



ACUITY POWER GROUP

CONSULTING ENGINEERS

NANOGRIDS

AT GRID'S END: WHERE THE POWER MEETS THE LOAD

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MICROGRID (Many Definitions)

“group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can operate in both grid-connected and island mode”

Source: Office of Electricity, DOE Microgrid Workshop Report, 2011, San Diego, CA

NANOGRID - Building Blocks of a Microgrid

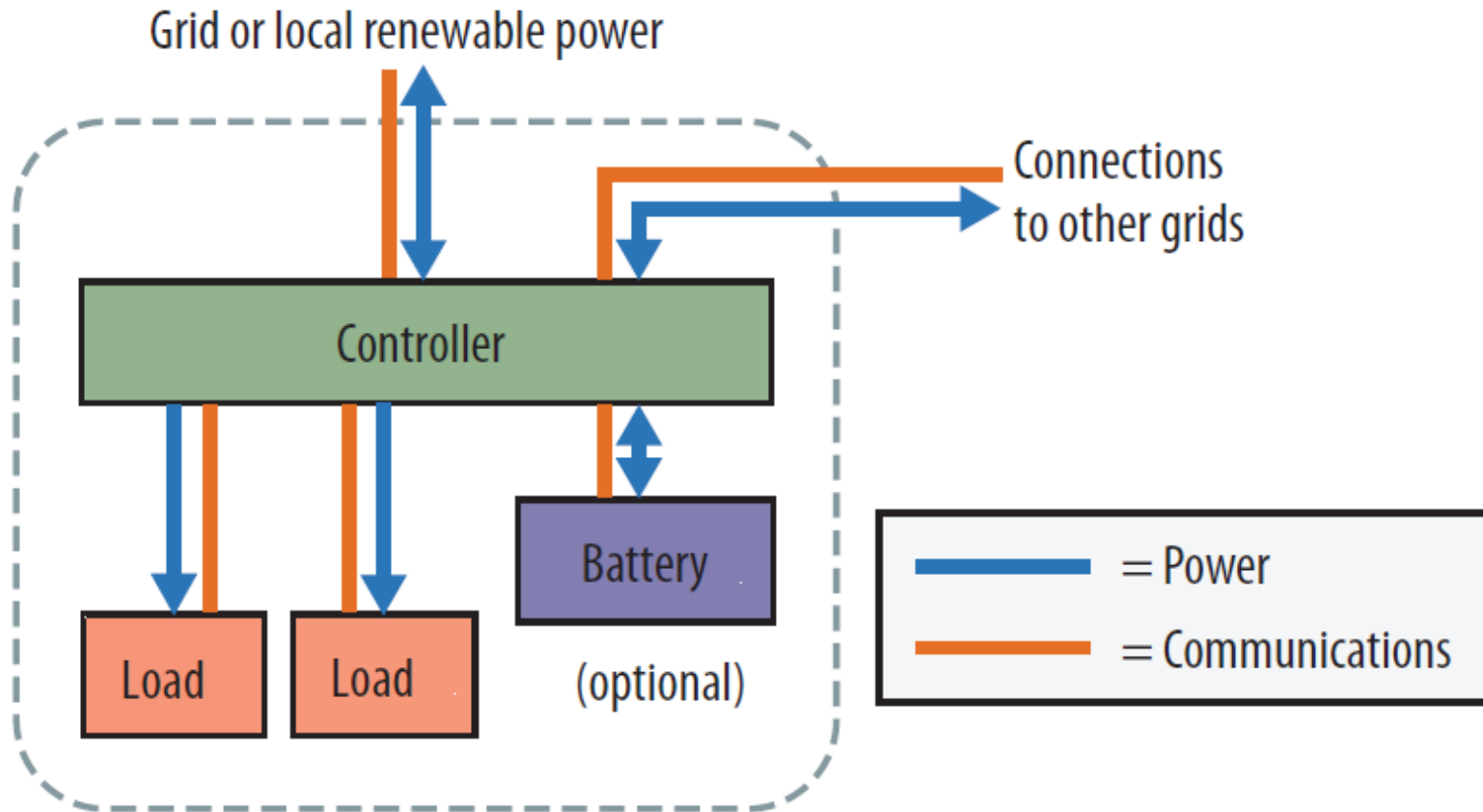
A nanogrid is a single domain for voltage, quality, reliability, price, and administration. It must have at least one load or sink of power—which could be electricity storage—and at least one gateway to the outside. Electricity sources aren't part of the nanogrid, but a source often will be connected only to a single nanogrid.

Source: IEEE Computer Magazine Sept. 2012 *Think Globally, Distribute Power Locally: The Promise of Nanogrids* Bruce Nordman and Alan Meier, Lawrence Berkeley National Laboratory and Ken Christensen, University of South Florida

NANOGRIDS

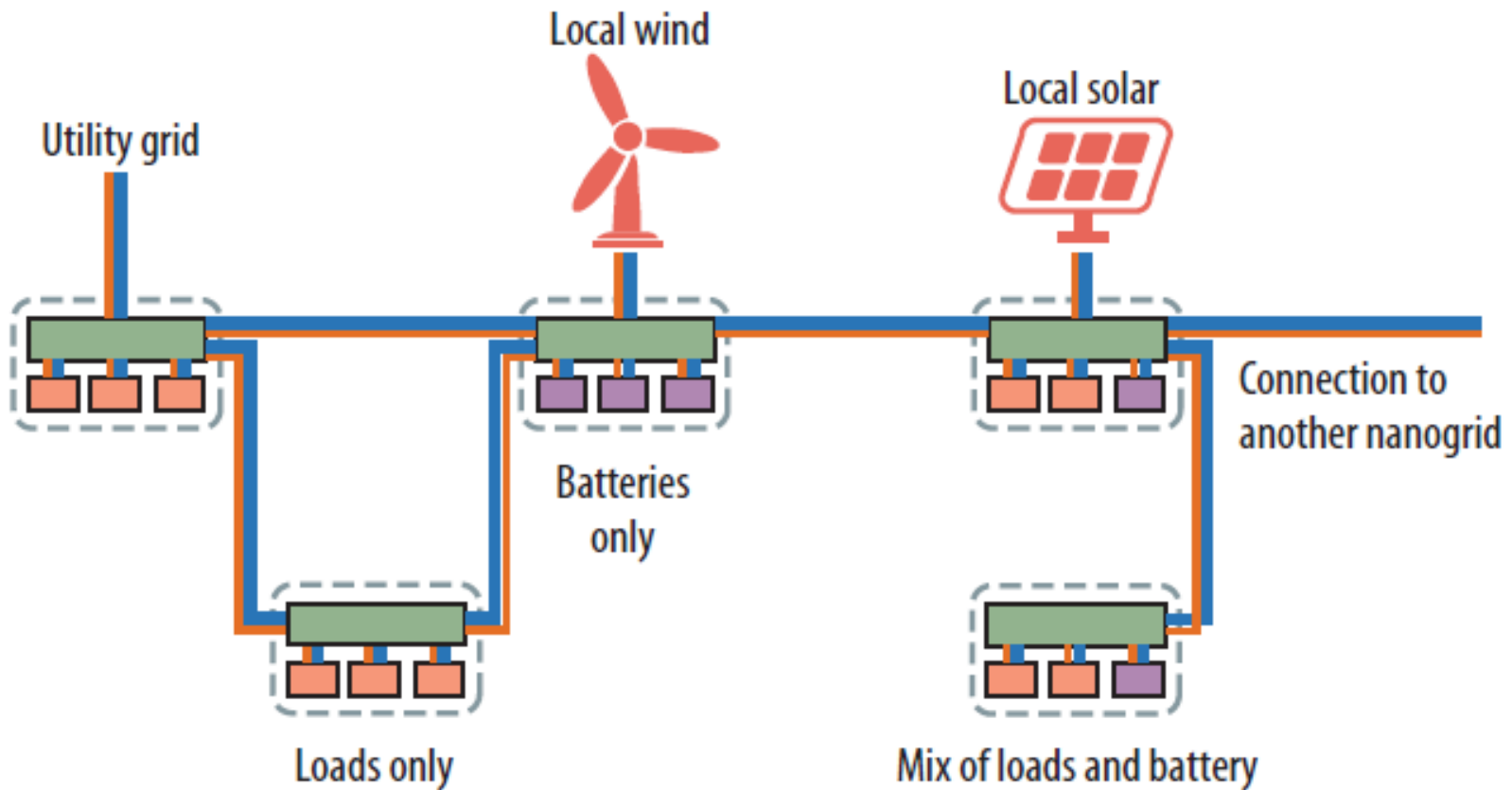
- **Use Price (Priority)** to mediate local electricity supply and demand, improving electricity allocation at the local level
- **Facilitate Integration** of local storage and generation, and
- **Achieve** more efficient use of low-voltage DC from local sources

NANOGRID CONCEPT



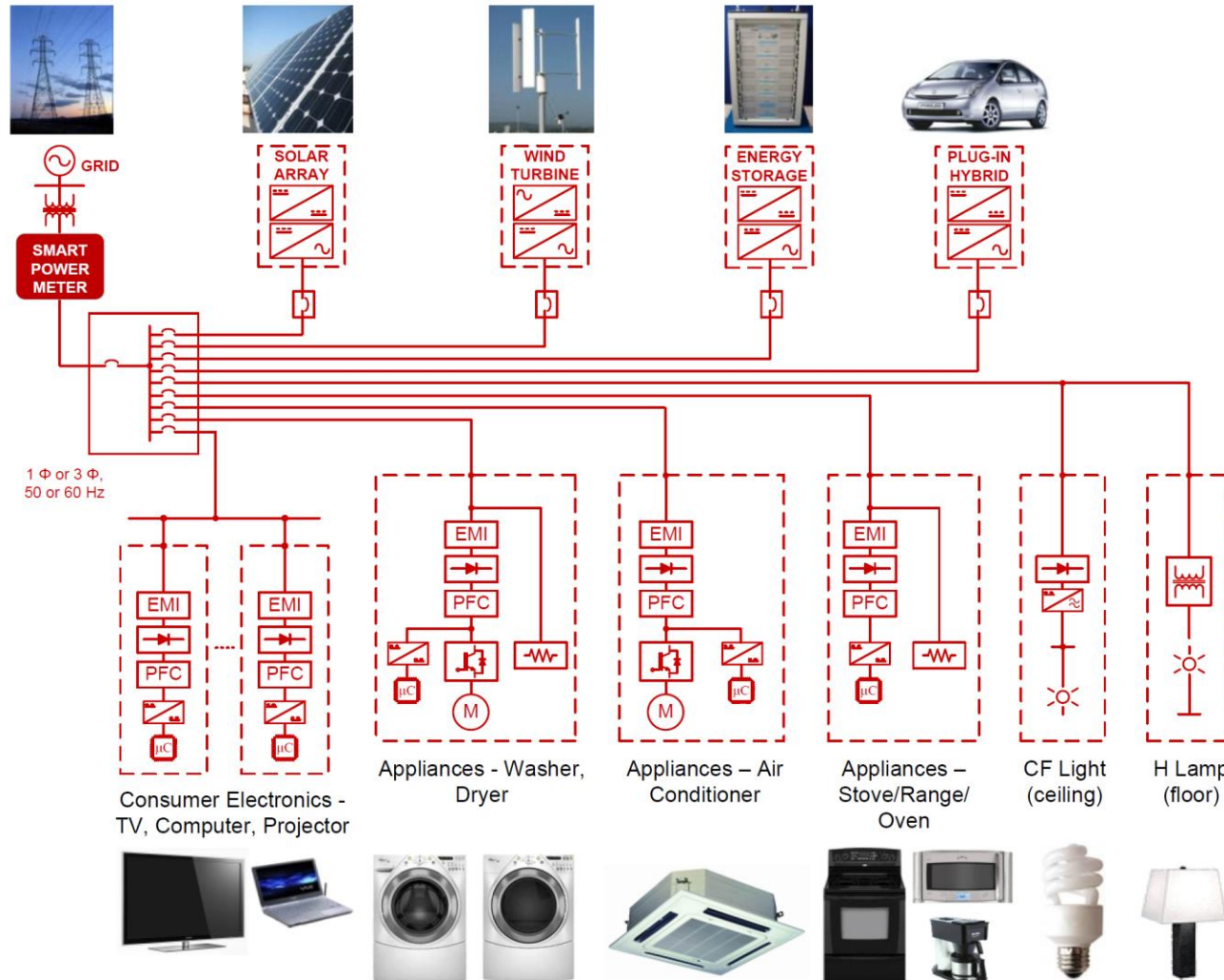
Source: IEEE Computer Society Sept. 2012

NANOGRID NETWORK EXAMPLE



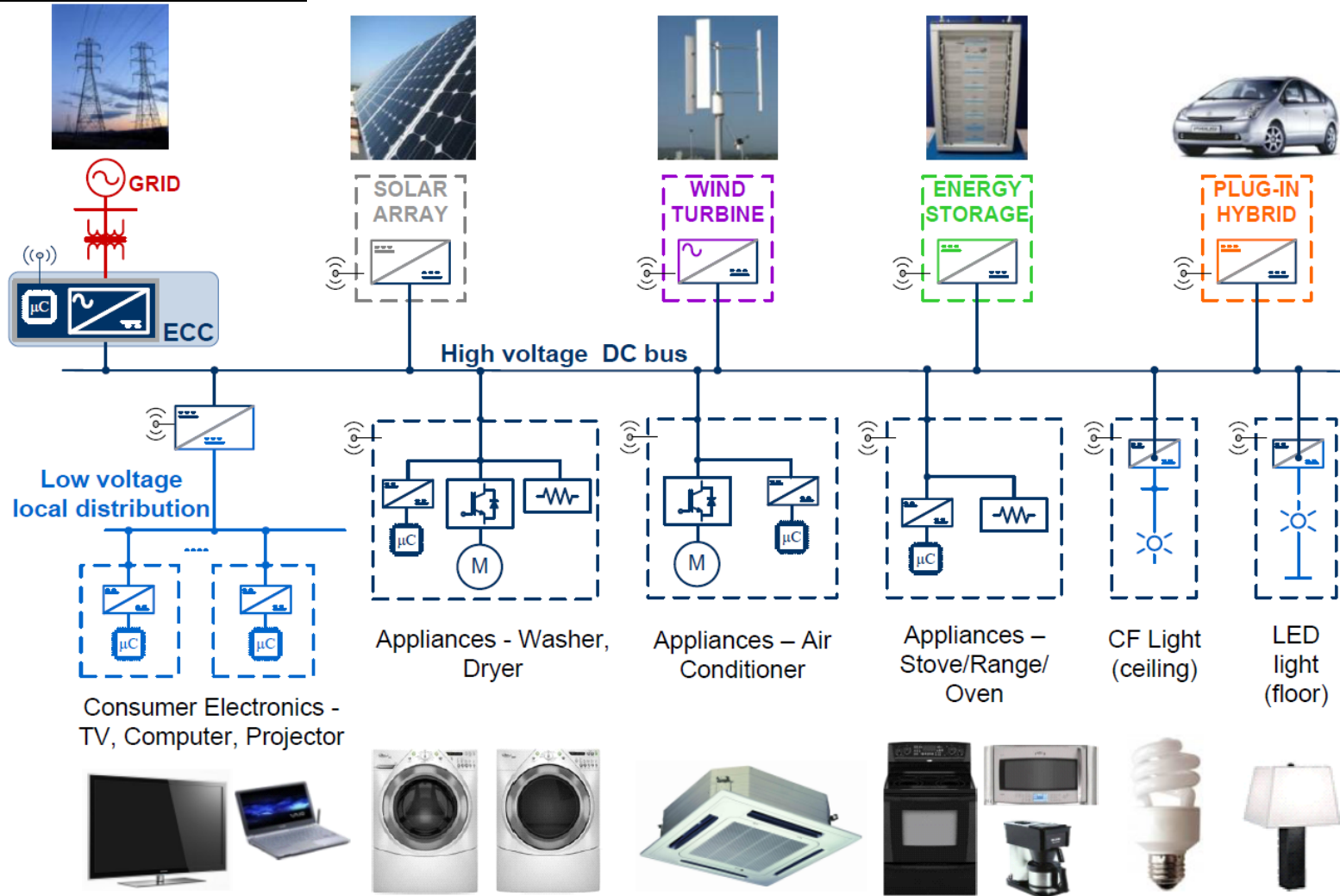
Source: IEEE Computer Society Sept. 2012

AC MICROGRID APPROACH TO A SMART, SUSTAINABLE HOME



Source: Igor Cvetkovic, MSEE Thesis Virginia Polytechnic Institute 2010 - "Modeling, Analysis and Design of Renewable Energy Nanogrid Systems"

DC NANOGRID APPROACH TO A SMART, SUSTAINABLE HOME



Source: Igor Cvetkovic, MSEE Thesis Virginia Polytechnic Institute 2010 - "Modeling, Analysis and Design of Renewable Energy Nanogrid Systems"

LESSONS FROM GERMANY

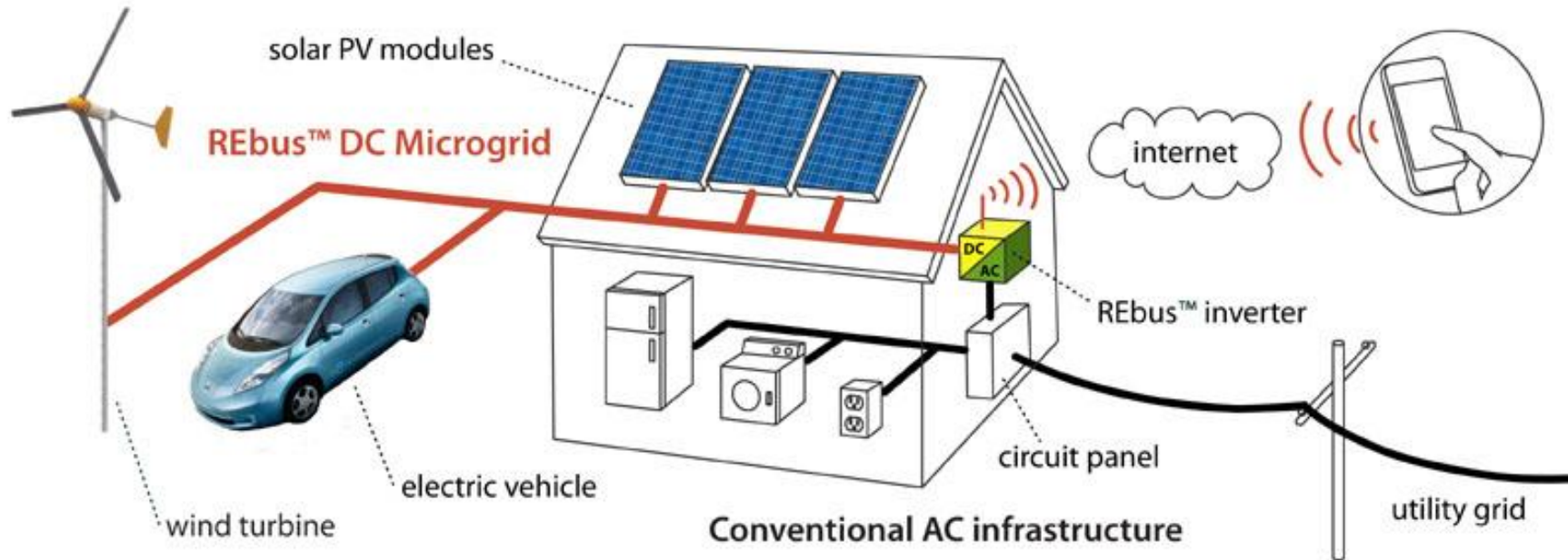
- High penetration of renewable energy can cause some grid instability
- Energy storage allows smoothing of very fast ramp-rates from intermittency
- Energy efficiency / Load management is also key to smoothing and matching demand to supply from renewable energy
- On a distributed scale, EE/DM, on-site DG and energy storage, combined with smart control systems, allow for independent “self-generation,” resilience to utility outages events and enhancement of overall utility grid stability

APPLICATIONS

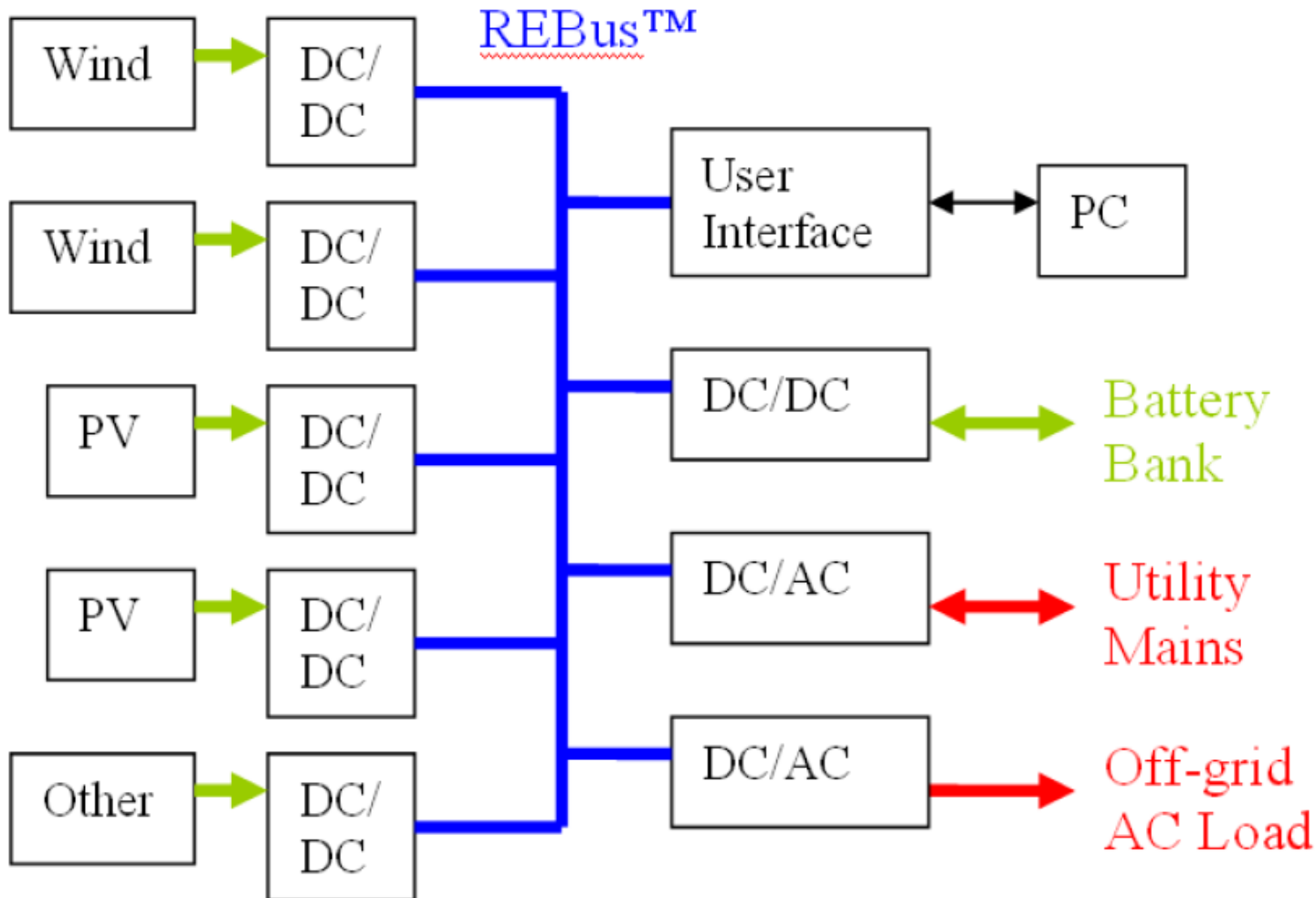
- Zero-Net Energy Applications – e.g. Living Building Challenge, residential, commercial, industrial, institutional
- Any Critical and Essential Power Applications – Circulation Pumps, Air Handlers, IT Servers, Telecom, Lights, USB Chargers, Elevators, etc.

REBus™ ALLIANCE

Renewable Energy Bus Distribution at 380 VDC



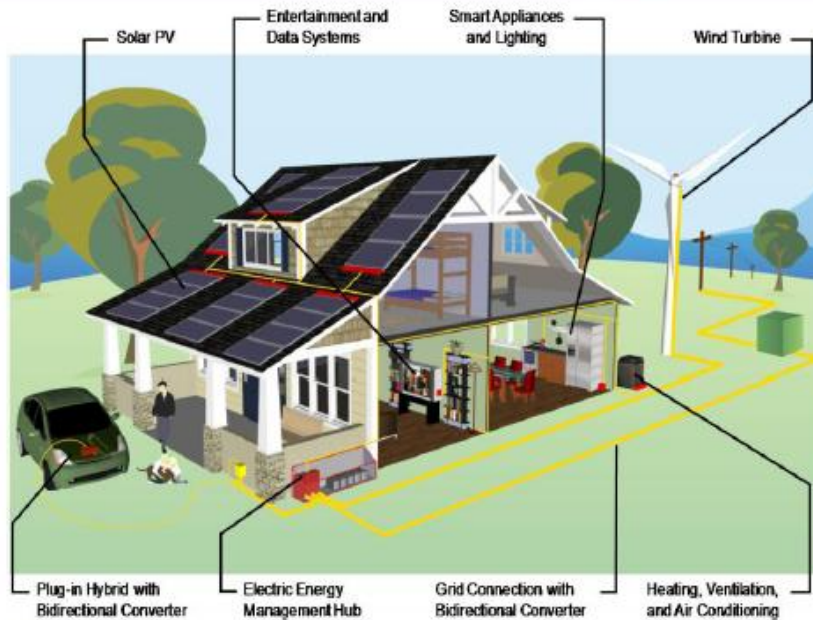
REBus™ Microgrid Specification Draft v. 0.14



Virginia Tech Center for Power Electronics Systems (CPES)



Mini-Consortium for Renewable Energy and Nanogrids (REN)



Work Scope

- PV System
- Plug-in Hybrid Electric Vehicles / Battery Storage
- Wind Power
- Energy Management for the Nanogrid
- AC Nanogrid
- DC Nanogrid
- Solid State Lighting

Current Principal Plus Members in this area:



Research Sponsors



Nanogrids

EMerge Alliance™

What is the EMerge Alliance?

- Not-for-profit 501c
- Open application standards for DC platform
- Eco-system development and promotion
- 100+ membership and growing

Who is the EMerge Alliance?

- Architects, Engineers, Contractors, Builders, Integrators
- Manufacturers – Service Providers
- Building Owners – Facility Managers
- National & Indep. Labs, Academic Inst.
- Codes and Standards Groups

What is an EMerge Standard?

- Commercial applications standards
- Subordinate to safety/equipment standards
- Physical, electrical, operational interfaces
- Application definition – listing requirements of other standards (incl. IEC)



EMerge Alliance™

VISION

- DC microgrids throughout commercial buildings
- Hybrid AC and DC platform w/open architecture
- Reduce/eliminating inefficient AC to DC conversions between power sources & digital devices
- Address ongoing and increasing demand for improved reliability and energy efficiency across all areas of commercial buildings

Vision: DC Microgrids in Buildings



Copyright 2012 EMerge Alliance

Occupied Space 24-volt DC microgrid for use in commercial interiors, featuring safety and flexibility along with efficiency benefits.

Data/Telecom Centers The EMerge Alliance Data/Telecom Center Standard is our second standard. It creates an integrated, open platform for power, infrastructure, peripheral device and control applications to facilitate the hybrid use of AC and DC power within data centers and telecom central offices.

Outdoor Power needs exist for buildings exteriors: lighting, signage, and the need to recharge electric vehicles can be addressed with DC microgrids. Work is underway now to develop this standard.

Building Services Larger building loads such as HVAC, motor loads and high bay/industrial applications are often DC-based and are ideally suited for DC microgrids

EMerge Alliance™

Alliance News Releases



EMerge Alliance Launches Residential DC Power Initiative

Application standards group is the first to focus on homes and small businesses

SAN RAMON, Calif. (Nov. 18, 2013) – The EMerge Alliance – an open industry association leading the rapid adoption of safe direct-current (DC) power distribution standards for buildings – today announced the launch of a new residential DC power standards initiative to advance the use of DC power in homes and small businesses. The Alliance is the only application standards development group working on advancing the use of DC power in residential and commercial buildings.

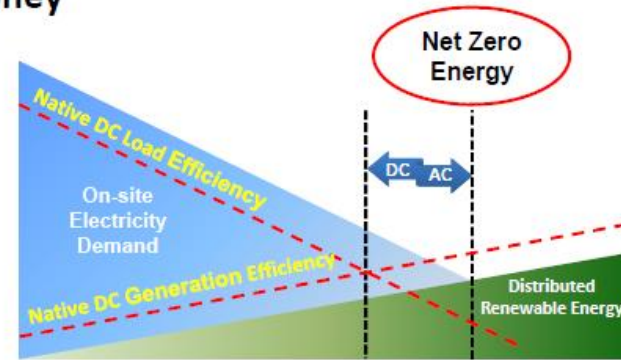
EMerge Alliance™ and Commercial Buildings Consortium (CBC) Accelerating Net Zero Attainment

The Right Approach can save Time and Money

1. **Integrated design** and operations planning
2. **Site renewable** strategies get optimized using dc
3. **Energy Storage** in dc allow Grid independence
4. **System Intelligence** control, monitor, verify



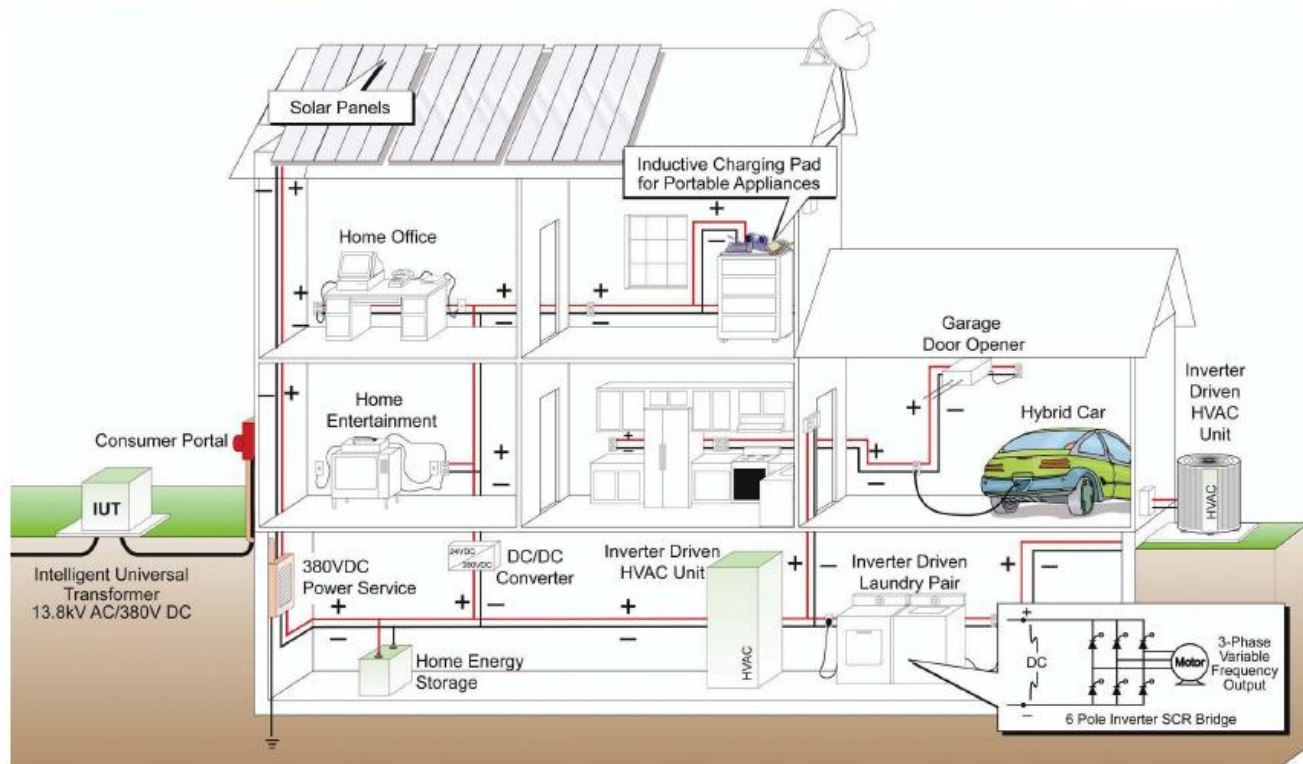
- 2013:** Begin DC Microgrid Demonstrations
- 2030:** All new commercial buildings
- 2040:** 50% of commercial building stock
- 2050:** All commercial buildings



"DC power would fundamentally change the way power is distributed in commercial buildings..."



DC-Powered Home - Fantasy or Future Reality?





Our Main Office in Wellesley Hills, MA



FOR MORE INFORMATION COME VISIT US AT BOOTH # 840

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