

DC Microgrids / DC Homes

Feb 21, 2024

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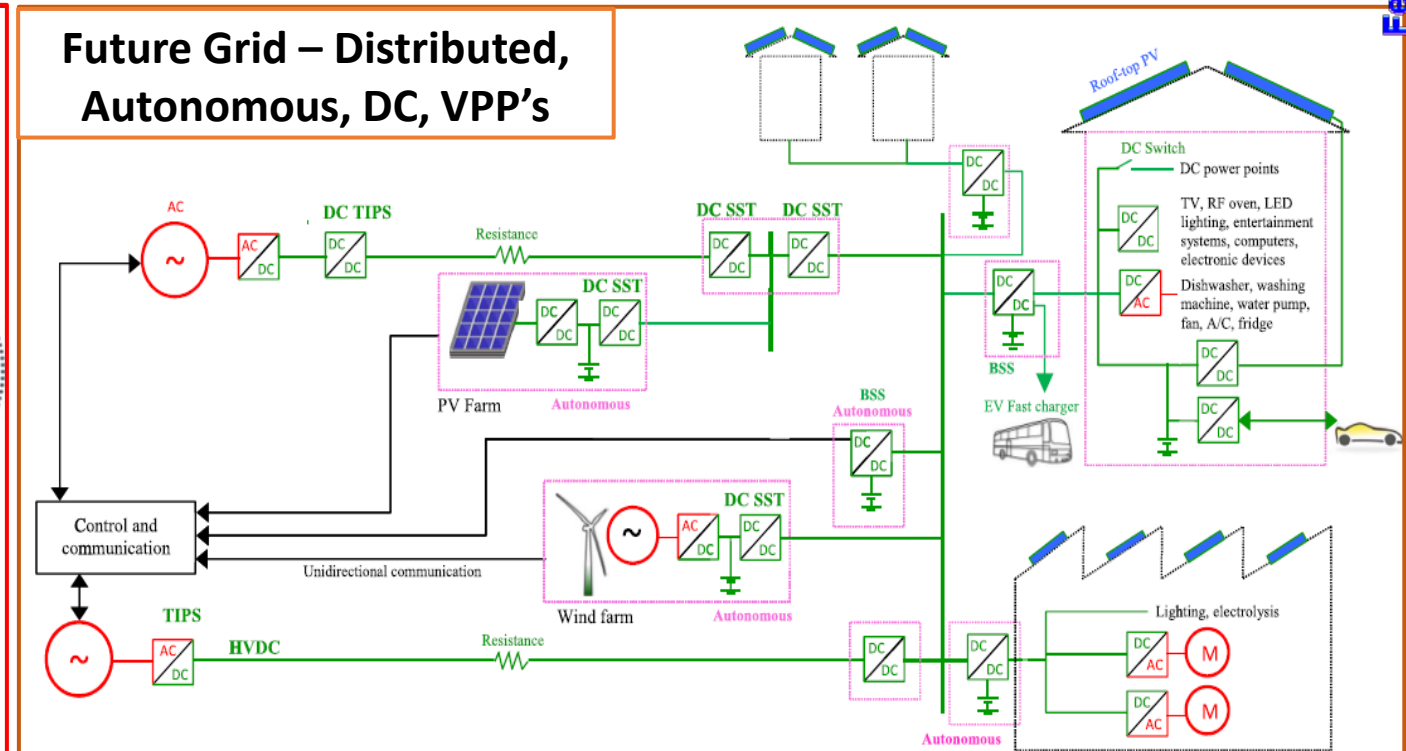
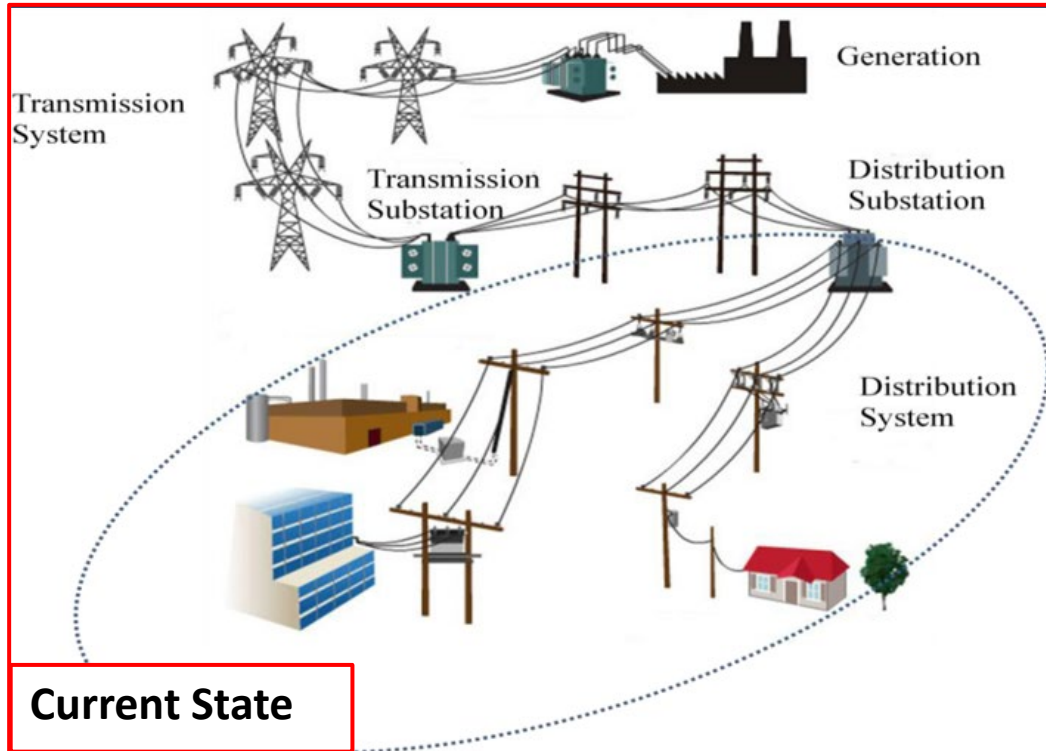


Feb 27 2024



Duke Energy Grid Emission Goals

- 50% reduction in CO₂ emissions from electricity generation by 2030
- Net-zero methane by 2030; Net-zero CO₂ by 2050
- Modernize our electric grid to be more reliable & resilient while embracing Distributed Energy Resources and DC Microgrids
- Improve energy efficiency with DC systems and create energy equity for renewables
- Enable Energy Orchestration



DC Microgrids and Services

Benefits of DC

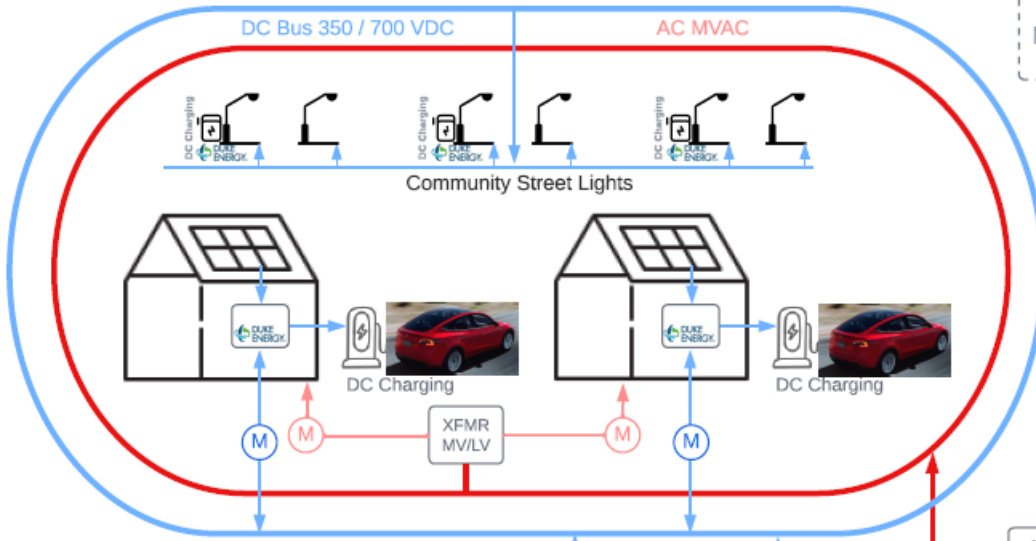
- **Eliminates conversion.** PV, Battery, EV, and modern loads are DC; why convert to AC?
- **Matches existing load.** ~85% of loads found in buildings / homes are DC.
- **Avoids conversion losses.** Typically, 5-20% on DC/AC and AC/DC conversions. Round trip can easily be > 15%.
- **Improves energy efficiency.** DC motors and appliances have better power to size ratios and DC lighting is 75% more efficient than incandescent lighting.
- **Reduce Wiring Costs.** Savings of 55% by reducing copper used.

Bay5 DCMG Capabilities

- **DC Panel.** Solar canopy, EV charger, and loads are all coupled through a DC panel, and balanced by the CE+T Power conversion system (PCS).
- **System cold start from solar.**
- **Fast EV charging:** Solar direct to EV charger through the DC Panel at 350VDC, ~20kW.
- **All loads are DC.** USB-C, USB-A sockets, lighting, displays, computers, 350VDC wall sockets, LG appliances (Dryer and Robo-Vacuum)
- **Battery:** Savant POMCube (Li-ion) and Adena (molten salt) provide power reliability

Community Microgrids

Designed by **DEP**
DIRECT ENERGY PARTNERS



Virtual Power Plant for Duke Energy
Resilient Community for Residents
Maximum CO2 reduction for Environment

- Solid State Protection**
- Highest possible safety for DC Systems
 - Ultra-fast breaking
 - Ultra-limited short circuit currents
 - Remote operation
 - Remote monitoring
- ABB**

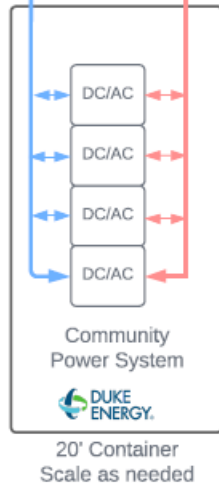
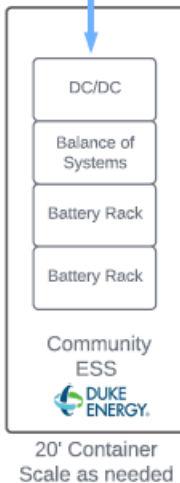
- Current OS Power Management**
- Hardware interoperability
 - Multi-vendor support (Schneider, ABB, Eaton)
 - Distributed control layer for system operation and demand management



Voltage based system operation

Protection	Overvoltage (548/1088)VDC
	Abs Max (410/820)VDC
Dump loads active	
	Umax (380/760)VDC
Happy hour	(375/750)VDC
None Critical	(370/740)VDC
None Essentials	(365/730)VDC
None Important	(360/720)VDC
None Priority	(355/710)VDC
Nominal (by DC ¹)	Nominal (350/700)VDC
Nominal (by DC ²)	(345/690)VDC
Priority	(340/680)VDC
Important	(335/670)VDC
Essentials	(330/660)VDC
Most Essentials	(325/650)VDC
Critical	Umin (320/640)VDC
Emergency Operation	(255/510)VDC
Grid down	(250/500)VDC

LG ESS or Duke Energy's Preferred Vendor



- OpenFMB**
- Software interoperability
 - Multi-vendor support
 - Cybersecure
- OPEN FMB**

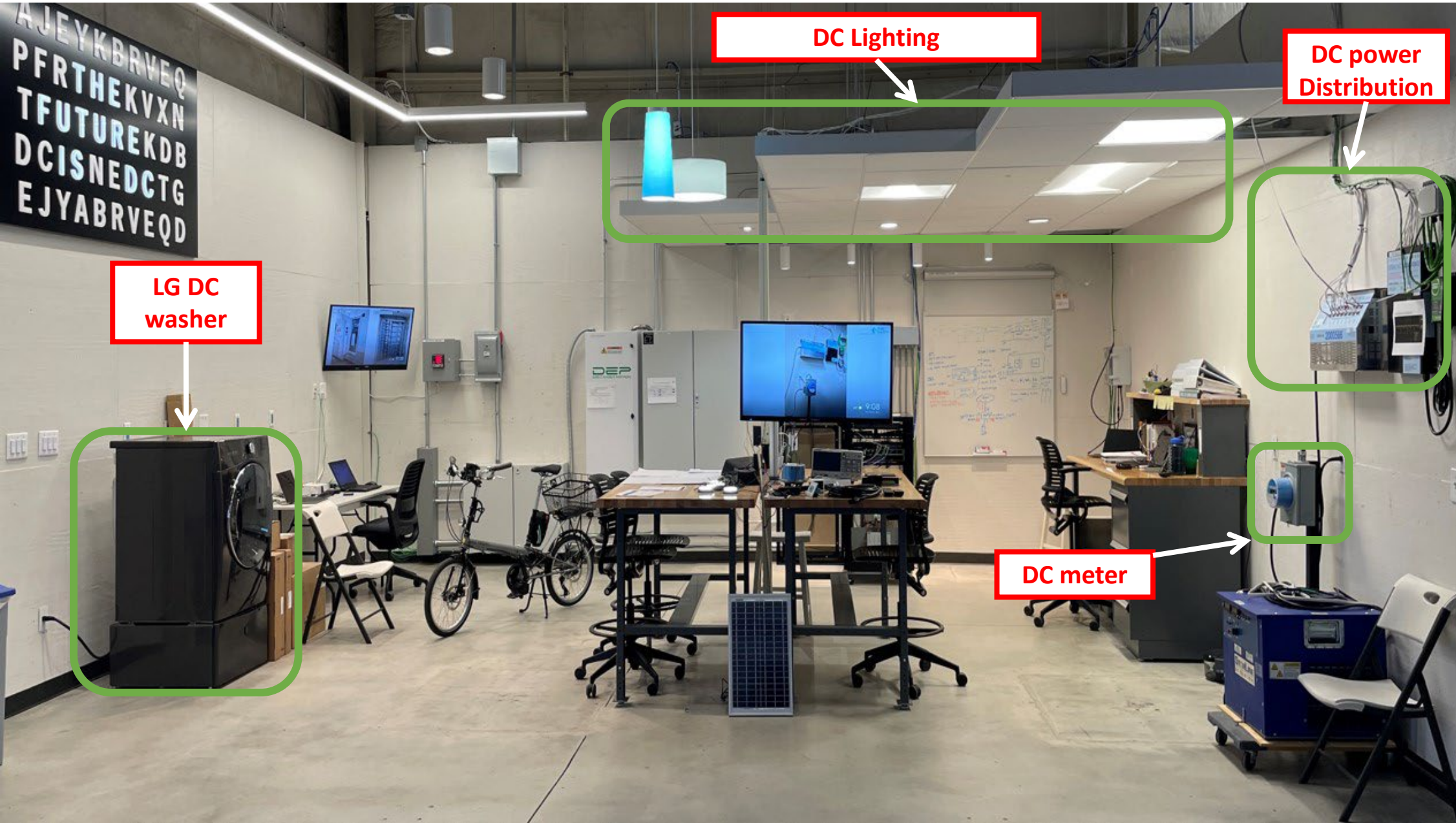
Owned, Operated, Maintained by Duke Energy

- Innovation and Leadership
- Improved grid efficiency
- Enhanced resiliency and reliability
- Opportunities for load management
- Integration of renewable energy sources
- Scalability
- Improved grid management Opportunities with Microgrids and VPP's

Status

- Design for the community energy center and DC home integration – complete.
- Messaging interface to DC microgrid controller in-test.
- Scripting control of PLCNext controller in-test.
- Electrical connection preparation to Adena Power battery – complete.
- Adena Power solid state “Molten Salt” Battery - Delayed
- Savant POMCube is on-site – implementation in-progress.
- NCREPS final report out – in-progress.

Mock DC Home at Mount Holly Bay 5



DC Lighting

DC power
Distribution

LG DC
washer

DC meter