

Lighting

2019 DOE
Energy Codes
Conference
Denver, CO



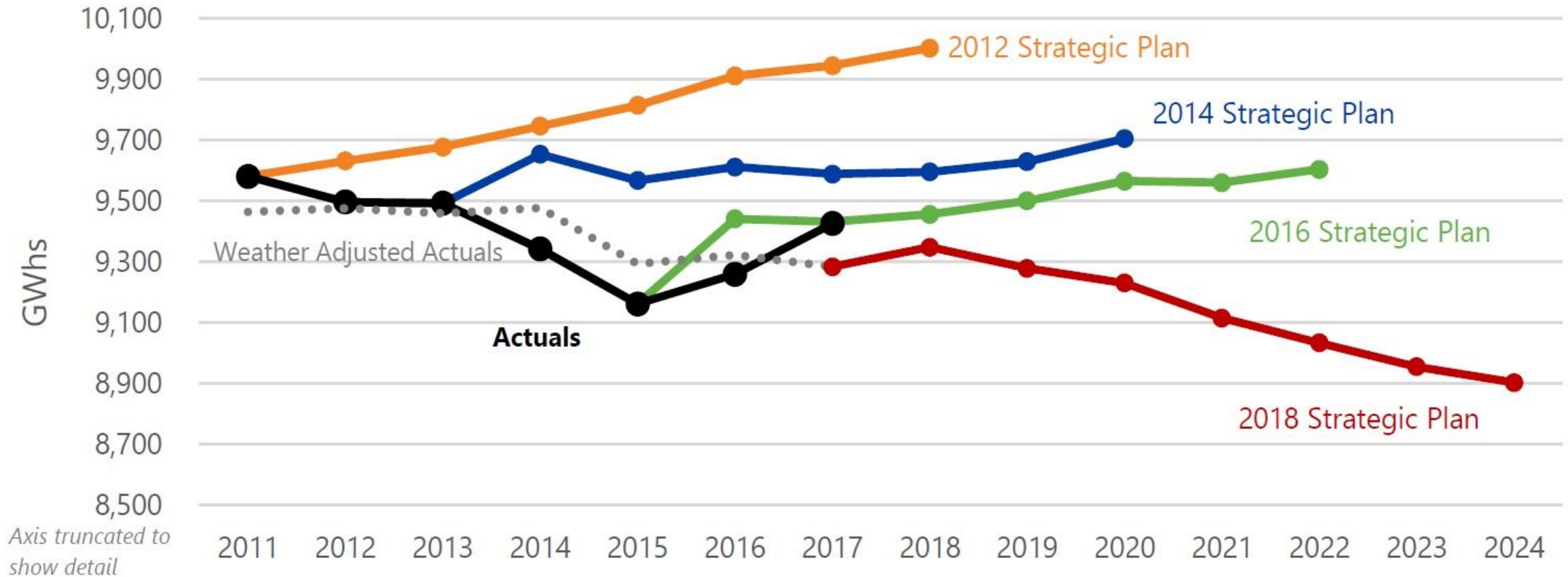
Image: Jonlin



Seattle Department of
Construction & Inspections

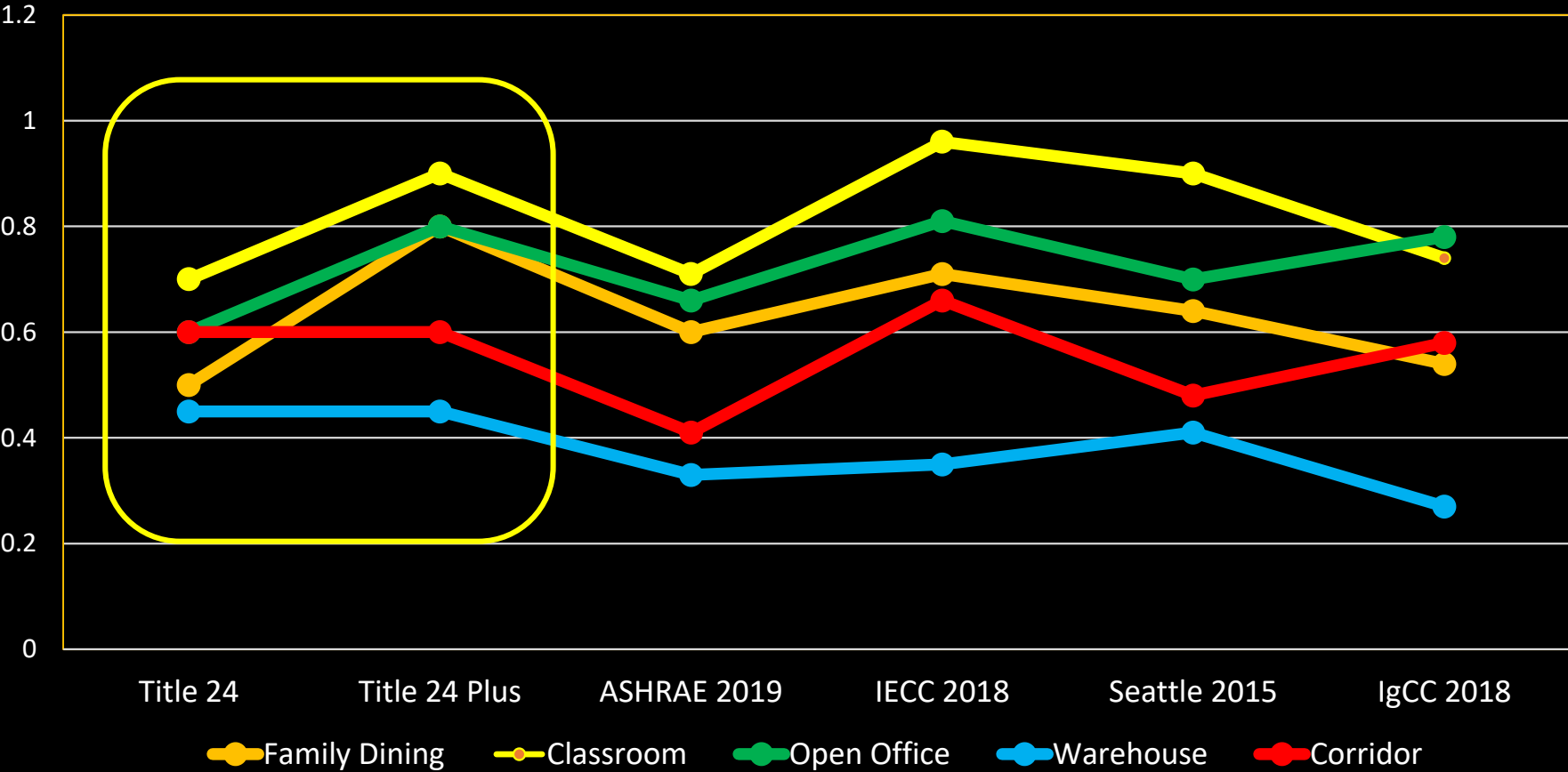
Duane Jonlin, FAIA
May, 2019

Prediction vs. performance



“Skate to where the puck is going to be, not where it has been.”

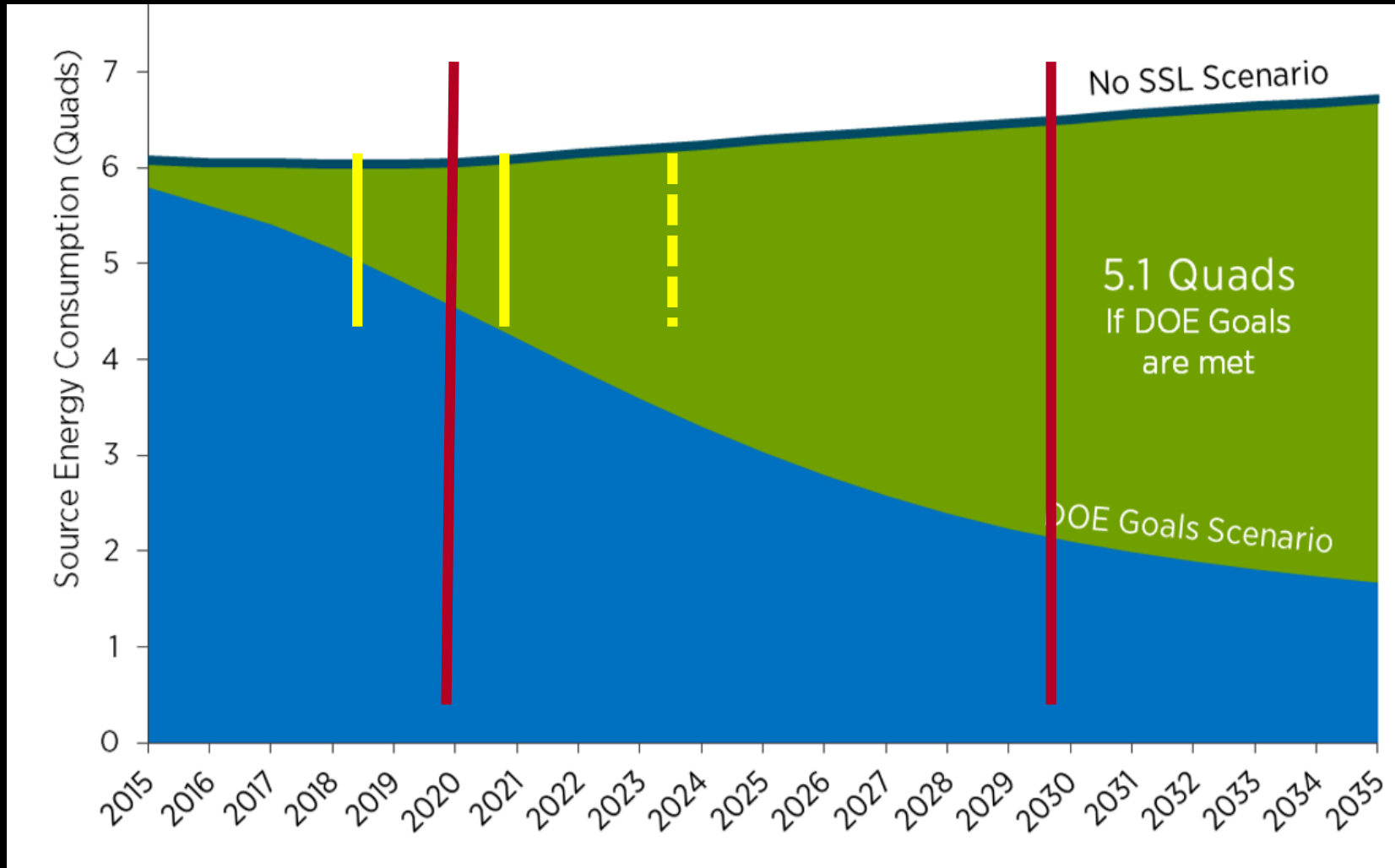
Lighting comparison



The decade passes:

- 2017 lighting data collected
- 2019 IECC and ASHRAE action
- 2021 IECC published
- 2022 states adopt 2021 code
- 2025 final 2021 code permits
- 2027 buy lighting packages
- 10 years later!

Continuing improvement @ 5%/year

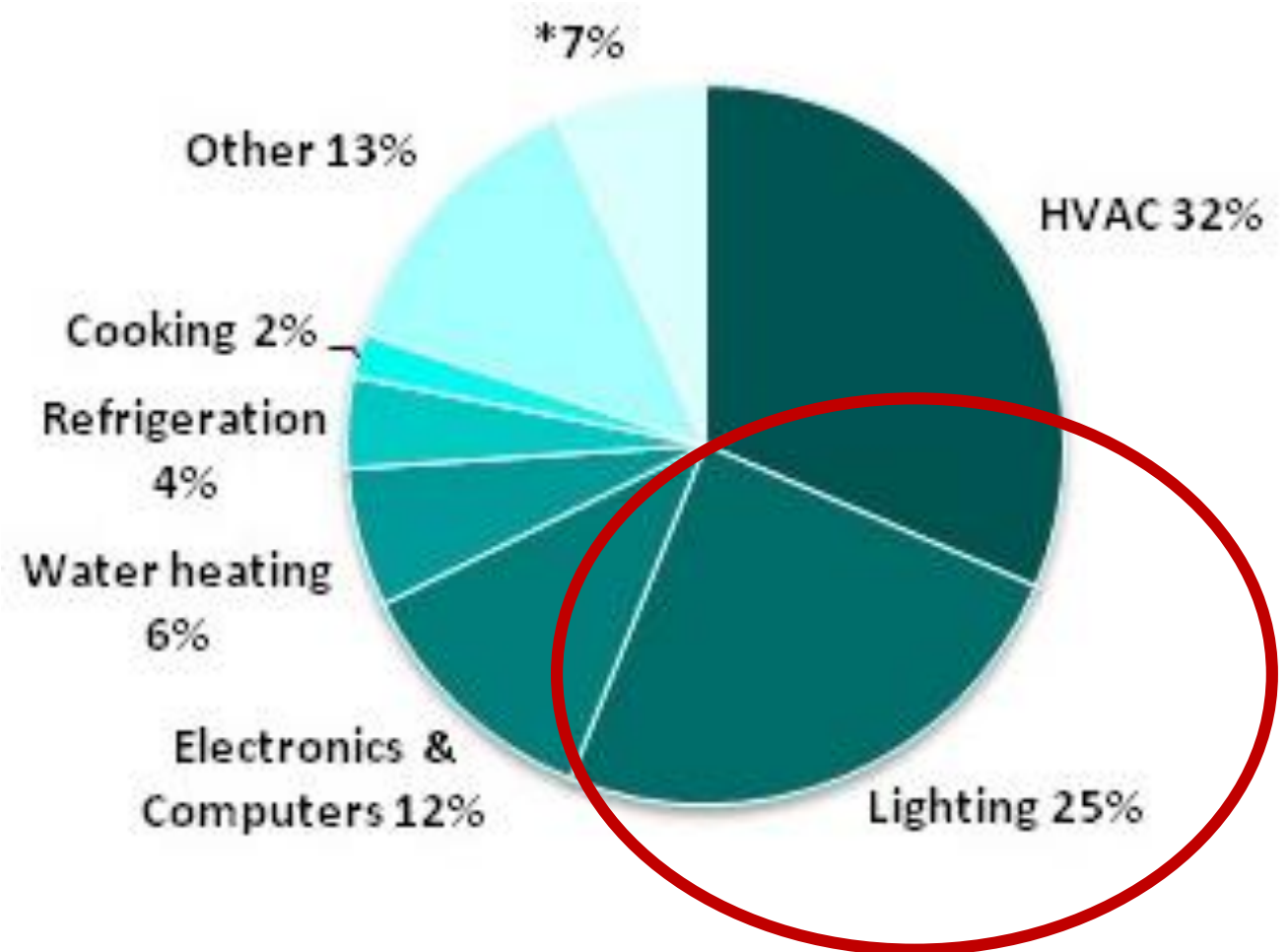


Progress will be greater than zero

- Reflectances
- The 10% adder

How to reduce lighting energy use?

1. Automatically **turn lights off** when you don't need any
2. Automatically **turn lights down** when you don't need as much
3. **Use efficient lamps & fixtures** to begin with



Interior Lighting Controls

1. Turn lights *off* when you don't need any
 - A. Manual controls (light switches)
 - B. Occupancy sensor controls
 - C. Time clock controls
2. Turn lights *down* when you don't need as much
 - A. 50% light reduction switching
 - B. Daylighting controls



In daylight zones:

- **Occupancy + daylight sensors**
- OR
- **Time switch + daylight sensors**

Occupancy sensors required in:

- **Enclosed spaces 300 SF or less**, including:
- Classrooms
- Private offices
- Restrooms
- Warehouses (each aisle)
- Conference & meeting rooms
- Employee lunch & break rooms
- Storage & janitor rooms



- Auto off, plus
- Auto on to 50% or
- Manual on to 100%

Time Switch Controls required everywhere

Except:

- **Areas with occupancy sensors**
 - Lighting that stays on 24/7
 - “...endanger safety or security”
 - Dwelling units & sleeping units
 - Shop & lab classrooms
 - Patient care
-
- Override switch required each zone



Daylight controls required in daylight zones

Except:

- Security or emergency use
- Egress stairs and corridors
- Spaces with <150 W

Rules

- Primary, secondary, toplit zones
- Continuous dimming in office, classroom, lab, library



Image: Jonlin

LLLC: cheaper and better?

- “**Luminaire-Level Lighting Control**”

- Daylight-sensor
- Occupancy sensor
- Factory calibrated
- Wireless controls
- Individually adjustable with hand-held remote



- **Less expensive without all that control wiring?
(Maybe yes, maybe no.)**

Separate Switching:

- Display, display case & accent
- Plant grow lights
- Food warming
- Task lighting



Exterior controls

- Always off during daylight hours
- Façade and landscape lighting
 - Shut off completely for 6 hours
- Other exterior lighting
 - 30% night turndown
 - **Occupancy sensor (15 min)**

Exterior power

Calculation:

1. Base site allowance +
2. Tradeable surfaces +
3. Non-tradeable surfaces



Image: Wikimedia Commons Jim Simonson

C406 Additional Efficiency Options:

#2: Lighting power

LPA **10%** below table values

- So, it's the only option anyone takes



#3: Digital lighting controls

- **Digital control system** capable of:
 - Setting schedules and light levels of fixtures or groups of fixtures
 - Load shedding
 - Configuring occupancy & daylight controls
 - ~~Individual user control in open office~~
- Continuous dimming capability
- Max 8 lights on each daylight sensor
- Sequence of operations defined on permit documents

New: C406 Additional Efficiency Req's Table

Points by occupancy & CZ 218

- Get 10 credits total
- Great work by Reid Hart of PNNL
- With NW Energy Codes Group

Plus additional credits:

- Dwelling units lighting **226**
- Metering where not req'd **237**
- FDD where not req'd **239**
- Commercial kitchen equip **240**

Table C406.1(3) Additional Energy Efficiency Credits for Group E Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% Cooling	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% Cooling	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3.1: 10% LPA	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6: DOAS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.1: SWH HR*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.2: SWH NG eff*	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.3: SWH HPWH*	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: 85% UA	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Low Leak	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3

IECC 2021

Meanwhile,
back in
Albuquerque

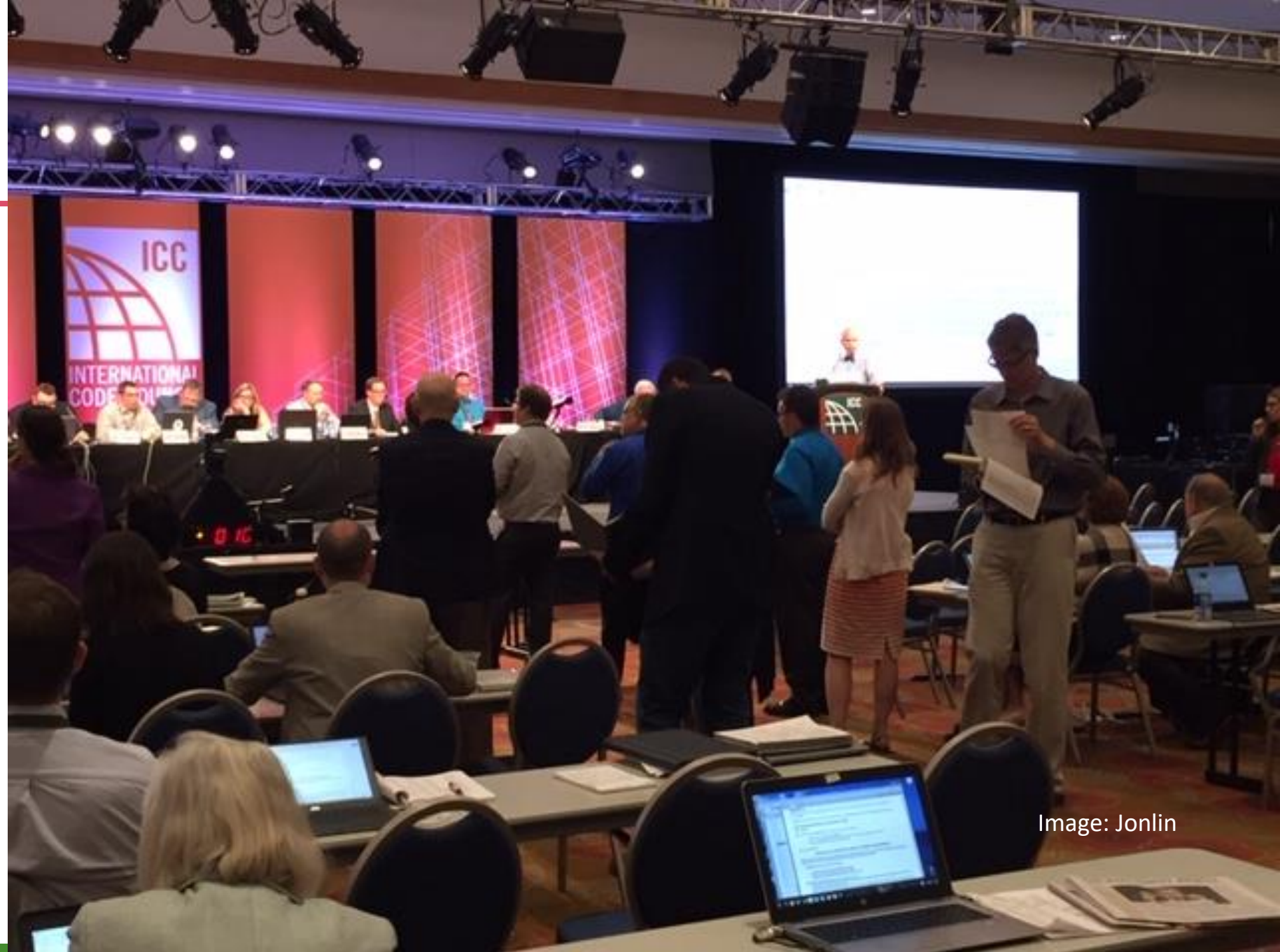


Image: Jonlin

Scope

- “Sites” now in IECC *and* ASHRAE (maybe)
- So, parking lot lighting...



Image: Wikimedia Commons Kim Hansen

Interior lighting: Great IECC clarifications

Mostly from Jack Bailey and Glenn Heinmiller, representing IALD

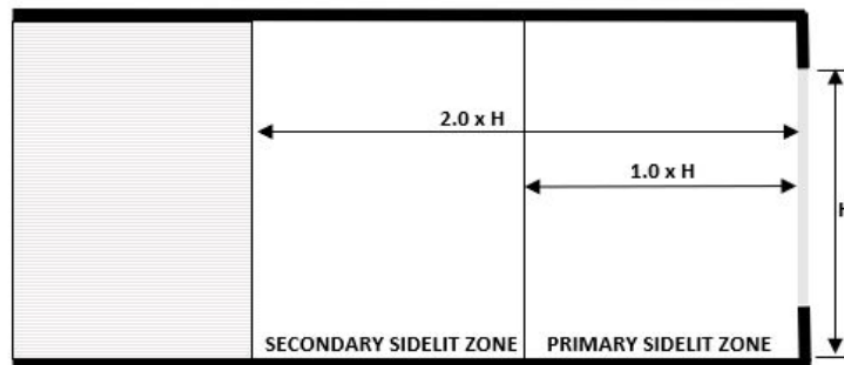
- Untangles occ sensor & daylight sensor **170**
- Untangles rules for open-plan office **171 & 172**
- Clarifies stepped dimming rules **181**
- Reduce lighting power per ASHRAE **206 & 208**
- “Horticultural” lighting standard **209**
- Occ sensors required for corridors **169**
 - turn lights down 50% after 20 minutes
- ASHRAE: Nifty table **(9.2.2.3)** consolidates all the exceptions for lighting power and controls



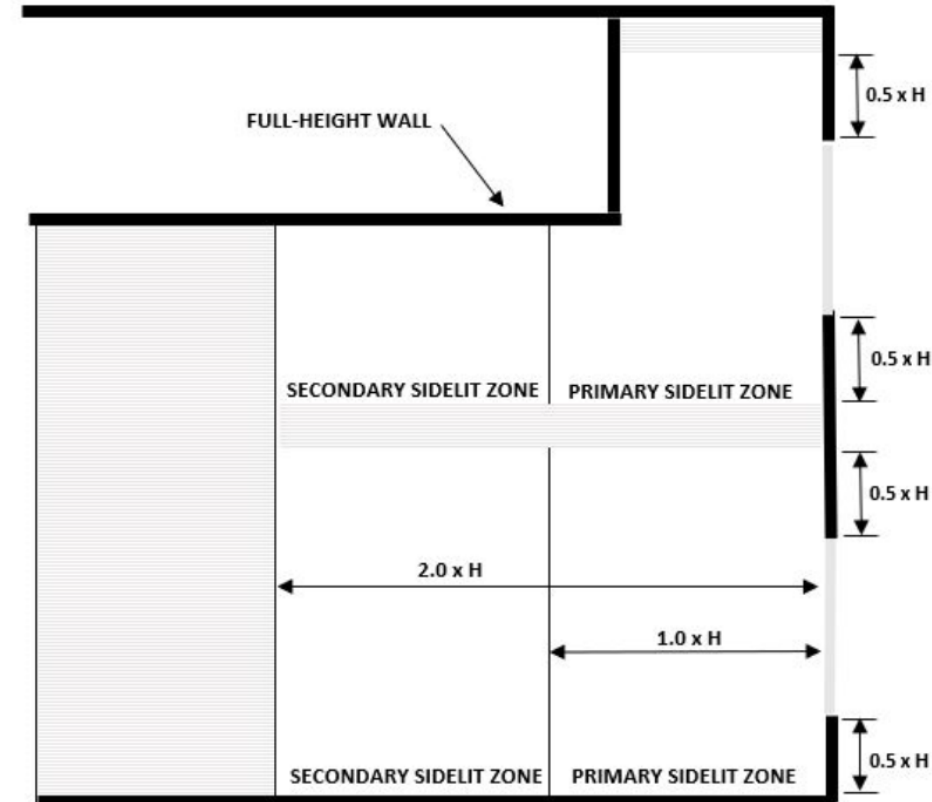
Image: Wikimedia Commons
insaphowetrust

Daylighting

- **Continuous dimming** req'd in all daylight zones **185**
- Daylighting language cleanup & diagrams **187**
- Zone extends 1/2 window height to sides **191**
- Exception for deep overhangs **192**



(a) Section View



(b) Plan View

Exterior lighting

- Parking lot lights <24 ft height – **reduce 50% after 15 minutes 198**
 - Retailers might not like this
- Spell out exterior lighting power calculation rules **211**



Image: Wikimedia Commons
Prime minister's office, India

Controlled Receptacles

- Private offices, open offices, classrooms, etc: 50% of all outlets controlled by time clock switch or occ sensor
- **Either top half switched, or within 12" of non-controlled**
- 5,000 sf max by one override
- (Could use same override switch as lighting)

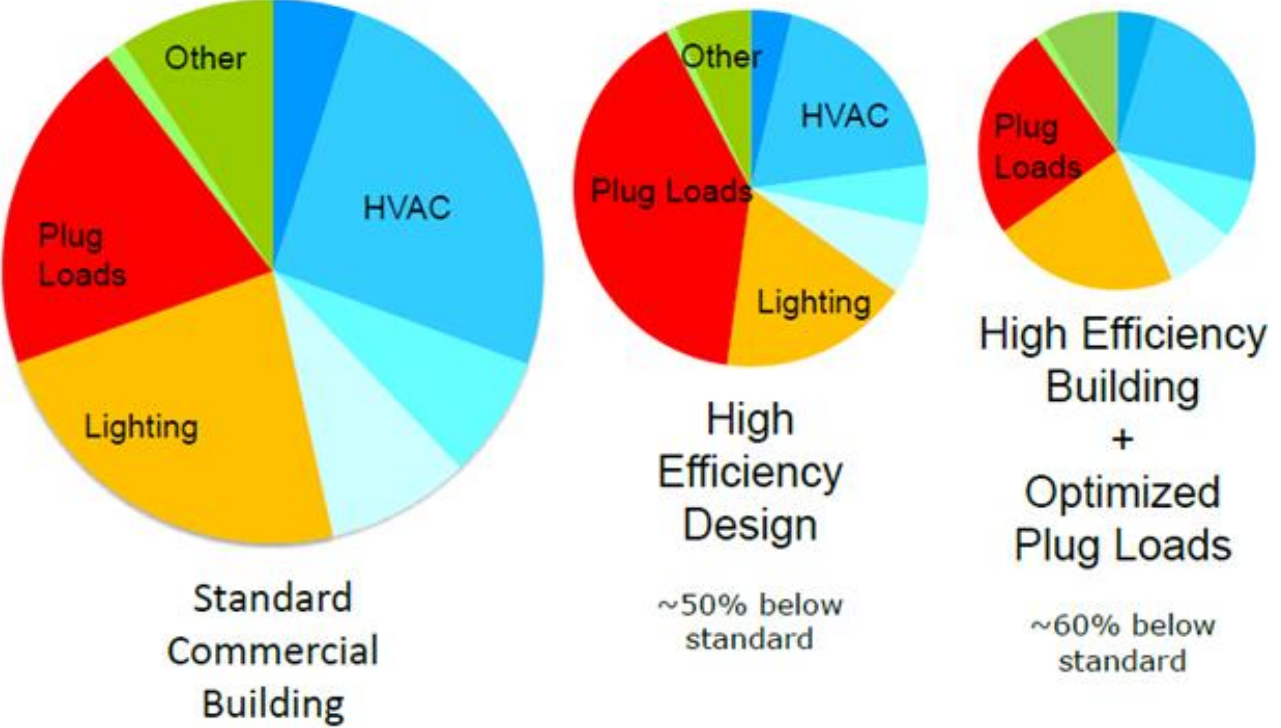


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Duane Jonlin, FAIA

206-233-2781 duane.jonlin@seattle.gov

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