The Attraction of DC Power in Buildings

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Bosch Building Grid Technologies
About Bosch

Established 1886

Roughly 389,000 associates worldwide
Around 440 subsidiaries and regional companies in approximately 60 countries
73.1 billion euros sales revenue in 2016
3.3 billion euros EBIT in 2016
120 engineering locations worldwide
Roughly 7 billion euros spent on research and development

Bosch Group Business Sectors

Mobility Solutions
Industrial Technology
Consumer Goods
Energy & Building Technology

The Bosch DC Building Grid Technologies Team

Provides solutions that improve the integration of renewable energy resources, electrical loads and power infrastructure within Commercial buildings, creating a new level of energy efficiency, resilience and intelligence
What is a Microgrid?

U.S. Department of Energy definition:

- “An integrated energy system consisting of distributed energy resources (DER) and multiple energy loads operating as a single controllable entity in parallel to or islanded from the existing power grid”

Microgrid Building Blocks
The Future of Microgrids – North America

Microgrid Capacity by Segment, North America: 2015-2024

(Source: Navigant Research)
The War of the Currents

- Electrification of the Country occurred in late 1800s

- Battle of alternating current (AC) versus direct current (DC) won by Tesla
  - 1893 Chicago World Fair
  - AC was better for long-distance transmission
  - Received backing by Westinghouse
  - Power electronics did not exist

- Thomas Edison’s initial power systems were DC microgrids
  - Over 50 DC microgrids had been installed by 1886
  - Systems were installed in the United States, Russia, Chile, and Australia
Will Edison Win Out After All?

The energy landscape is quickly leaning towards DC…

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80% Of residential and commercial loads are DC

20% Of electric production is used by lighting
The Inefficiency of AC Buildings

A Conventional AC System

There is 10% energy lost in power conversions that are the **first devices to fail** and onsite energy is **unavailable** in an outage.
The Complexity of an AC Building Design

It’s a systems architecture that requires independent building systems that need separate wiring or wireless controls for data using a multitude of power conversion devices and switches.
AC Systems Don’t Work in an Outage

Puerto Rico power outage set to hurt global reinsurers
Suzanne Barlyn, Noor Zainab Hussain

Delta: Atlanta airport power outage cost $25M to $50M in income

Power outage brings CES to a standstill
By Janko Roettgers, Variety
January 10, 2018 | 4:21pm
The highest energy efficient solution available using a 380Vdc architecture where onsite generation directly powers building loads and data networks are run over the power wires for an intelligent system at no additional cost.

A reliable solution for retrofit and new construction facilities that is resilient when the grid fails and is cost effective from day 1 and throughout the 25 year system life.
The Simple Design of a DC Building Grid

It’s a system architecture that integrates building systems using existing wires for power and data with a single point for bi-directional power conversion without the need for switches.
DC Lighting – Best in Class Efficiency

DC Lighting Approach
- Nearly 100% Efficiency
- 380v DC
- 96% Driver Efficiency
- 98% utilization

Traditional AC Lighting Approach
- 95% Inverter Efficiency
- AC Driver
- 90% Driver Efficiency
- 86% utilization

*does not include grid distribution losses

DC LED luminaires are the most efficient and reliable LED luminaires in the market which helps to lower O&M and maintenance costs
DC Driver – Efficient and Reliable

DC LED Driver

98% efficient with no AC/DC conversion components resulting in cooler operation, extended product life, and fewer replacements.

AC LED Driver

Only 80-90% efficient with power conversion components that generates heat and frequently fails which increases the need for replacements.
DC an Enabling Platform for Zero Net Energy

- DC Power would fundamentally change the way power is distributed in commercial buildings

- Future ZNE requirements
  - 2030: All new commercial buildings
  - 2040: 50% of commercial building stock
  - 2050: All commercial buildings
Networked Energy Management System Through the Cloud

- Local orchestration for optimized operation
- Standards based API
- Power and data connected to create an IoT network that can control every channel (and the devices)
- Cybersecurity enabled
Potential Cost Savings of DC Building Grids

25 year Lifetime Costs - 30% reduction

- AC system
- DC system

- Installation Costs
- Energy costs
- Operations and Maintenance cost
DC Products Available and Expanding
Data Center DC Product Examples

380VDC Power Supplies, Interconnect Cables, Bus Ways, Outlet Strips, Breakers
# 380Vdc Eco-System Availability Summary

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**Power Components**
- HP – major platforms available
- IBM – some X and Z series available today
- Juniper – products in final evaluation
- NEI – Commercial products available
- NEC – Commercial products available
- Supermicro – 2 trial servers available
DC Systems Compliant with Code and Safety Standards

- NFPA 70 (National Electric Code) compliant
  - All present electrical building codes that apply to AC systems also apply to DC systems
  - 2017 NEC includes a new Article 712 that provides additional clarity on certain aspects of a DC microgrid

- UL compliant
  - All DC components can be UL listed with their respective UL standards

- IEC compliant

- EMerge Alliance
  - Developing open standards for DC microgrids in buildings

- Safety
  - Ungrounded, high resistance grounded, or low resistance grounded systems
Sample Projects

- Industrial Building
- Fitness Center
- Distribution Facility
- Bank
- Office Building
DC Building Technologies – A Growing Market

All DC Building Technologies Revenue by Region, World Markets: 2013-2020

- North America
- Europe
- Asia Pacific
- Latin America
- Middle East & Africa
Summary – Technology that is Truly Efficient and Reliable

- Lower Investment & TCO
- Minimizes Interconnection Impacts
- Operates during grid outages without complex switching
- Zero Net Energy Capable
- Significant reduction in greenhouse gas emissions
- Efficiency improvement

Sustainable + Cost Effective + Resilient
Questions?

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