Energy Efficient Streetlights and Outdoor Lighting

Presented by

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Republic ITS-A Siemens Company

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Goal - To Create an Understanding of:

- Acquisition-
- Introduction/Terminology
- Status of the Industry
- IESNA RP-8
- Design Considerations
- Acqu

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Street Light Acquisition

- MGL 164 § 34A
- Savings 20-60%
- Energy Efficiency Upgrades & Incentives
- MGL 25A § 11C

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Terms And Definitions

- Lumens
- Color Rendition Index
- Correlated Color Temperature
- Efficacy

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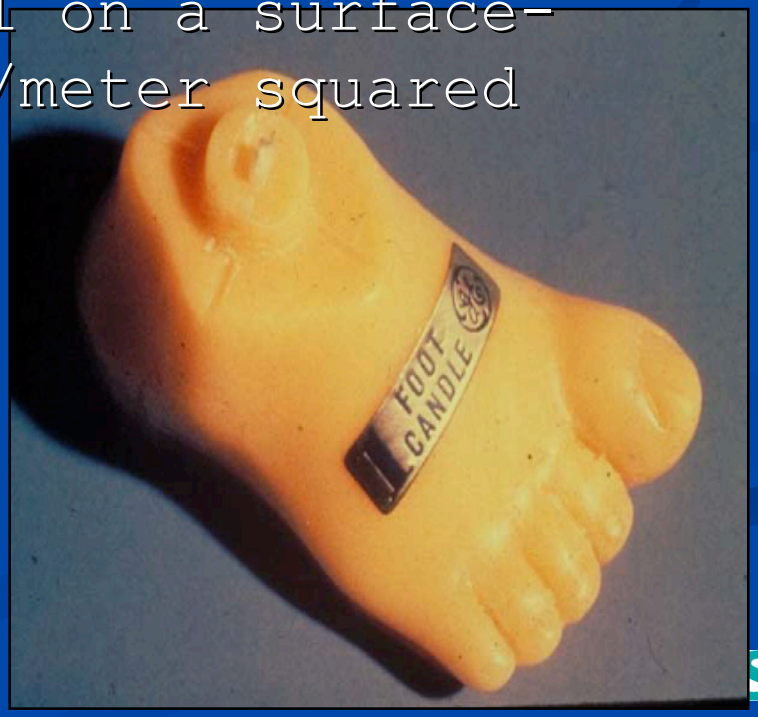
Lumens

- Measure of the total light output of a light source
- Measured in a sphere
- Unit of measure-Candela
- Measure of light level on a surface-footcandle or candela/meter squared



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Color Rendition Index-CRI

- Relative ability of a light source to match the color rendering of a standard reference source

Incan-descent	Mercury Vapor	HPS	LPS	MH	Ceramic MH	Induction	LED
100	20-45*	21	0	65-70*	85-92	70-82	68-80

*Coated lamps provide higher CRI

- CRI impacts on night vision

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Night Vision Basics

- Rods and Cones
  - Rods-night vision-visual purple
  - Cones-daylight vision-three types
- Scotopic-Mesopic-Photopic Vision
  - Pupil Lumens affect of light wavelength on pupil
  - Affect of color on visual effectiveness

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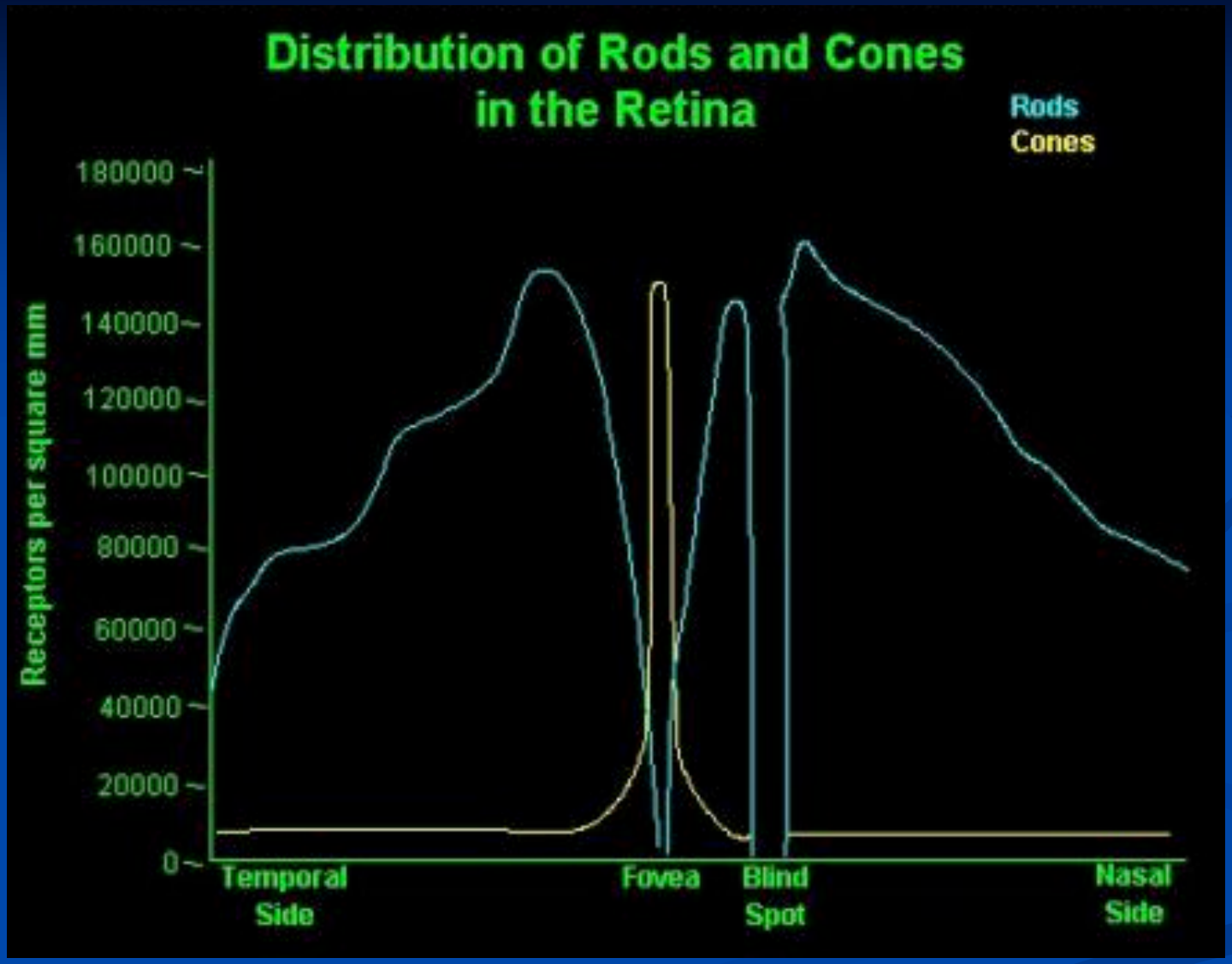

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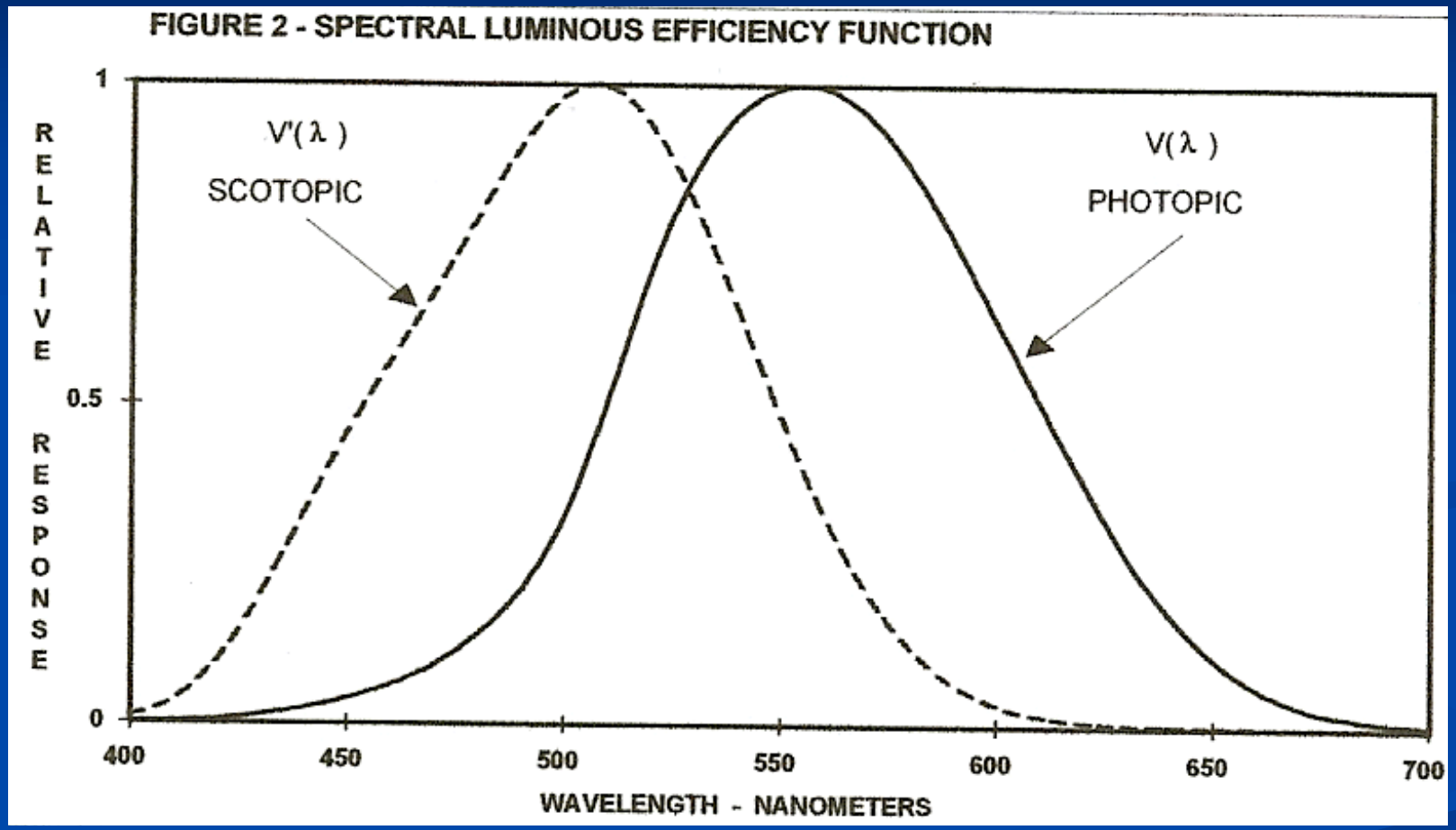
Wavelength Sensitivity



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Photopic Sensitivity

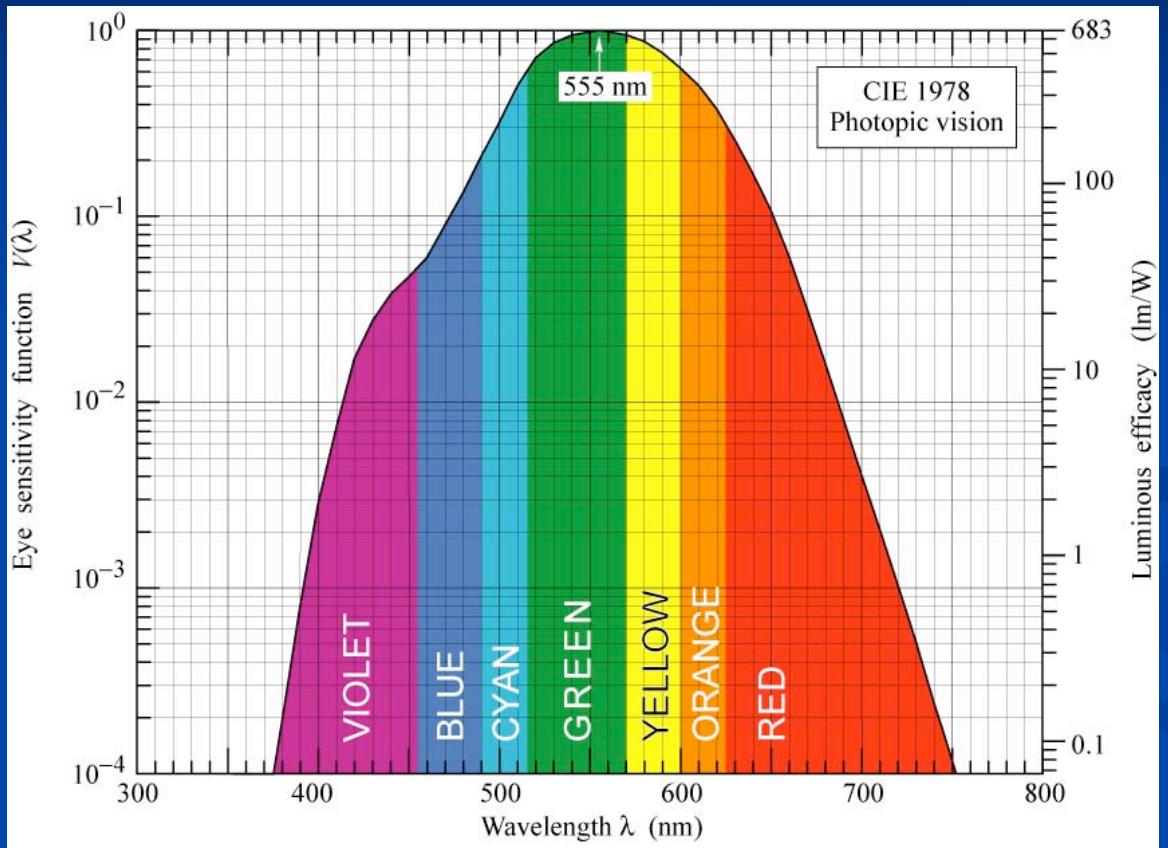

Fig. 16.7. Eye sensitivity function, $V(\lambda)$, (left ordinate) and luminous efficacy, measured in lumens per Watt of optical power (right ordinate). $V(\lambda)$ is greatest at 555 nm. Also given is a polynomial approximation for $V(\lambda)$ (after 1978 CIE data).

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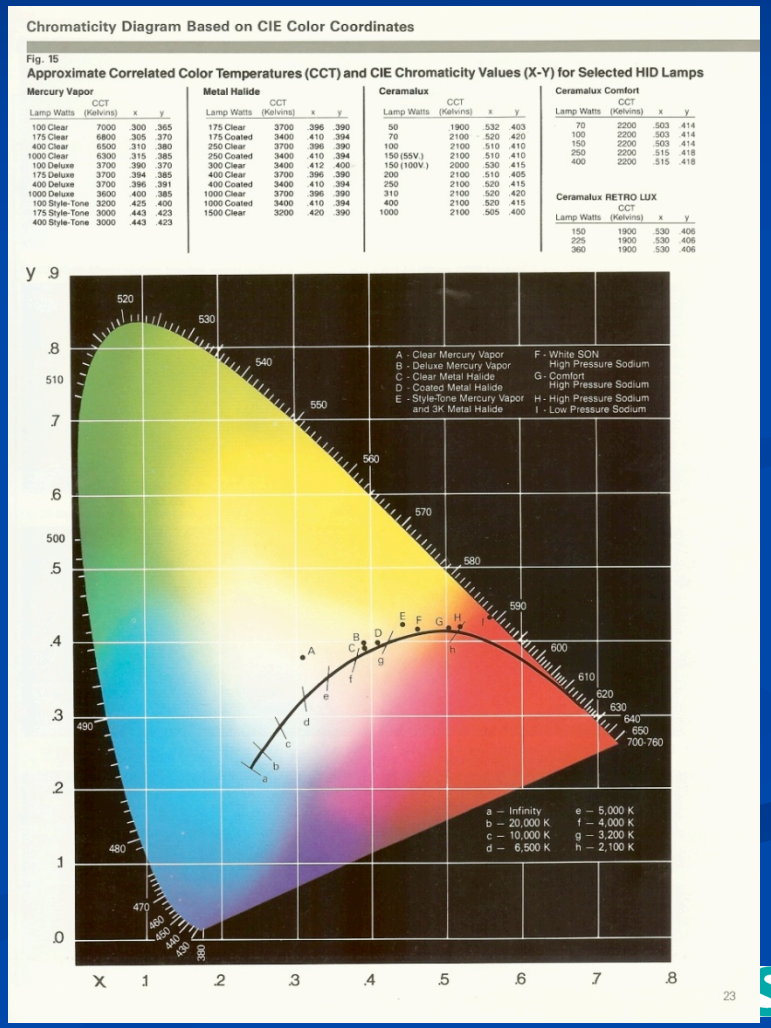
Correlated Color Temperature-CCT

- Measured in Degrees Kelvin
- Warm to Cool
- 2800^{0} to 5000^{0}



Chromaticity Diagram Based on CIE Color Coordinates

Fig. 15

Approximate Correlated Color Temperatures (CCT) and CIE Chromaticity Values (X-Y) for Selected HID Lamps

Mercury Vapor

Lamp Watts	CCT (Kelvins)	x	y
100 Clear	7000	.300	.365
175 Clear	6800	.305	.370
400 Clear	6500	.310	.380
1000 Clear	6300	.315	.385
100 Deluxe	3700	.390	.370
175 Deluxe	3700	.394	.385
400 Deluxe	3700	.396	.391
1000 Deluxe	3600	.400	.385
100 Style-Tone	3200	.425	.400
175 Style-Tone	3000	.443	.423
400 Style-Tone	3000	.443	.423

Metal Halide

Lamp Watts	CCT (Kelvins)	x	y
175 Clear	3700	.396	.390
175 Coated	3400	.410	.394
250 Clear	3700	.396	.390
250 Coated	3400	.410	.394
300 Clear	3400	.412	.400
400 Clear	3700	.396	.390
400 Coated	3400	.410	.394
1000 Clear	3700	.396	.390
1000 Coated	3400	.410	.394
1500 Clear	3200	.420	.390

Ceramalux

Lamp Watts	CCT (Kelvins)	x	y
50	1900	.532	.403
70	2100	.520	.420
100	2100	.510	.410
150 (55V.)	2100	.510	.410
150 (100V.)	2000	.530	.415
200	2100	.510	.405
250	2100	.520	.415
310	2100	.520	.420
400	2100	.520	.415
1000	2100	.505	.400

Ceramalux Comfort

Lamp Watts	CCT (Kelvins)	x	y
70	2200	.503	.414
100	2200	.503	.414
150	2200	.503	.414
250	2200	.515	.418
400	2200	.515	.418

Ceramalux RETRO LUX

Lamp Watts	CCT (Kelvins)	x	y
150	1900	.530	.406
225	1900	.530	.406
360	1900	.530	.406

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Efficacy

- Measure of Lumens per watt of power
- Not a measure of system efficacy
- Useful lumens
- Glare
- Maximum possible RGB efficacy 400 lm/W or source efficacy of 200 lm/W

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LED Street Lights-Where are we?

- Prices have nearly dropped by 50%
- Efficacy 19 lm/watt to 208 lm/watt
- Most streetlights 68 lm/watt to 90 lm/watt
- Drive wattages from 3 volts to 46 volts
- Life expectancy at 700mA from 50,000 hrs to over 100,000 hours

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What Can We Expect

- Efficacy to exceed 100 lm/w
- Sapphire Substrate
- Heat Management
- Color Temperature shift to warmer CCT
- Adaptive controls

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Changing Standards-IESNA

- Scotopic vs Photopic-S/P ratios
- BUG-Backlight, Uplight, Glare
- Luminance vs. small target visibility
- Pedestrian vs. Roadway

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Designing and Upgrading Your System

- Redesign/retrofit
- Project goals
- Politics, Public & Finances
- Cost considerations
  - Energy cost
  - First costs
- Energy costs-metered/ummetered

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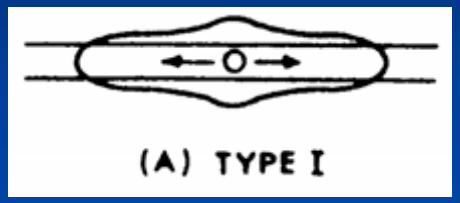
Distribution Patterns



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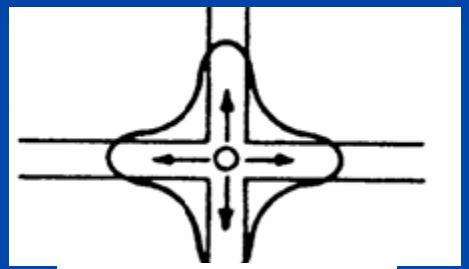

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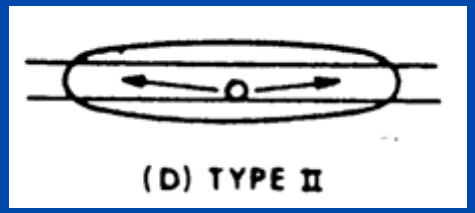

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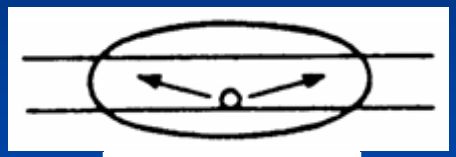

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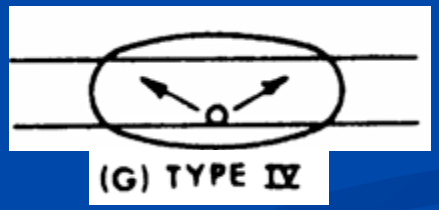

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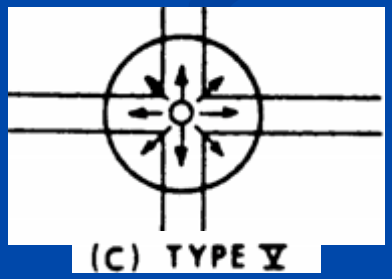

(C) TYPE V

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Modifying Existing Systems

- Map system-capture attributes
- IESNA guidelines
- Standardize lighting levels
- Adjacent land use
- Route classification
- Any special considerations
- Lamp type
- Goals-New Construction

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100w HPS Replacement

	Watts	Cost	Lamp rating Lumens	Effective Lumens	Efficacy lm/watt	Annual Energy Savings @ $.10
100w HPS	118	N/A	9600	6240 (4368)	56	
30 Led						
350 mA	35	$325	2,936	2,789.2	85.3	$ 34.03
525 mA	51	$325	4,086	3,881.7	81	$ 27.47
700 mA	70	$325	5,257	4,994.2	75.2	$ 19.68
40 LED						
350 mA	45	$375	3,897	3,702.2	87.3	$ 29.93
525 mA	66	$375	5,423	5,151.9	82.1	$ 21.32
700 mA	92	$375	6,922	6,575.9	75.5	$ 10.66

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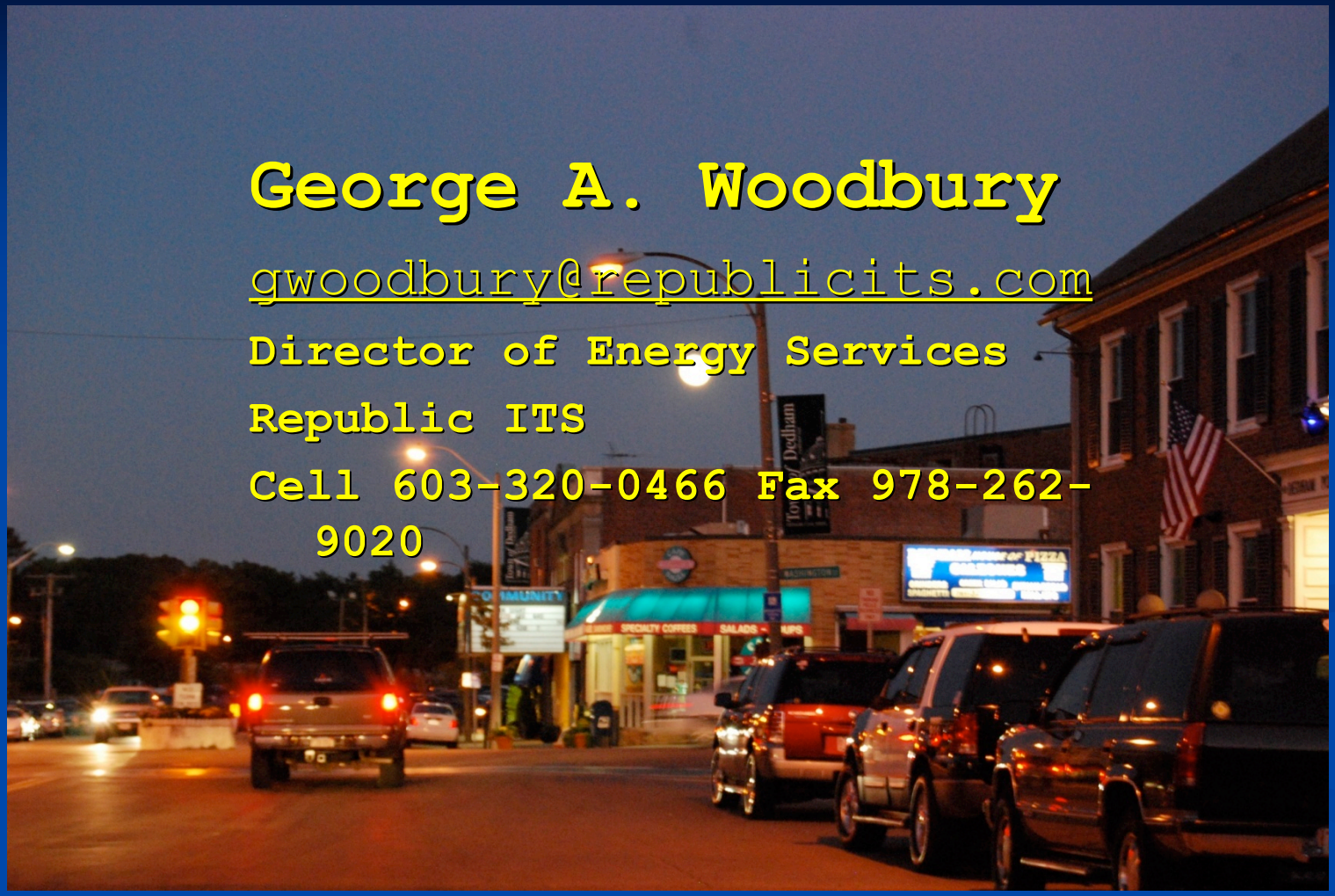

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