Alterations Table 141.0-A (CZ 2-15)
U-Factor	Fixed: 0.36 Operable: 0.46 Storefront: 0.41 Glazed Door: 0.45	0.47
RSHGC	Fixed: 0.25 Operable: 0.22 Storefront: 0.26 Glazed Door: 0.23	0.31
VT	Fixed: 0.42 Operable: 0.32 Storefront: 0.46 Glazed Door: 0.17	Same as Prescriptive

Alterations: Luminaires

Space, LPD, Space controls, Luminaire controls

IF no change to space size or occupancy, and:

IF change < 10% of existing Luminaires, THEN …

IF change >= 10% of existing Luminaires, THEN …

TABLE 141.0-E Requirements for Luminaire Alterations

Quantity of existing affected luminaires per Enclosed Space [1]	Resulting Lighting Power for Each Enclosed Space	Applicable Mandatory Control Provisions for Each Enclosed Space	Multi-level Lighting Control Requirements for Each Altered Luminaire
Alterations that do not change the area of the enclosed space or the space type			
Sum total < 10% of existing luminaires	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 10% of existing luminaires	≤ 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control [2] or §130.1(b)
	> 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c), (d) [3]	§130.1(b)
Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space			
Any number	Comply with Section 140.6	§130.0(d) [3] §130.1(a), (c), (d) [3], (e)	§130.1(b)

1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)2Iii:
2. Two level lighting control shall have at least one control step between 30 and 70% of design lighting power in a manner providing reasonably uniform illuminations
3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.

Alterations: Luminaires
Modifications-in-Place

"Space" is one of these:

- Complete single story building
- Complete floor of multi-story building
- Entire space of a single tenant under a single lease
- All of the common, non-leasable space in a single building

Affected luminaires, per space, per year:

- If less than 40: existing power and controls may remain
- If more than 40:
  - Meet new Lighting Power Density requirements AND controls
  - OR – reduce LPD and fewer controls

Tenant Improvements …

Is it Newly Conditioned?

- Has Envelope compliance been done?
- Install both HVAC and Lighting?

Is it remodeling in an existing space? What is being changed? E + A

- ENV?
- HVAC?
- Lighting?
- Occupancy types?
- Processes?

Performance: E + A

Outline

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2. Getting More Specific
3. **Show me an Example**
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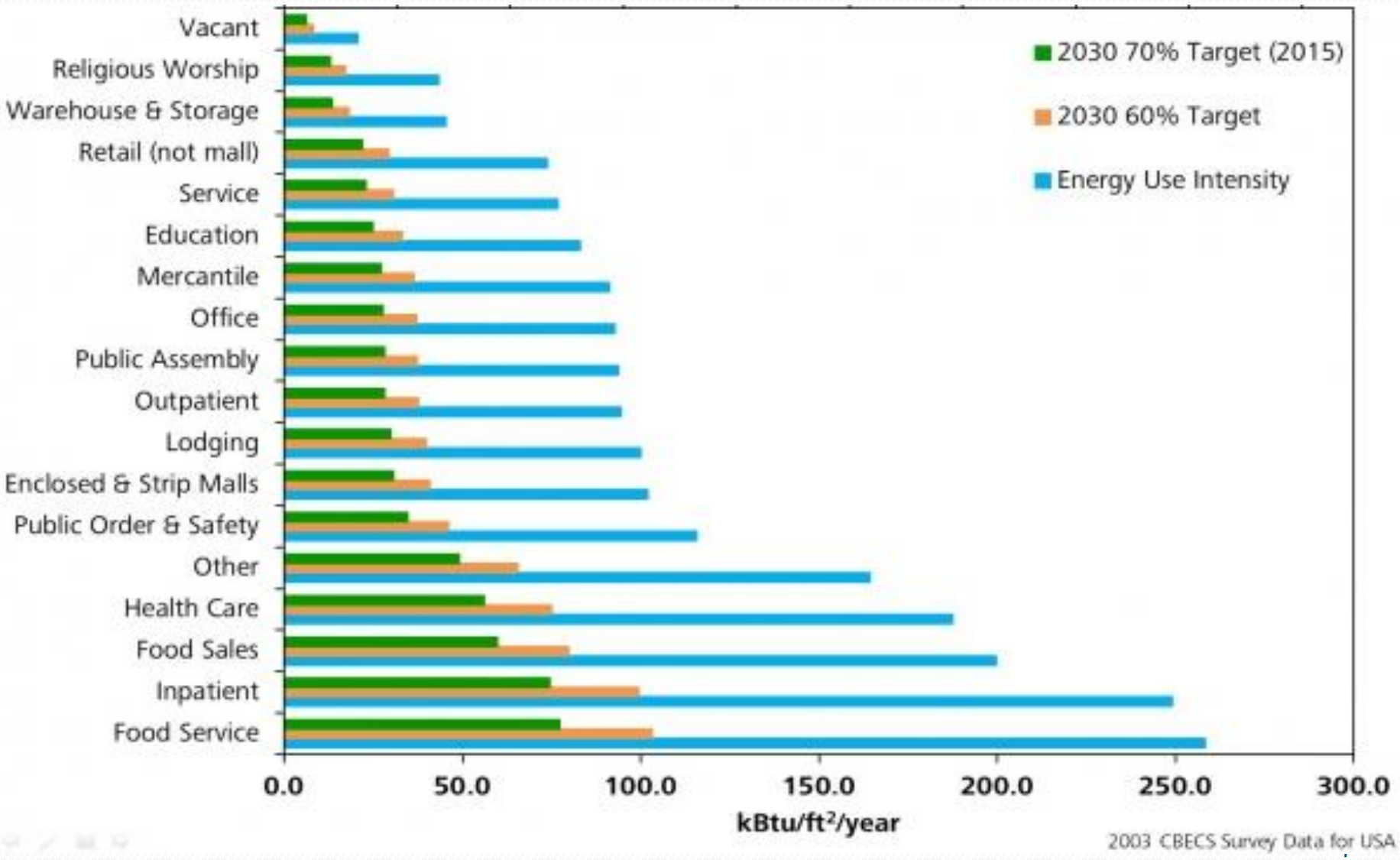
General:
Energy Use Intensity (EUI) & 2030 Challenge



Where does the energy go?

Example Building in Chula Vista:

- Office Building, Chula Vista Climate Zone 7
- 2 Stories - 24,000 sf of conditioned floor area
- 40% Window Wall Ratio (WWR)
- 4-ton Single Zone Heat Pumps
- Daytime Occupancy

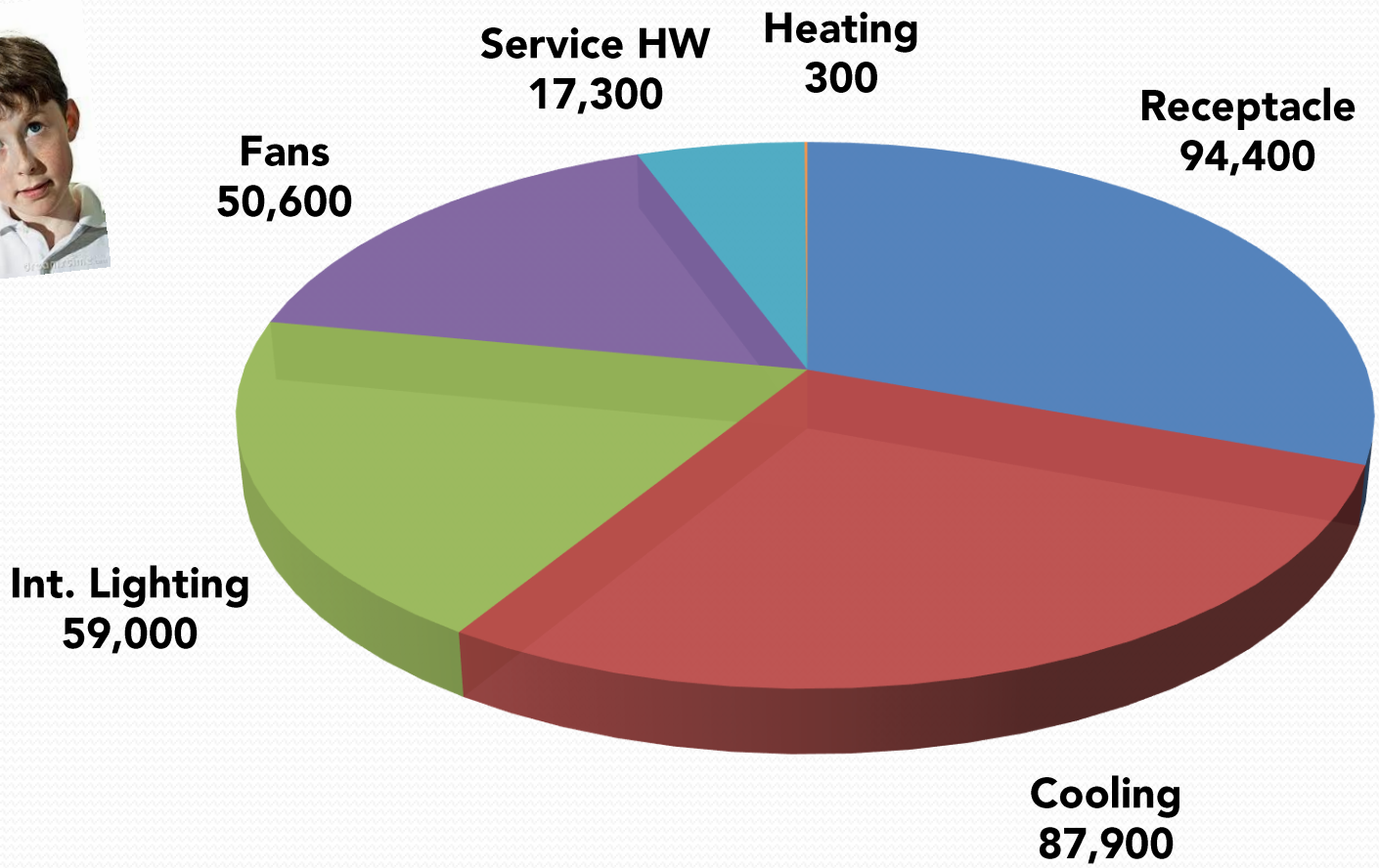
Where does the energy go?

Example Office Building in Chula Vista:

Assembly	Prescriptive CA Climate Zone 7	"Initial Design"
Walls	Metal Frame - U= 0.098	U= 0.105 * (T24-13 mandatory)
Roofs	Other - U= 0.067	U= 0.075 * (T24-13 mandatory)
Window SHGC	RSHGC = 0.22	SHGC = 0.41 *
Window U-value	U = 0.46	U = 0.56 *
Lighting (LPD)	0.80 w/sf	0.80 w/sf (T24-13 prescriptive)
HVAC Cooling Efficiency	14 SEER (as of 1/1/2015)	13 SEER *
Economizers	No economizers	No economizers
DHW Heater	Electric: 0.93 Efficiency	Electric: 0.93 Efficiency

Where does the energy go?

"Initial Design" Predicted Annual Energy Use (kWh)

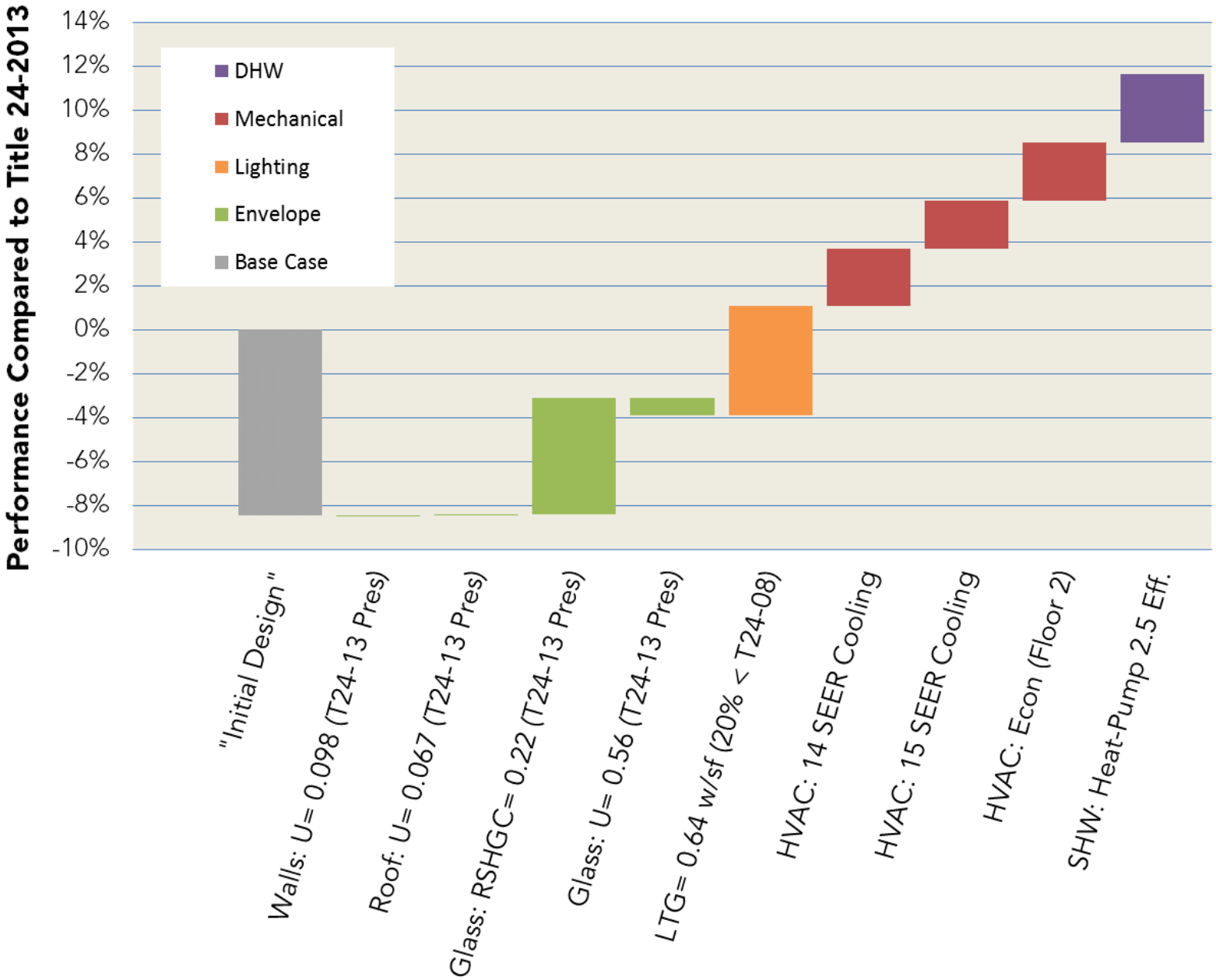


Where does the energy go?

Example Office Building in Chula Vista:

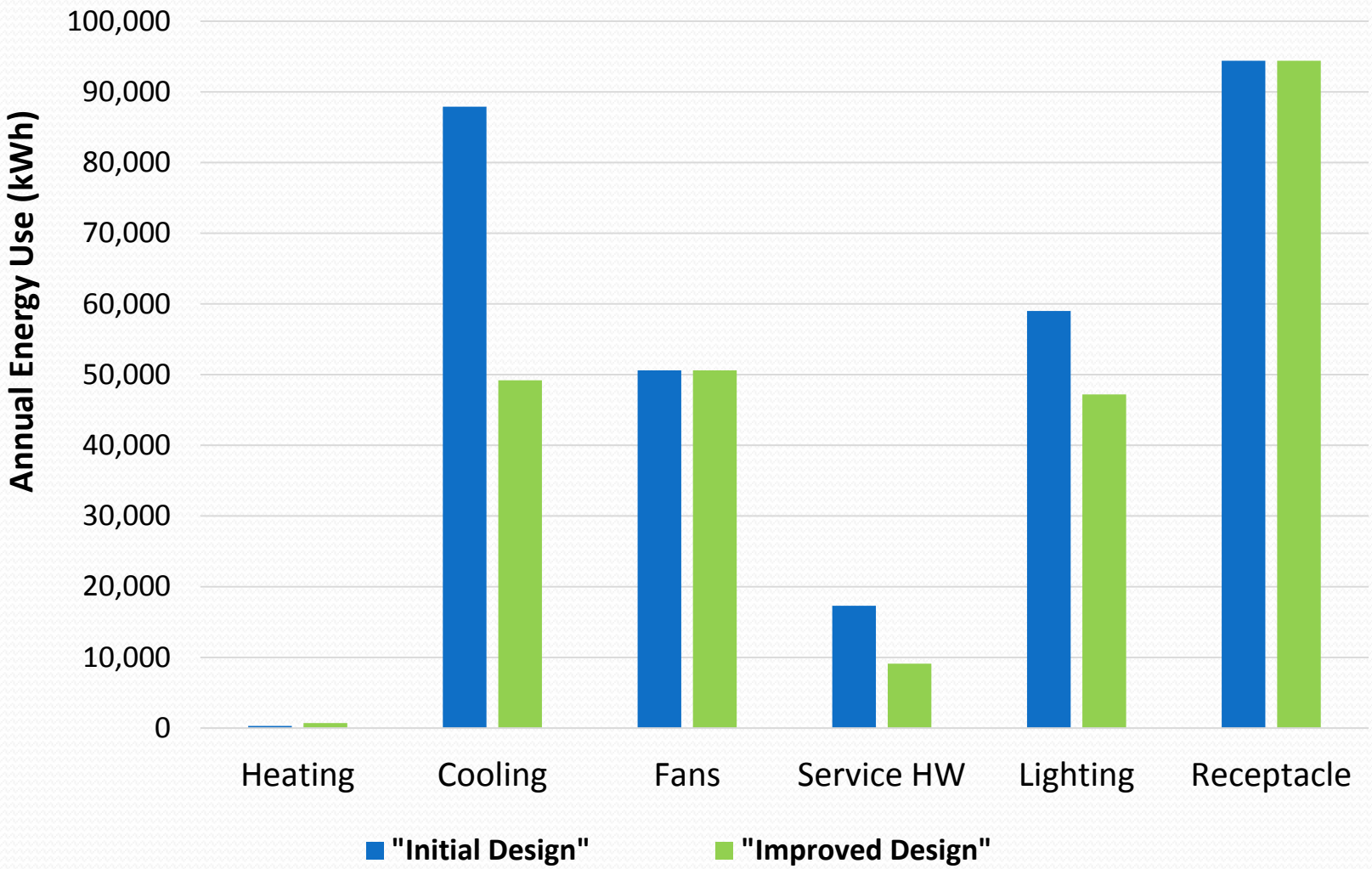
Assembly	"Initial Design"	"Improved Design"	Overall Performance Improvement
Walls	U= 0.105 (T24-13 mandatory)	U= 0.098 (T24-13 prescriptive)	0.0%
Roofs	U= 0.075 (T24-13 mandatory)	U= 0.067 (T24-13 prescriptive)	0.1%
Window SHGC	SHGC = 0.41	SHGC = 0.22 (T24-13 prescriptive)	5.3%
Window U-value	U = 0.56	U = 0.46 (T24-13 prescriptive)	-0.8%
Lighting (LPD)	0.80 w/sf (T24-13 prescriptive)	0.64 w/sf (20% <T24-13)	5.0%
HVAC Cooling Efficiency	13 SEER	14 SEER 15 SEER	2.6% OR 4.8%
Economizers	No economizers	2nd Floor Only	2.7%
DHW Heater	Electric: 0.93 Efficiency	Heat Pump: 2.0 Efficiency	3.1%

Getting to cost-effective T24-13 compliance



Where does the energy go?

"Initial vs. Improved Design" Annual Energy Use (kWh)



Outline

1. Setting the Stage
2. Getting More Specific
3. Show me an Example
4. ***Wait: One Thing More …***

New Forms

Defining the Difference

Mandatory Measures

Two Ways to Comply with the Standards

Prescriptive Approach

- ENV
- MECH
- LTG NR only

No tradeoffs between ENV, MECH, and LTG

Performance Approach

Standard Design → Proposed Design

Some prescriptive requirements likely "traded away" via performance method
Look for features that were **improved** to compensate for the "tradeoff"

Compliance Documentation

New Forms

2013 Forms Conventions

Nonresidential → NRCC-PRF-01-E

Document Type

Certificates of...

CC = Compliance

CI = Installation

CA = Acceptance

CV = Verification

Primary user

E = Enforcement agency

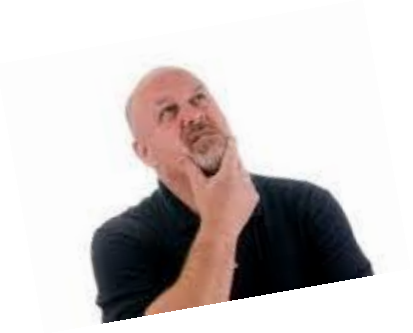
H = HERS Rater

F = Field Technician (Contractor)

A = Acceptance Test Tech

New Forms

2013 Forms Conventions



Document Category

PRF =	ENV =
CXR =	MCH =
LTI =	ELC =
LTO =	PLB =
LTS =	PRC =
SRA =	STC =

Nonresidential → NR CC - PRF - 01 - E

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New Forms

2013 Forms Conventions

Document Category

PRF	= Performance approach	ENV	= Envelope
CXR	= Commissioning	MCH	= Mechanical
LTI	= Indoor Lighting	ELC	= Electrical
LTO	= Outdoor Lighting	PLB	= Plumbing (DHW)
LTS	= Sign Lighting	PRC	= Covered Process
SRA	= Solar Ready	STC	= Solar Thermal

Nonresidential → **NR CC - PRF - 01 - E**

Document Type

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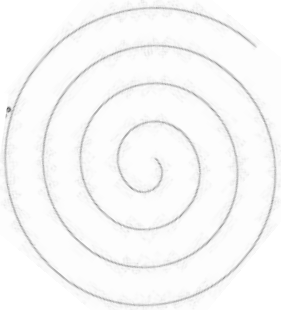
The Path to High Performance and ZNE:



1) **Goal**
   a) Informed, Assertive
   b) OPR, BOD
2) **Design**
   a) Assess Opportunities
   b) Early / Predictive Modeling
   c) Evaluate Strategies
   d) Integrate Solutions
3) **Construction**
   a) Commissioning
4) **Operations**
   a) Ongoing Engagement: Staff and Occupants
   b) Measure and Verify

CV SCP: Community Seminars

Topic	Dates / Times	Instructor
Overview of Sustainable Communities Program	Wednesday April 30 12-1:30pm	Beth Brummitt
Residential Energy Code & Reach Code Concept	Wednesday May 21 12-1:30pm	Jeanne Fricot
Non Residential Energy Code	**Wednesday June 11 12-1:30pm**	Beth Brummitt
Residential Cal Green	July	Lynne Mitschke
Non Residential Cal Green	August	Susan DiGuilio
Highlights of Projects	November	Beth Brummitt and John Zinner

Also:

- **Energy Innovation Center** **www.sdge.com/eic**
- **www.CABEC.org**
- **www.energy.ca.gov/title24/training/**

CITY OF CHULA VISTA

Sustainable Communities Program

Thank you!

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Center for Sustainable Energy® CALIFORNIA