



Implementing a Portfolio Lighting Strategy

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Learning Objectives



- 1. Understand the life cycle impact of a buildings lighting system to it's environmental footprint and on occupant well-being.*
- 2. Explain the benefits of a lighting strategy toward meeting sustainability goals and improving the occupant experience*
- 3. Understand current technologies and options in lighting systems, discussing the financial operational, environmental, and occupant well-being benefits and short falls.*
- 4. Understand the environmental and occupant well-being benefits from LED + controls lighting projects vs either deployed individually.*
- 5. Demonstrate benefits of a lighting system upgrade with real world examples.*

Agenda



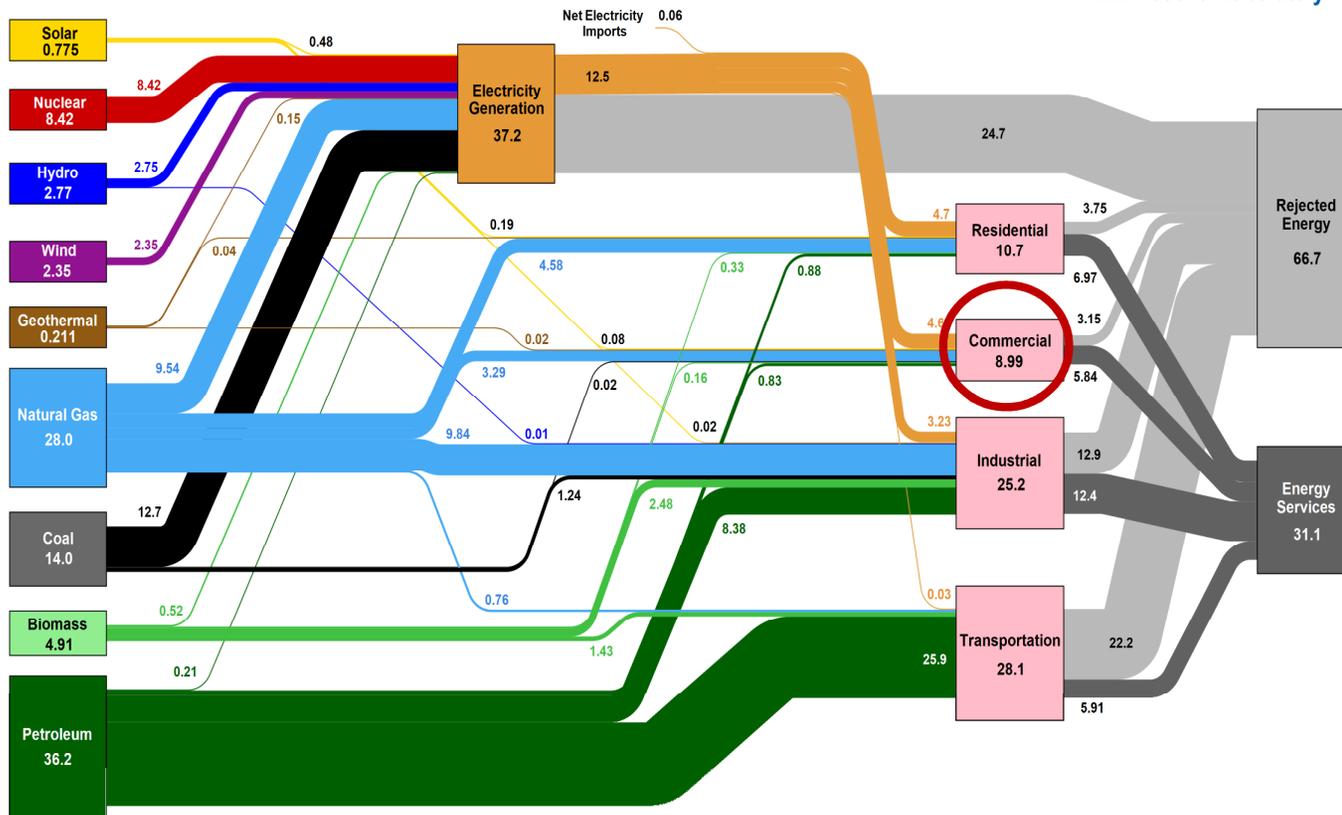
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1. The Need for a Strategy

Commercial Buildings and Lighting Fun Facts



Estimated U.S. Energy Consumption in 2017: 97.7 Quads



Buildings = 9% energy
30% of buildings = Lighting

3% of domestic energy is **OFFICE LIGHTING**

Source: EIA, April, 2018. Data is based on DOE/EIA (2017). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. This chart was revised in 2017 to reflect changes made in mid-2016 to the Energy Information Administration's analysis methodology and reporting. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 21% for the transportation sector, and 49% for the industrial sector which was updated in 2017 to reflect DOE's analysis of manufacturing. Totals may not equal sum of components due to independent rounding. EEMS-M2-131027

Commercial Buildings and Lighting Fun Facts

Humans and the Built Environment



25% at work



90% indoors



**1 in 7 don't use
night vision**

Why do I need a strategy?

Shouldn't we be strategic in everything we do?



Optimum Benefit

- Energy Savings
- Occupant Well-being impacts
- Smart Building infrastructure



Missed Opportunities

- Securing planned capital spend
- FY end funding / spend



Avoid Waste

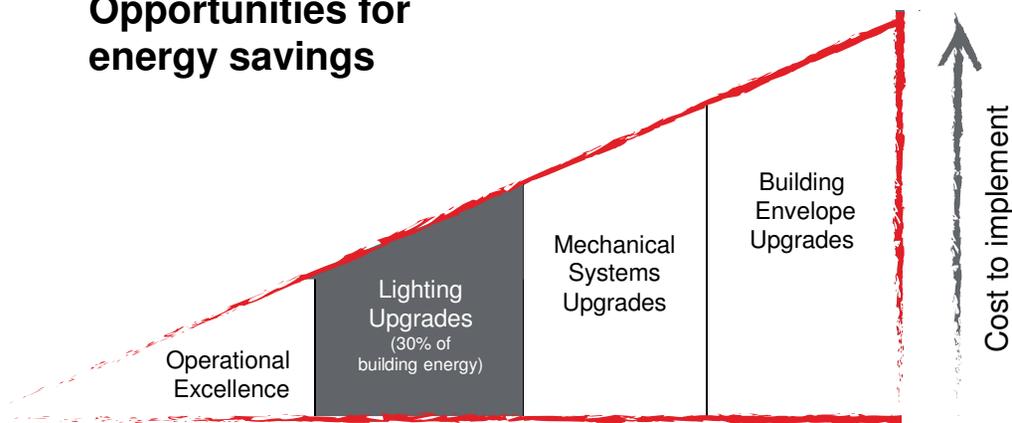
- Capital \$\$
- Time chasing one off projects / funding
- Operational \$\$ from lack of results

Why do I need a strategy?

Example Strategy



Opportunities for energy savings



50% energy reduction
with modern technology

15% Overall Savings

Smart Building Platform



Global Plan:

1. Implement w/ new construction
2. Phase in w/ renovations
3. Phase in w/ Smart bldg. initiatives
4. Retrofits:
 - Owned and high elect cost
 - Lighting system issues

Why do I need a strategy?

But you also need a plan!



	Project Type	Scope	Fixture Type	Technology	Controls	Cost	Savings	Incentives	Payback (Years)	Comments
Site 1	Retrofit	Open Office	Linear Suspended	LED tubes - Type A	N	\$11k	\$7k	\$9k	0.4	Leased space
Site 2	Renovation	Open Office Meeting Rooms	Linear Suspended Troffers	LED tubes - Type C New fixtures	Yes	\$53k	\$10k	\$9k	4.4	Magnetic ballasts, need replaced anyway
Site 3	New Construction	Open Office Meeting Rooms Primary Corridors	Troffers Canned Lights	All new fixtures	Yes	\$180k	\$21k	\$30k	N/A	LED cheapest option for new construction w/ rebate
Total						\$244k	\$38k	\$48k	5.2	

And also need standards! --- Start with DLC or DLC premium

2. Technologies

Lighting Technologies

Linear Tubes



Benefits



Lamp Type	Description	Life Time (Hrs)	Dimmable option?	Energy Reference	Cost (\$ -each)	Incentives (\$ - each)	Comments / watchouts
Flourescent	Standard lamp	35k - 80k	Yes	1	\$4-10	-	Not recommended
LED - Type A	Plug n' Play	50k - 70k	Yes	0.35 - 0.5	\$6-13	\$3-6	Ballast compatability
LED - Type B	Line Voltage	50k - 70k	No	0.35 - 0.5	\$6-14	\$3-6	Not recommended - safety concerns
LED - Type C	External Driver	50k - 70k	Yes	0.35 - 0.5	\$6-15	\$3-6	Best for full retrofit w/ controls - highest cost

Notes:

1. Based on 4' linear tube from reputable manf
2. Duke Energy Ohio rebate amounts

Lighting Technologies

New Fixtures



Benefits



Improved appearance

Full functionality

- **Dimmable**
- **Embedded controls and sensors**
- **Connected building tech (VLC, BlueTooth, etc)**

Downfalls



Lighting Technologies

Retrofit kits



Benefits



Downfalls



Watch-outs!

- Quality of Design
- DLC listed for application
- UL listing
- Appearance
- Install effort and forgiveness

Lighting Technologies

Luminaire Summary



Lighting Technology	Energy Savings	Maintenance Reduction	Well-being Impact	Upfront Costs	Funding Source	Comments / watchouts
Flourescent	-	-	-	\$	OpEx	Not recommended - spot relamping only
LED - Type A	☑☑	-	-	\$	OpEx	Expect ballast failures
LED - Type B	☑☑	☑☑☑☑	-	\$\$	OpEx	Not recommended - safety concerns
LED - Type C	☑☑	☑☑☑☑	☑☑	\$\$\$	CapEx	Recommended value based project
LED Retrofit Kits	☑☑	☑☑☑☑	☑☑☑☑	\$\$\$\$	CapEx	Recommended depending on kit and \$ avaiability
LED - New Luminaires	☑☑	☑☑☑☑	☑☑☑☑	\$\$\$\$	CapEx	Recommended depending on kit and \$ avaiability

What is your strategy?

What problem(s) are you trying to solve?

Watch out for over lighting the space! Recommend installing controls concurrently

Lighting Technologies

Lighting Controls



Benefits



Fully leverage your LEDs

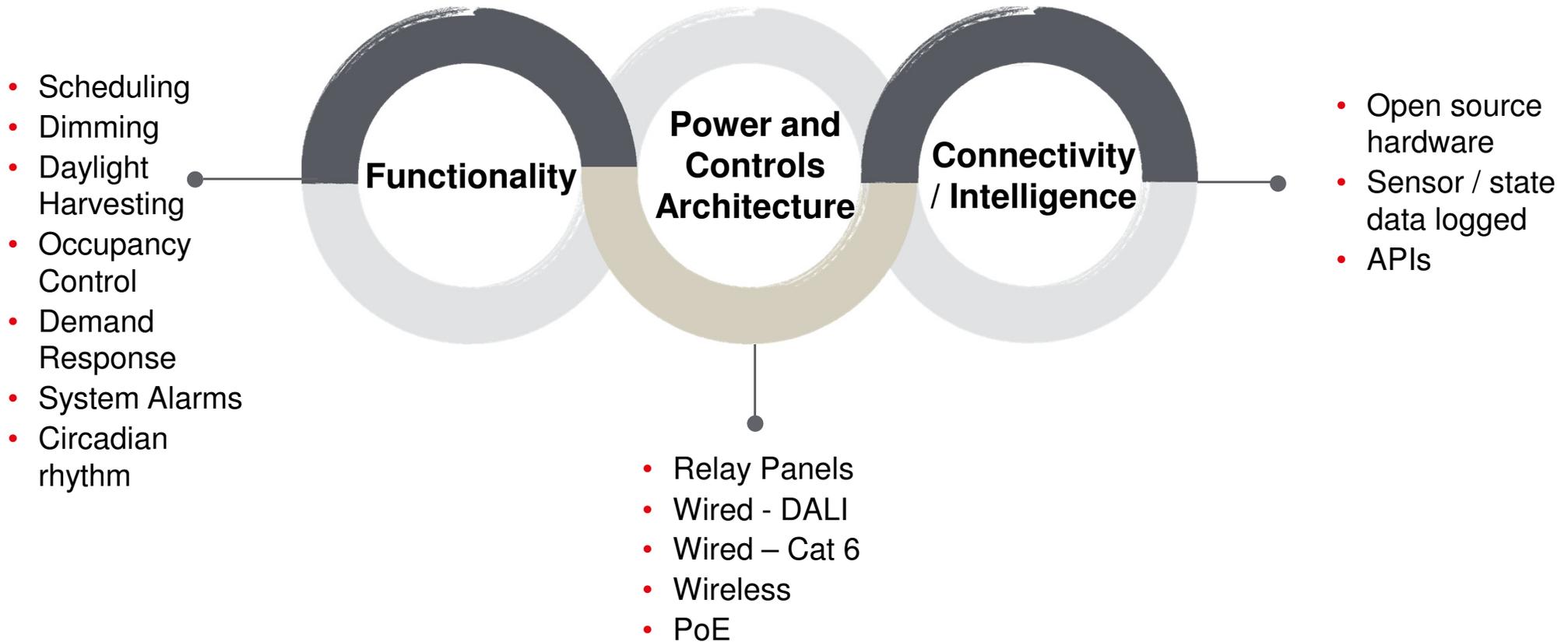
- **Dimmability**
- **Occupancy Sensing**
- **Daylight harvesting**

Other Benefits

- **Meta-data → Operational Intelligence**
- **Employee experience add-ons: Indicator lights, room finding**
- **Smart Building platform**

Lighting Technologies

Lighting Control System Options



Lighting Technologies

Circadian Rhythm Lighting



Occupant Well-being

Applications

- Healthcare, hospitality, retail
- Offices – maybe in the Artic Circle?
Or is 4000K too cool?

Equipment

- LED luminaires (3 sets of chips)
- Special controls



Lighting Technologies

LED + Controls concurrently



Benefits



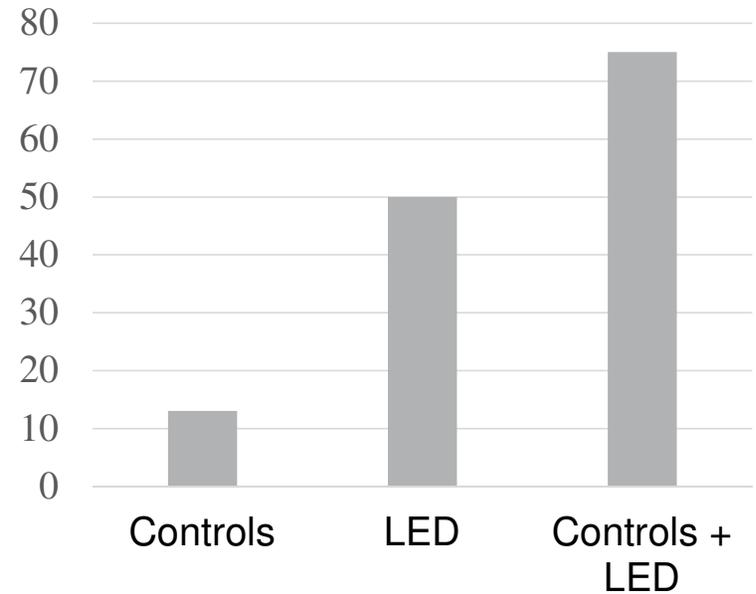
Dimming (*50% common*)

- Correct light levels
- More savings
- Extends LED life
- Personalized light levels

Other Benefits

- Long term capital savings
- Provides smart building platform

% Savings vs Fluorescent



3. Case Studies

Case Studies

Lease renewal and renovation - Europe



Results

Lighting System

Lease Renewal and Space Renovation

- Consolidated 4 floors to 2
- Complete “gut” renovation
- Full Lighting redesign

- **100% LED**
 - Integrated LED luminaires
 - Locally procured
 - Adhered to global performance / safety standards
- **DALI lighting system**
 - Occupancy sensing
 - Dimming switches
 - Daylight harvesting

- **Environmental / Operational**
 - 61% reduction in energy
 - 264 MWh/year reduction (lighting)
 - “Green” score increased, 60 to 88
- **Well-being**
 - “Productive” score increased, 60 to 90
 - Visual comfort score increase, 80 to 96
- **Financial**
 - \$32k / year energy savings

Results (expected)

Lighting System

Renovation Project

- 88,000 ft²
- Complete “gut” renovation
- LEED C&I Project
- Full Lighting redesign

- **100% LED**
 - Integrated LED luminaires
 - 2x4 troffers / downlights
 - Adhered to global performance / safety standards
 - Integrated wireless controls
- **Advanced lighting system**
 - Centralized, wireless system
 - Zigbee protocol
 - Standard functionality – Sched / Occ / Dim / Daylight
 - Remotely accessible
 - Meeting room VAV control - Occ

- **Environmental / Operational**
 - 0.43W/ft² LPD → 60% reduction
 - 300 MWh / year savings
 - 22% less building energy
 - 223 tonnes of CO₂/year
 - No hazardous waste disposal for 20+ years
 - Near zero lighting maintenance for 20+ years
- **Well-being**
 - 5 -15% gains in occupant productivity (better views/ reduced glare)
- **Financial**
 - \$21k / year energy savings

Thank you

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