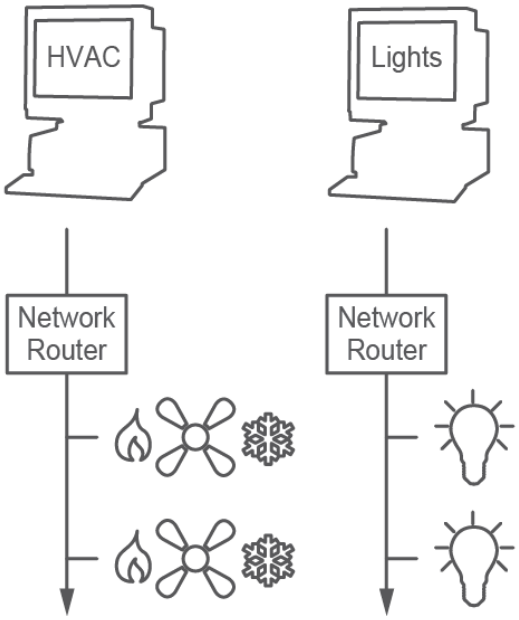
UNIFIED LIGHTING CONTROL

Unified Lighting Control

Important Differences

Stand Alone

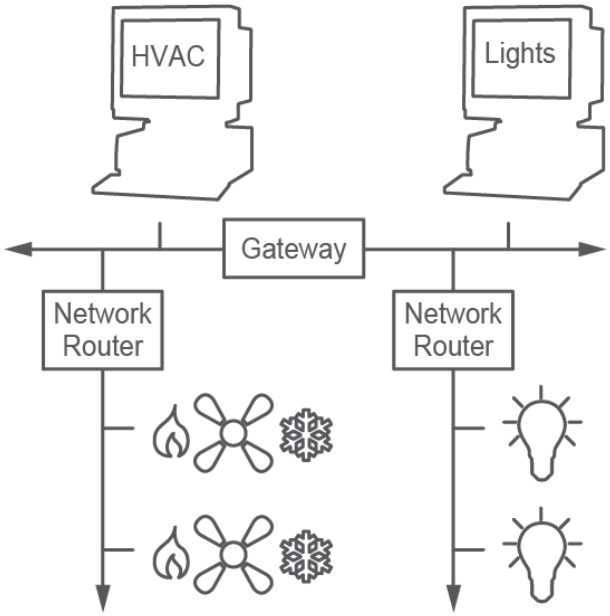


Separate Networks

Separate User Interface

No Integration

Gateway



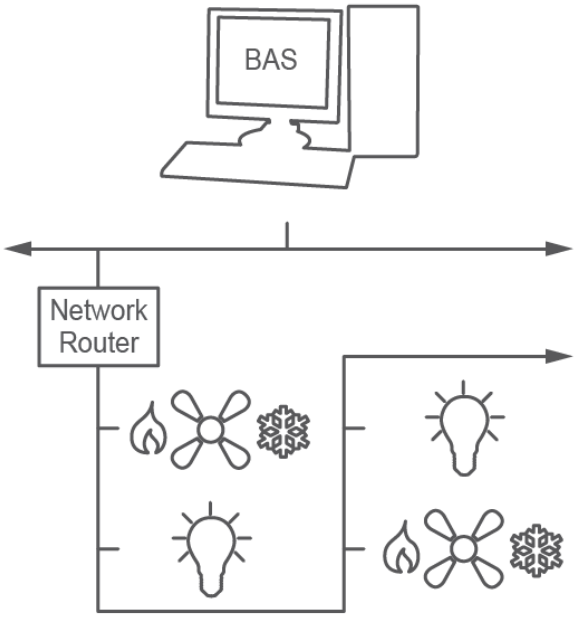
Separate Networks

Separate User Interface

Limited Integration

Finger Pointing / Delays

Unified



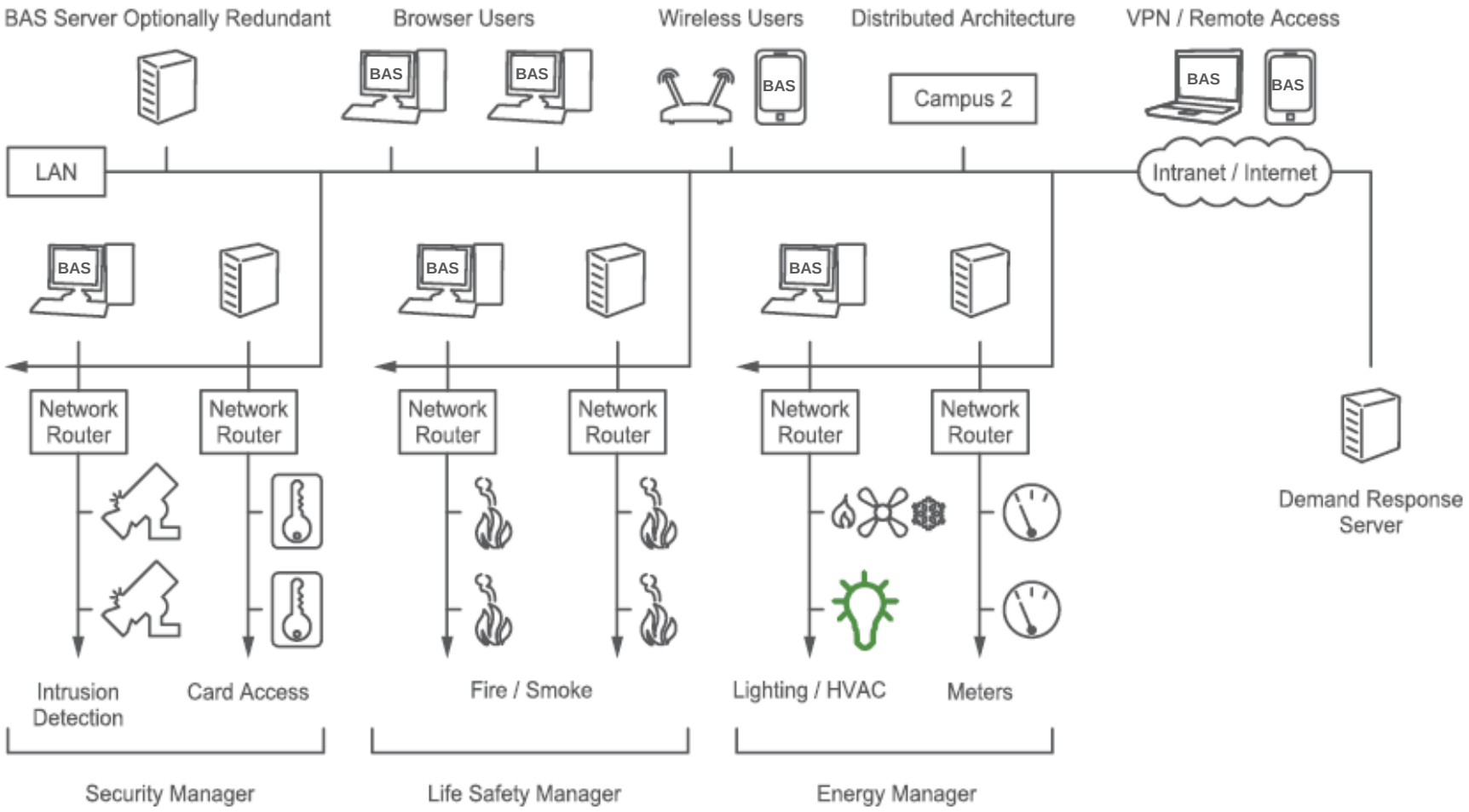
One Network

One User Interface

Wide Open Integration

Unified Lighting Control

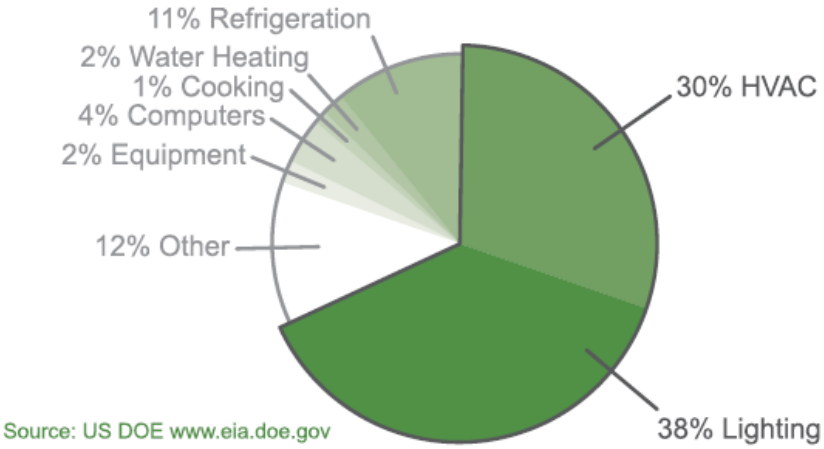
Leverages BAS Infrastructure



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

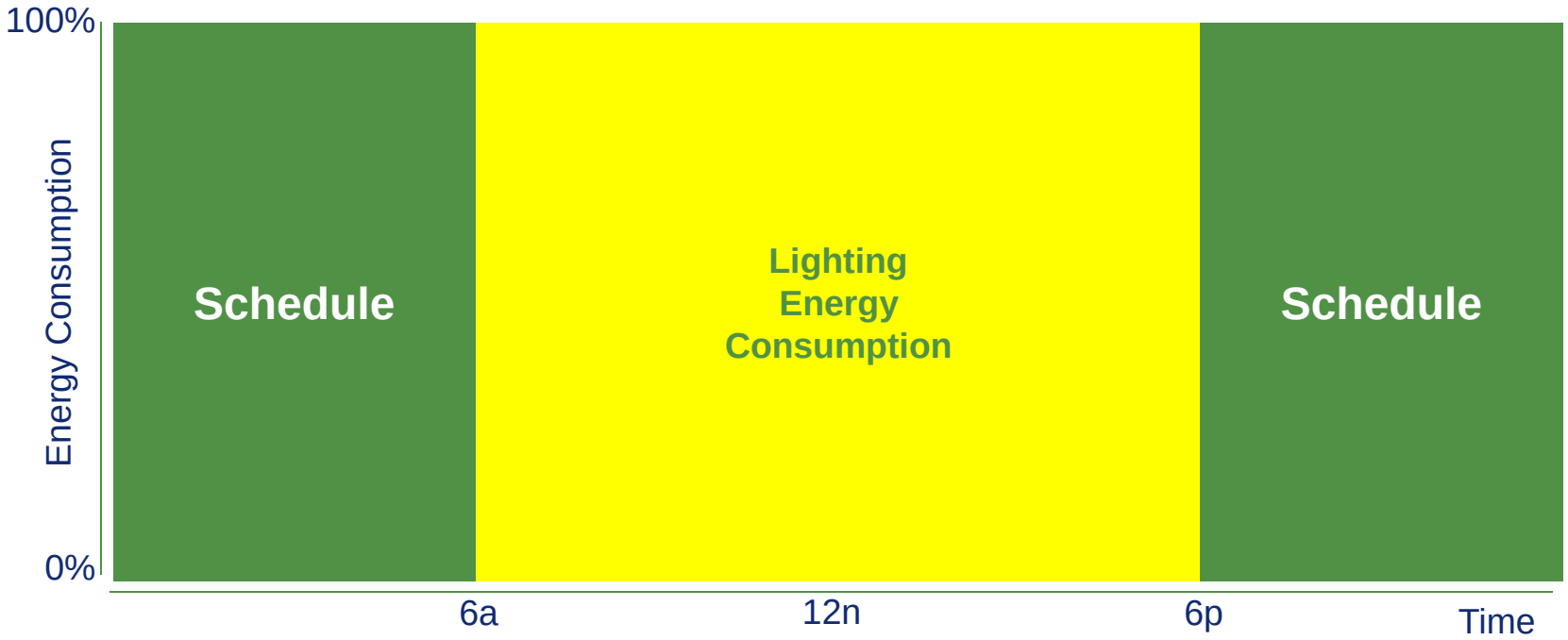
Lighting is typically the largest electrical load in commercial buildings

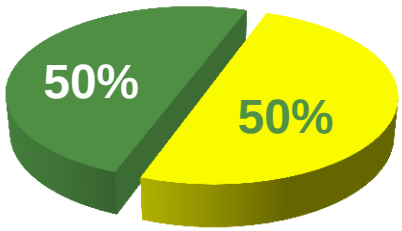
Experience the Difference

Energy Management Strategies

Control The Bookends

Up to 50% Savings





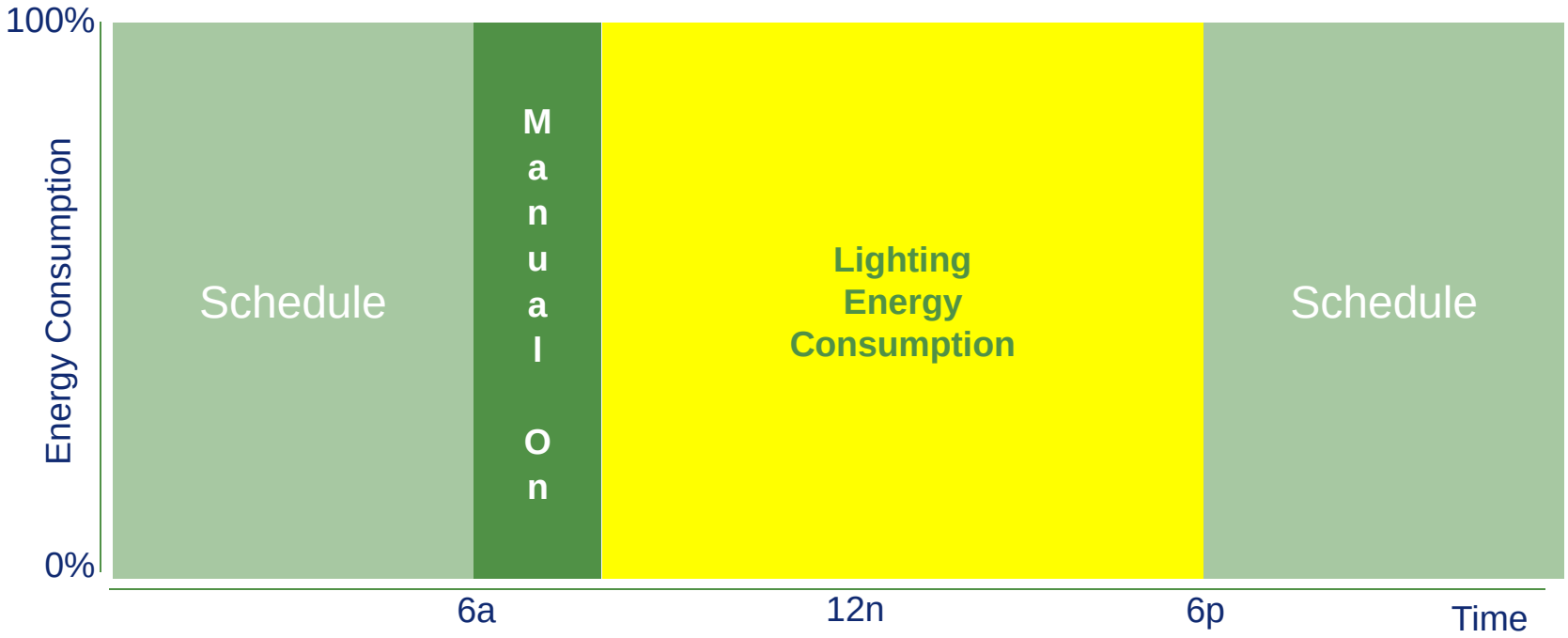
Annual Savings per Kilowatt

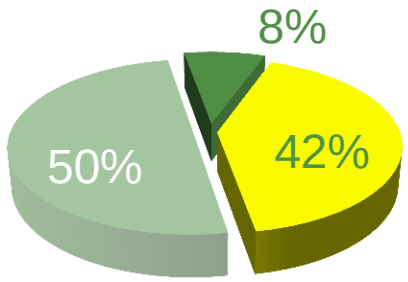
Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Work Week	1.0	12	250	3,000	240.00
Weekends	1.0	24	104	2,496	199.68
Holidays	1.0	24	11	264	21.12
Total - Combined				**5,760**	**460.80**

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%

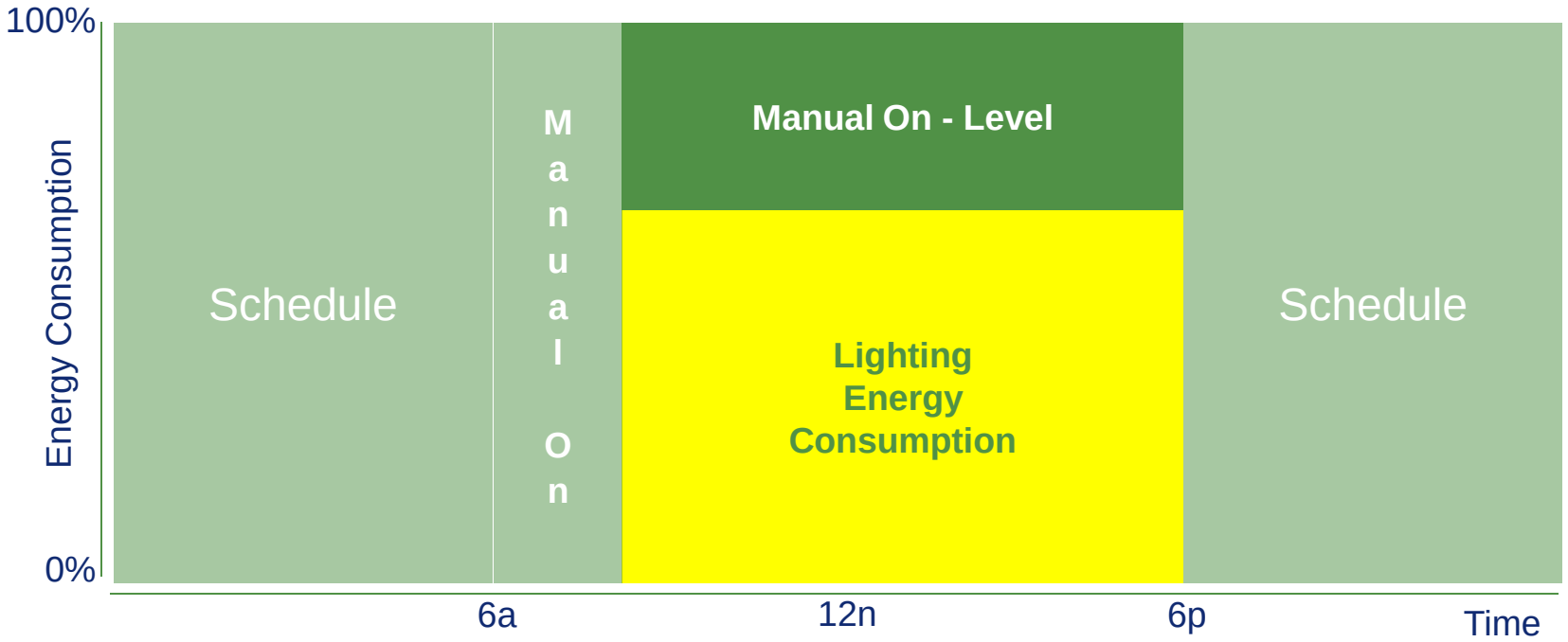
Benefit:

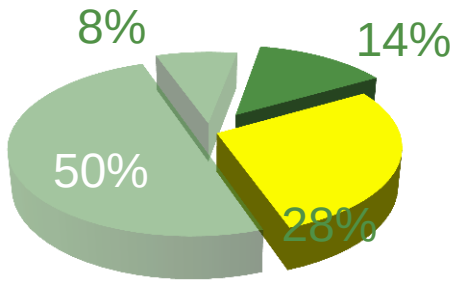
Occupant does not have to do anything

Common applications: hallways / corridors, public spaces

Bookends + Manual On

Up to 72% Savings





Annual Savings per Kilowatt

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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	2	250	500	40.00
Manual On - Level	0.33	10	250	825	66.00
Total - Combined				**7,085**	**566.80**

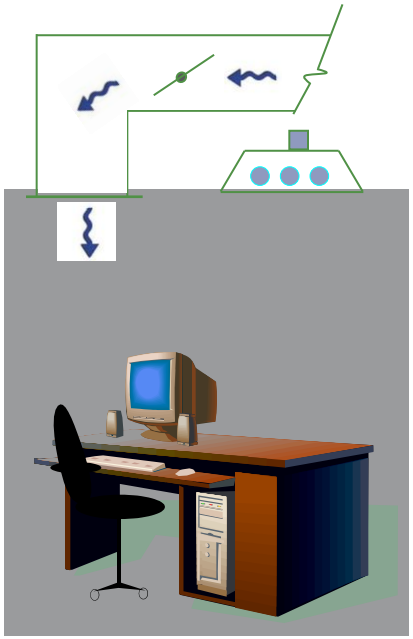
Base upon $0.08 per kWh (National Average)

Bookends + Manual On

A Closer Look

Morning

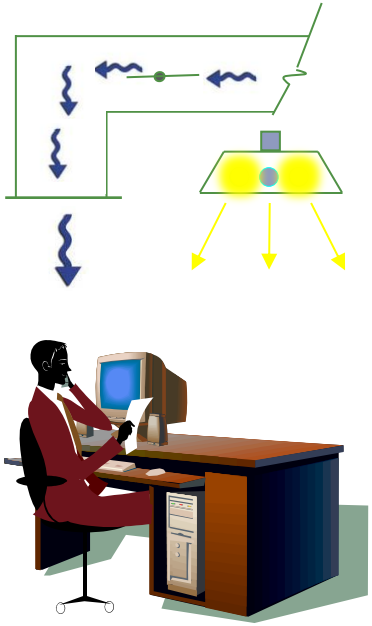
BAS Schedule: **Occupied**
Local Override: **Off, Timer Disabled**
Lights: **Off**
HVAC Temp: **Reset**
Ventilation: **Minimum**



Mid-day

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

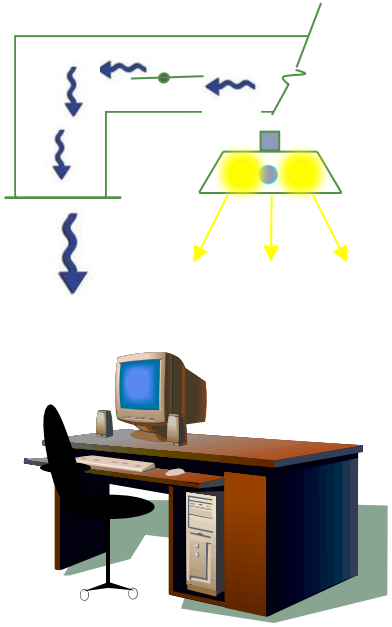
Lights: **On 2/3, manually**
HVAC Temp: **Set Point**
Ventilation: **Full**



Late Afternoon

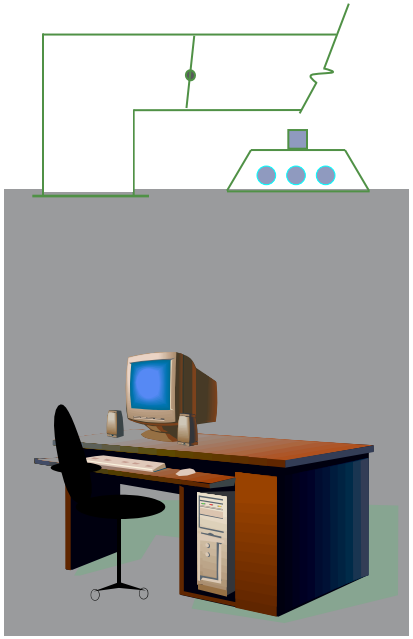
BAS Schedule: **Occupied**
Local Override: **On**

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



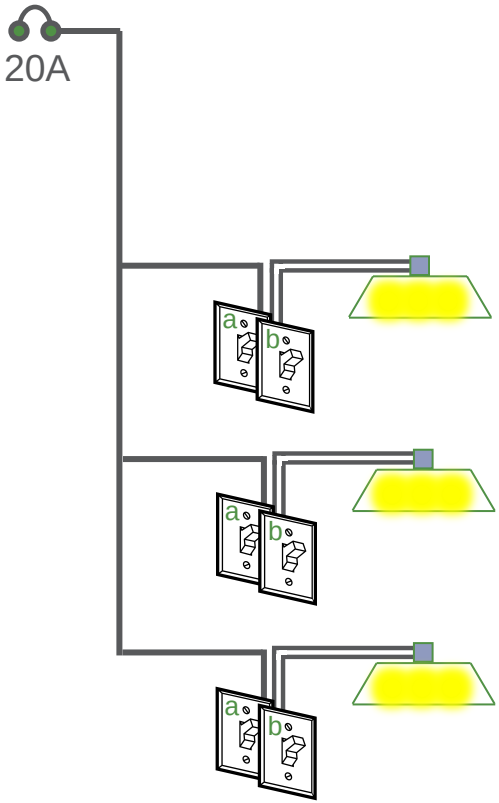
Night

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

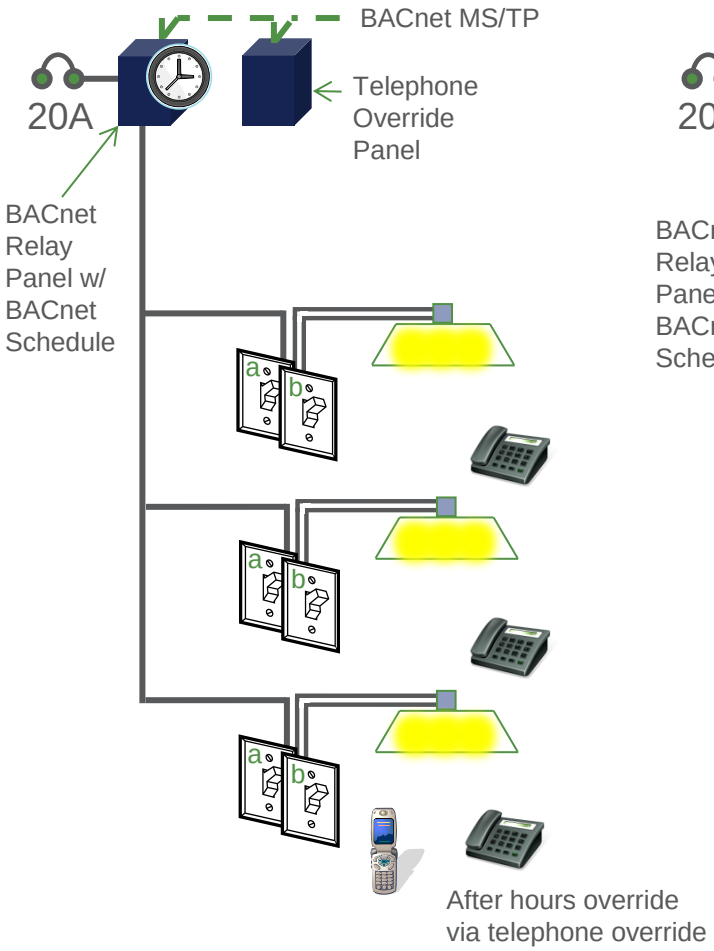
Re-wiring to add centralized control is not an effective solution

How do the occupants initiate after hours override?

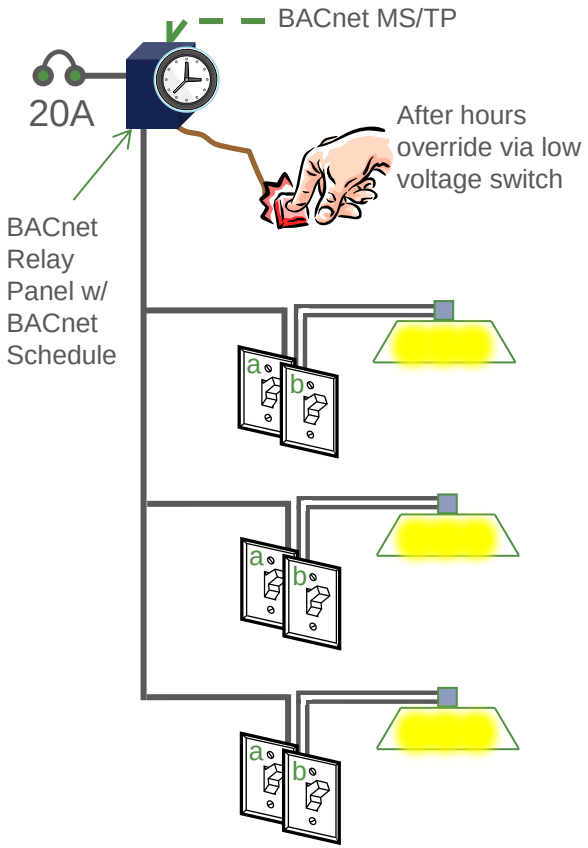
Bookends + Manual On

Implementation Options To Consider

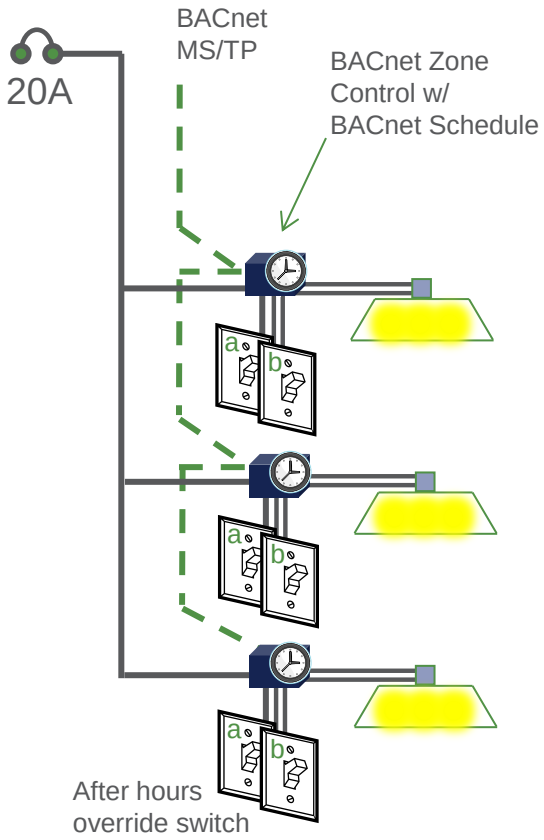
Good *



Better *

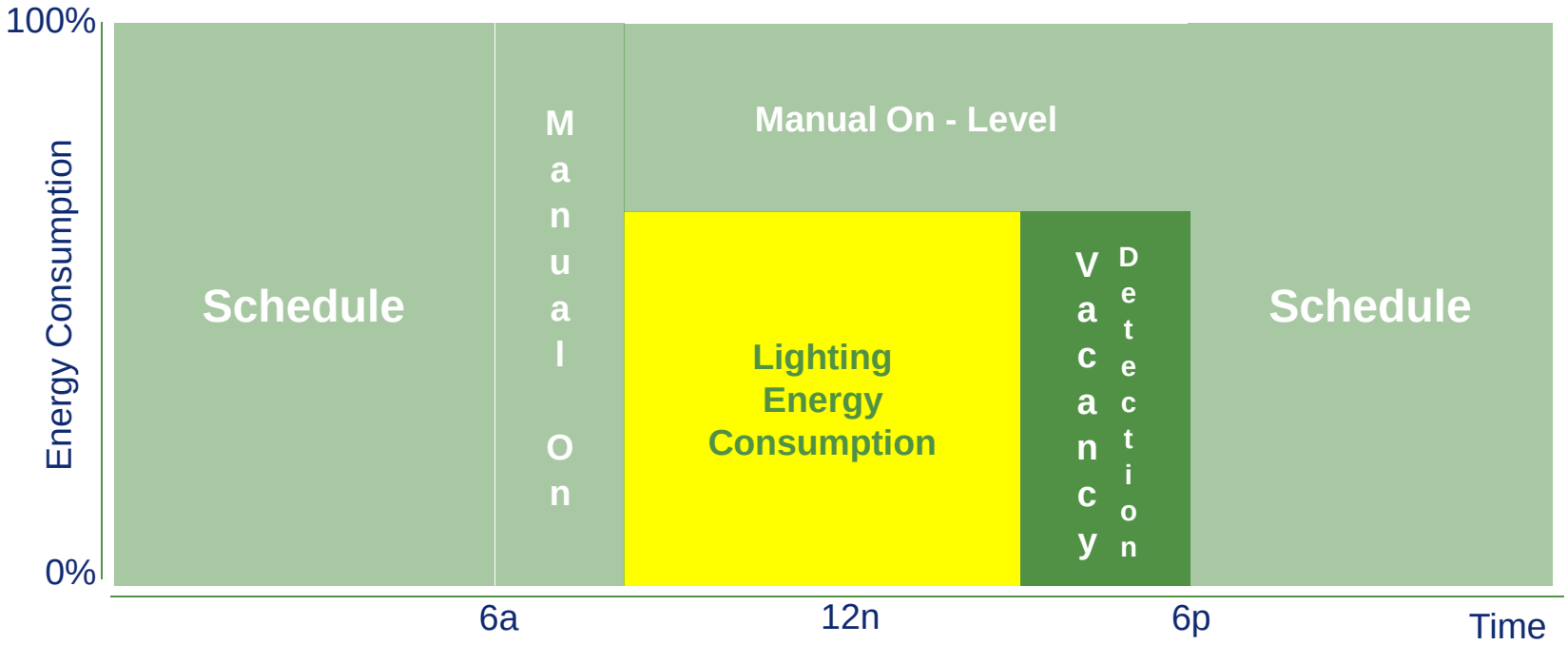


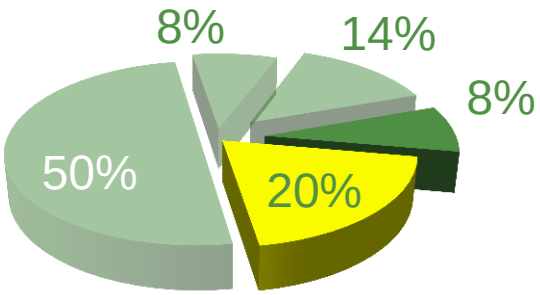
Best



* 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**

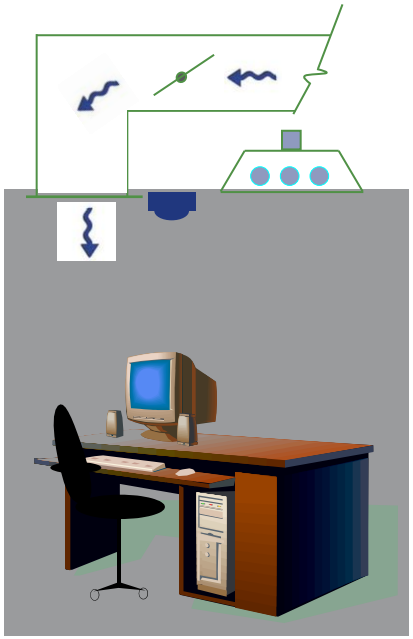
Base upon $0.08 per kWh (National Average)

Add Vacancy Detection

Save up to 80%

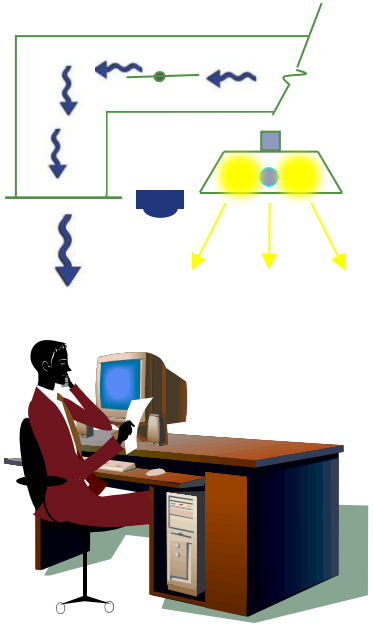
Morning

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



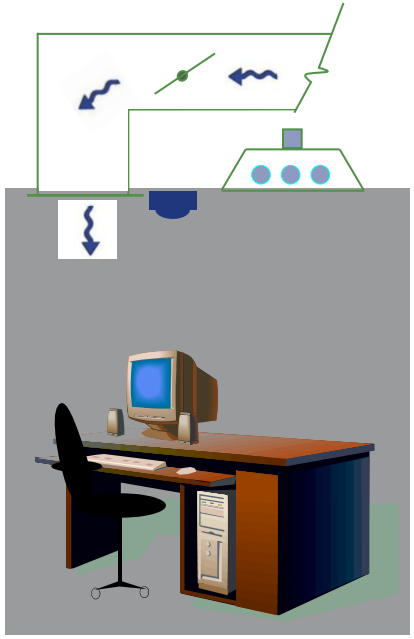
Mid-day

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



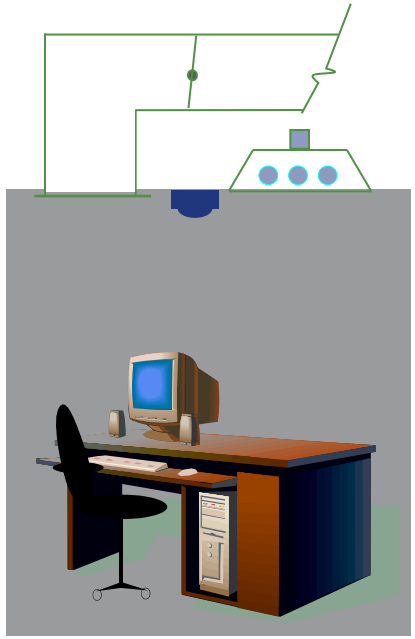
Late Afternoon

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



Night

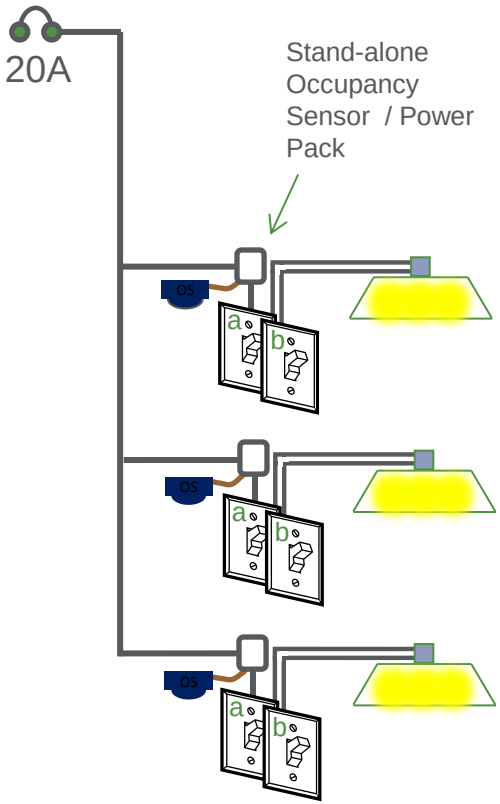
BAS Schedule: **Unoccupied**
Occupancy Sensor: **Off, 10 min timer set**
Lights: **Off, auto by OS**
HVAC Temp: **Night Set Back**
Ventilation: **Off**



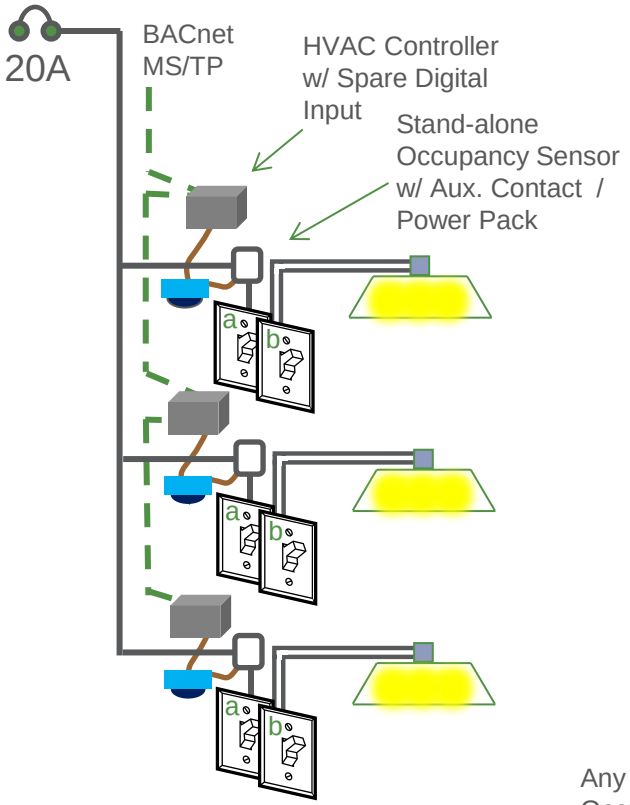
Add Vacancy Detection

Make Occupancy Sensors Better

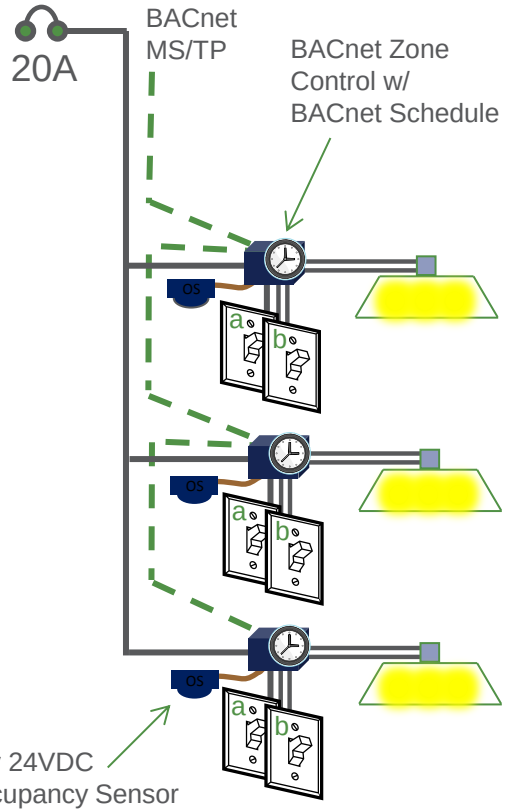
Stand-alone *



Spare Input *



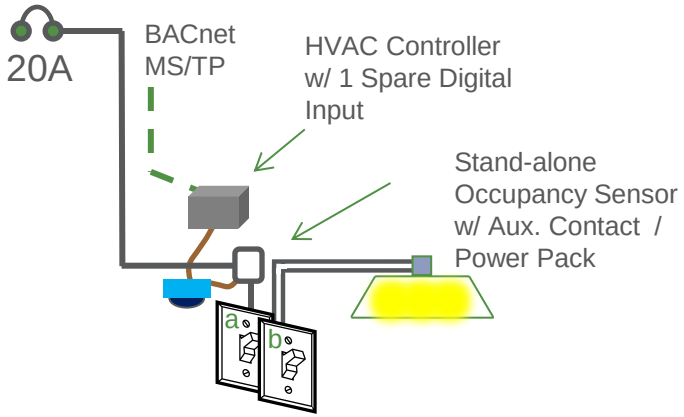
Unified



* 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

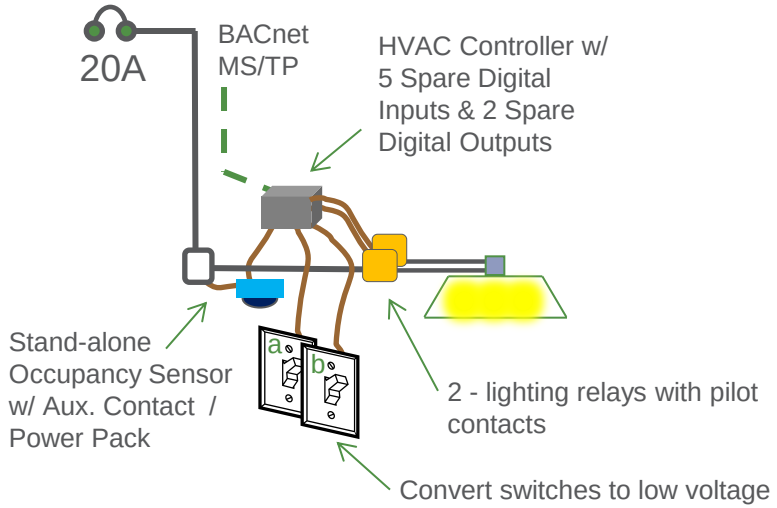
Spare Input – Basic



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

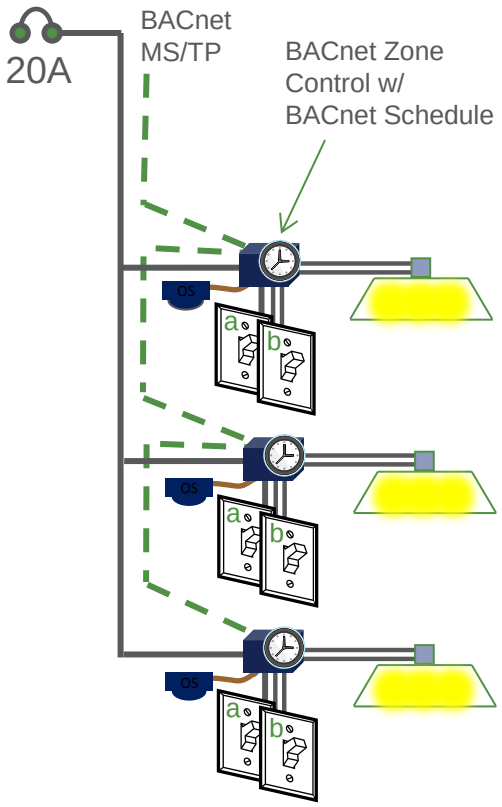
Better Performance

- 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

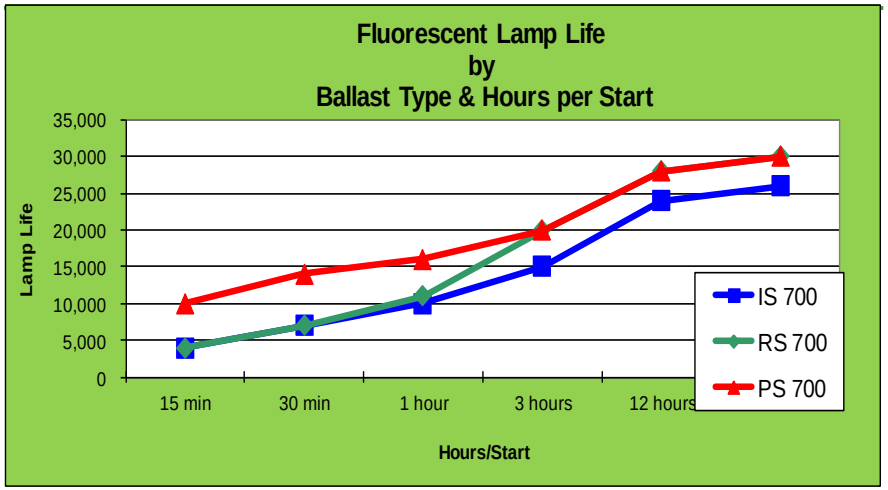


Add Vacancy Detection
Track and Optimize Lamp Life

Unified Solution

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

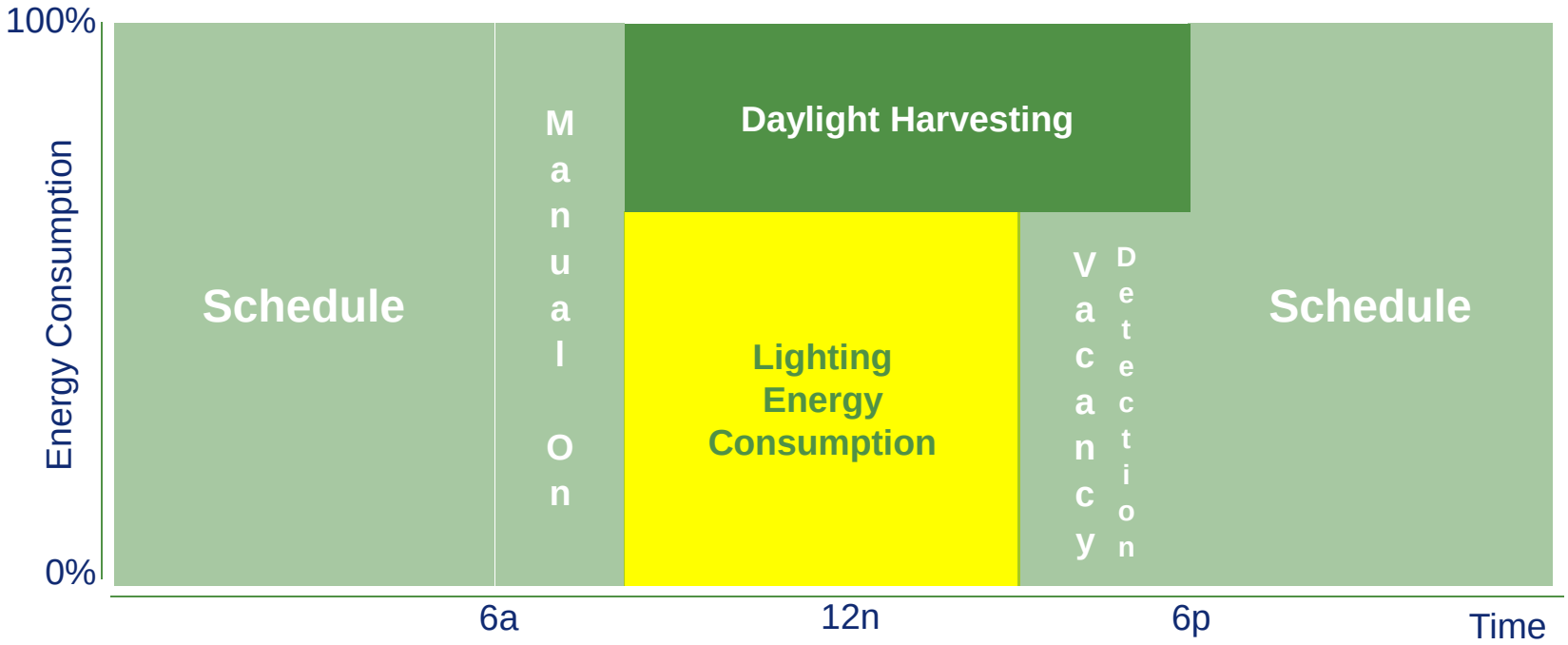
- Track actual performance
- Fluorescent lamp life can be dramatically reduced by short sensor timers and increased cycles
- Especially important for those that do spot lamp replacement
- US DOE spot re-lamp cost = $9.00 / lamp
  - $2.00 material (T-8 lamp)
  - $7.00 labor

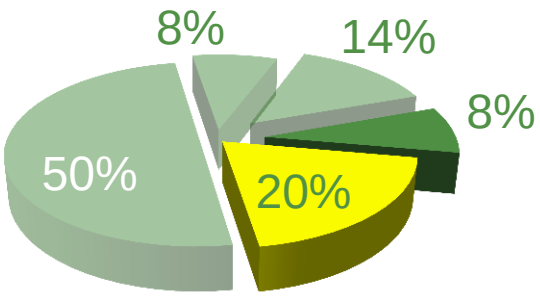


Source: Osram Sylvania

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

Daylight Harvesting
Up to 80% Savings





Annual Savings per Kilowatt

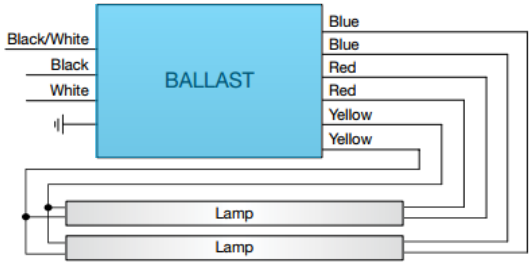
Period	Load (kW)	Hours Saved per Day	Days per Period	Total Savings (kWh)	Total Savings ($)
Total - Schedule Off			**365**	**5,760**	**460.80**
Manual On			250	500	40.00
Vacancy			250	495	39.60
Daylight Harvesting	0.33	10	250	825	66.00
Total - Combined				**6,755**	**606.40**

Base upon $0.08 per kWh (National Average)

Level & Daylight Harvesting
Step or Bi-level Ballast

Ballast

Step Ballast



Input Wiring Control

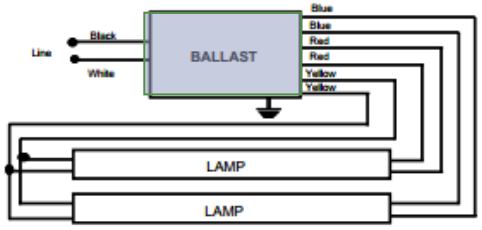
Line S1 Line 1

S1 Line 2

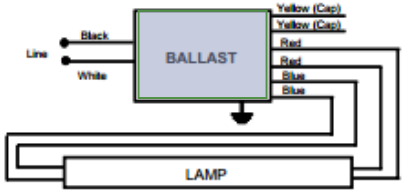
NOTE: Line 1 & Line 2 (Black & Black/White) must be derived from the same circuit.

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

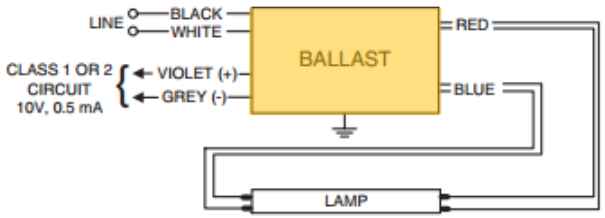
Levels:
Step Ballast: 3 levels (100/50/Off)
Bi-level Ballast: 4 levels (100/66/33/Off)

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

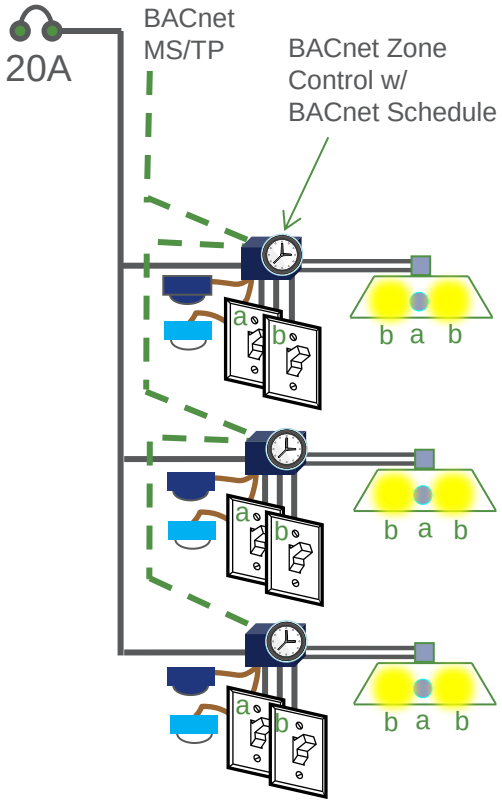
Light output vs. energy
Linear between 100% - 20%

- 50% lighting output = 50% energy

Daylight Harvesting Zone

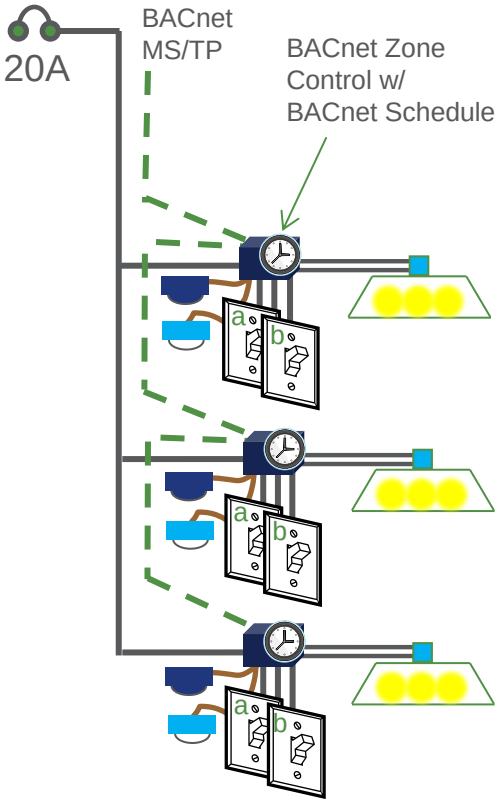
Implementation Options To Consider

Good



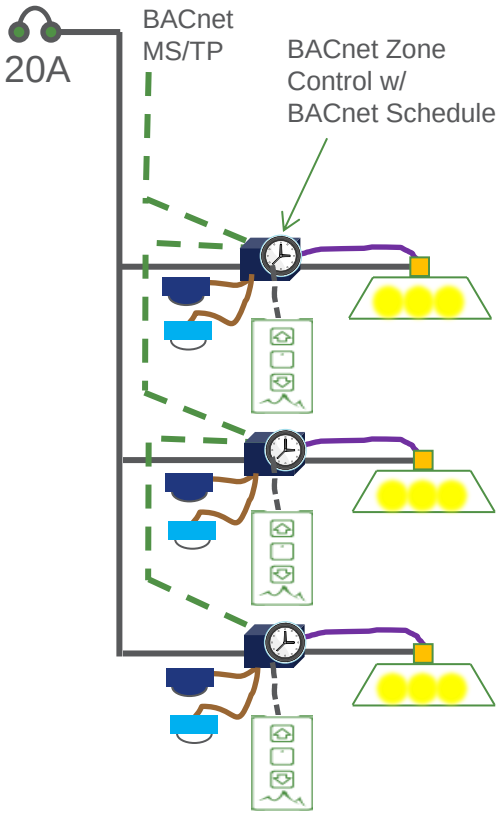
Bi-Level Ballast

Better



Step Ballast

Best



0-10V dc Dimming Ballast

Add Daylight Harvesting

Save up to 80%

Morning

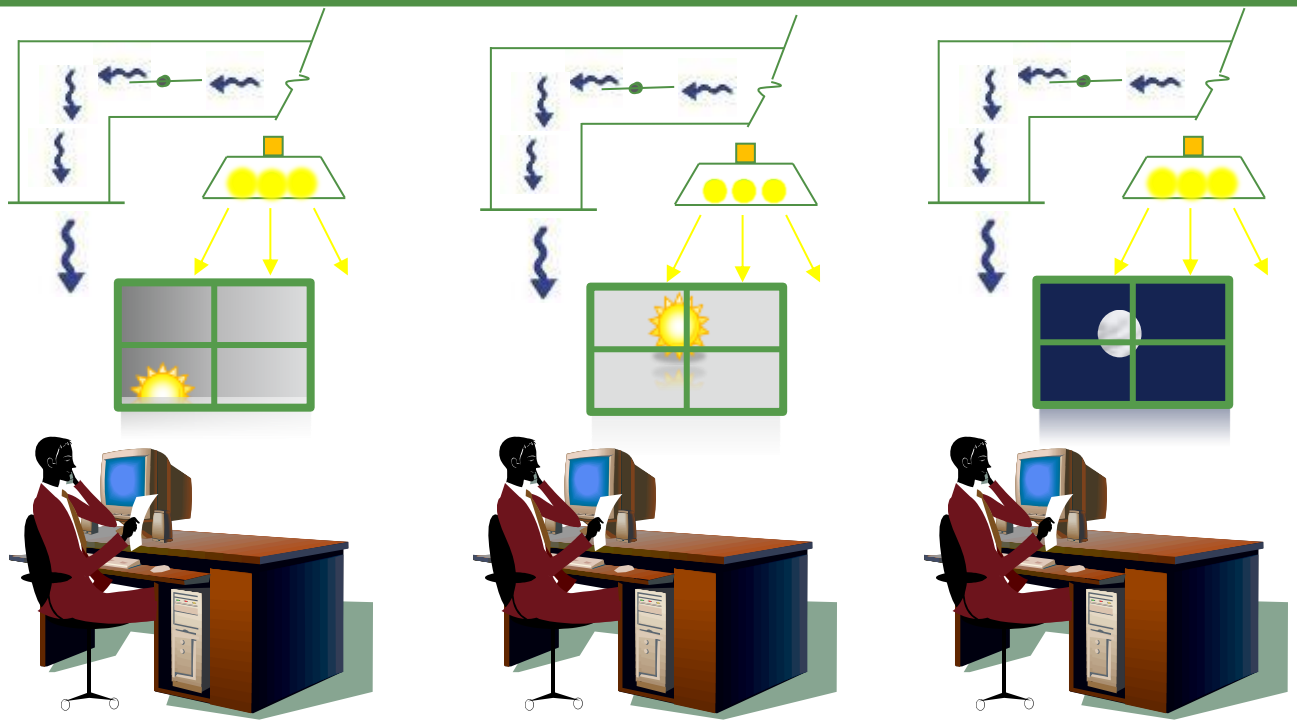
BAS Schedule: **Occupied**
Daylight: **Medium**
Lights: **On, 50%**
Occupant Set Point: **70%**
HVAC Temp: **Set Point**
Ventilation: **Full**

Mid-day

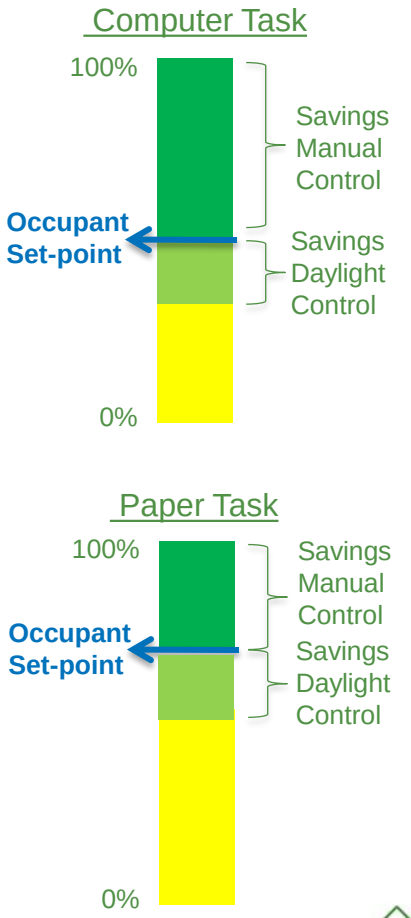
BAS Schedule: **Occupied**
Daylight: **High**
Lights: **On, 30%**
Occupant Set Point: **70%**
HVAC Temp: **Set Point**
Ventilation: **Full**

Evening

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

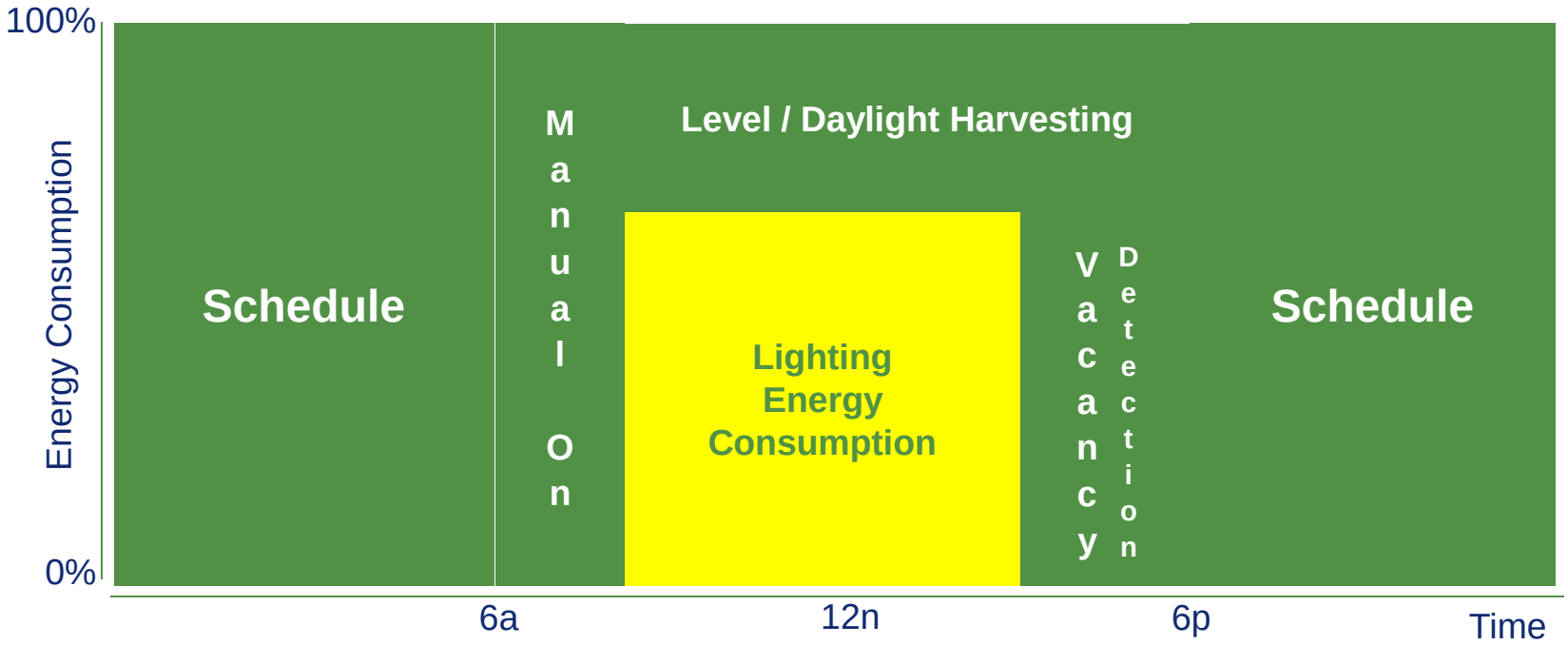


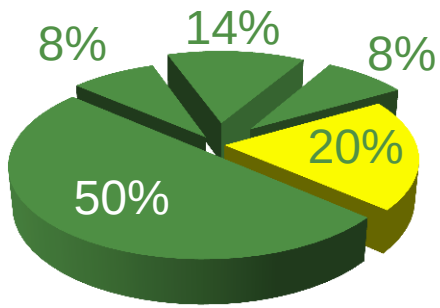
User Centered Control



Unified Lighting Control

Up to 80% Savings





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
Level / Daylight	0.33	10	250	825	66.00
Total - Combined				**6,755**	**606.40**

Base upon $0.08 per kWh (National Average)

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