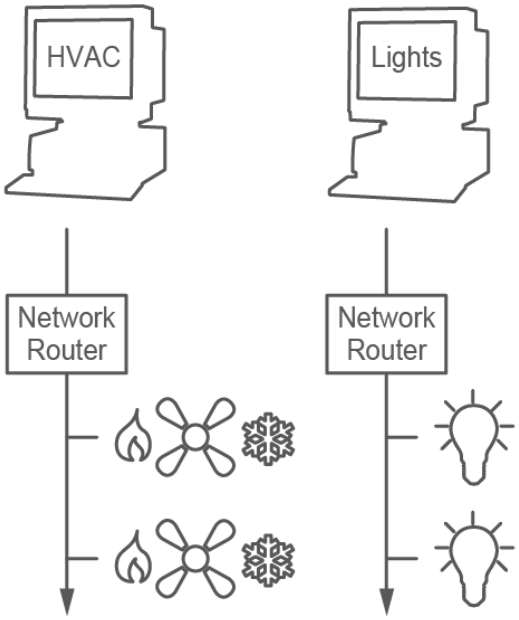
UNIFIED LIGHTING CONTROL

Unified Lighting Control

Important Differences

Stand Alone

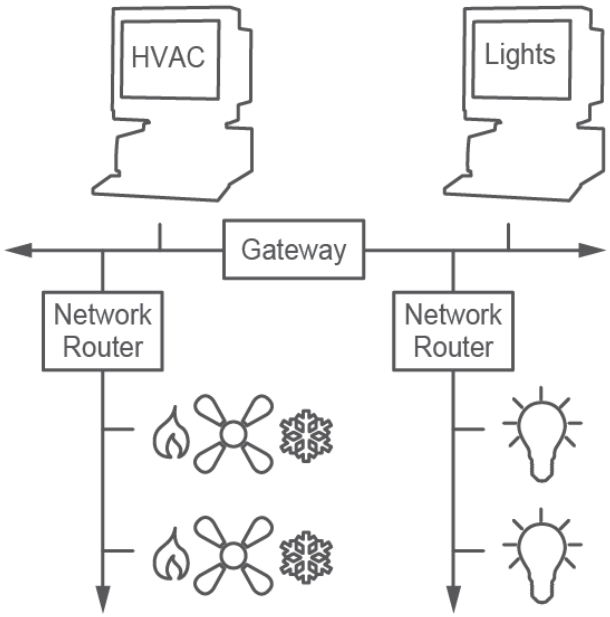


Separate Networks

Separate User Interface

No Integration

Gateway



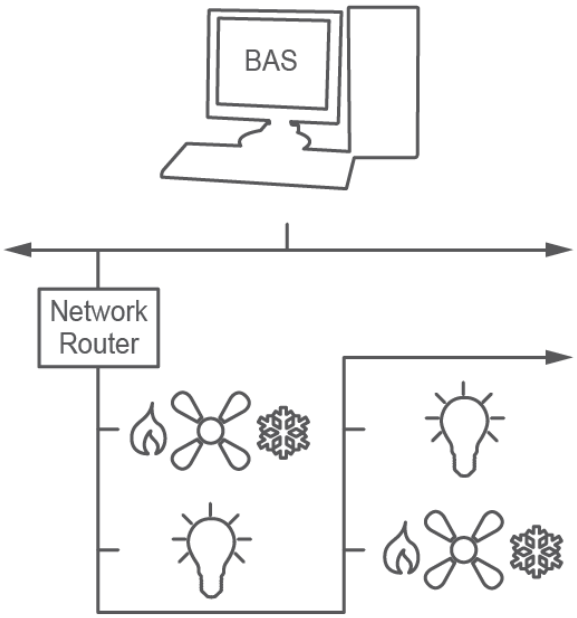
Separate Networks

Separate User Interface

Limited Integration

Finger Pointing / Delays

Unified



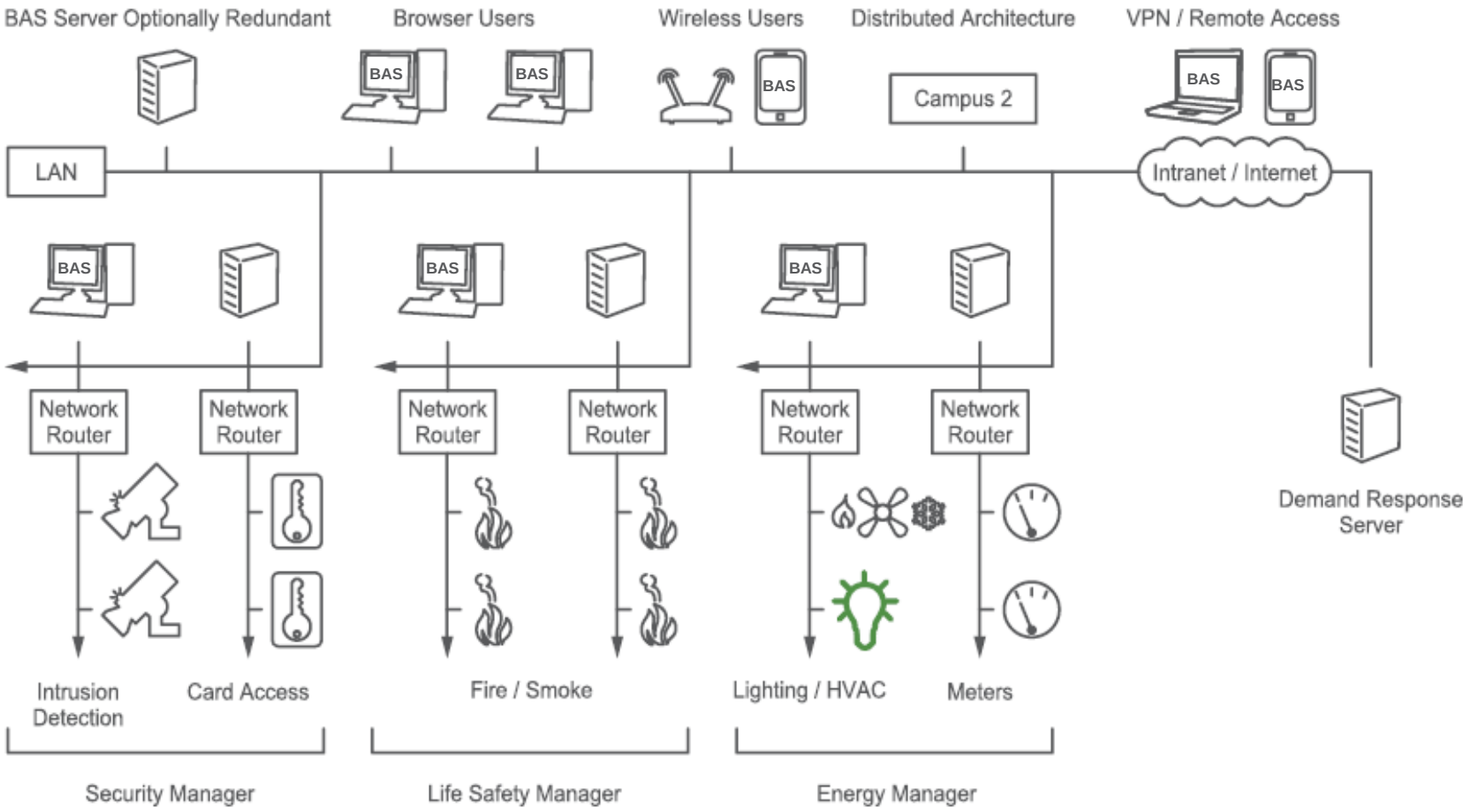
One Network

One User Interface

Wide Open Integration

Unified Lighting Control

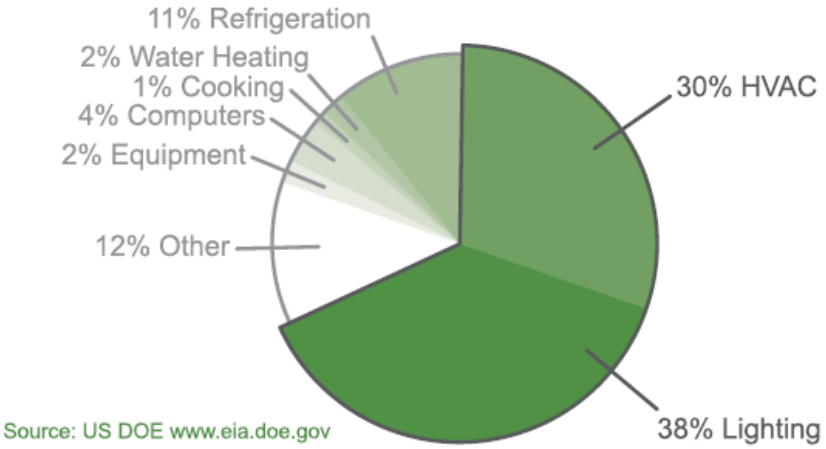
Leverages BAS Infrastructure



Commercial Energy Usage

Lighting + HVAC Over 65%

Commercial Electricity Usage : Aggregate



Source: US DOE www.eia.doe.gov

Commercial Electricity Usage : Building Type

Building Type	HVAC	Lighting	Total
Education	46%	30%	76%
Health Care	33%	42%	75%
Lodging	22%	53%	75%
Retail	32%	42%	74%
Office	27%	39%	66%

A Building Automation System that only controls HVAC is incomplete.

Light & HVAC account for more than 2/3 of energy usage

Lighting is typically the largest electrical load in commercial buildings

Unified Lighting Control

BACnet Enables a Unified System

BACnet is the Open Standard

- ASHRAE SSPC 135
- ISO Global Standard 16484-5

BACnet enables "Best of Breed"

- Easily replace legacy controls
- Sustainable platform

BACnet Tools for System Designer

- Protocol Implementation Conformance (PIC) Statement
- BACnet Interoperability Building Blocks (BIBBs)

www.bacnet.org

www.bacnetinternational.org

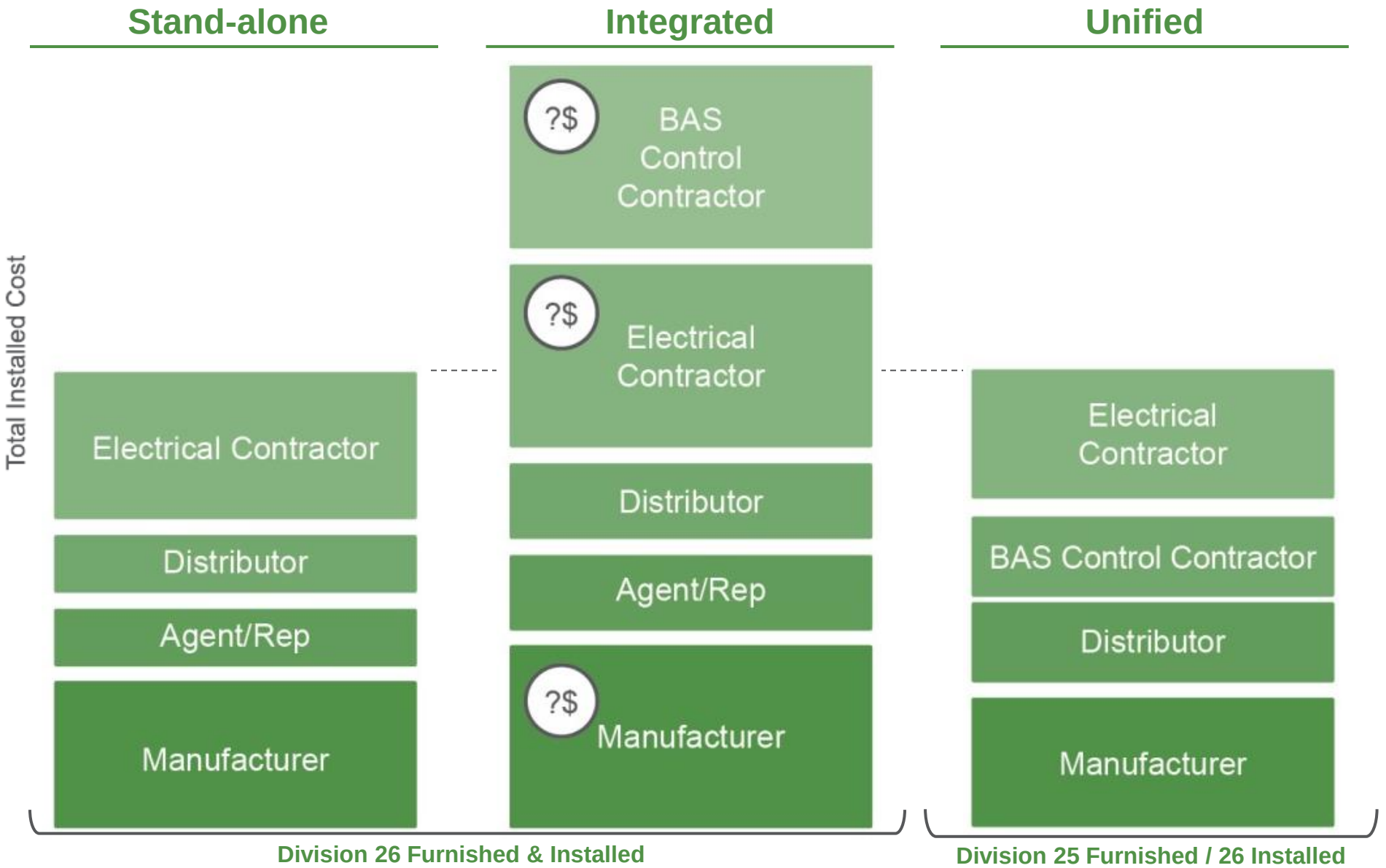
Experience the Difference

Specification

Best Practices

Unified Lighting Control

Where is the Money Going?



Unified Lighting Control
Alignment Critical to Success

Accountability requires the alignment of responsibility with core competencies

Simply stated

BAS Controls Contractor provides the lighting control

And, the Electrical Contractor installs the lighting control

Benefits

Lowest risk delivery method

Local resources assist with control system design, quickly resolve difficulties

Leverages everyone's expertise

CSI	Furnish	Install / Rough-in	Low Voltage	Line Voltage	Integration	Start-up	Training
1995	17	16	16	16	17	17	17
2004	25	26	26	26	25	25	25

Unified Lighting Control
Improving Delivery and Accountability

CSI 1995

Division 15 - Mechanical
- Mechanical Equipment
- DDC / HVAC Controls

Division 16 - Electrical
- Lighting Controls
- Lighting Equipment

CSI 2004

Division 23 – HVAC
- Mechanical Equipment

Division 25 – Integrated Automation
- DDC / HVAC controls
- Lighting Controls

Division 26 – Electrical
- Lighting Equipment

<u>Important Tip:</u> Lighting control equipment still represented on electrical drawings. Also, it is important to note scope on the drawings.

Unified Lighting Control

Contractor Responsibility Guide – Part 1

System Equipment	Division 25				Division 26			
	Furnish	Install	Wire	Note	Furnish	Install	Wire	Note
Centralized Panels (Switching or Dimming)	X					X	X	Tag / label device as required
Distributed Controllers (Switching or Dimming)	X					X	X	Tag / label device as required
Satellites (Switching or Dimming)	X					X	X	Tag / label device as required
Contactors	X					X	X	Tag / label device as required
Low Voltage Field Device - Wall Switch or Key Switch	X					X	X	Tag / label device as required
Low Voltage Field Device - Addressable Stations	X					X	X	Tag / label device as required
Low Voltage Field Device - 24VDC Occupancy Sensors	X					X	X	Tag / label device as required. Set timer to min. or zero. Set coverage pattern. Coordinate location with Div 25
Low Voltage Field Device - 24VDC Light Level Sensors (Indoor, Outdoor, or Daylight)	X					X	X	Tag / label device as required. Coordinate location with Div 25
Low Voltage Field Device - Faceplates					X	X		Engrave / label as required
System Warranty	X							
System Installation Warranty					X			

Unified Lighting Control
Contractor Responsibility Guide – Part 2

System Infrastructure	Division 25				Division 26			
	Furnish	Install	Wire	Note	Furnish	Install	Wire	Note
BACnet Network (Conduit and Raceway)					X	X		Pullstring
BACnet Network (Wire and Terminations)	X	X	X	Address Device				
Line Voltage (Class I) Between Circuit Breaker and Lighting Controller and Lighting Load (Conduit, Raceway, Wire, and Terminations)					X	X	X	All 0-10V Signal wires shall be wired as Class I
Low Voltage (Class II) between Lighting Controller and Low Voltage Field Devices (Conduit, Raceway, Wire, and Terminations)				Address Stations and Satellites	X	X	X	All 0-10V Signal wires shall be wired as Class I

System Engineering	Division 25				Division 26			
	Furnish	Install	Wire	Note	Furnish	Install	Wire	Note
Submittal Package and As-built Drawings	X			Provide Div 26 with drawings	X			Provide Div 25 mark-ups for As-built
Sequence of Operations	X	X						
Operators Interface	X	X						
Programming and Configuration	X	X						
System Checkout & Commissioning	X				X			Be present to address items
System Demonstration and Acceptance	X				X			Be present to address items
System Training	X							

Unified Lighting Control

A Closer Look at Scope

Division 25:

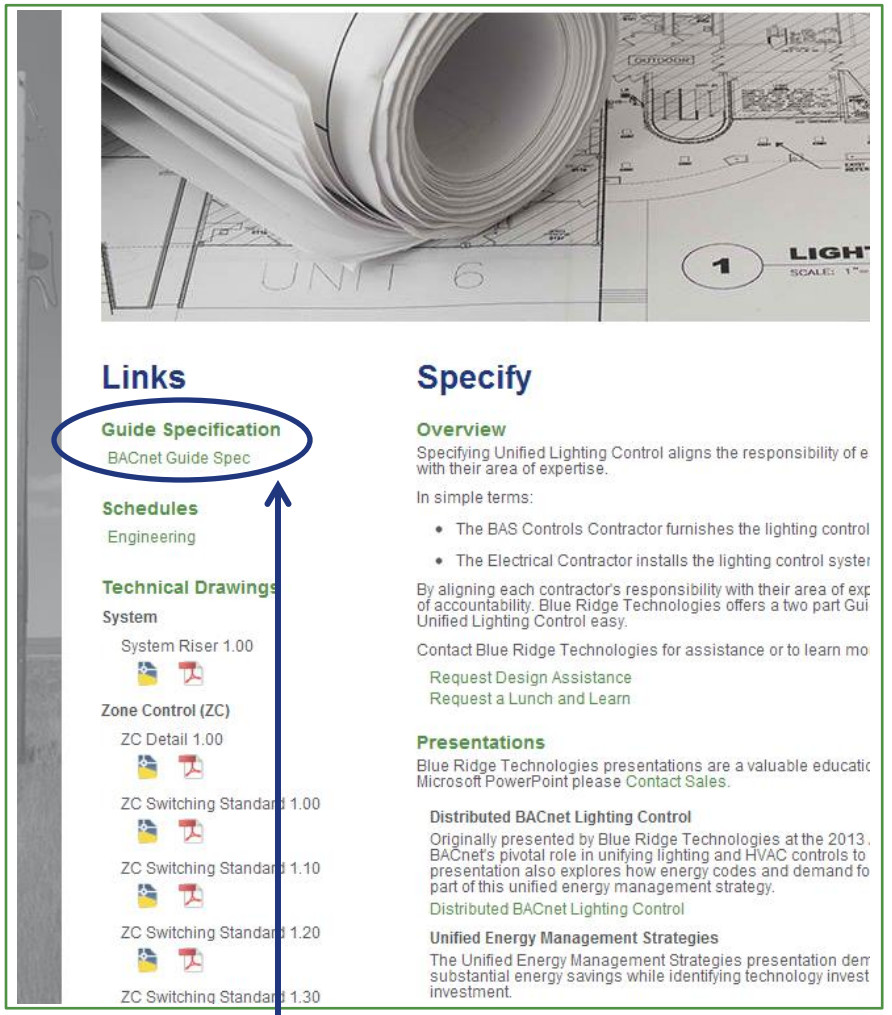
Provide a fully operational lighting control system per specs and drawings

- Provide lighting control equipment
- Provide low voltage field devices
- Provide engineering and product submittals
- Provide system submittals with point to point drawings, panel schedules, and control sequences
- Provide system programming, integration, graphics, and training

Division 26:

Install the lighting control systems per the specs and drawings

- Rough-in, mount and install equipment
- Install all line voltage and low voltage wiring and conduit
- Make all terminations as indicated on the drawings and point to point drawings
- Provide BAS Control Contractor with as-built drawings / mark-ups of original system submittal



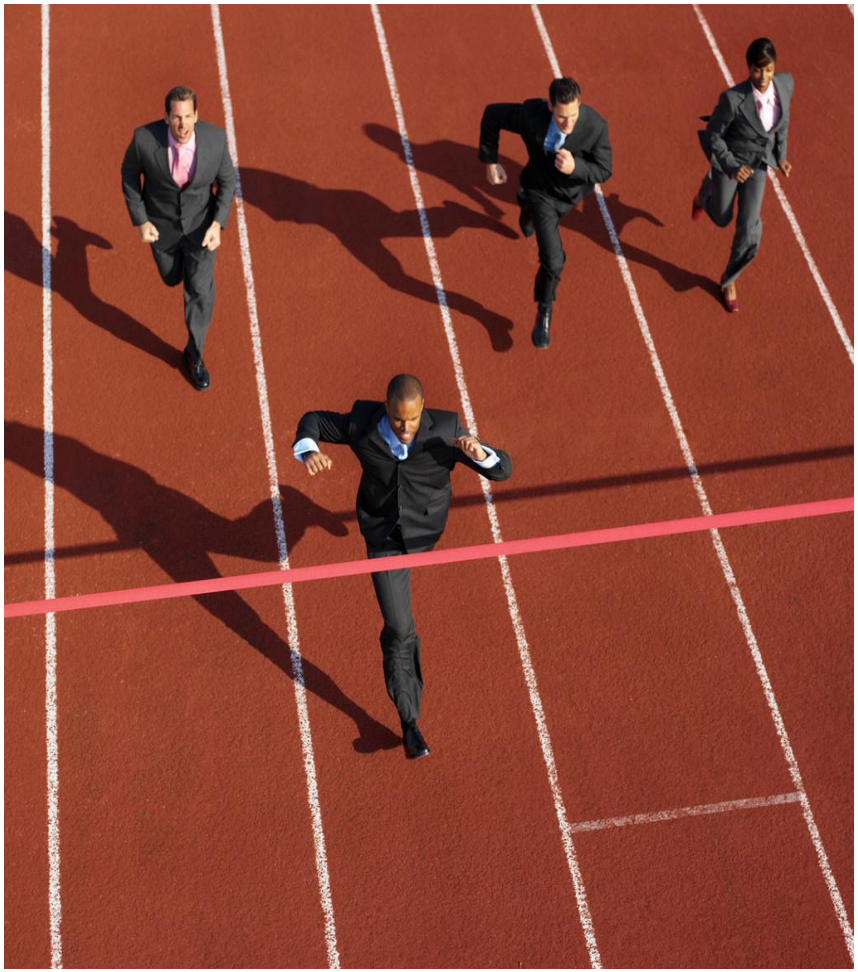
Unified Lighting Control
Performance Spec Drives Competition

Written Control Sequences

- Define how lighting control system operates within each space / space type
- Provides basis for lighting and HVAC interoperation

Graphics

- Define what lighting control points are represented
- Define what status points are represented
- Define what trends and alarms are represented



Unified Lighting Control

Use it on Your Next Project

One System

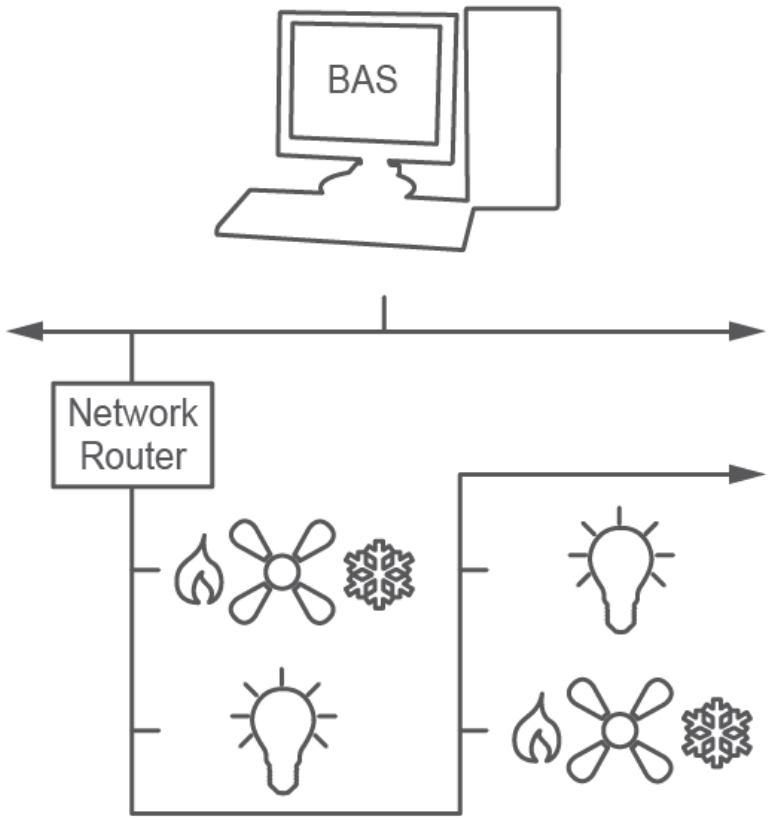
- Lighting and HVAC controls on same network
- Leverage BIBB's for distributed operation

One User Interface

- Same front-end software for lighting & HVAC
- No gateways or extra networks

One Point of Accountability

- Align responsibility with core competencies
- BAS Controls Contractor provides and supports
- Electrical Contractor installs



Unified Lighting Control
What does a BAS look like?

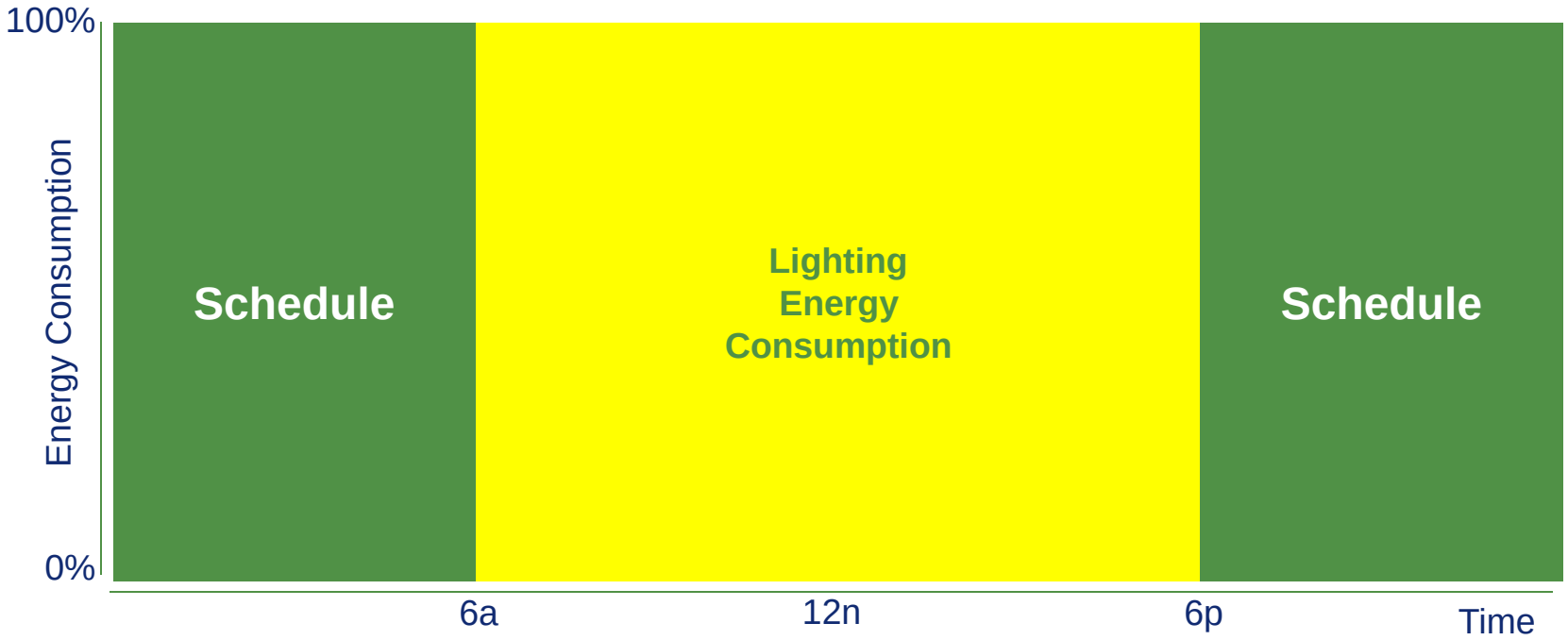
Insert BAS screen caps here or live demo

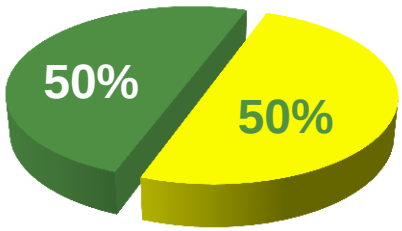
Experience the Difference

Energy Management Strategies

Control The Bookends

Up to 50% Savings





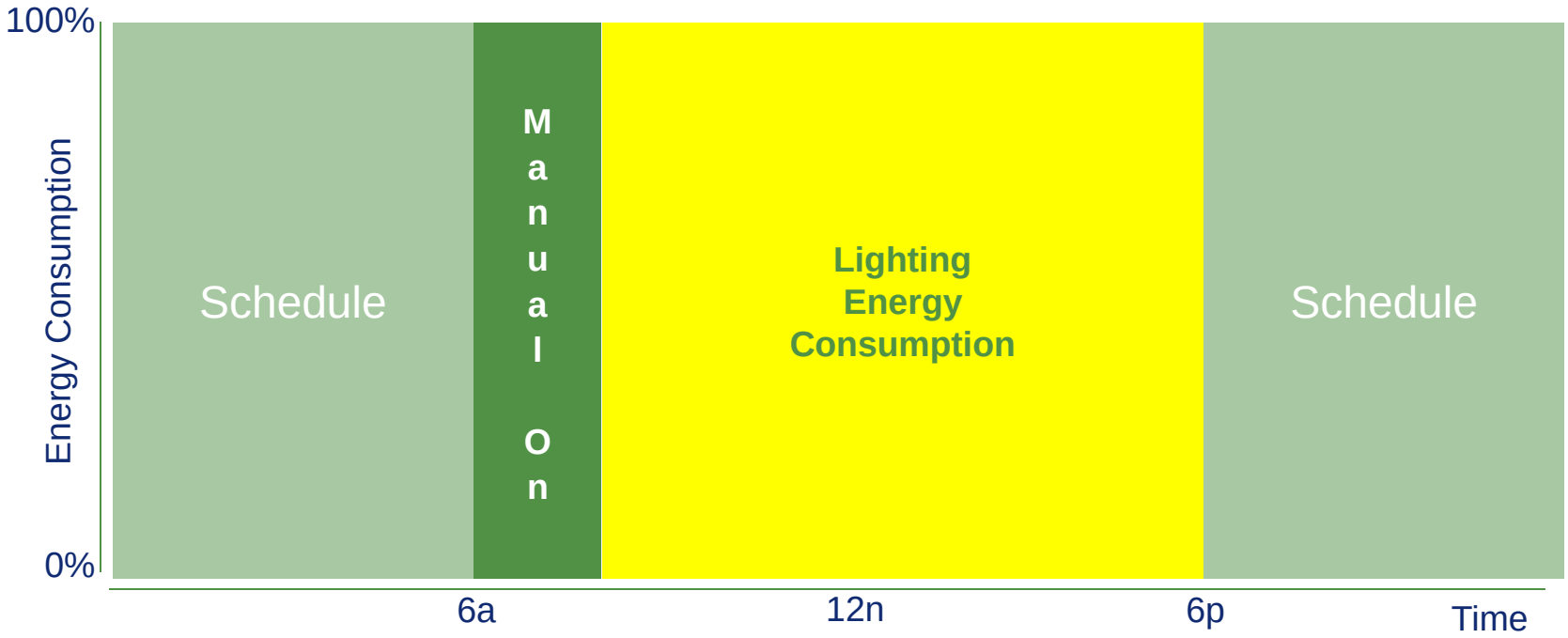
Annual Savings per Kilowatt

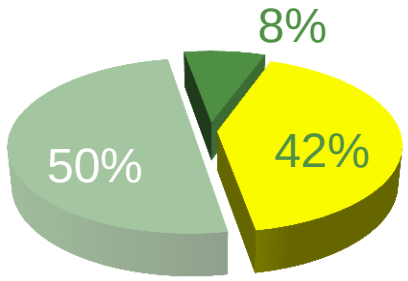
Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Work Week	1.0	12	250	3,000	240.00
Weekends	1.0	24	104	2,496	199.68
Holidays	1.0	24	11	264	21.12
Total - Combined				**5,760**	**460.80**

Base upon $0.08 per kWh (National Average)

Bookends + Manual On

Up to 58% Savings





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Work Week	1.0	12	250	3,000	240.00
Weekends	1.0	24	104	2,496	199.68
Holidays	1.0	24	11	264	21.12
Total - Schedule Off			**365**	**5,760**	**460.80**
Manual On	1.0	2	250	500	40.00
Total - Combined				**6,260**	**500.80**

Base upon $0.08 per kWh (National Average)

Manual On vs. Auto On
Comparison

Manual On

Lights turned on manually when occupant actuates wall switch

Benefits:

Occupant determines when lights are turned on, and at what level

Savings from later On time, and lower light level

Commons applications: Private office, conference room

Auto On

Lights turned on automatically by;

- a schedule or transition of building state from unoccupied to occupied
- Some energy codes limit Auto On to 50%

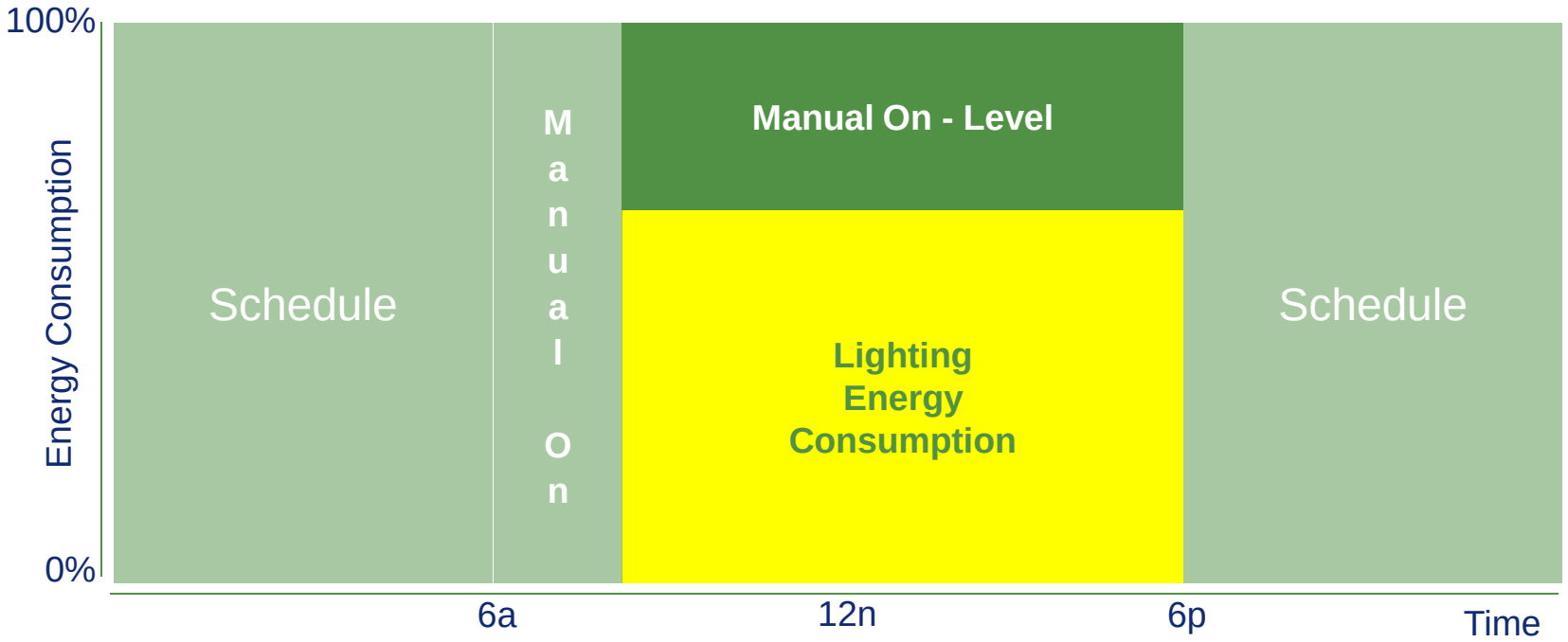
Benefit:

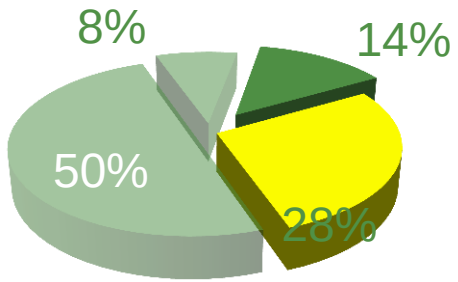
Occupant does not have to do anything

Common applications: hallways / corridors, public spaces

Bookends + Manual On

Up to 72% Savings





Annual Savings per Kilowatt

Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Work Week	1.0	12	250	3,000	240.00
Weekends	1.0	24	104	2,496	199.68
Holidays	1.0	24	11	264	21.12
Total - Schedule Off			**365**	**5,760**	**460.80**
Manual On	1	2	250	500	40.00
Manual On - Level	0.33	10	250	825	66.00
Total - Combined				**7,085**	**566.80**

Base upon $0.08 per kWh (National Average)

Bookends + Manual On

A Closer Look

Morning

BAS Schedule: **Occupied**
Local Override: **Off, Timer Disabled**
Lights: **Off**
HVAC Temp: **Reset**
Ventilation: **Minimum**

Mid-day

BAS Schedule: **Occupied**
Local Override: **On**

Lights: **On 2/3, manually**
HVAC Temp: **Set Point**
Ventilation: **Full**

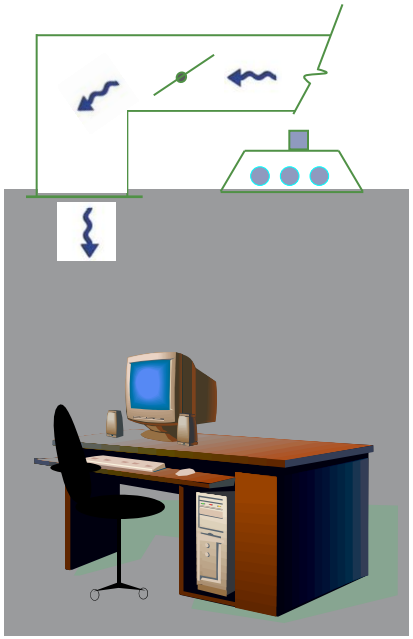
Late Afternoon

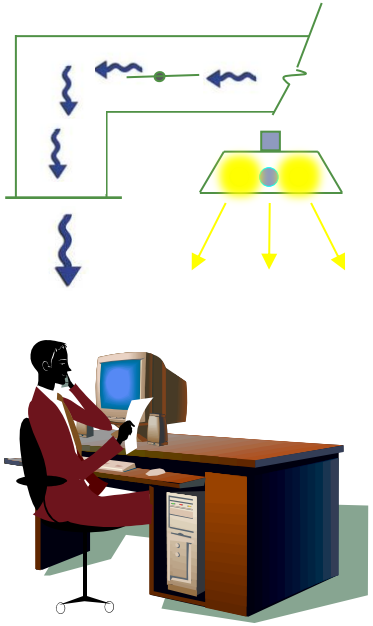
BAS Schedule: **Occupied**
Local Override: **On**

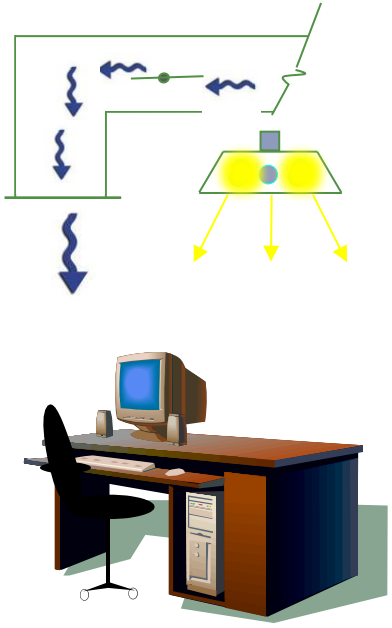
Lights: **On 2/3, manually**
HVAC Temp: **Set Point**
Ventilation: **Full**

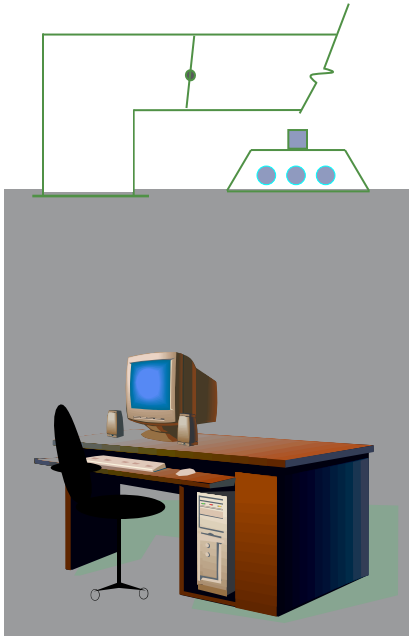
Night

BAS Schedule: **Unoccupied**
Local Override: **Off, Timer Enabled**
Lights: **Off, auto w/ blink warn**
HVAC Temp: **Night Set Back**
Ventilation: **Off**



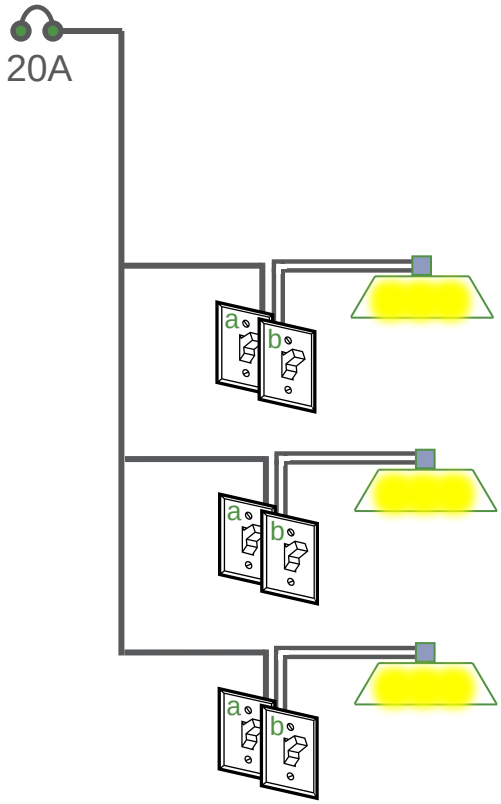






Bookends + Manual On
Existing Buildings

The Reality



Considerations

Existing circuiting does not always meet desired control zones

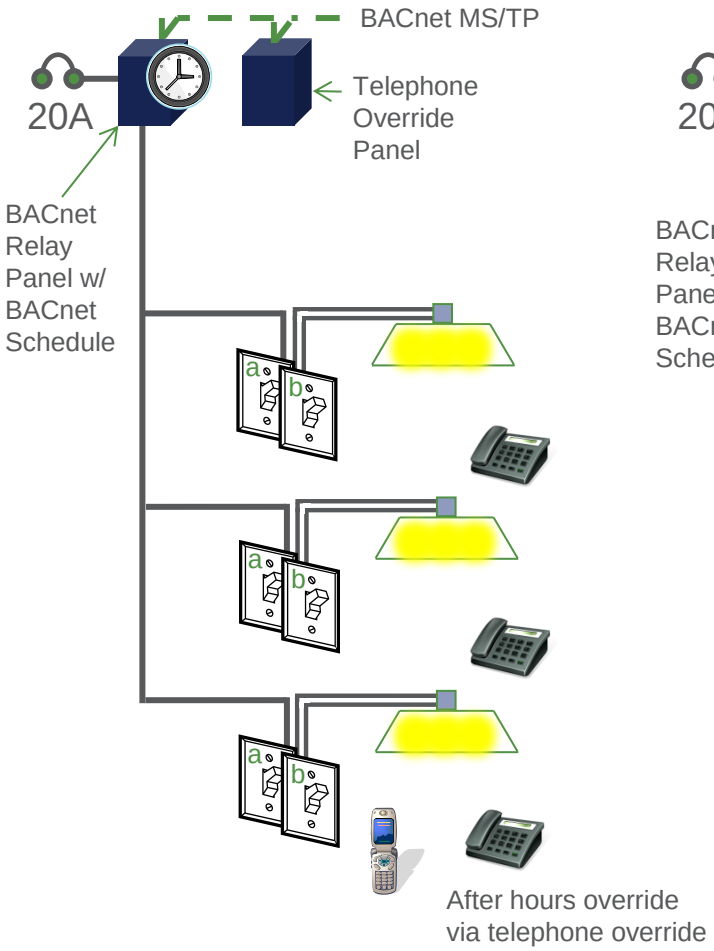
Re-wiring to add centralized control is not an effective solution

How do the occupants initiate after hours override?

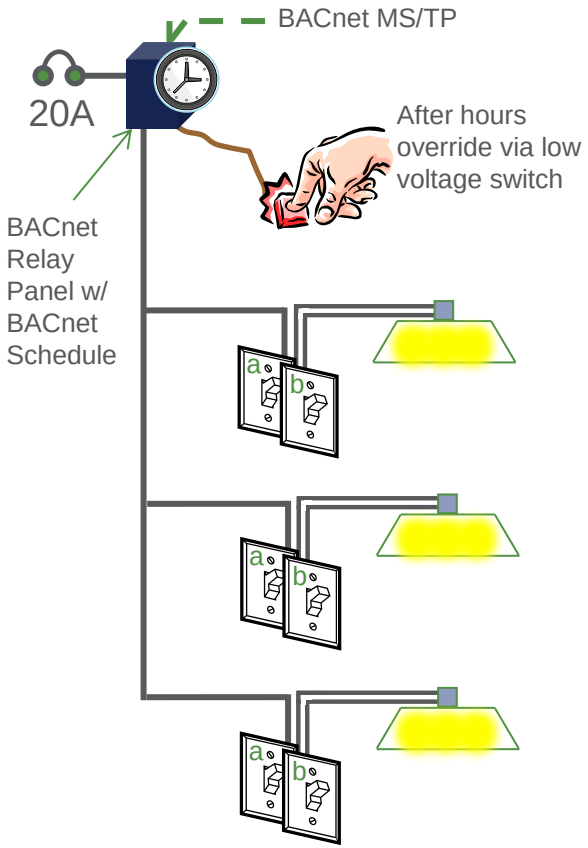
Bookends + Manual On

Implementation Options To Consider

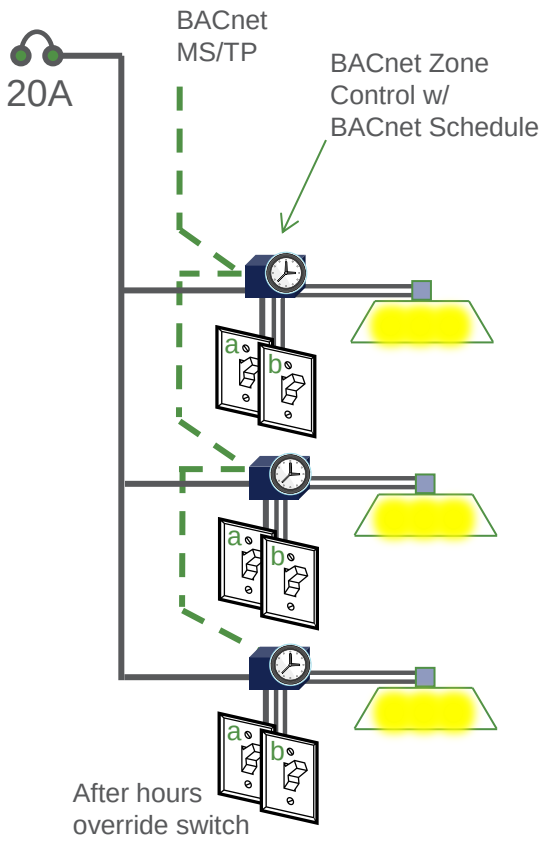
Good *



Better *

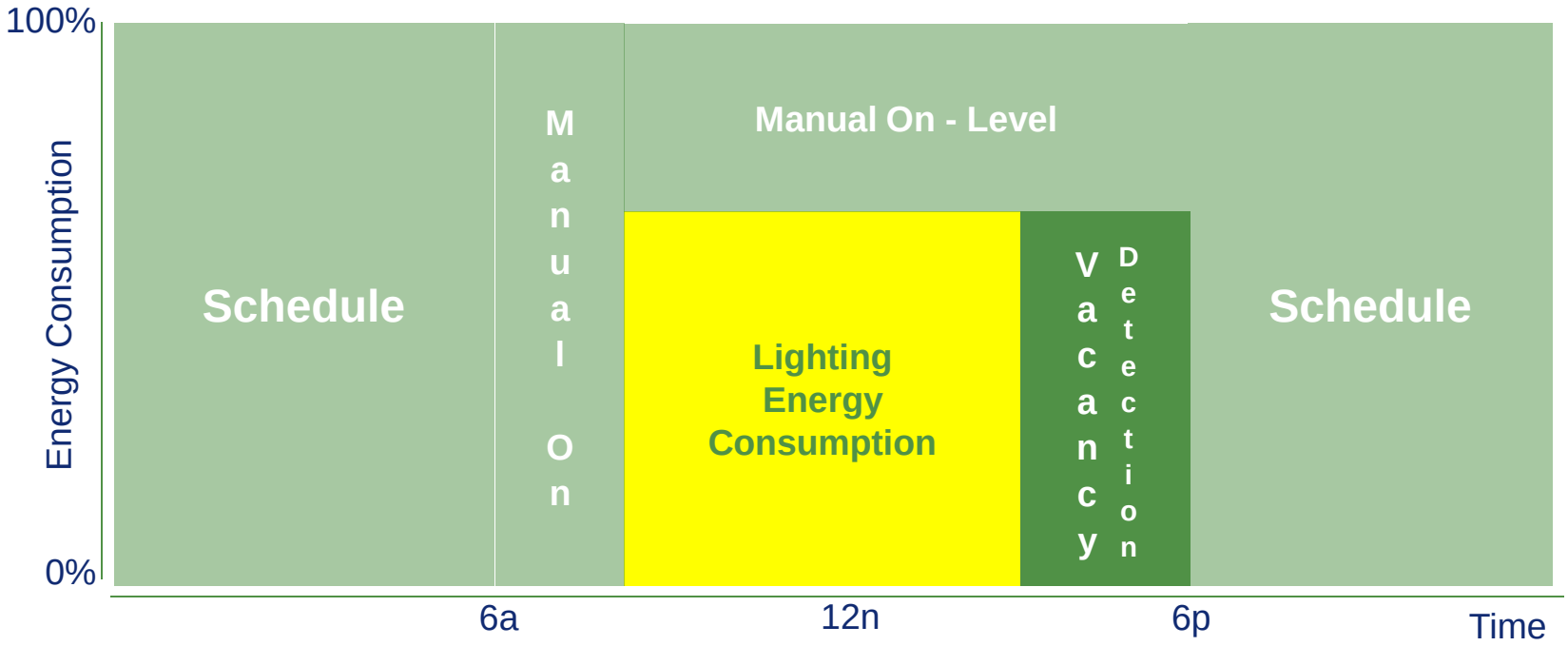


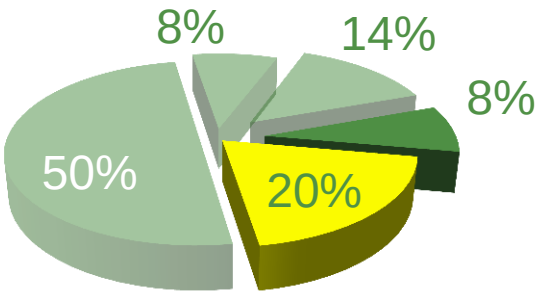
Best



* To achieve Manual On a & b wall switches shall be sweep switch.

Add Vacancy Detection
Up to 80% Savings





Annual Savings per Kilowatt

Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Total - Schedule Off			**365**	**5,760**	**460.80**
Manual On - All			250	1,325	106.00
Vacancy	0.66	3	250	495	39.60
Total - Combined				**7,580**	**606.40**

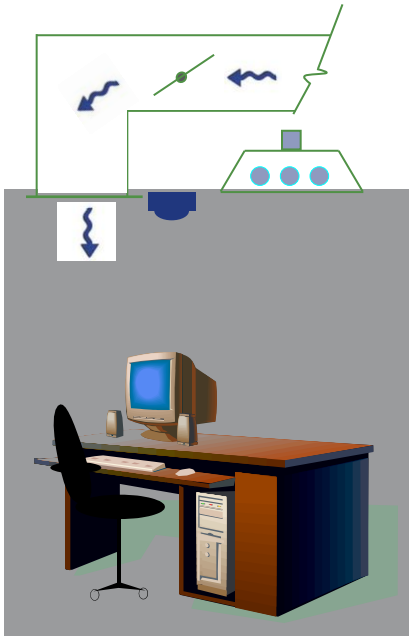
Base upon $0.08 per kWh (National Average)

Add Vacancy Detection

Save up to 80%

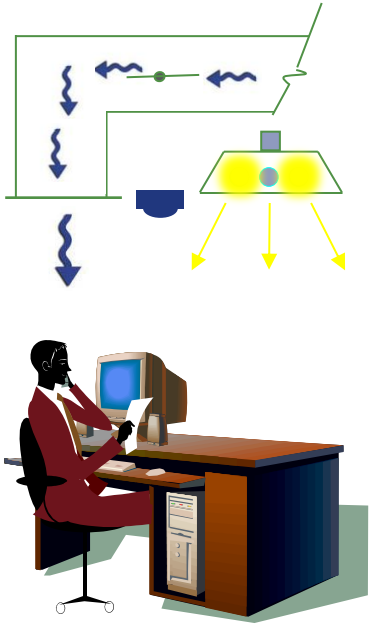
Morning

BAS Schedule: **Occupied**
Occupancy Sensor: **Off , 30 min timer set**
Lights: **Off**
HVAC Temp: **Reset**
Ventilation: **Minimum**



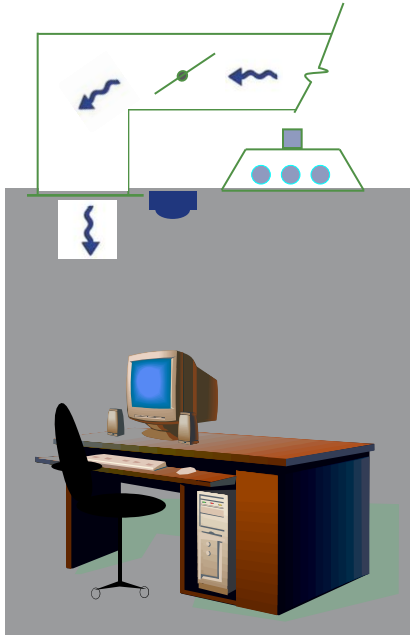
Mid-day

BAS Schedule: **Occupied**
Occupancy Sensor: **On, 30 min timer set**
Lights: **On 2/3, manually**
HVAC Temp: **Set Point**
Ventilation: **Full**



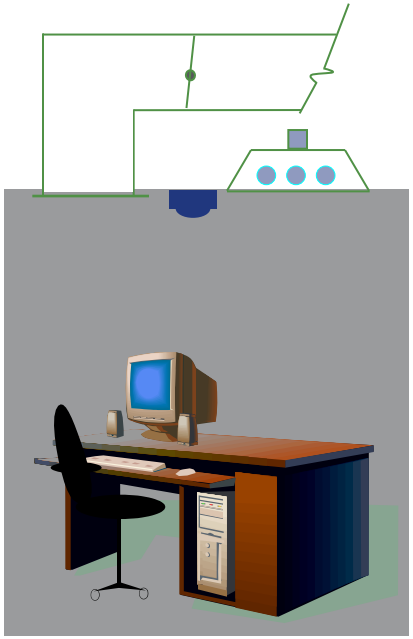
Late Afternoon

BAS Schedule: **Occupied**
Occupancy Sensor: **Off, 30 min timer set**
Lights: **Off, auto by OS**
HVAC Temp: **Reset**
Ventilation: **Minimum**



Night

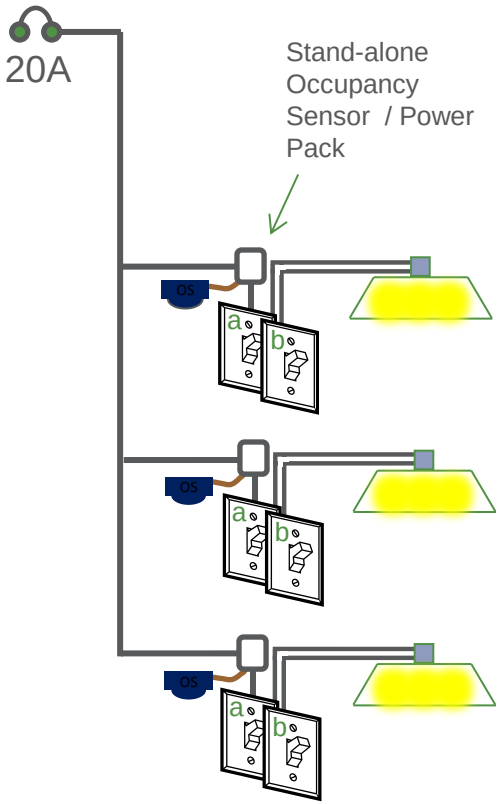
BAS Schedule: **Unoccupied**
Occupancy Sensor: **Off, 10 min timer set**
Lights: **Off, auto by OS**
HVAC Temp: **Night Set Back**
Ventilation: **Off**



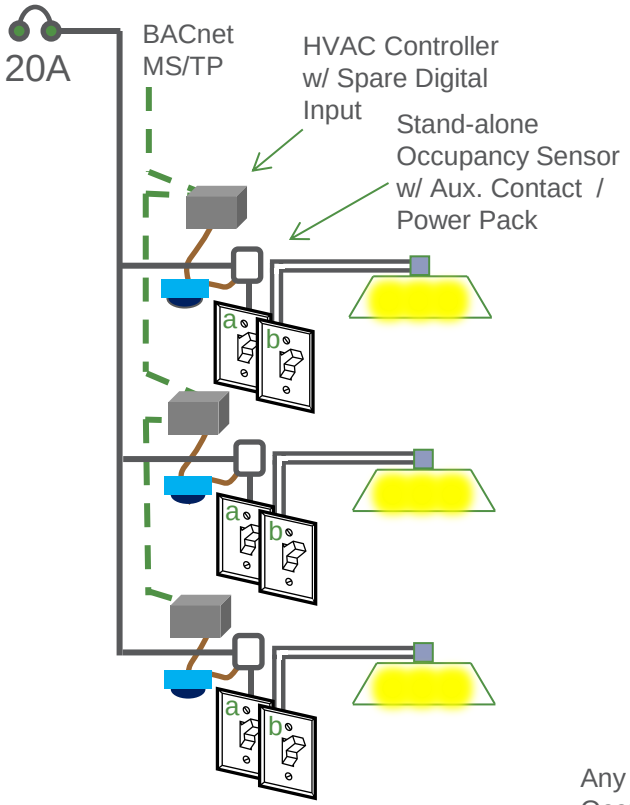
Add Vacancy Detection

Make Occupancy Sensors Better

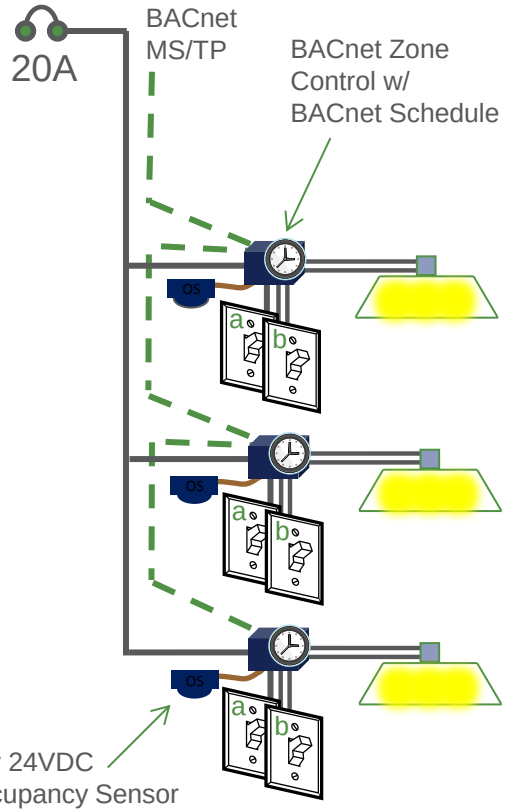
Stand-alone *



Spare Input *



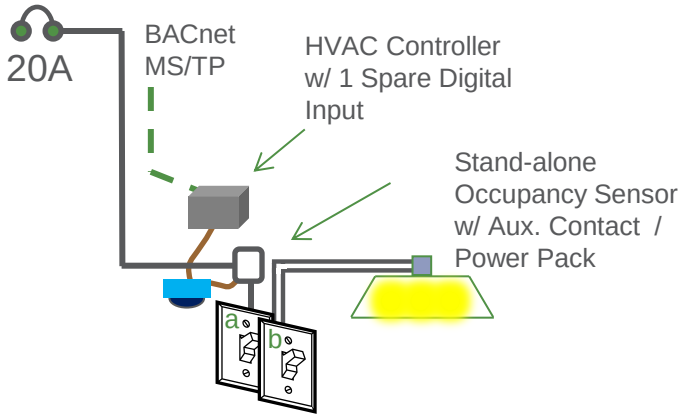
Unified



* Does not comply with Manual On. Requires the installation of a momentary, low voltage wall switch to each occupancy sensor.

Spare I/O
Inferior to Unified

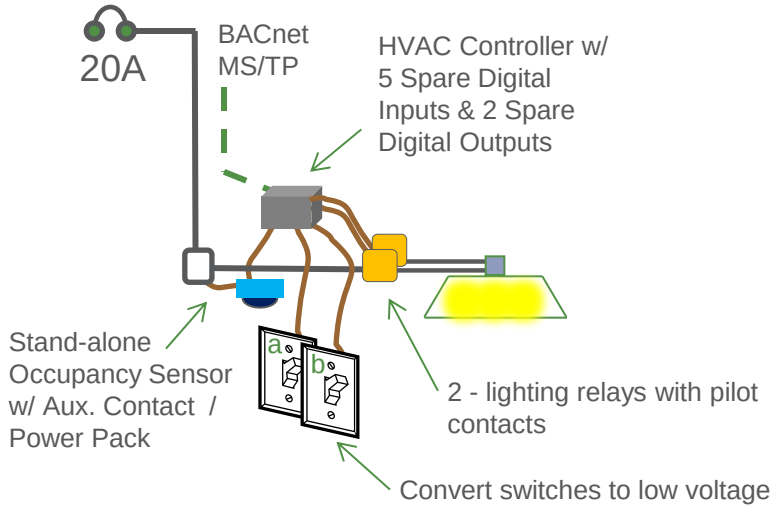
Spare Input – Basic



Does not support:

- Manual-On
- Timer in system
- Relay status

Spare Inputs / Outputs – Advanced



Requires a minimum of;

- 5 - spare DI's & 2 - spare DO's

Very difficult in retrofit

Possible latency

Add Vacancy Detection
Make Occupancy Sensors Better

Unified Solutions

Better performance and verified energy savings

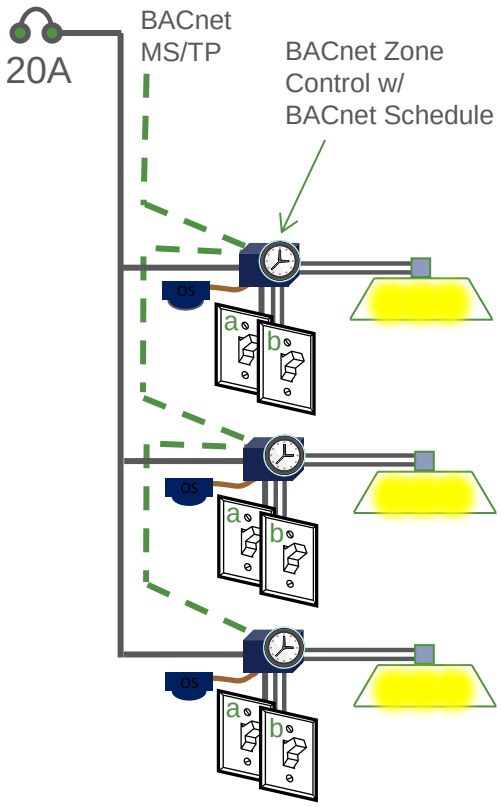
Better Performance

- Reduced complaints
  - Timer managed from BAS, easily modify
  - Manual On, eliminate false On from walk-by
  - False Off grace period, sensor able to re-activate lights
- Control can be customized and monitored
  - Based upon occupied / unoccupied status
  - Add manual control
  - Add level control / dimming
  - Add daylight harvesting
- Increase HVAC savings
  - Share sensor status for set-back

Verification

- Sensor and relay status shared

Unified

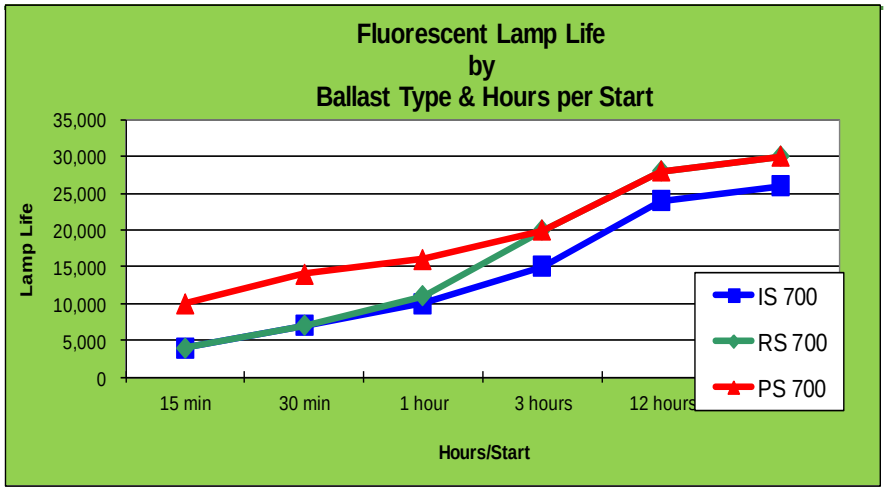


Add Vacancy Detection
Track and Optimize Lamp Life

Unified Solution

Monitoring and customization enables a balance between equipment life and energy savings

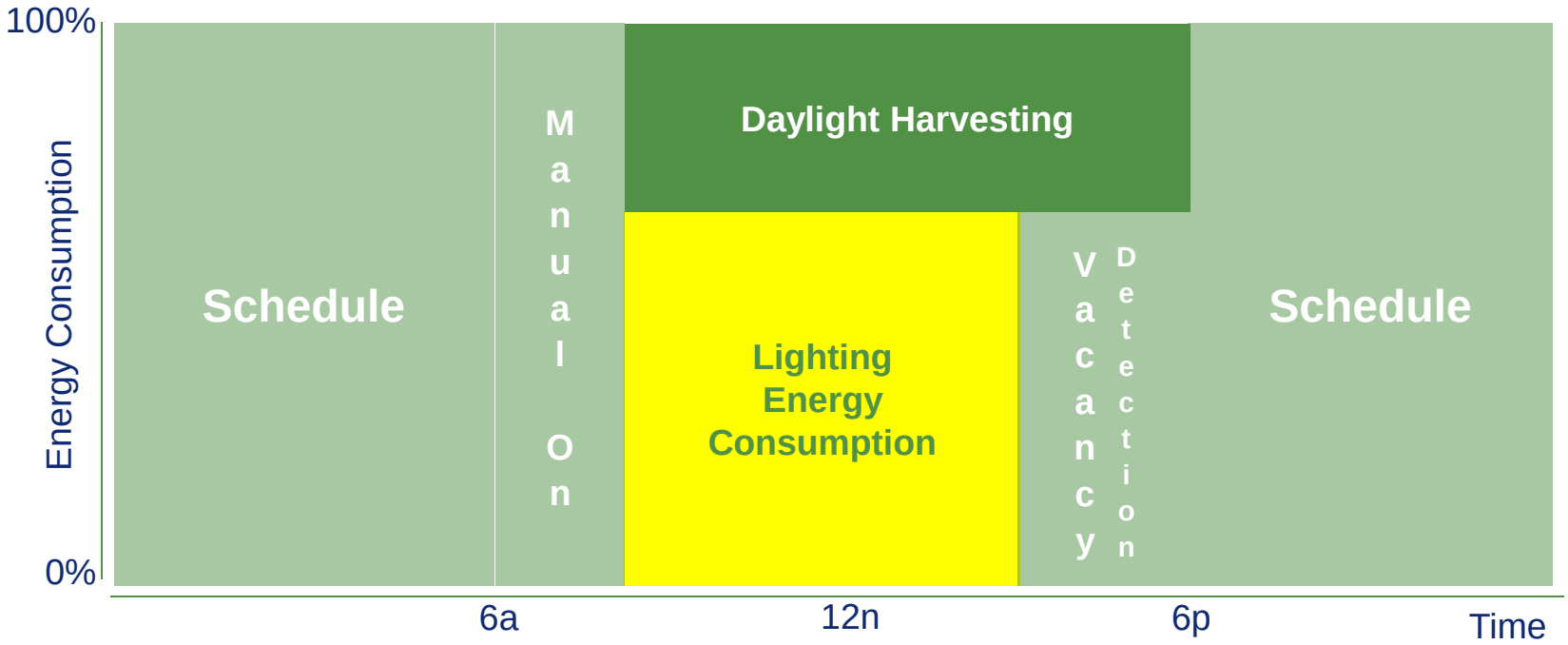
- Track actual performance
- Fluorescent lamp life can be dramatically reduced by short sensor timers and increased cycles
- Especially important for those that do spot lamp replacement
- US DOE spot re-lamp cost = $9.00 / lamp
  - $2.00 material (T-8 lamp)
  - $7.00 labor

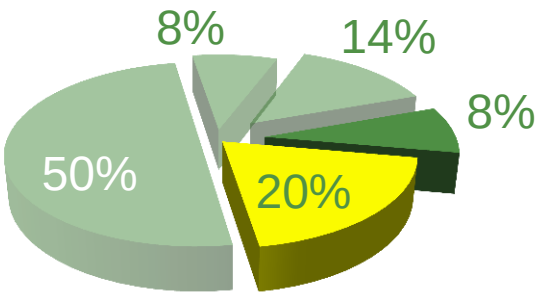


Source: Osram Sylvania

Ballast Type
IS = Instant Start
RS = Rapid Start
PS = Programmed Start

Daylight Harvesting
Up to 80% Savings





Annual Savings per Kilowatt

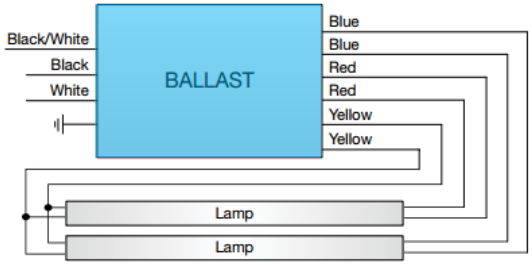
Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Total - Schedule Off			**365**	**5,760**	**460.80**
Manual On			250	500	40.00
Vacancy			250	495	39.60
Daylight Harvesting	0.33	10	250	825	66.00
Total - Combined				**6,755**	**606.40**

Base upon $0.08 per kWh (National Average)

Level & Daylight Harvesting
Step or Bi-level Ballast

Ballast

Step Ballast



Input Wiring Control

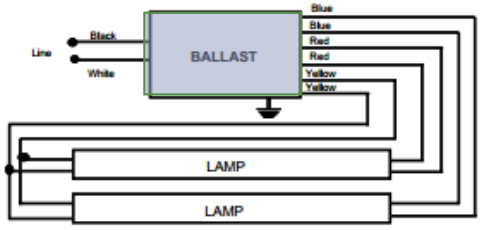
Line S1 Line 1

S1 Line 2

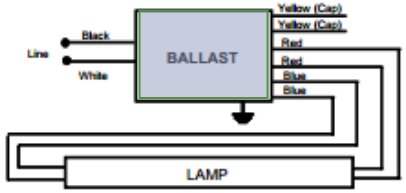
NOTE: Line 1 & Line 2 (Black & Black/White) must be derived from the same circuit.

S1	S2	Condition
On	On	Full Intensity
On	Off	Half Power
Off	On	Half Power
Off	Off	Off

Bi-Level Ballasts



TWO LAMP APPLICATION



ONE LAMP APPLICATION
Cap unused yellow leads, insulate to 600 volts

Considerations

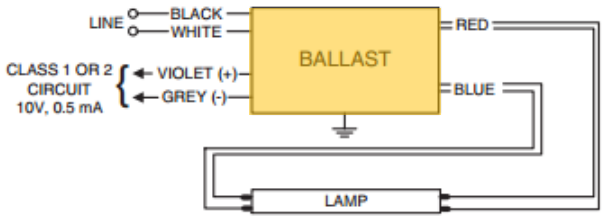
Levels:
Step Ballast: 3 levels (100/50/Off)
Bi-level Ballast: 4 levels (100/66/33/Off)

Wiring:
Both utilize two relays for control

Illumination:
Step Ballast: All lamps same level
Bi-level Ballast: Some lamps out

Level & Daylight Harvesting
0-10V dc Ballast

0-10V Ballast



100%

Max.

Min.

0%

Controller capabilities:
Max – set limit to allow for task tuning or lumen maintenance

Min. – set limit to allow for load shed limit

Considerations

Levels:
Continuous range (Typically 100% - 10%)
Varies by ballast and lamp type

Cost:
Quickly becoming the energy management ballast

- lower price point than architectural dimming ballast

Control method:
Available for fluorescent (linear & CFL), HID and LED

- Many manufacturers

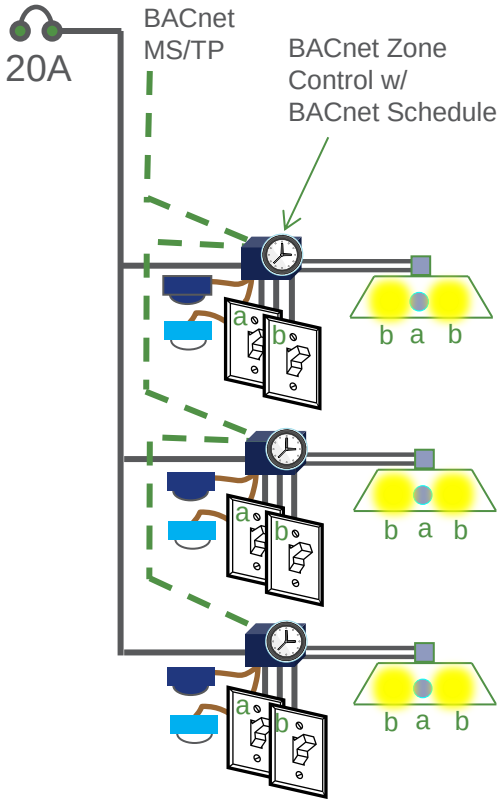
Light output vs. energy
Linear between 100% - 20%

- 50% lighting output = 50% energy

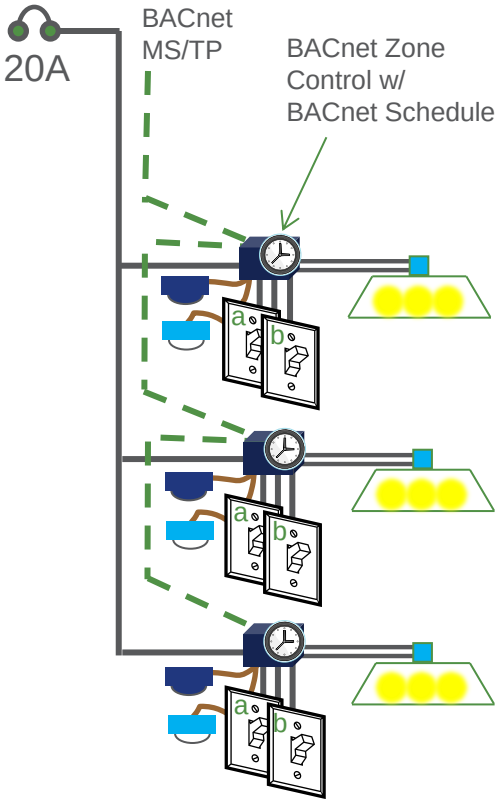
Daylight Harvesting Zone

Implementation Options To Consider

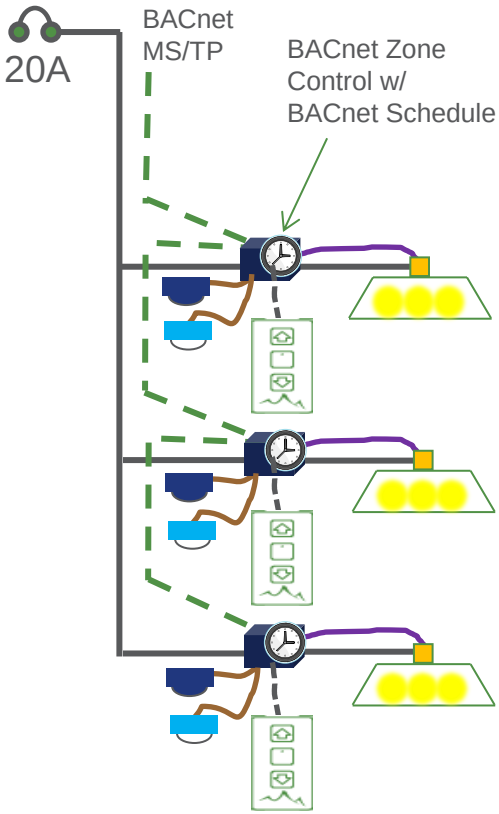
Good



Better



Best



Bi-Level Ballast

Step Ballast

0-10V dc Dimming Ballast

Add Daylight Harvesting

Save up to 80%

Morning

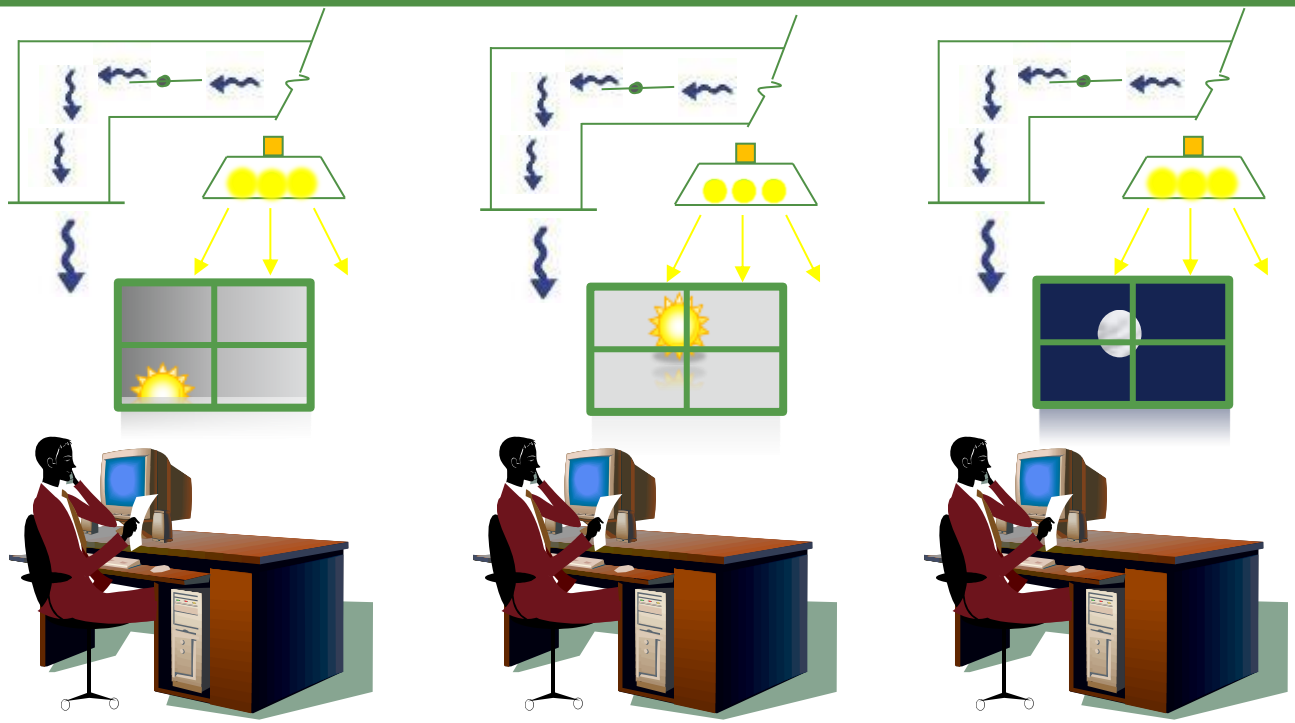
BAS Schedule: **Occupied**
Daylight: **Medium**
Lights: **On, 50%**
Occupant Set Point: **70%**
HVAC Temp: **Set Point**
Ventilation: **Full**

Mid-day

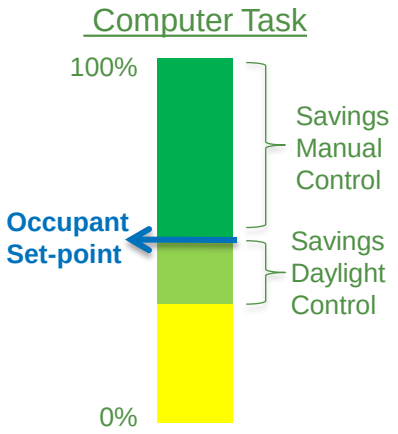
BAS Schedule: **Occupied**
Daylight: **High**
Lights: **On, 30%**
Occupant Set Point: **70%**
HVAC Temp: **Set Point**
Ventilation: **Full**

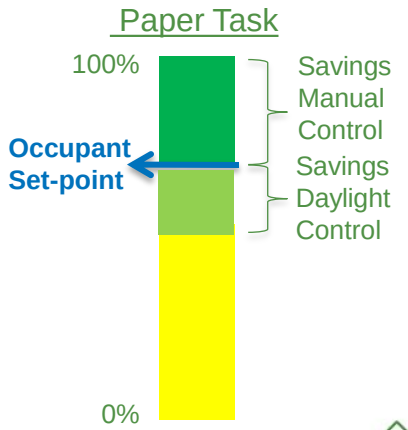
Evening

BAS Schedule: **Occupied**
Daylight: **Low**
Lights: **On, 100%**
Occupant Set Point: **70%**
HVAC Temp: **Set Point**
Ventilation: **Full**



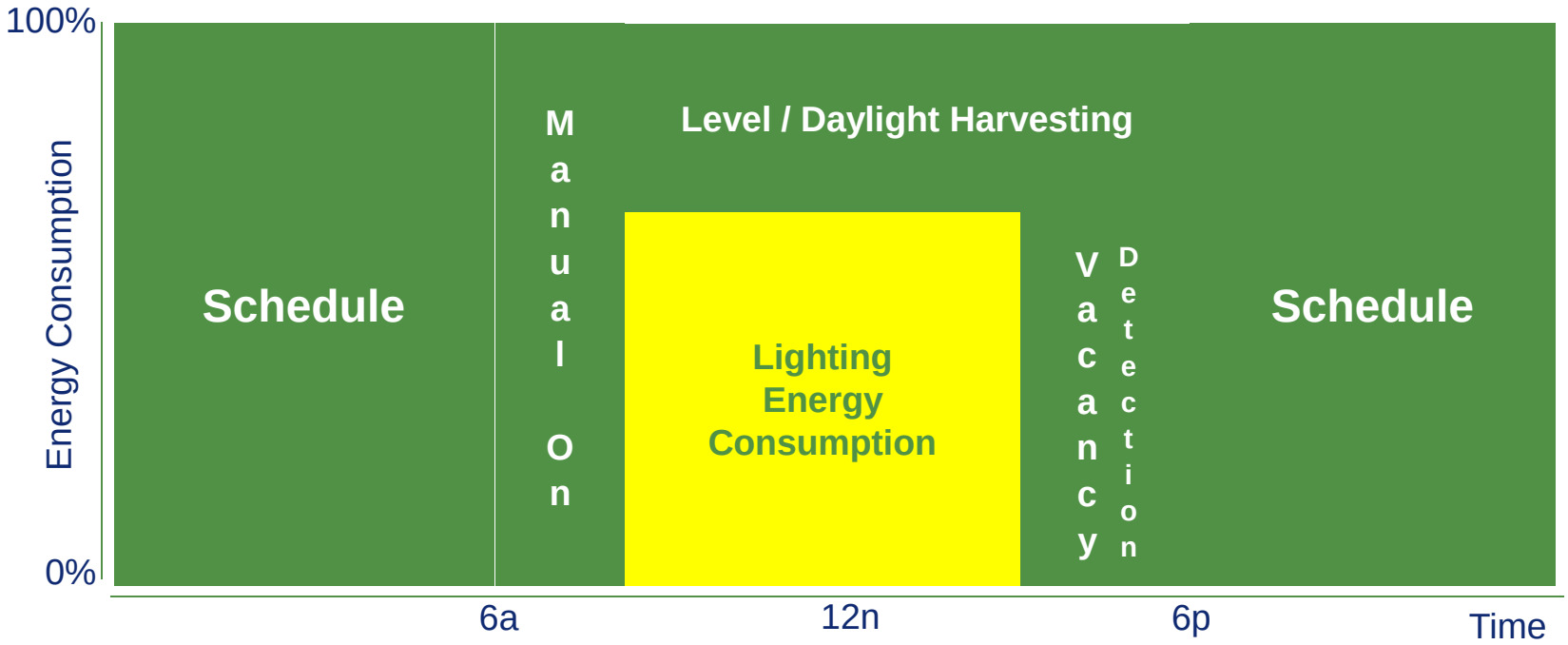
User Centered Control

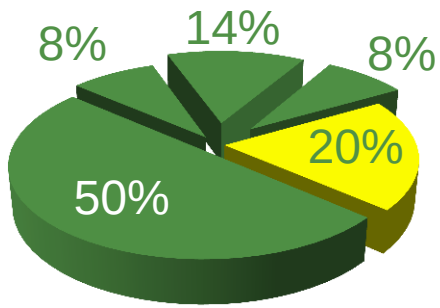




Unified Lighting Control

Up to 80% Savings





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Task Lighting / Plug Load
Control for a Complete Solution

Lower ambient light levels drives need for task lighting

Energy codes require same control of task lighting

Coming soon:

Requirements for control of 50% of plug load

- Already in ASHRAE 90.1 – 2010
- Shut down after hours – space heaters, fans, printers, task lighting, monitors/displays/TV's, coffee warmers, etc…

Experience the Difference

800-241-9173