A hybrid approach to building power:

adding DC to power to interior architecture

Presented by:

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The youniversal Facility Management Experience

Oct. 7-9, 2009
Orlando, Florida, USA

“”

**The future is already here;
it is just not evenly distributed.**

— William Gibson, *author, Neuromancer*

learning objectives

Understand how:

1. DC distribution embraces trends in using alternative energy
2. power trends and a changing DC model
3. DC distribution enhances efficiency, flexibility, and sustainability

agenda

1. trends
2. a solution
3. a standard
4. examples
5. opportunity to participate

When will DC power devices (fans, lights, appliances, computers, fire suppression, and projectors) surpass the use of AC power devices in a building?

Prius

current trends in power

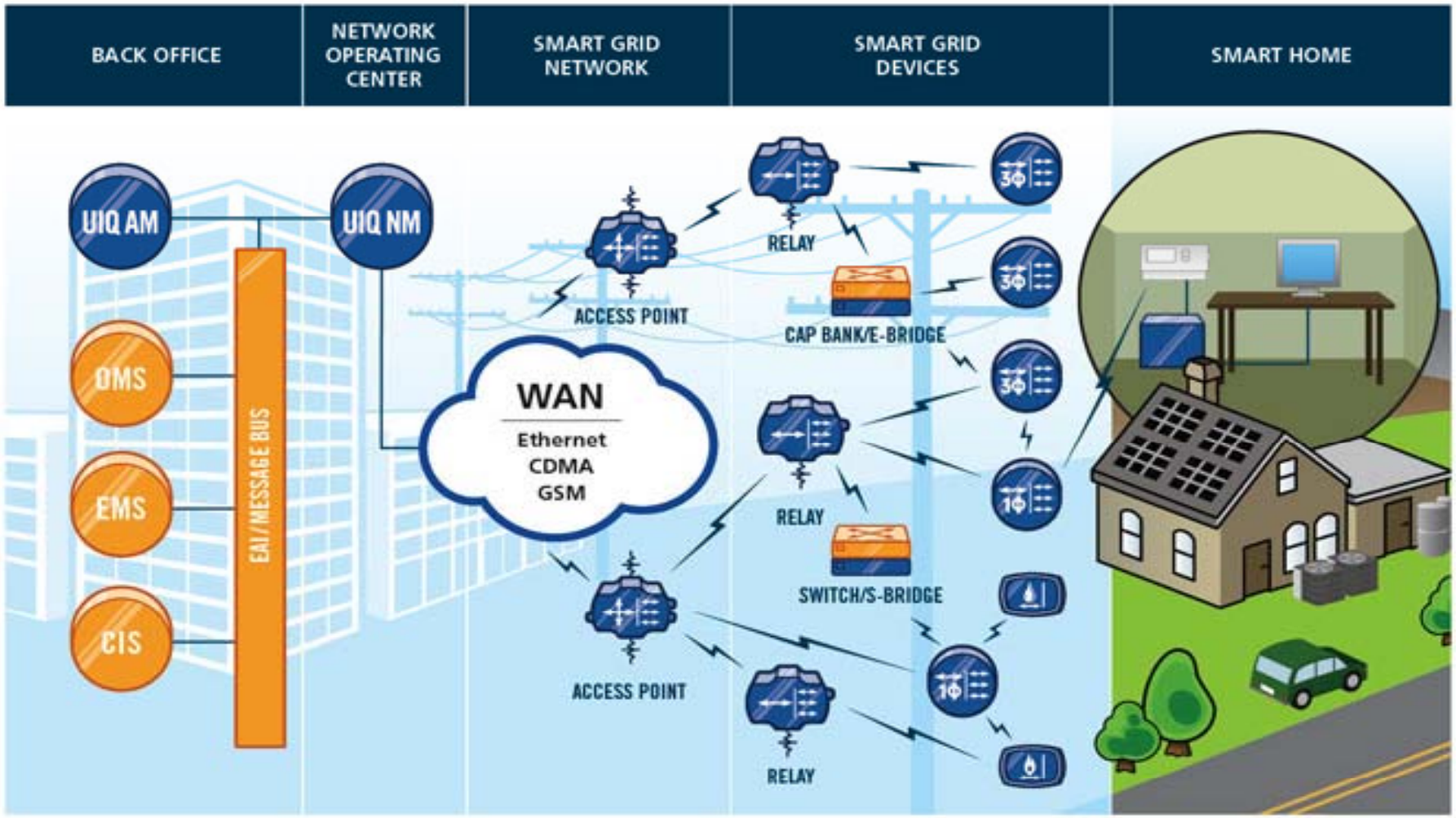
distribution trends

Paul Savage | Nextek Power Systems

best practices in net-zero buildings

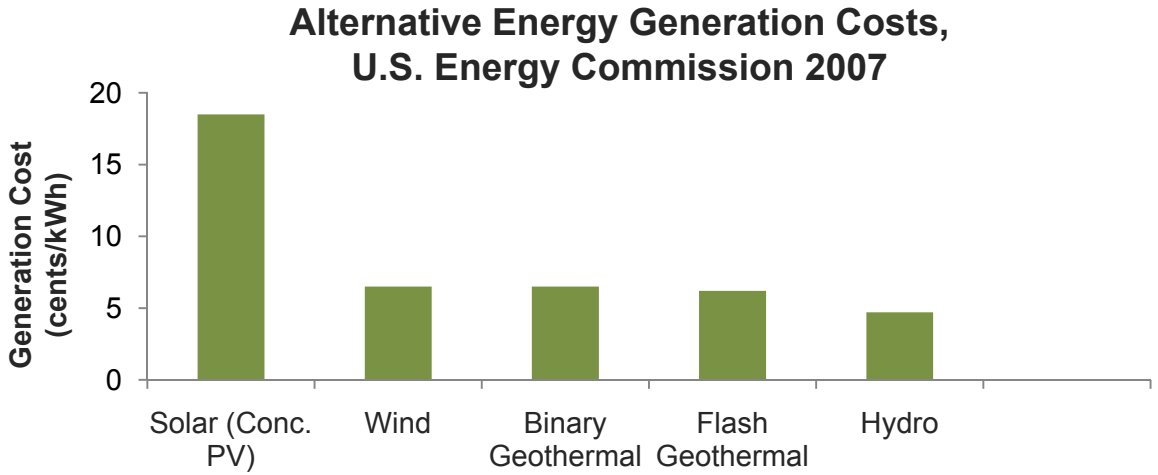
- NC's www.dsireusa.com database
- USGBC's LEED programs
- MASCO's Efficiency Guarantees
- Oak Ridge National Lab
- California Energy Commission
- Austin Energy
- BASF
- Brad Pitt, for crying out loud…

Smart Grid or “Where is my internet for power”?

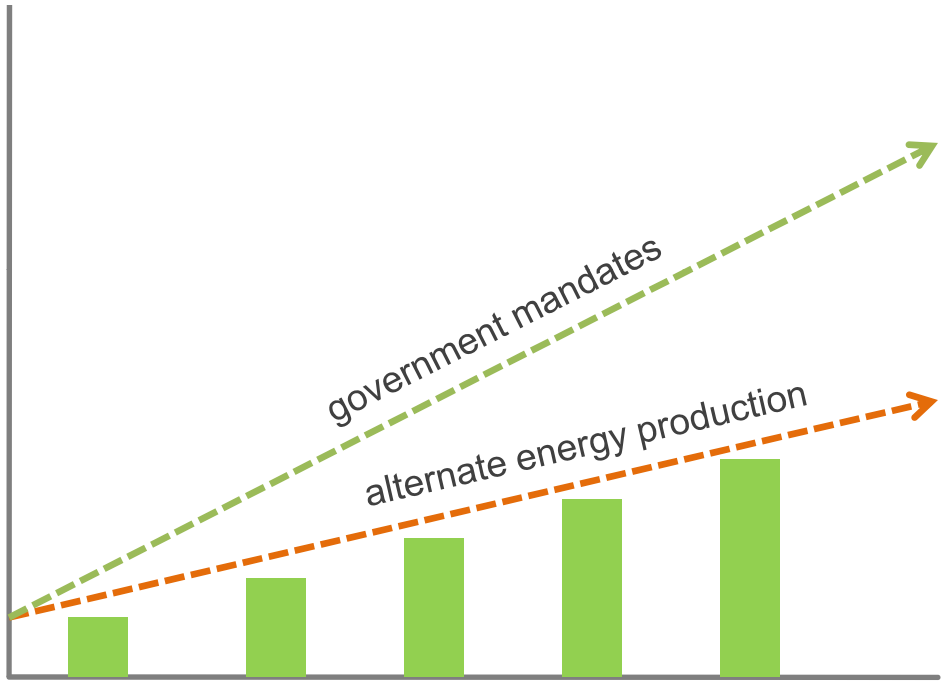


What infrastructure favors alternate energy sources?

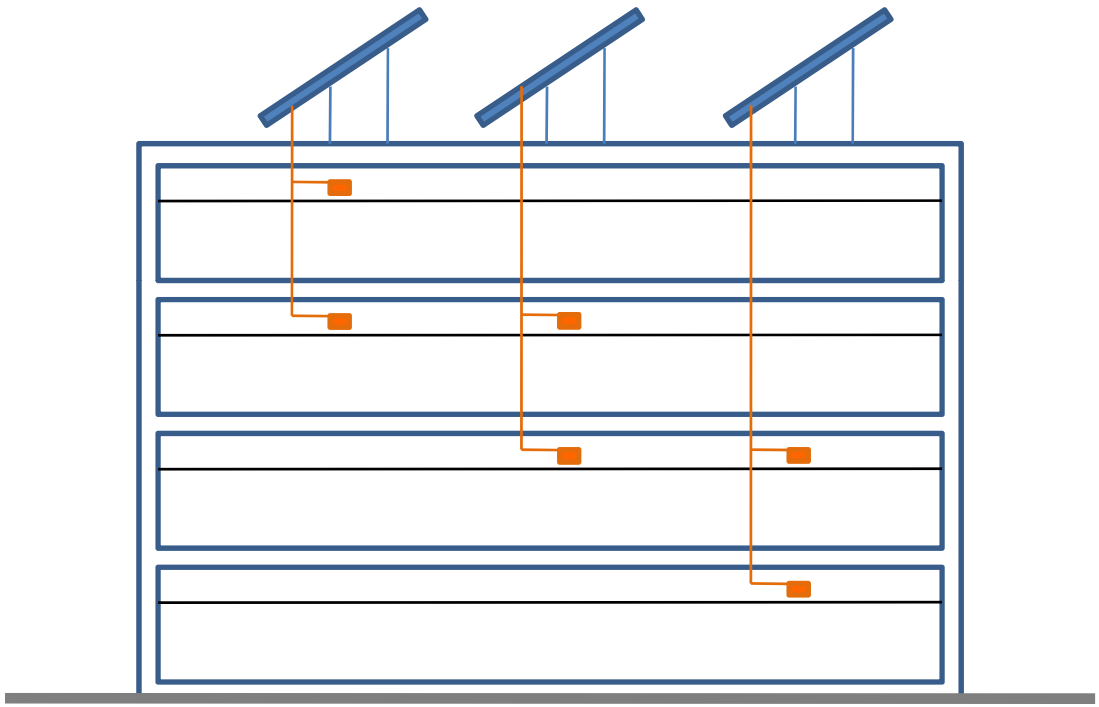




Distributed Generation
or Grid Support
or Both?

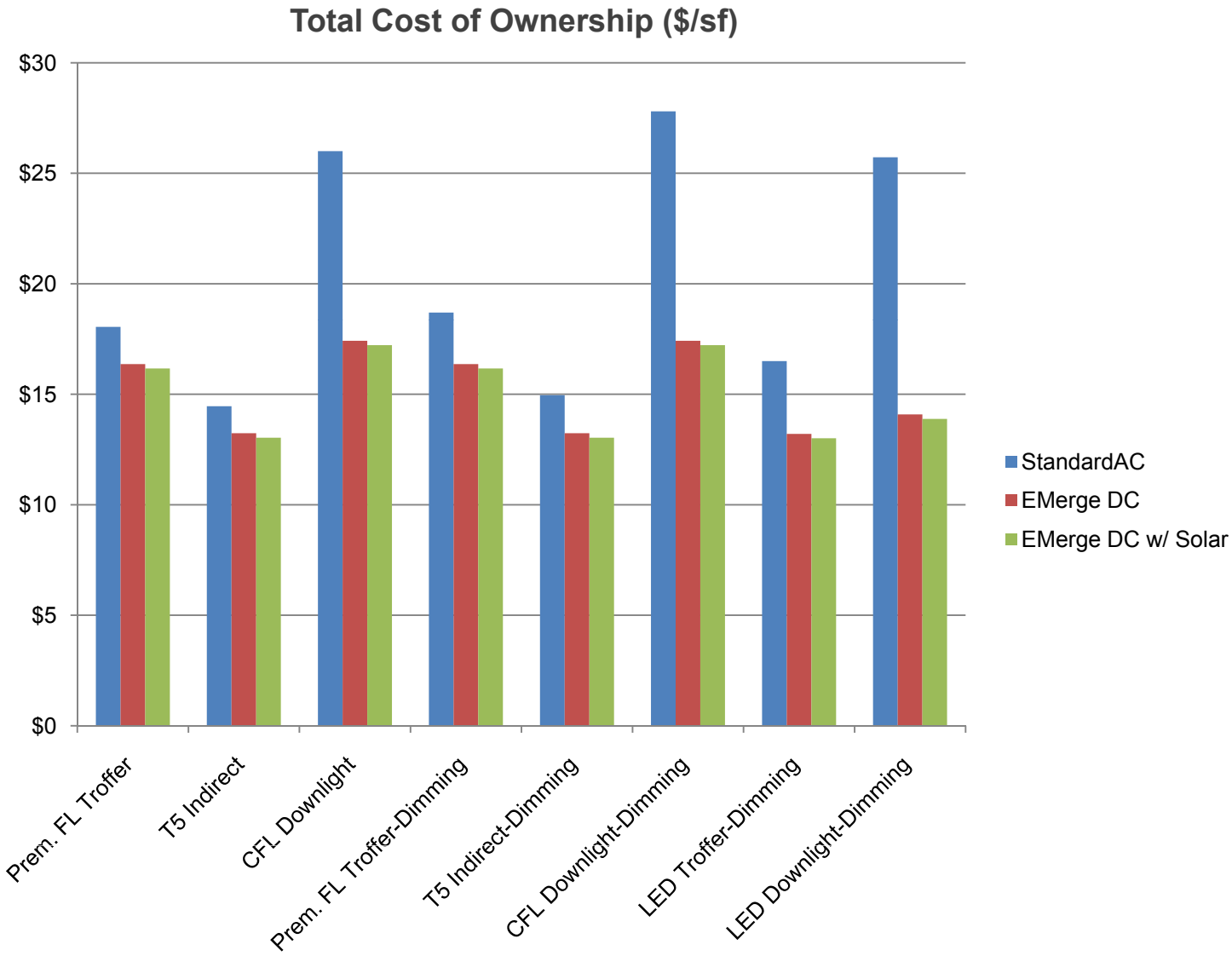


How could this gap be bridged?



distributed micro generation

How does it look in Orlando?



building trends

Brian Patterson | Armstrong BPO

power generation trends

- Strain on national AC grid
- Need for Smart grid
- Strong focus on alternative energy
  - Photovoltaic
  - Fuel Cell
  - Wind Power
  - Battery/Capacitor Storage

…most alternatives are native DC power generators

Photovoltaic

Microturbine

Wind

Fuel Cell

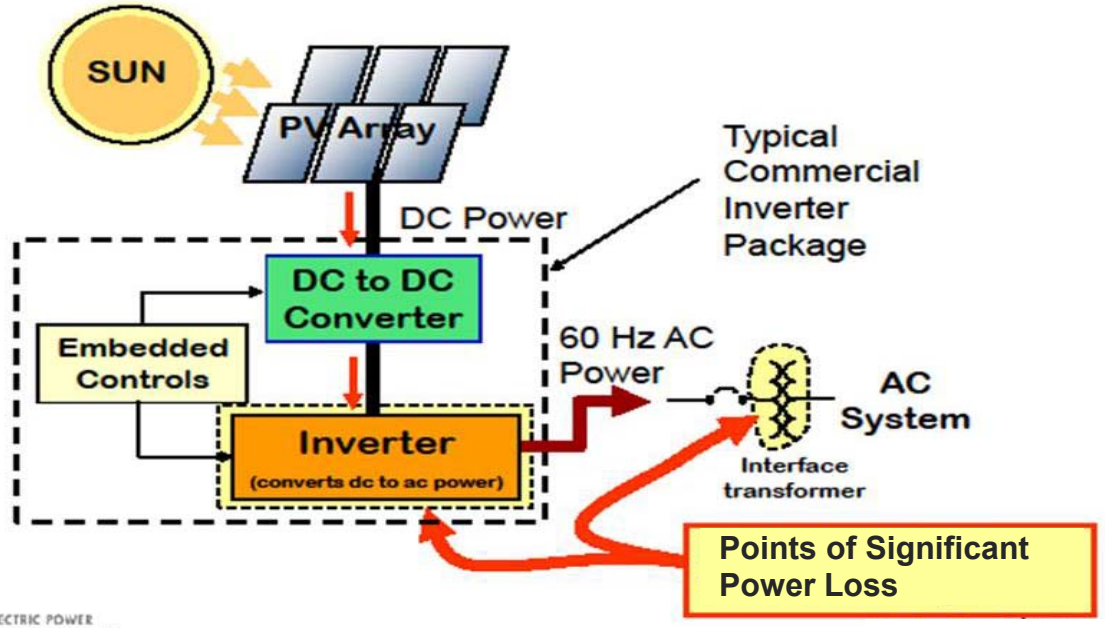
Storage (e.g. Ultra Capacitators)

Source: EPRI | ELECTRIC POWER RESEARCH INSTITUTE

power generation trends

- Building power distribution is only AC today
- Alternate DC power sources must be converted to AC
  - Must be isolated from utility grid
  - Inverter, isolation transformer and power conditioning required

…consumes 7-15% of the power generated in the conversion process



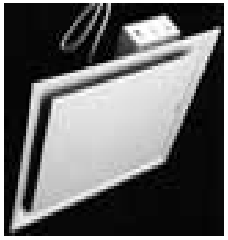
Source: EPRI | ELECTRIC POWER RESEARCH INSTITUTE

power device trends

- Mostly digital devices in use today
- Digital is ‘code’ for DC power
  - AV and IT equipment
  - Electronic & dimmable ballast
  - LED lighting
  - HVAC actuators
  - Digital controls

…most used DC powered electronics

Sensor & Controls



HVAC Actuators

Security & Safety

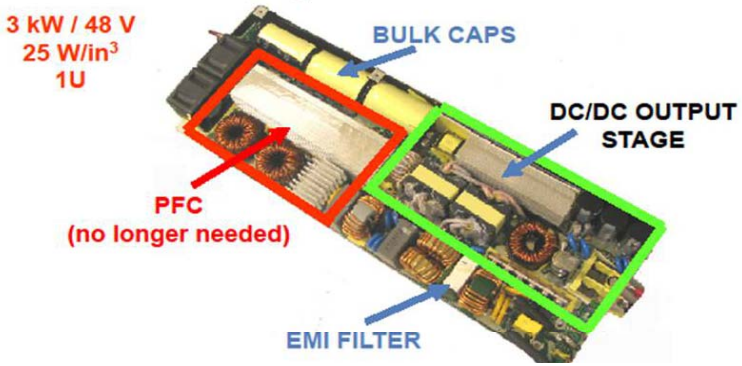
AV/IT Devices

Electronic Lighting

power device trends

- Building distributes only AC power today
- DC devices must convert AC power to DC
  - Converter & power conditioning required
  - Side effects:
    - Higher component count/bulk
    - Higher cost
    - Lower reliability

…typically consume 10 – 20% of the power in conversion process



Source: Karl Johnson
California Institute for Energy and the Environment / PIER

PROBLEM: MISMATCHED AC & DC POWER REQUIREMENTS

ENERGY SOURCES – MIXED AC & DC

AC/DC Site Generation

DC Campus Fuel Cells

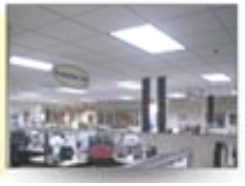
DC Photovoltaic

DC Wind Power

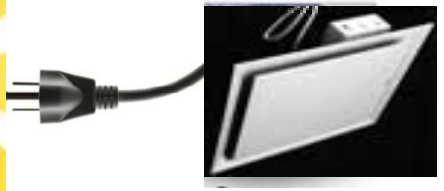
AC Line Power

?

ELECTRIC DEVICES – TYPICALLY DC



Electronic Lighting



HVAC Actuators

Sensor & Controls

AV/IT Devices

Security & Safety

RESULT: LOST OPPORTUNITY TO REDUCE ENERGY UP TO 30%

Source: Armstrong

lighting trends

Paula Ziegenbein| LC, LEED AP – OSRAM SYLVANIA

lighting trends… according to US lighting specifiers

- Shift from functional light to personal light – mobile, flexible, self-powered or rechargeable
- Lighting used for visualization
- Substantial shift from lamp to application and system integration business driven by:
  - Energy reduction approaches
  - Technology development
- Continued interest in sustainability and protecting the environment
- Interest in lighting that improves the health and well-being of people




Source: Siemens Pictures of Lighting Future Interviews

market drivers defining these trends

Product Legislation and Advocacy

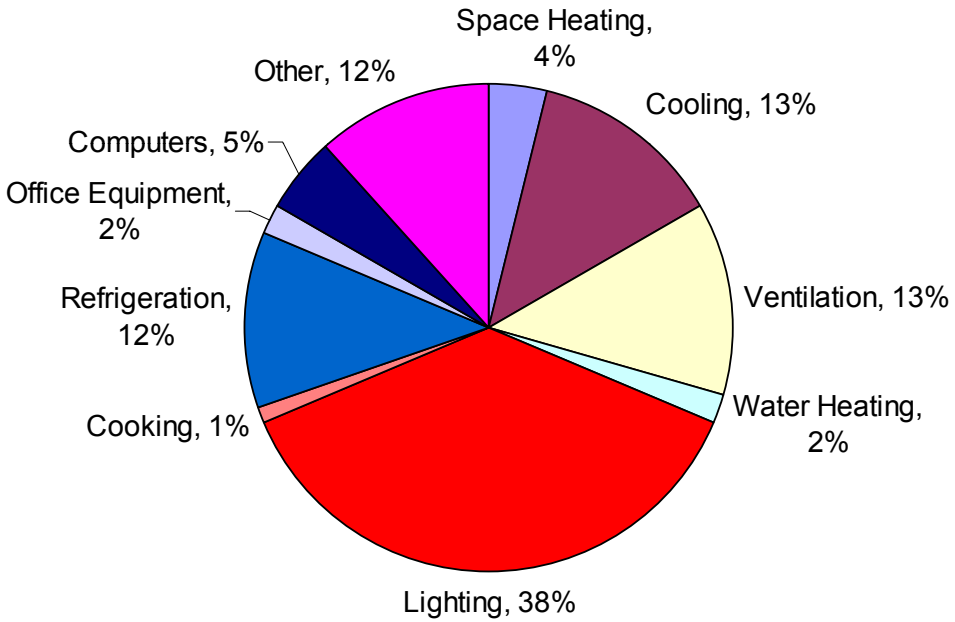
- Unrelenting pressure to improve lamp efficacy
- Increasing interest in system efficacy
- Belief that solid state lighting will be the next high efficacy solution
- Energy and environment will be paired in more legislation

Building Design and Codes

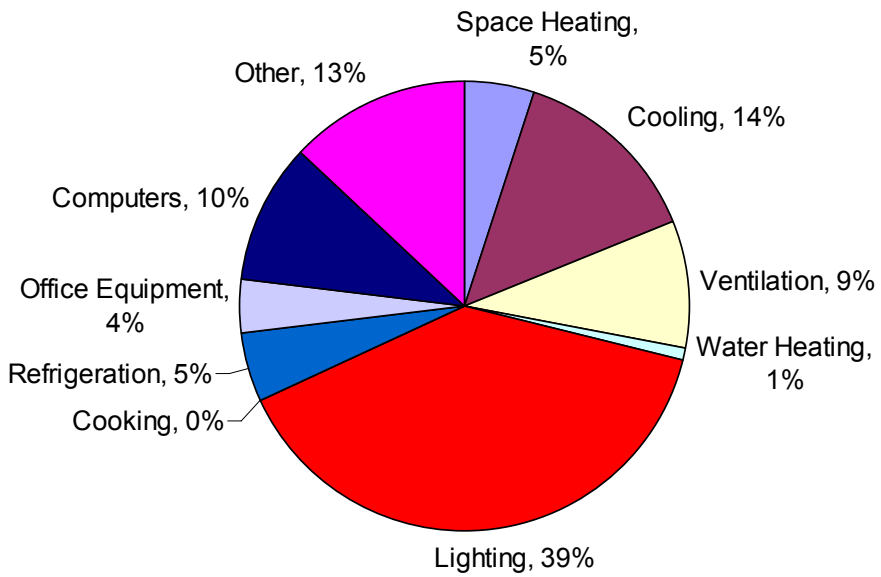
- Increased awareness of benefits of daylighting (what's old is new again)
- Government interest in regulating commercial building efficiency and environmental impact
- Possible move to kWh/square foot rather than W/square foot in energy codes – or at the very least, mandatory controls provisions

the role of lighting in energy consumption

U.S. Total Commercial Building Energy Use



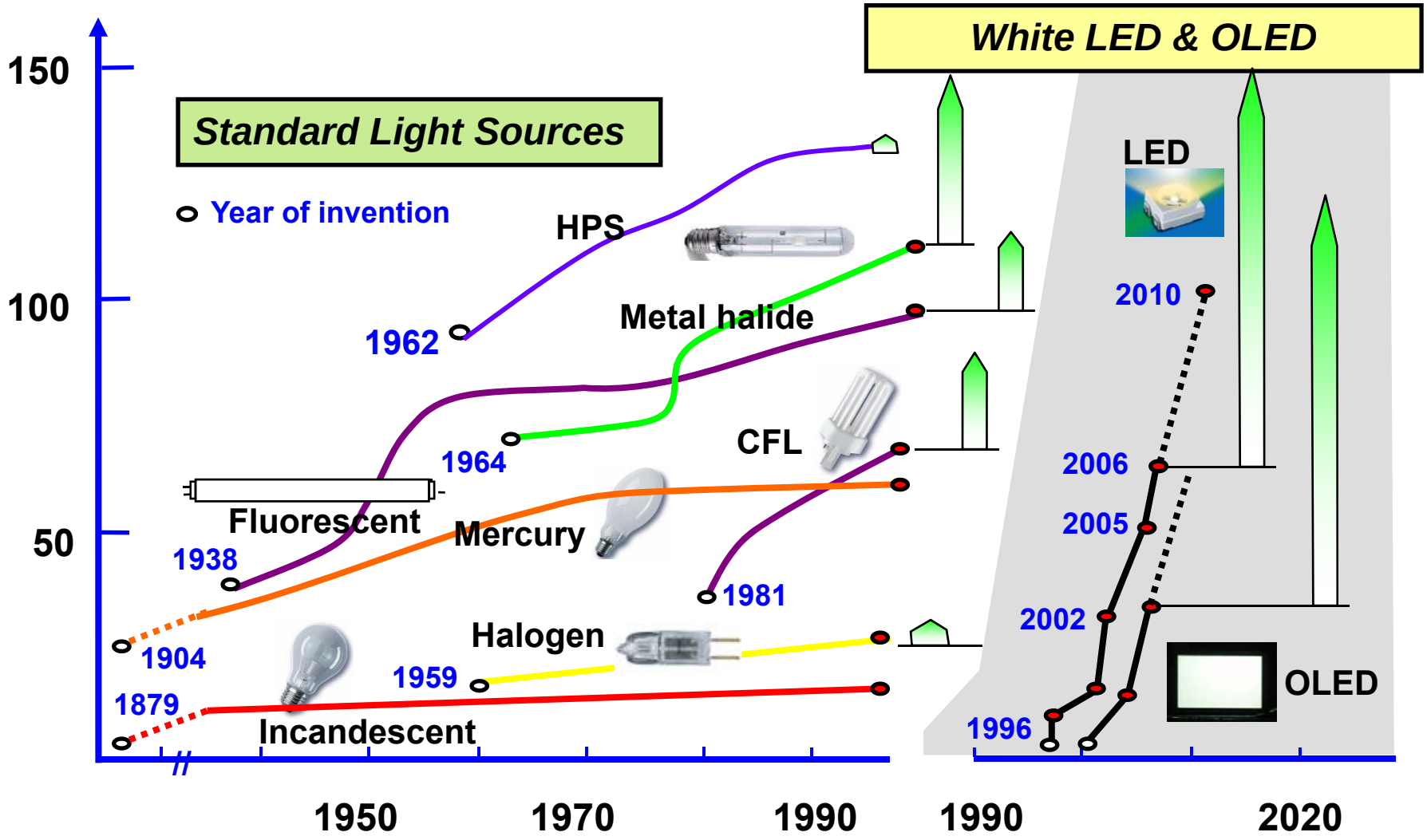
U.S. Office Building Energy Use



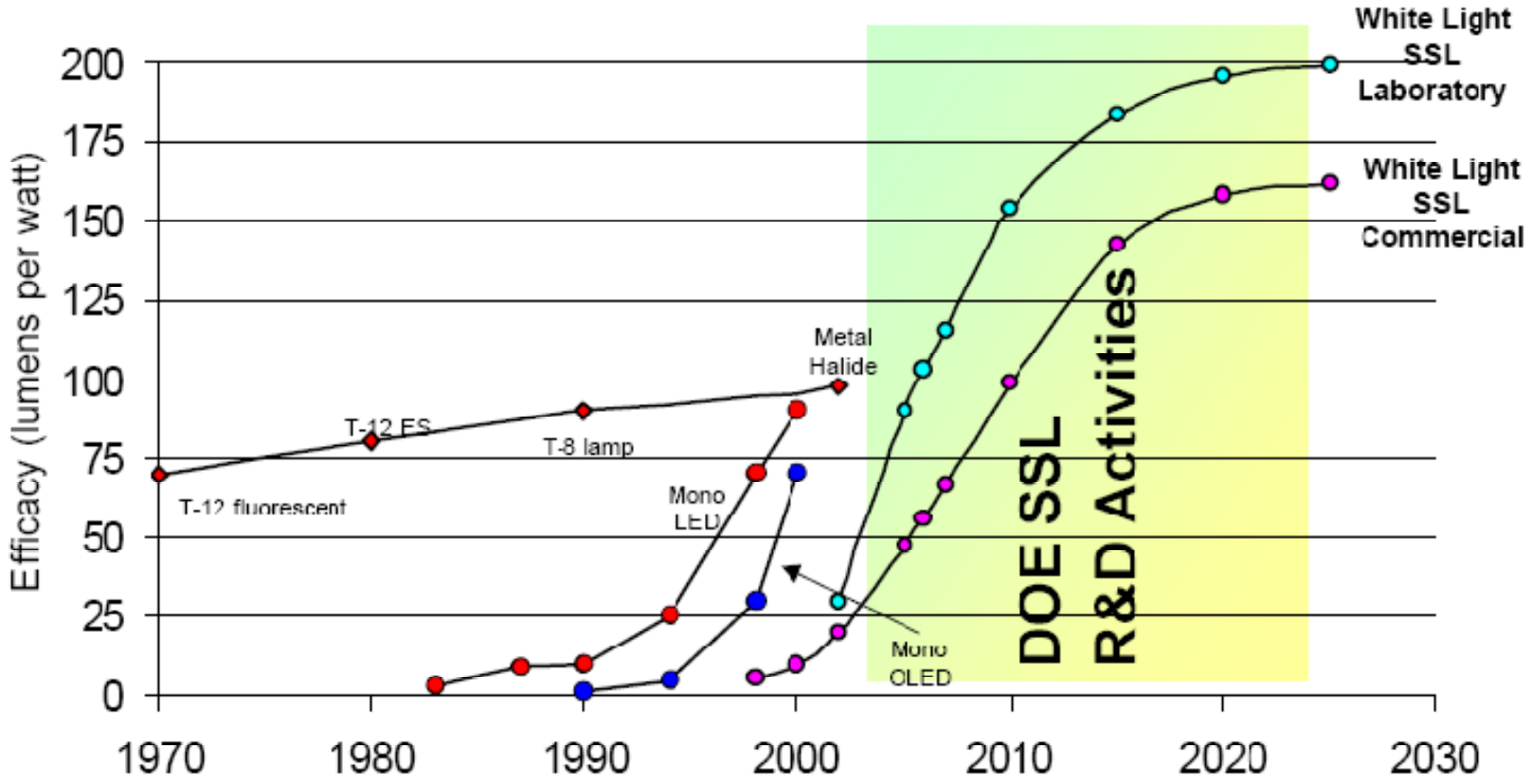
lighting is the largest single opportunity for saving energy

Source: US Energy Information Administration – Table E5 – 2003 Data

light sources in transition – lumens per watt



improvement trends in LED efficacy



light levels in transition – lumens per square foot (footcandles)

Task	*Recommended FC (horizontal)*		
Year	**1972**	**1987**	**2000**
Reading #2 pencil writing	70	20-50	30
Kitchen general lighting	50	20-50	30
Active storage, small items	50	20-50	30
Retail circulation	30	10-30	10
Retail feature displays	500	150-500	100
Office, accounting	150	50-100	30*
Open parking	1	0.2-0.9	0.2-0.5
Basketball, college and pro	50	50	80-125
Hospital operating table	2500	2500	300-1000

** now a VDT task*

lighting energy codes in transition – watts per square foot

*Building Area Method**	*Lighting Power Densities*		
Year	**1989**	**1999**	**2004**
Dining: Family	1.37	1.90	1.60
Hospital	1.44	1.60	1.20
Hotel	1.15	1.70	1.00
Library	1.29	1.50	1.30
Manufacturing Facility	0.96	2.20	1.30
Office	1.26	1.30	1.00
Retail	2.25	1.90	1.50
School/University	1.29	1.50	1.10
Sports Arena	2.07	1.50	1.10
Warehouse	1.03	1.20	0.80

energy efficiency in lighting – changes in meaning

Pre-1970
» More light for the same (or more) power

1973
» Less light for less power

1980s
» Same light for the same power

1990s
» Same light for less power

2000s
» More light for less power – higher efficacy lighting
» Less light for less power – dimming
» More and less light for less power – better utilization of light for less power through controls

desktop trends

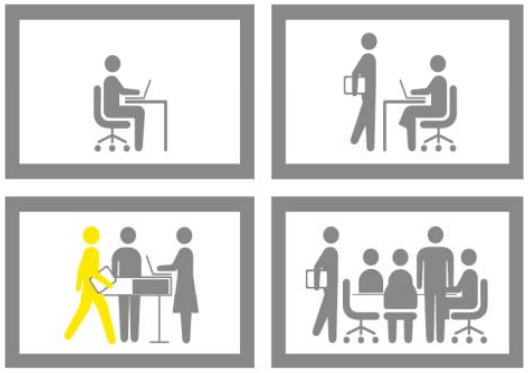
Joel Zwier | AIA - Steelcase, Inc.

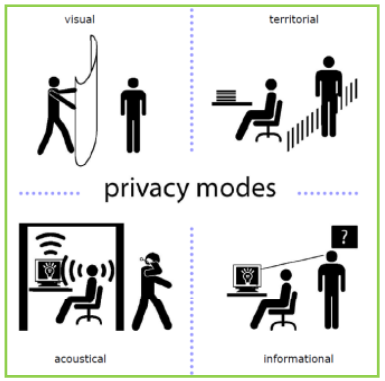
desktop trends

- desktop survey – what is being used
- cords and bricks – spaghetti
- broader technology trends impact on the workplace

technology trends in the workplace

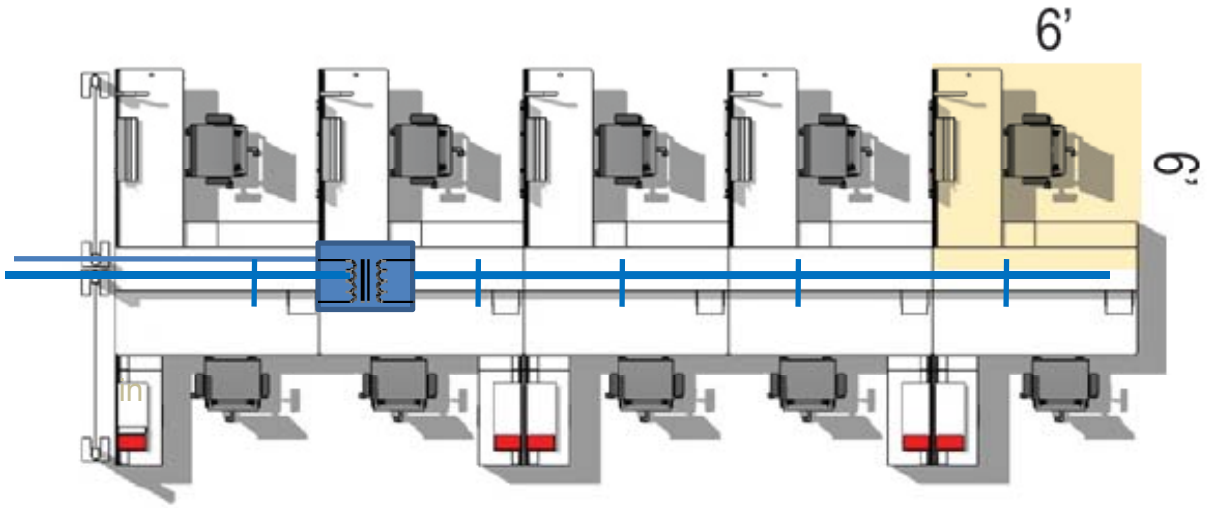
- ubiquitous access
- growth in active collaboration
- persistent large screen display and projection
- more movable architecture furniture and technology
- proliferation of mobile technology





energy reduction

- ways to demonstrate commitment to sustainability
- concern over large screen energy use
- questions about automated ways to turn off devices

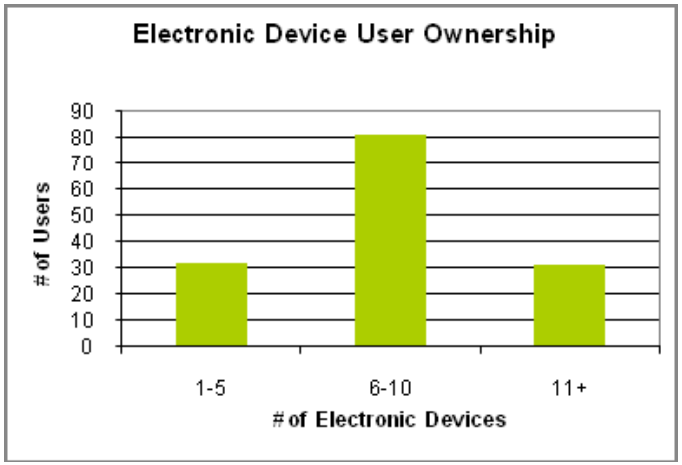


11+ devices

9 Receptacles
5 USB

desktop power usage is changing

- workstations are spec-ed with 1 or 2 duplexes (2 – 4 outlets)
- desktop survey indicates employees are using 6 – 10 electronic devices
- employees frustrated by transformer blocks covering outlets
- cord spaghetti is becoming a problem



Voltage Requirements	Common office tools
Very low (5V)	Cell phone PDA iPod Digital camera
Low (20V)	Laptop computer Some task lights
AC or DC devices	Light Monitor Printer Scanner Calculator Computer speakers Space heater Radio

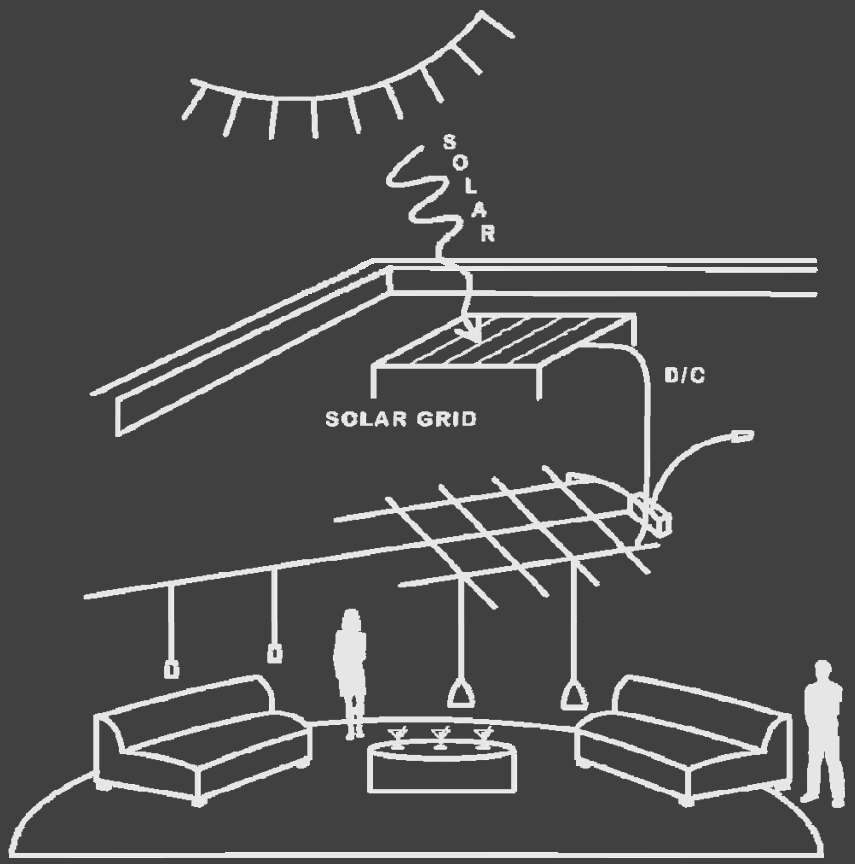
task lighting

- reduction in lumen levels from architectural lighting
- automated task lighting control
- aging workforce needs task specific supplemental lighting
- furniture mounted neighborhood lighting and control

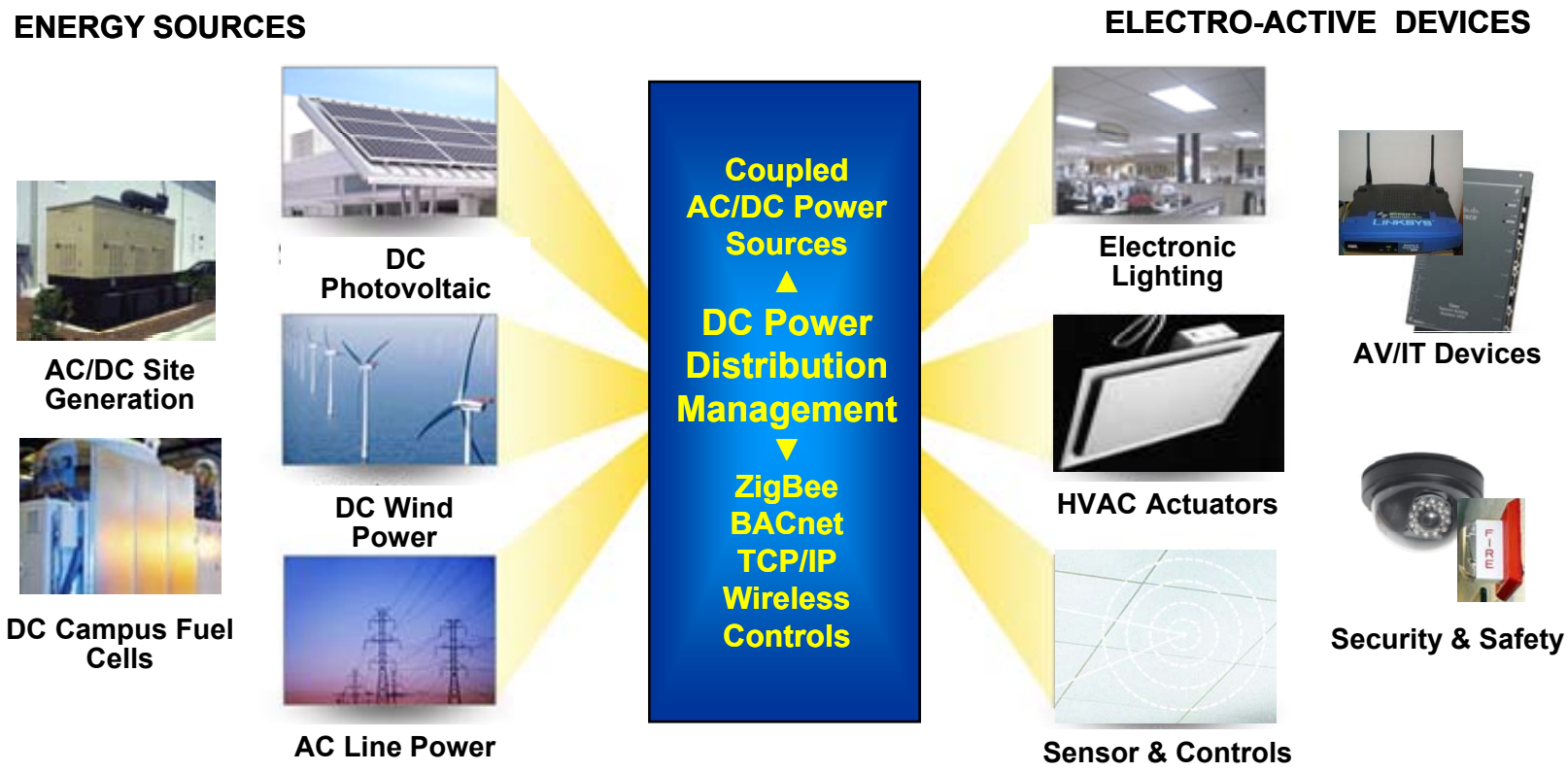
recap need

- AC power is not going away – infrastructure
- Need transition that is scalable
- Solution needs to be hybrid – switch AC/DC

a solution



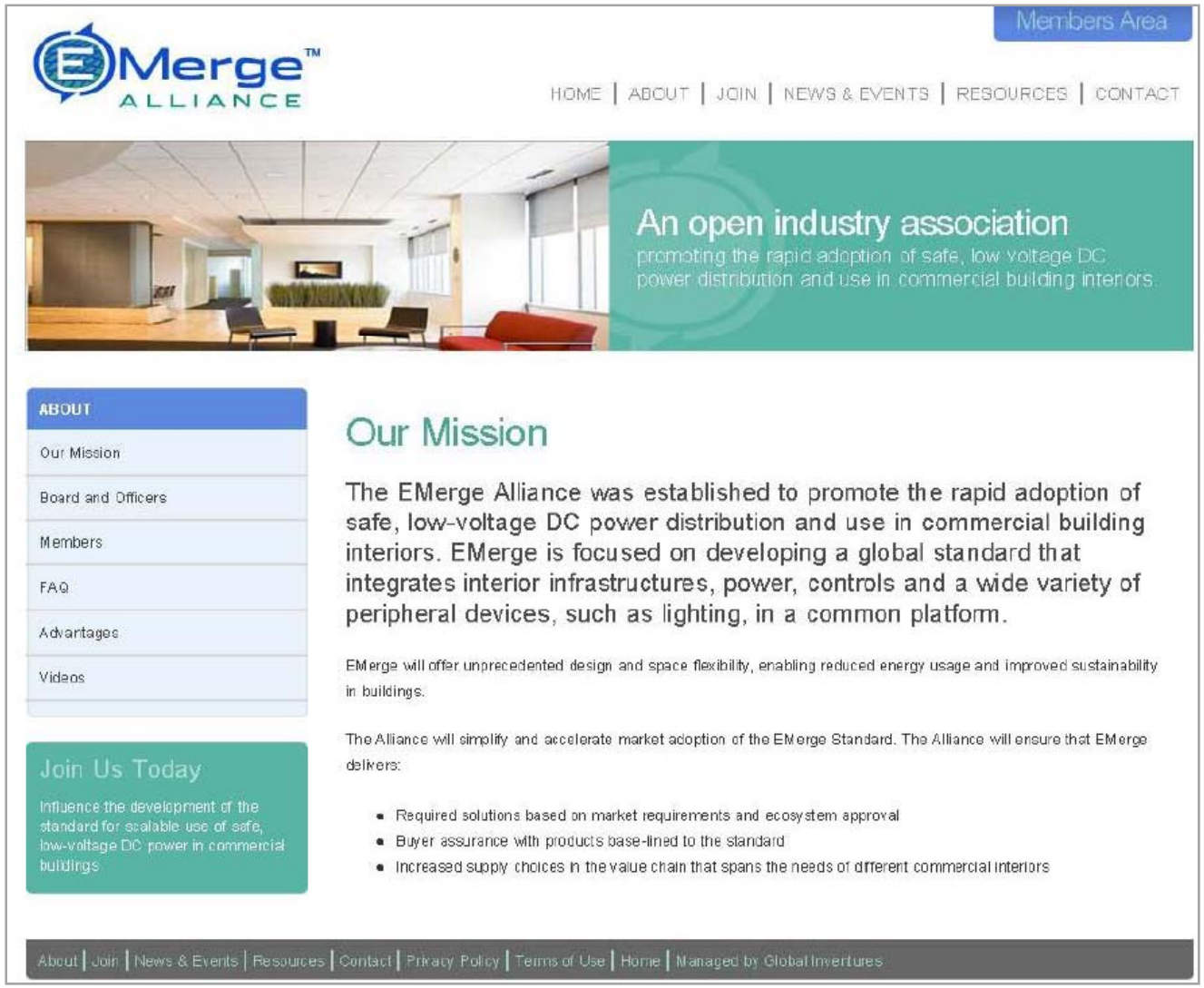
SOLUTION: A SIMPLIFIED AC/DC HYBRID COUPLED POWER SYSTEM



OPPORTUNITY: 28% LESS ENERGY, 15% LESS CAPITAL, 200% MORE RELIABLE

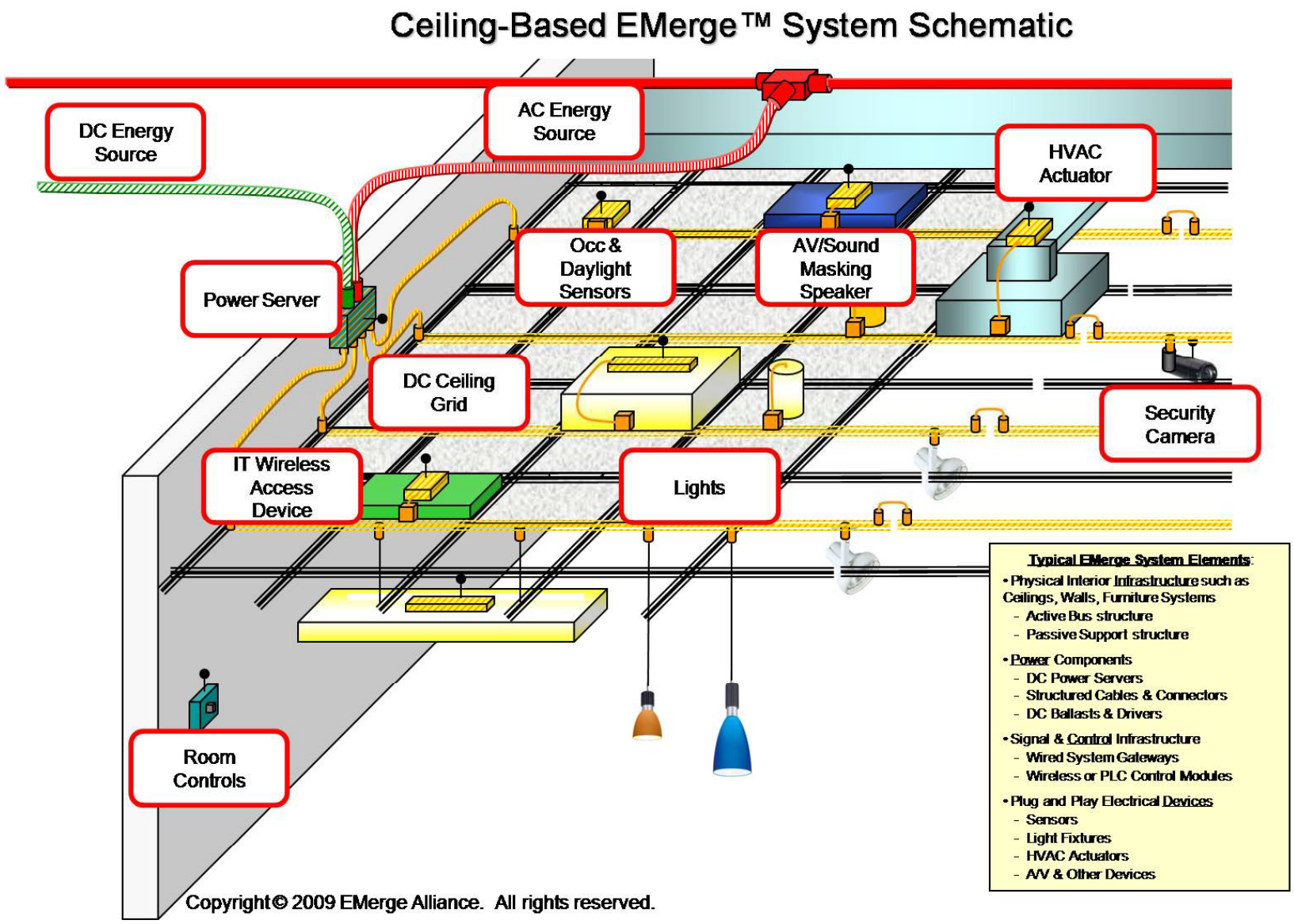
Source: Energy Systems Research intel

an open source building industry alliance



initial design goals of standardization

- reduce complexity, reduce installation time, first-cost competitive
- simple and flexible reconfiguration
- NEC recognized Class 2 power levels
- reduce system energy loss
- create interoperable device controls
- simple integration of solar panels, wind, fuel cell, and batteries


Ceiling-Based EMerge™ System Schematic
DC Energy Source
AC Energy Source
HVAC Actuator
Occ & Daylight Sensors
AV/Sound Masking Speaker
Power Server
DC Ceiling Grid
Security Camera
IT Wireless Access Device
Lights
Room Controls
Typical EMerge System Elements:
• Physical Interior Infrastructure such as Ceilings, Walls, Furniture Systems
- Active Bus structure
- Passive Support structure
• Power Components
- DC Power Servers
- Structured Cables & Connectors
- DC Ballasts & Drivers
• Signal & Control Infrastructure
- Wired System Gateways
- Wireless or PLC Control Modules
• Plug and Play Electrical Devices
- Sensors
- Light Fixtures
- HVAC Actuators
- A/V & Other Devices
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benefits

to community

» direct connection to alternate energy sources

to owners, facilities managers, groups and teams

» increase flexibility
» decrease installation costs
» supports reconfiguration
» promote sustainability
» future-proof the changing office

to individuals

» safety
» flexibility

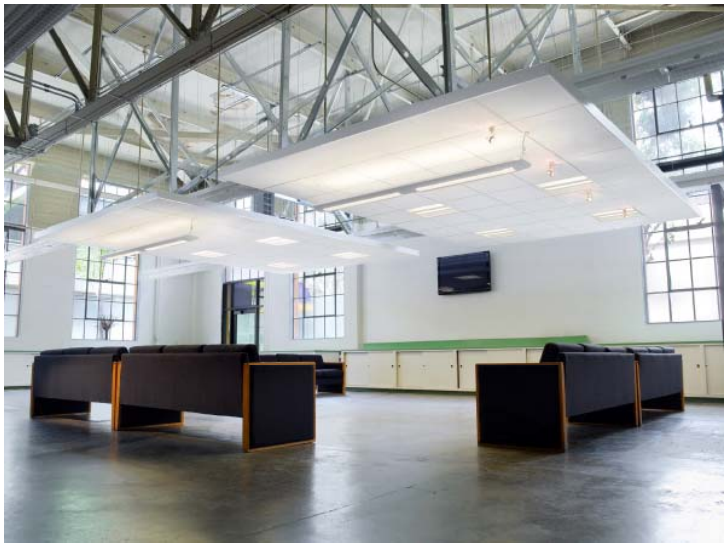
early applications

- Offices
- Learning environments
- Retail
- Government
- Hospitality

examples

Los Angeles Community College District

- Trade & Technology College campus – home of architectural, electrical & renewable energy depts
- Repurposed single story hi-bay multi-use building
- Seismic – non-union contractors installation
- Cloud configured – high light reflectivity acoustical ceiling
- DC multi-channel power servers – solar (PV) primary planned with utility AC alternate
- Fluorescent lighting fixtures – dimmable DC ballasts
- Wired controls – touch panel interface
- Daylight, occupancy and dimming functions



LOS ANGELES TRADE–TECH LATTC A Community College

“Smart Ceiling” in place – Case Study / Public Demo in Los Angeles, CA

US Green Building Council Headquarters

- Renovated downtown commercial office hi-rise (floors 5 & 6)
- Non-Seismic – union contractors installation
- Continuous – high light reflectivity acoustical ceiling
- DC multi-channel power servers – utility AC Primary – Solar supplemental planned
- Fluorescent lighting fixtures – with DC ballasts
- Wired controls, touch-panel interface
- Daylight, occupancy and dimming functions
- LEED Registered

“Smart Ceiling” in place – Case Study / Public Demo in Washington DC

PNC Financial Services

- Downtown Hi-rise commercial office building
- Non-seismic – union contractors installation
- Continuous – high light reflectivity acoustical ceiling
- DC multi-channel power servers – utility AC input
- Fluorescent & incandescent lighting fixtures – with DC ballasts
- Wireless (Zigbee) controls - touch panel interface – IP addressable
- Daylight, occupancy and dimming functions
- A/V DC powered speakers

PNC
LEADING THE WAY

“Smart Ceiling” in place – Case Study / Private Demo in Pittsburgh, PA

Southern California Edison

- Single story commercial office complex
- Seismic – non-union contractors installed
- Continuous – high light reflectivity acoustical ceiling
- DC multi-channel power servers – utility AC primary with alternate Solar (PV) planned
- Fluorescent lighting fixtures – with DC ballasts
- Wireless (Zigbee) controls – touch panel interface – IP addressable
- Daylight, occupancy and dimming functions

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

"Smart Ceiling" in place – Case Study / Public Demo in Irwindale, CA

Armstrong World Industries

- Two-story mixed use commercial office/classroom/ factory building
- Non-seismic – non-union contractors installation
- Continuous – high light reflectivity acoustical ceiling
- DC multi-channel power servers – solar (PV) primary power with utility AC back-up
- Fluorescent lighting fixtures – with DC ballasts
- Wired bus/branch controls – touch panel interface
- Daylight, occupancy and dimming function

Armstrong®

“Smart Ceiling” in place – Case Study / Public Demo in Lancaster, Pa

Nextek Power Systems

- One-story mixed use commercial office/lab/ factory building
- Non-seismic – non-union contractors installation
- Continuous – High light reflectivity acoustical ceiling
- DC multi-channel power servers – utility AC with Solar (PV) planned
- Fluorescent lighting fixtures – with DC ballasts
- Wired bus/branch controls – traditional wall switch interface
- Daylight, occupancy and dimming function

Nextek Power Systems

“Smart Ceiling” in place – Case Study / Public Demo in Detroit, Mi

availability

commercialization/availability

- Fall 2009 – 1st product category introductions
  - Ceiling grid
  - Power Supplies
  - Connector & Wiring Interconnects
  - Fluorescent , LED lighting fixtures
  - Wired & wireless room controls & sensors
- Spring 2010 – expect multi-source choices
- 2009 – early 2010: Demonstration and proof-of-design installations
- 2010 – 1MM SF already specified
- Typical user profile
  - New or Renovation
  - LEED Building project
  - Buildings adding alternative energy
  - Building looking to gain greater energy efficiency
  - Building looking to lower cost of occupancy churn

invitation for action

- www.emergealliance.org
- building support by asking you to join us

EMerge™ ALLIANCE

Participating Member

- Key suppliers of products and technology that comply with the standard
- Committee voting, voice in development of specifications, access to all specifications

General Member

- Organizations wanting to make/use products needing deeper knowledge of standard
- Access to completed specification prior to public availability; attend general meetings

Supporting Member

- Architects, engineers, consultants, owners and other industry professionals interested in support and otherwise facilitating use of the standard
- No voting rights, but may attend open sessions at general meetings

Liaison Member

- Standards/industry organizations interested in cooperation and integration of Standards
- No voting rights, attend select committee meetings/serve on select panels

Interest Group Participation

- Free periodic updates covering EMerge Alliance news & invitations to EMerge events
- On-line sign-up @ www.EMergeAlliance.org

question + answer