Northwest Power and Conservation Council

October 2, 2008

MEMORANDUM

TO: Council Members

FROM: Charlie Grist

SUBJECT: Preliminary Cost and Availability of Conservation Potential in the Commercial Sector

Staff is updating its assessment of the conservation opportunities in the commercial sector. This presentation will provide an overview of the preliminary findings of costs and savings potential for interior lighting, exterior lighting, sewage treatment and water supply. Time permitting, staff will also provide a brief review of its assessment of the conservation potential in packaged refrigeration equipment. These measures cover about half of the suite of commercial-sector measures we are looking at. The remainder will be developed over the next two months.

Lighting is the single largest electric end use in the commercial sector and has accounted for a large share of commercial-sector conservation potential in every Council power plan since 1981. Lighting measures accounted for over one-third of the commercial-sector savings potential in the 5th Power Plan and will remain an important focus in the 6th Plan.

Since the 5th Plan, there have been some significant changes that impact energy conservation potential in lighting. The Energy Independence and Security Act (EISA), passed in 2007, and some state standards passed in 2005-2006, will capture some of the potential identified in the 5th Plan at no cost to the electric system. This reduces estimates of future potential compared to the 5th Plan. On the other hand, new measures have been added to the measure list for both interior and exterior lighting and will expand conservation potential relative to the 5th Plan. New measures include the addition of efficient fluorescent fixtures, lighting control measures, and new solid-state lighting technologies for lighting systems on roadways, parking lots, parking structures, walkways, building facades and electric signage.

We will also review revised conservation potential estimates in sewage treatment and water supply. Initial estimates show less potential and higher costs in sewage treatment and similar potential and higher costs in water supply compared to estimates in the 5th Power Plan.

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Status Report on Commercial Sector Conservation Assessment

Preliminary Cost & Availability for Lighting

October 15, 2008

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What's Covered Today

- Interior Lighting in Buildings
- Street Lighting

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Not Covered Today

- Heating Ventilation & Air Conditioning
- Process Loads:
  - Cooking, water heating, refrigeration, computing, sewage, water
- Envelope - Glass

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Commercial Sector

- About 3 billion square feet of non-residential buildings
  - 40 to 50 million SF of new stock per year
- Over 350,000 buildings
- Plus “Infrastructure”
  - Streetlights, parking, sewage & water treatment, communications, transportation, …

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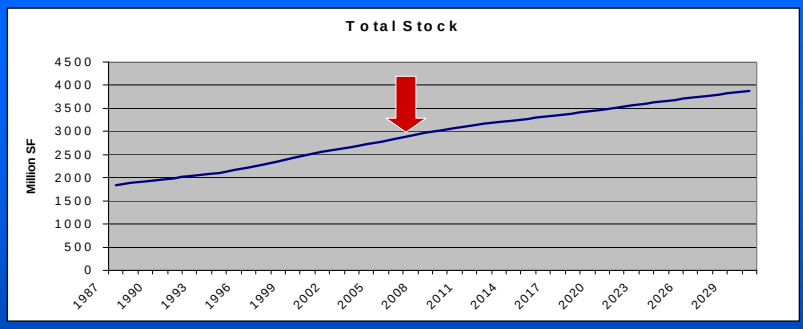

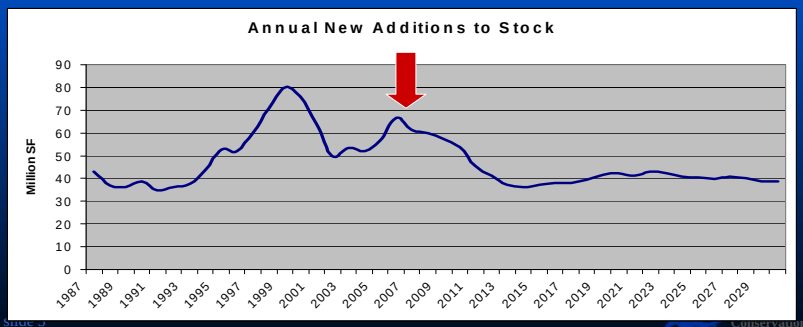

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Commercial Sector

- Can't do an estimate for each building
- So we simplify things:
  - 18 building types
  - 5 vintage cohorts
  - 3 space heat fuel types
  - 8 end uses
  - 2 climate zones

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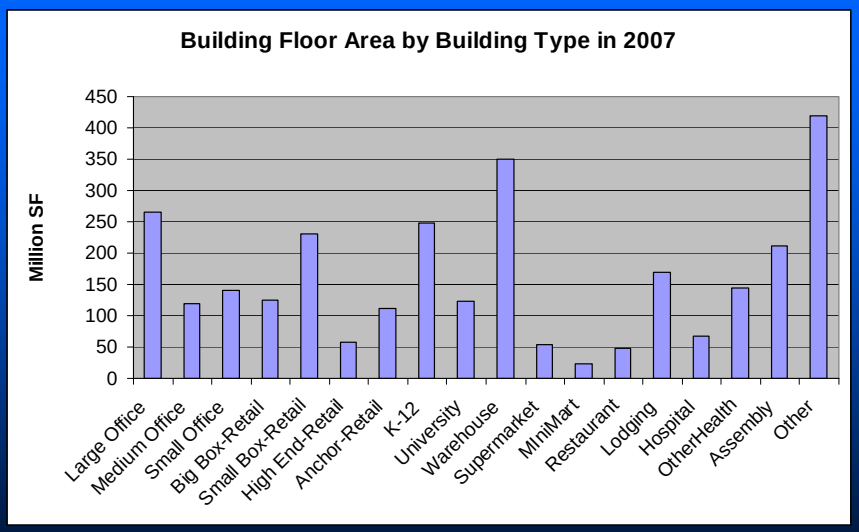

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Lighting

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Why Lighting is Important

- Lighting is big: About 40% of electric use
- Technological Change
  - New baseline conditions
  - New measures are available
- Proven track record
  - Programs, codes & standards capture savings

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How We Estimate Lighting Savings

Lighting Energy:
Watts x Hours = kWh

More Efficient Lamps & Ballasts
More Efficient Fixtures

Lighting Savings:
Watts Saved x Hours = kWh Saved + HVAC Interaction
or
Watts x Hours Saved = kWh Saved + HVAC Interaction

Control Measures: Occupancy sensors, timers, day lighting

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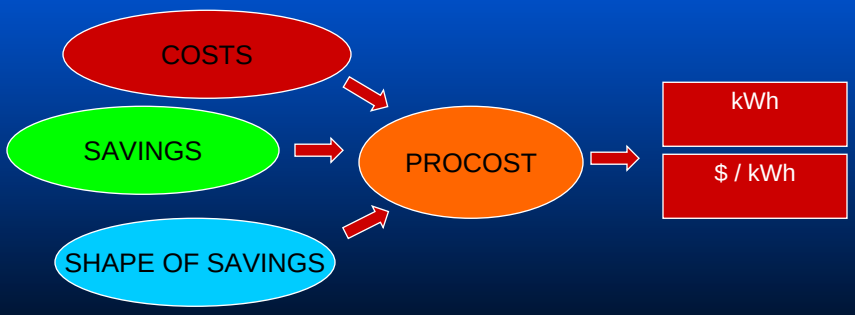
How We Estimate Cost of Savings

First Cost = Equipment + Labor + Markup + Disposal

Periodic Costs = Lamp replacement costs or savings

Annual Fuel Costs = Cost of gas to replace heat from lights



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Then Supply Curves

kWh/SF x (SF Applicable) x (Achievable) = Total Potential

Simple ...

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But Tedious

- 10 lighting measures, 18 building types, 3 fuel types, 3 vintage cohorts = 1620 lighting measures
- Each with a dozen different costs & savings inputs

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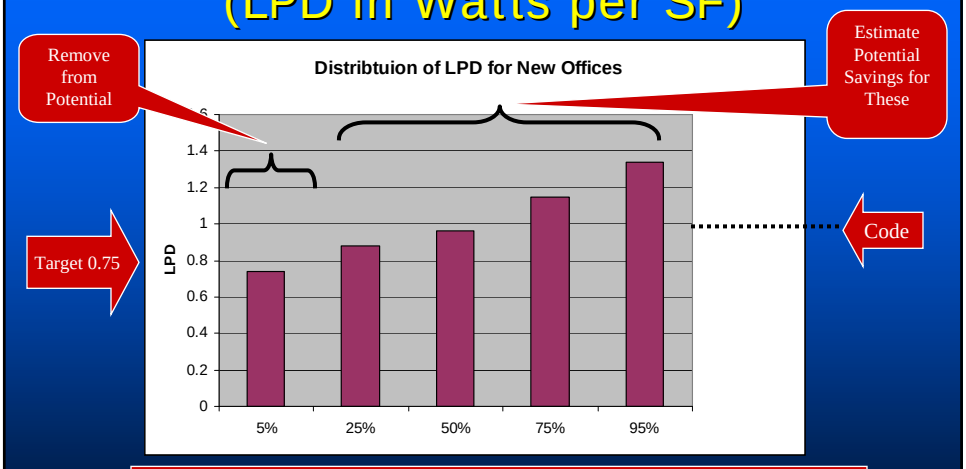
Reducing Lighting Power Density (LPD in Watts per SF)



Source: New Buildings Characteristics Survey, Ecotope for NEEA 2008

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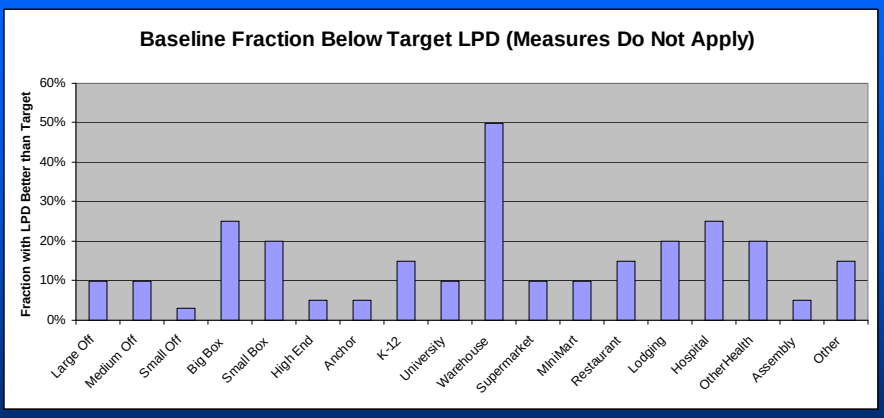

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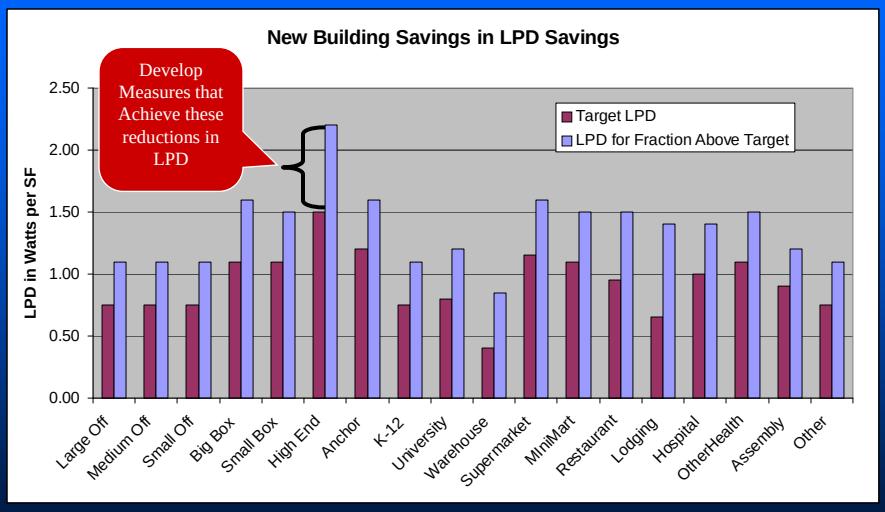

Lamp & Measures Distribution for New Large Offices

Lamp Type	Fraction
T12 Fluorescent	0.1
T8 Fluorescent	70.3
T5/HPT8 Fluorescent	8.4
Compact Fluorescent	9.9
Incandescent	9.2
MISC	0.1
HID-Ceramic Metal Halide	0.1
HID-Metal Halide	2.0
Sum	100

T12 to HPT8

T8 to HPT8

T8-2 to T8HP-2 & Efficient Fixture

Inc-R to LED

Inc to CMH

Savings from the measures applied add up to the LPD savings target. Savings and costs are weighted by contribution to LPD reduction.

Repeat for 18 Building Types for 3 Vintage Cohorts

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Some Key Measures

Measure Baseline System	Measure Description	Wattage Reduction for Similar Light Output
T12 Linear Fluorescent	T12-3 to T8HP-2	50%
	T12-4 to T8HP-3	44%
	T12-4 to T8HP-2	49%
	F96T12 to T8HP	22%
	F96T12HO to T8HP-4	24%
T8 Linear Fluorescent	T8-2 to T8HP-2	21%
	T8-3 to T8HP-2	19%
	T8-4 to T8HP-3	21%
	T8-2 to T8HP-2 & Adv Troffer	31%
	T8-2 to T8HP-2 & Adv Pendant	27%
	T8-2 to T8HP-2 & Adv Basket	31%
	T8-2 to T8HP-1 & Adv Troffer	30%
Metal Halide	Med MH to T8HP	45%
	Med MH to T5HO	44%
	Large MH to T5HO	49%
	Small MH to CF-R	45%
Incandescent	INC to CMH35	70%
	INC to CFL	73%
	MR to MR/IR	43%
	Inc-PAR-IRL to Inc-PAR-HIR	27%
	Inc-PAR-IRL to CMH25	68%
	Inc-PAR-IRL to LED PAR	72%
	Inc-R to LED DL	70%

New for 6th Plan

New for 6th Plan

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Notable Changes from 5th plan

- T12 Linear Fluorescent are dying out
  - None in new buildings, phasing out in existing stock
- High Performance T8 (HPT8) is FL measure of choice
- Replace 1990s T8s with HPT8 (75 to 95 lumens/Watt)
- Programs should promote HPT8 ONLY
- Baseline for incandescent is Halogen (EISA2007)
- Baseline for Metal Halide is Pulse Start (EISA2007)
  - Savings deltas are smaller
- Lot of CFLs in new buildings
- Linear Fluorescent is replacing Metal Halide
  - But MH to Linear FL still a good measure
- Added Efficient Fluorescent Fixtures as NEW MEASURE

Preliminary Results Lighting

Preliminary Disclaimer

- Waiting for new data on baseline for exiting stock
- Expect revisions to floor area and fuel cost
- Measure data refinements on costs and applicability
- Error checking

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Preliminary Results Lighting

- Increased achievable potential relative to 5th Plan
  - Over 500 MWa in 6th versus about 350 MWa in 5th
  - New measures added exceed accomplishments
  - Lower achievable LPDs
  - More ways to turn lights off
- More in Natural Replacement than Retrofit
- Somewhat higher cost
- Not all of this is cost-effective
- Low TRC cost due to High fraction on Non-Energy Benefits

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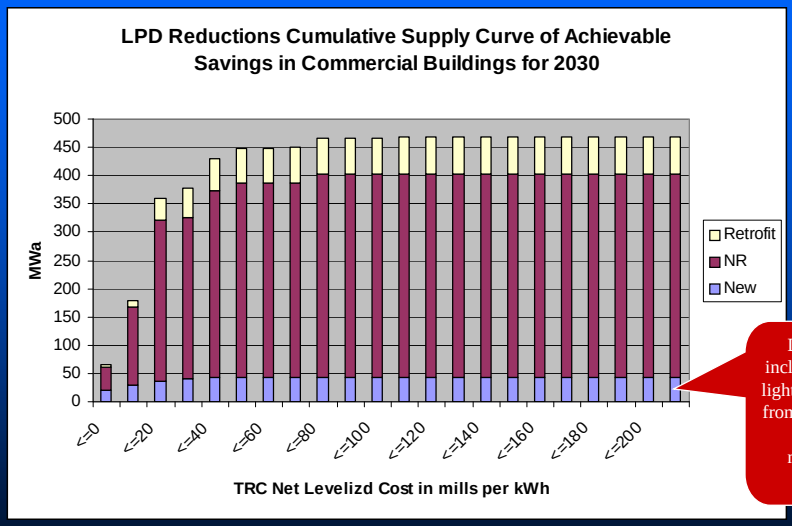
Preliminary Results for LPD Reductions



Does not include similar lighting savings from Integrated Design measure.

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Lighting Control Measures

- A minor revolution in technology & applications
  - Lower cost, higher reliability and more options
- Warehouse & Open Office occupancy sensors
- Classrooms
- Dimming during retail store stocking periods
- Bi-level stairwell & hallway
- Restrooms, break rooms

These measures were not in the 5th Plan

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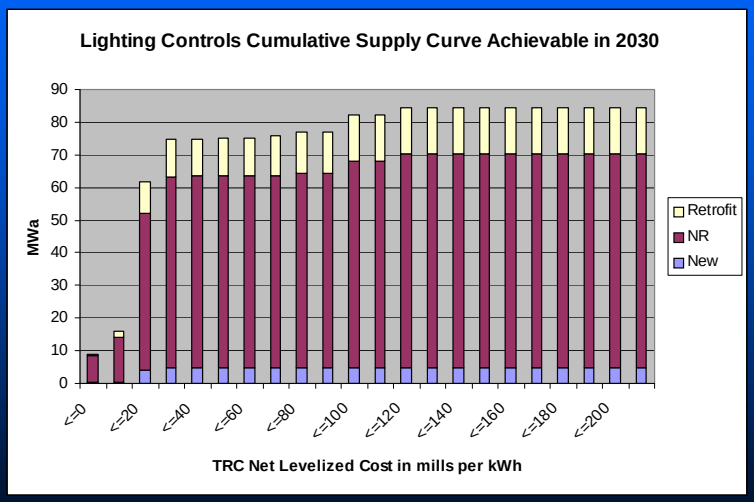
Preliminary Results for Lighting Control Measures



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Daylighting

- No new results yet
- Expect results similar to 5th Plan (40MWa)
- Most savings in skylight daylighting
- High penetration new in Big Box Stores
  - All new Wal-Mart stores
- Modest savings in side daylighting
  - Still working on control problems
  - Lower Baseline LDPs reduce savings

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Outdoor Lighting

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Advances in LED Streetlighting

Six Months Ago	Today
Oakland, CA	Oakland, CA
Replace 121W HPS	Replace 121 HPS
78W LED	58W LED
$610 per Fixture	$400 per Fixture
Better Light	Better Light
$14 per Watt Saved	$7 per Watt Saved

NICE PROGRESS

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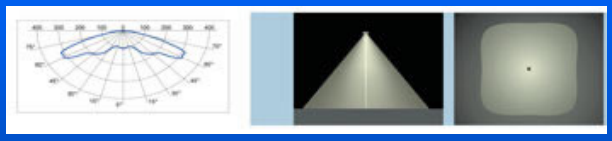
Directional Point Sources

Tunable Optics



Key Measure Inputs

- 8 measure permutations
- Baseline measure 100W & 150W HPS
- Two replacement options each
- Two strategies for lamp replacement costs
  - Group relamping & Utility tariff
- Gives a wide range of levelized costs

Measure Applicability

- Only apply to low-mast poles <30 feet
  - Most city streets
  - Tunnels & some highway
- Estimated 1.5 million applicable streetlights

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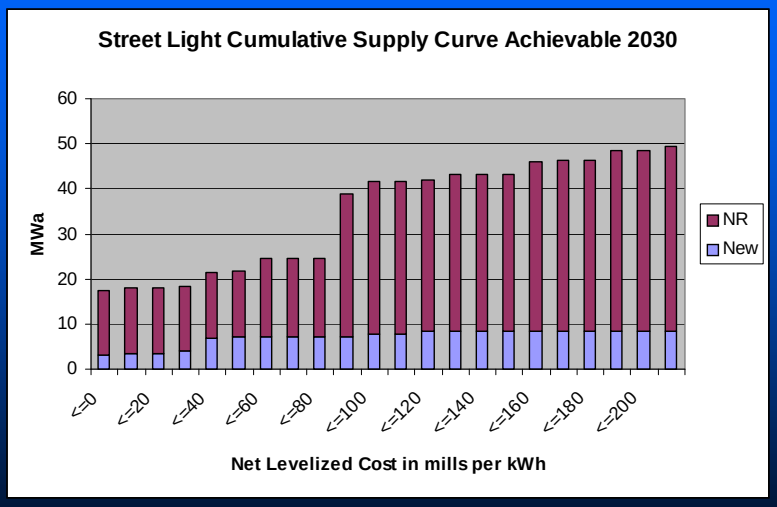
Streetlights



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Streetlight Issues

- High Non-Energy Benefits:
  - Value of maintenance savings equal or exceed energy
  - Limits utility incentives
- Nighttime power values are lower
- Fast-moving technology
  - Lots of bad products out there & a few good ones
- Challenging mix of ownership
  - Generally unmetered
  - City owned & maintained
  - City-owned but utility maintained
  - Utility-owned and maintained
- Good time for Demonstrations

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Other Outdoor Lighting Suitable for SSL

- Area Lights
- Step & Pathway Lights
- Parking Lot & Parking Garage
  - 50% Savings with occupancy sensors
- Building Façade & Architectural
- Electric Signage
  - 60 -70% Savings

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Parking Garages
1:30am “6 cars”

Dr. Michael Siminovitch.

Professor, UC Davis

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Dr. Michael Siminovitch.

Professor, UC Davis

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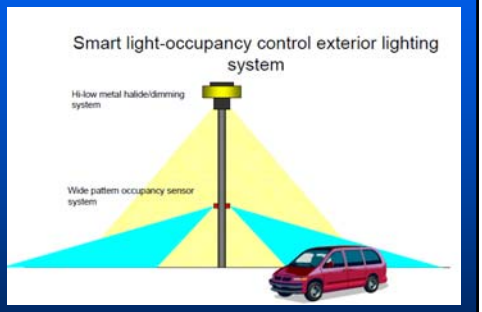
Exterior Lighting Systems

- Controls & Smart Systems
- Bi-Level Controls
  - Reduce Energy
  - Reduce Maintenance
  - Enhance Security



Dr. Michael Siminovitch.

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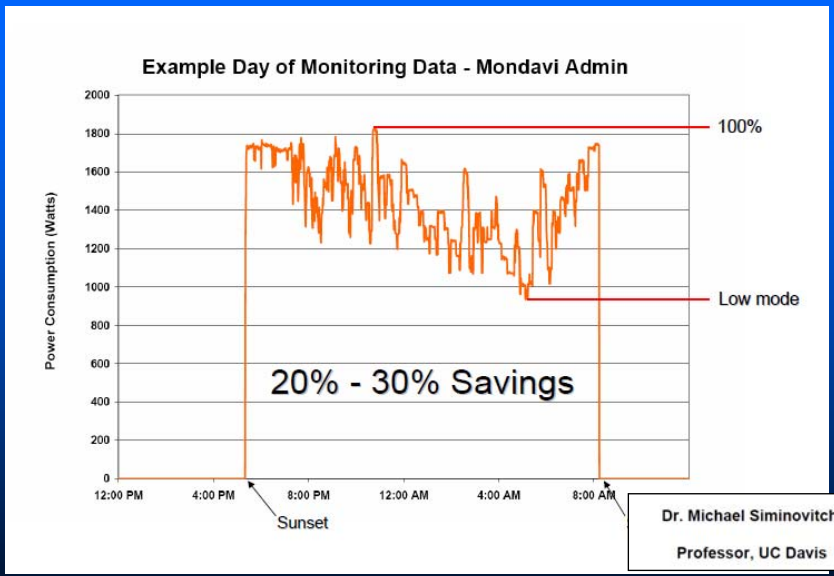

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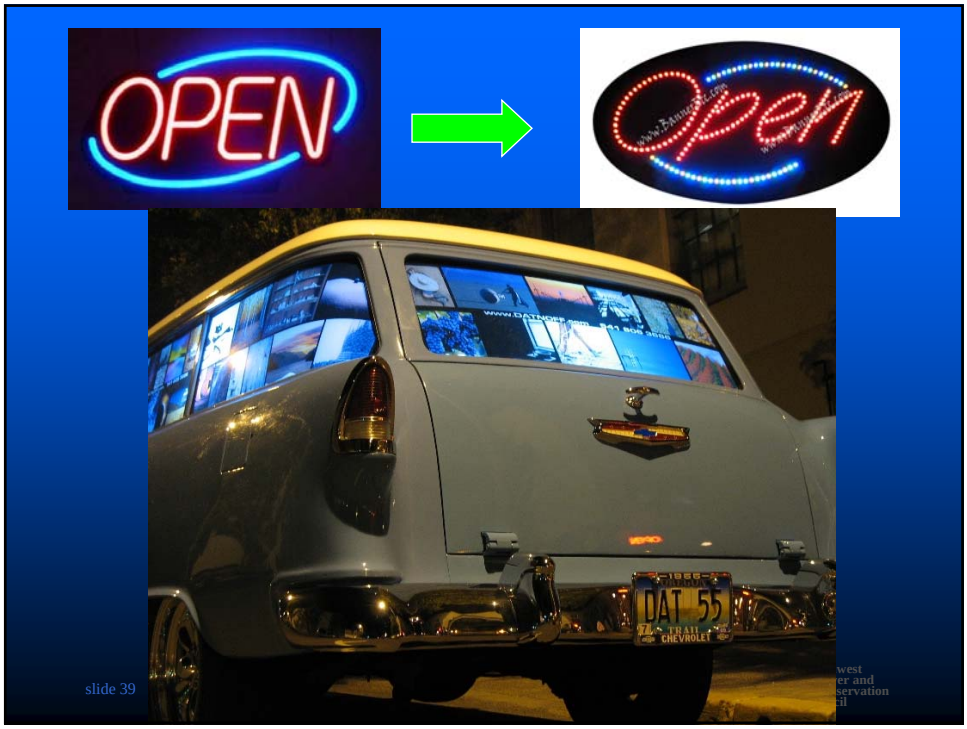
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