Session FG5

Microgrids Hold Key to Achieve Zero Net Energy Buildings

Brian T. Patterson
EMerge Alliance

Zero Energy Buildings (ZEB)

Buildings that produce as much energy as they use in a year

What's likely to change in the approach to design/build?

1. **Integrated design** and operations planning
2. **Site renewable energy** strategies get maxed out
3. **Energy Storage technology** will allow Grid independence breakthroughs
4. **System Intelligence** - More control, monitoring, verification of everything

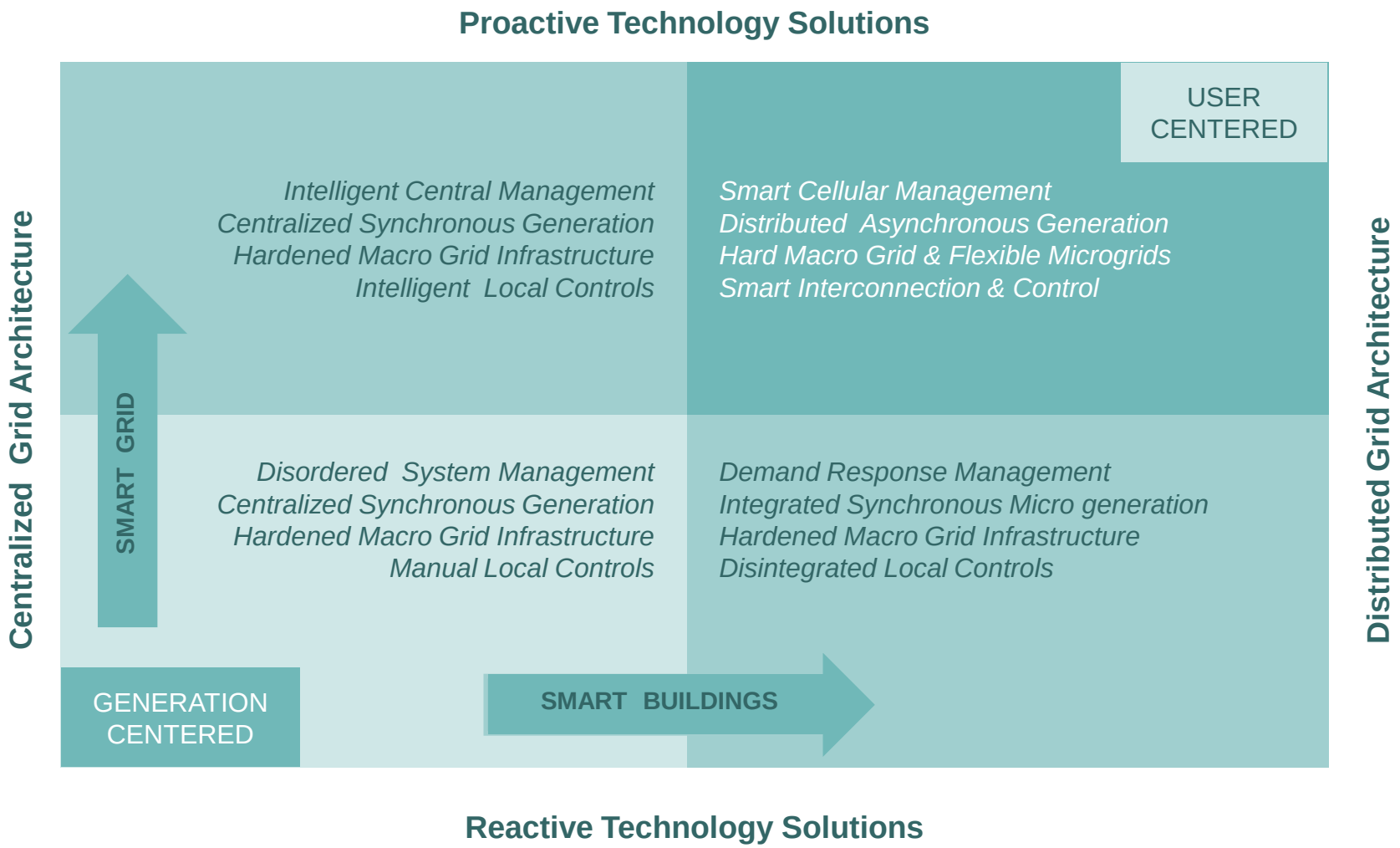
2030: All new commercial buildings

2040: 50% of commercial building stock

2050: All commercial buildings

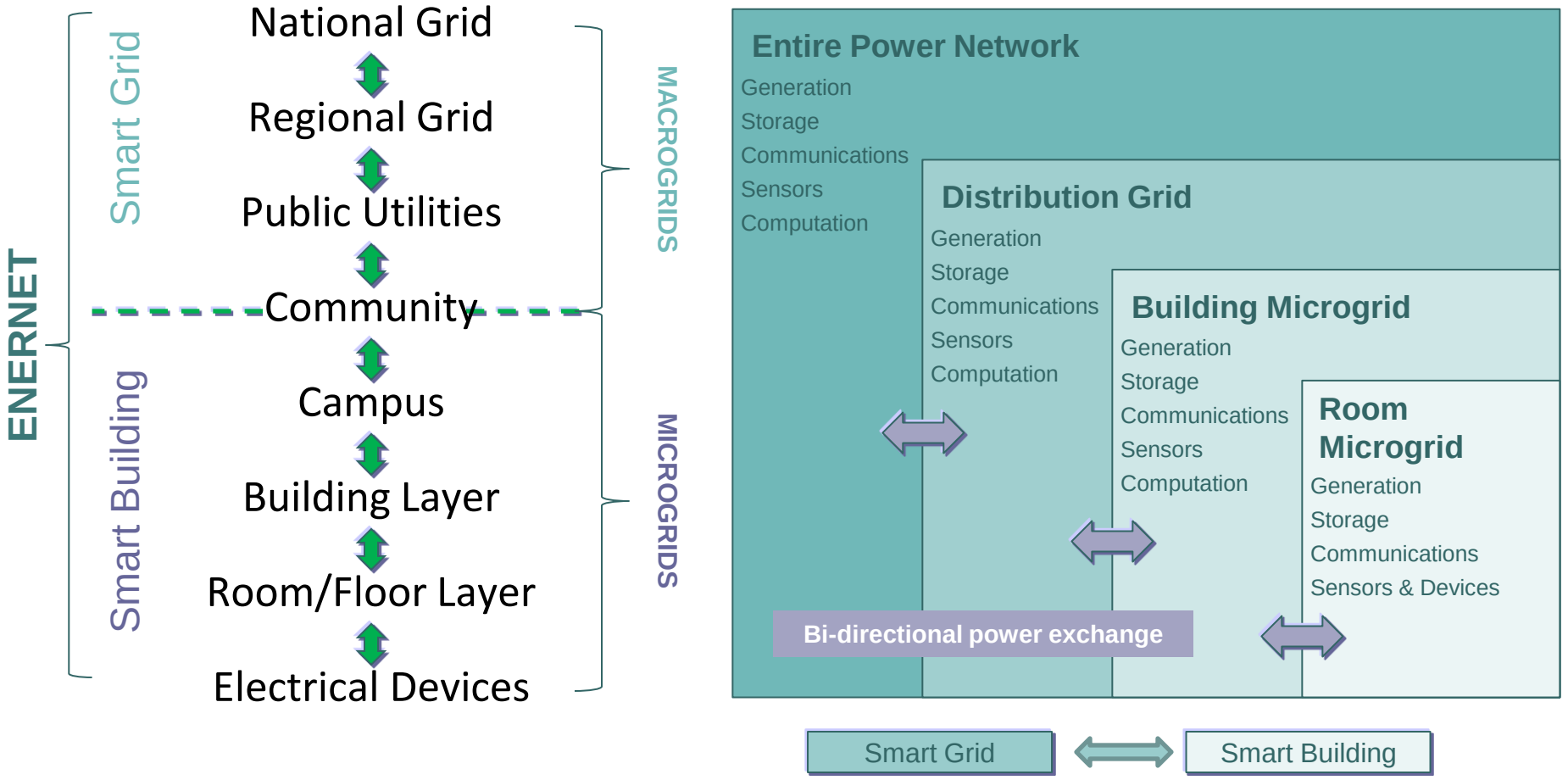
Zero Energy Buildings (ZEB)

Drive need to create an integrated microgrid energy network



Zero Energy Buildings (ZEB)

A ZEB driven network will look much like the Internet



PROBLEM: MISMATCHED AC & DC POWER REQUIREMENTS

ENERGY SOURCES – MIXED AC & DC

AC/DC Site Generation

DC Campus Fuel Cells

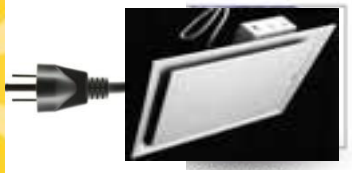
DC Photovoltaic

DC Wind Power

AC Line Power

ELECTRIC DEVICES – TYPICALLY DC

Electronic Lighting



HVAC Actuators

Sensor & Controls

AV/IT Devices

Data & Telecom Centers

Security & Safety

RESULT: LOST OPPORTUNITY TO REDUCE ENERGY UP TO 30%

Source: EMerge Alliance

SOLUTION: A SIMPLIFIED AC/DC HYBRID COUPLED POWER NETWORK

ENERGY SOURCES

AC/DC Site Generation

DC Campus Fuel Cells

DC Photovoltaic

DC Wind Power

AC Line Power

Coupled AC/DC Power Sources

▲

DC Power Distribution Management

▼

Wireless Controls BACnet TCP/IP

ELECTRO-ACTIVE DEVICES

Electronic Lighting

HVAC Actuators

Sensor & Controls

AV/IT Devices

Data & Telecom Centers

Security & Safety

OPPORTUNITY: 30% LESS ENERGY, 15% LESS CAPITAL, 200% MORE RELIABLE

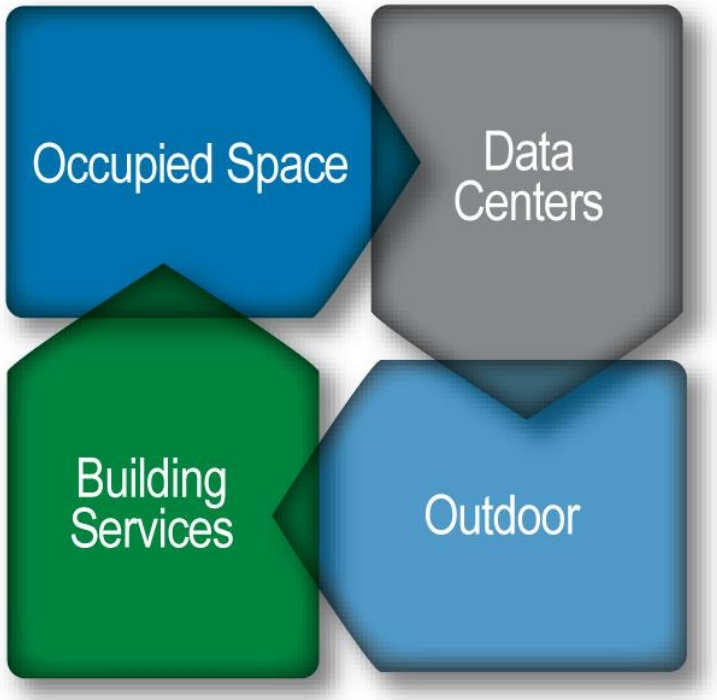
Source: EMerge Alliance

www.EMergeAlliance.org

Direct Current (DC) Power Standards for Buildings

A Platform of Open Standards for Hybrid DC Microgrids

Vision: DC Microgrids Throughout Buildings

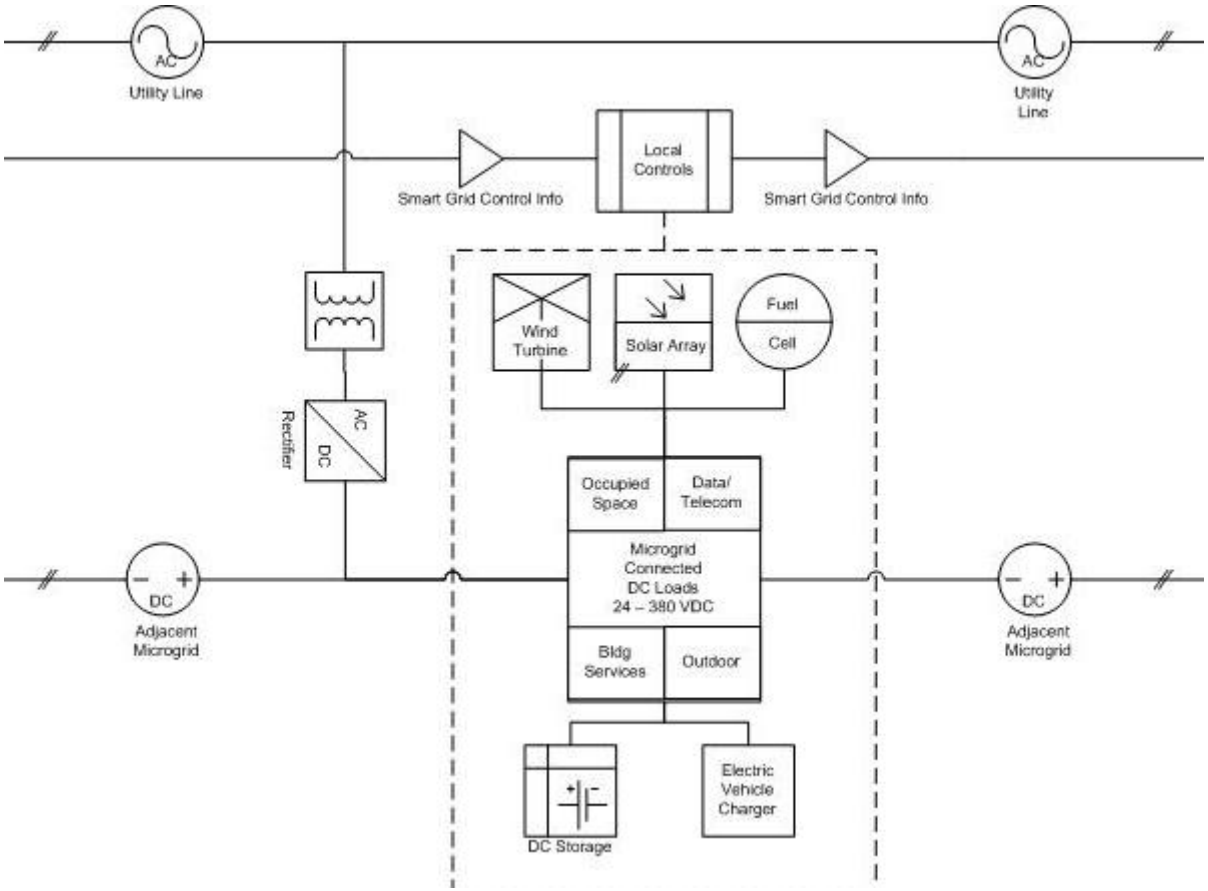


Save Energy - Connect New Energy Sources to Building Loads

Zero Energy Buildings (ZEB)

A ZEB driven network will look much like the Internet

DC MICROGRID MODEL



Energy Savings
Opportunities for Building Owners

Building Applications *(in priority timing of EMerge Alliance)*	**Ave % of Building Energy Used**	**Potential Energy Savings by Going DC**	**Keys to Maximizing Efficiency in Going DC**
Interiors (Lighting)*	28%*	Up to 15%	LED, Renewables
Data/Telecom	17%	Up to 30%	Higher voltage conversions, Renewables
Service/Utility (HVAC)	36%	Up to 10%	Renewables
Outdoor	6%	Up to 10%	LED, Renewables
Other (misc equip loads)	13%	Up to 5%	Different voltage conversions

*Higher energy use in office buildings, up to 40%

EMerge Goal

Reduce or Eliminate Conversions where practical with AC-DC Hybrid Microgrids

Connect DC sources directly to DC loads

Opportunity Examples:

LED Lighting

10-15% More Efficient in DC Form

On-Site Solar

5-10% More Efficient as DC Direct

Direct DC Data Center

15-30% More Efficient as DC Direct

EMerge ALLIANCE

Governing

Armstrong CEILING SYSTEMS

Johnson Controls

NEXTEK Power Systems

OSRAM SYLVANIA

WAVE WORTHINGTON ARMSTRONG VENTURE

Participating

AcuityBrands.

APP Anderson Power Products

CONVIA A HERMAN MILLER COMPANY

COOPER

CRESTRON

DTE Energy

EMERSON

FINELITE Better Lighting

HermanMiller

IDEAL

LEVITON

LUNERA

PHILIPS

ROAL living energy

sensorswitch

SOUTHERN CALIFORNIA EDISON An EDISON INTERNATIONAL Company

SPEAR POINT ENERGY

Steelcase

traxon | e:cue

Tyco Electronics

WattStopper legrand

EMerge ALLIANCE

General

CONFIGURA

ECA ELECTRI-CABLE ASSEMBLIES

kan·ə·pe

NORTHWIRE INC TECHNICAL CABLE

LEDing EDGE efficient lighting solutions

Universal Lighting Technologies

verve living systems

SAMSUNG

SAMSUNG LED

Corresponding

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

intel

DIRECT POWER TECHNOLOGIES, INC.

"Chip 2 Grid"™ Data Center Solutions

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Bill Tschudi
Lawrence Berkeley National Laboratories

Nana Wilberforce
The PNC Financial Services Group, Inc.

Kurt Yeager
Galvin Electricity Initiative

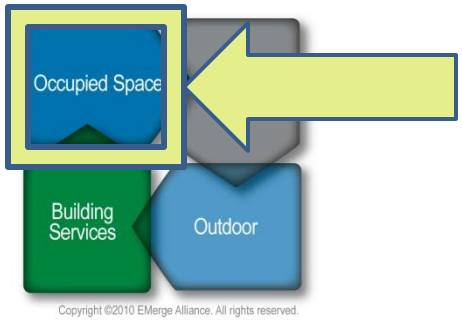
Online videos about EMerge mission/demos…

http://emergealliance.org/en/resources/videos.asp

The Evolution of Electrical Power…

Online video also at member site: http://vimeo.com/16061080

Vision: DC Microgrids Throughout Buildings



EMerge Alliance® Registered Products

24VDC Occupied Space Standard

380 VDC Data/Telecom Center Standard

Product Registration in 4 Categories:

- **POWER**
- **INFRASTRUCTURE**
- **PERIPHERALS**
- **CONTROLS**

1st Standard – Ceiling View

INFRASTRUCTURE:

Ceiling

↓

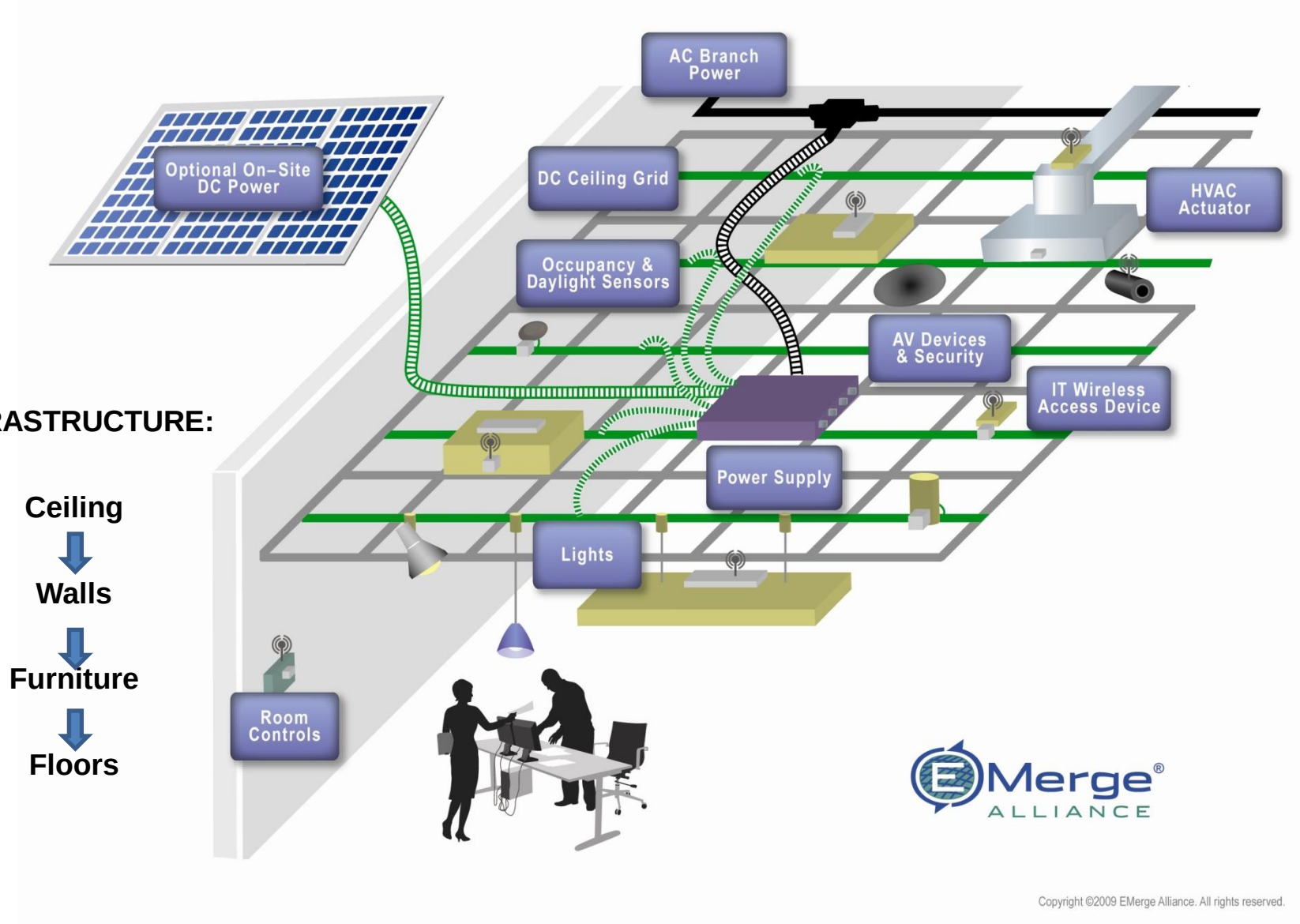
Walls

↓

Furniture

↓

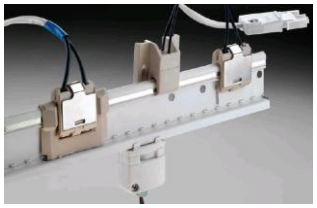
Floors



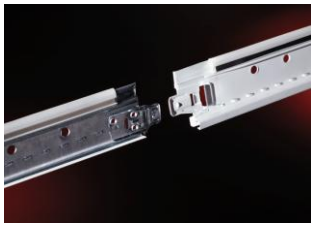
Recently Registered Products

NEXTEK Power Systems

Tyco Electronics

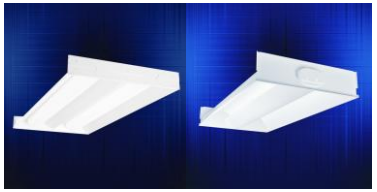


Armstrong



LUNERA™

COOPER



FINELITE
Better Lighting

Installation Examples Based on Applications of the 24V DC EMerge Alliance Standard

PNC Financial
Headquarters Office
Pittsburgh, PA

lauckgroup
Architectural Office
Dallas, TX

US Green Bldg Council
Conference Rooms
Washington, DC

Nextek Power
NextEnergy Center
Detroit, MI

UC San Diego
Sustainability Center
San Diego, CA

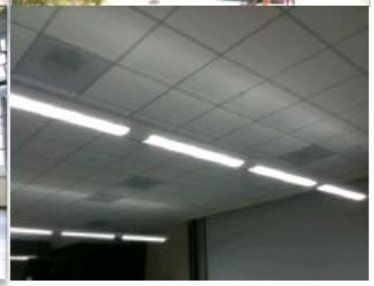
Southern Cal Edison
Utility Services Office
Irwindale, CA

Johnson Controls
Headquarters Office
Milwaukee, WI

Optima Engineering
MEP Firm
Charlotte, NC

LA Community College
Trade Tech Campus
Los Angeles, CA

CA Lighting Tech Center
UC Davis Campus
Davis, CA



Armstrong Case Study available:

Solar to Lighting & Controls

Sustainability Resource Center
Equity-Environment-Economy
UC San Diego
Local Impact, National Influence, Global Reach

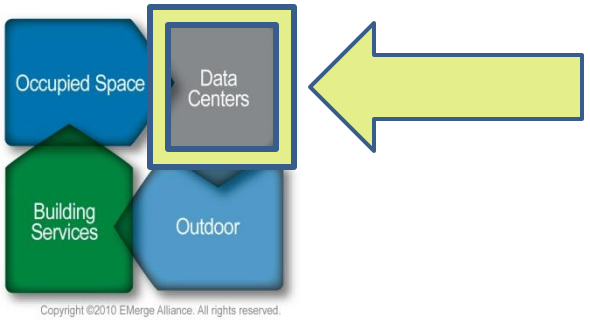
UC San Diego Sustainability Resource Center

Armstrong Case Study available:

Solar to LED Lighting

Optima Engineering
Charlotte, NC

Vision: DC Microgrids Throughout Buildings



New Technical Committee

Developing a **380VDC** Data Center Standard

Benefits of DC in Data Centers

"We need industry-wide participation to develop a standard …

The secret to maximizing energy efficiency is to use the highest possible voltage with the fewest number of power conversions while staying with volume components.

We're working on solutions that can accomplish both for significant savings in data centers."

Guy AlLee, Research Scientist, Intel Labs

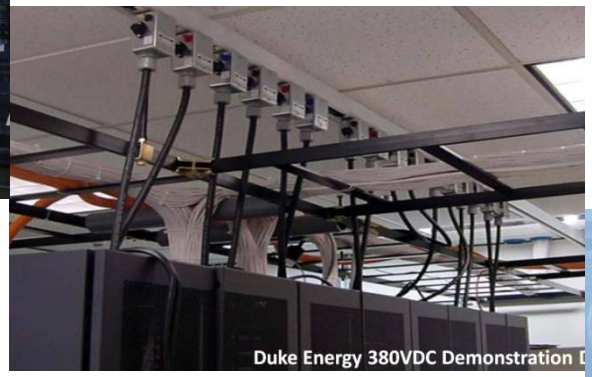
Intel Labs is planning an install of both 24VDC and 380VDC EMerge Standards at its New Mexico Energy Systems Research Center, including solar PV, a world-class PUE data center, energy storage, office lighting, and electric vehicle charging.

Installation Examples Based on Applications of the 380 VDC EMerge Alliance Standard

EPRI/LBNL - Electric Power Research Institute
Lawrence Berkeley National Lab, California

Ernest Orlando Lawrence Berkeley National Laboratory

Duke Energy data center in Charlotte, North Carolina



Calit2 - California Institute for Telecommunications and Information Technology , UC San Diego

Sustainability Resource Center
Equity-Environment-Economy
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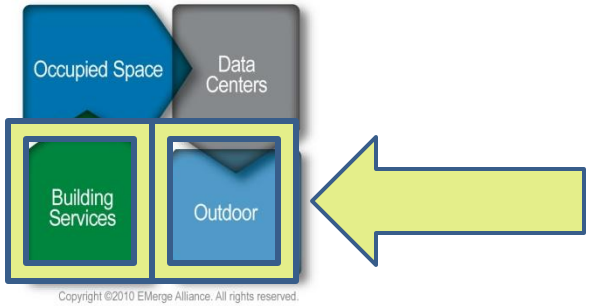
Local Impact, National Influence, Global Reach

Vision: DC Microgrids Throughout Buildings



Future Work: New Technical Standards in…

Outdoor DC / Electric Vehicle Charging

Building Services (HVAC)

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