Microgrid – Building block for Smart Cities

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December 2014

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COMED OVERVIEW

- The service territory covers 11,400 mi^2 in Northern Illinois
- Serving about 3.8 million (70%) of the customers in Illinois
- ComEd delivers electricity to 400+ municipalities, including the **City of Chicago**
- 23,750 MW all-time system peak (summer 2011)
- Transmission lines at 138, 345, 765 kV
- About 5,700 miles of transmission (69 -765kV) lines and about 66,000 miles of primary distribution (4 - 34kV) lines
- 225 HV, 526 MV distribution substations
- 5400 Distribution Feeders at 4, 12.5, 34.5 kV

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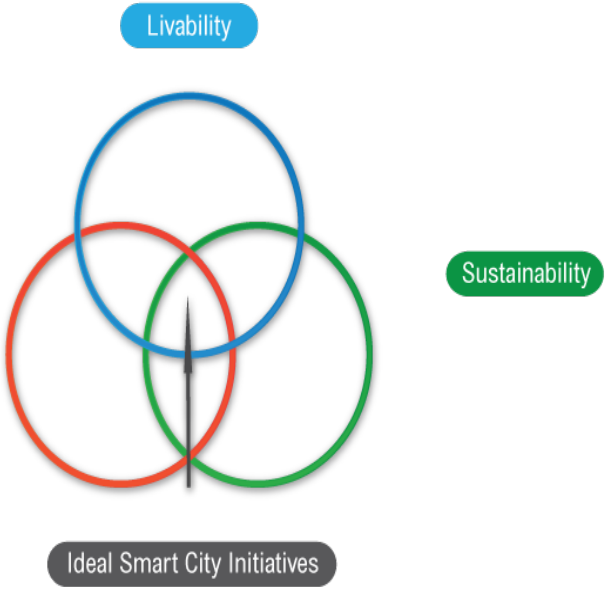
SMART CITY

- Smart City is a city that monitors and integrates conditions of all of its critical infrastructures for better optimizing its resources, planning its preventive maintenance activities, and monitoring security aspects while maximizing services to its citizens.

- The Smart City aims at enhancing three focus areas of livability, workability, and sustainability:
  - Enhanced livability means a better quality of life for city residents by providing access to a comfortable, safe, and healthy lifestyle.
  - Enhanced workability represents accelerated economic development.
  - Enhanced sustainability means giving people access to the resources they need without compromising the ability of future generations to meet their own needs.



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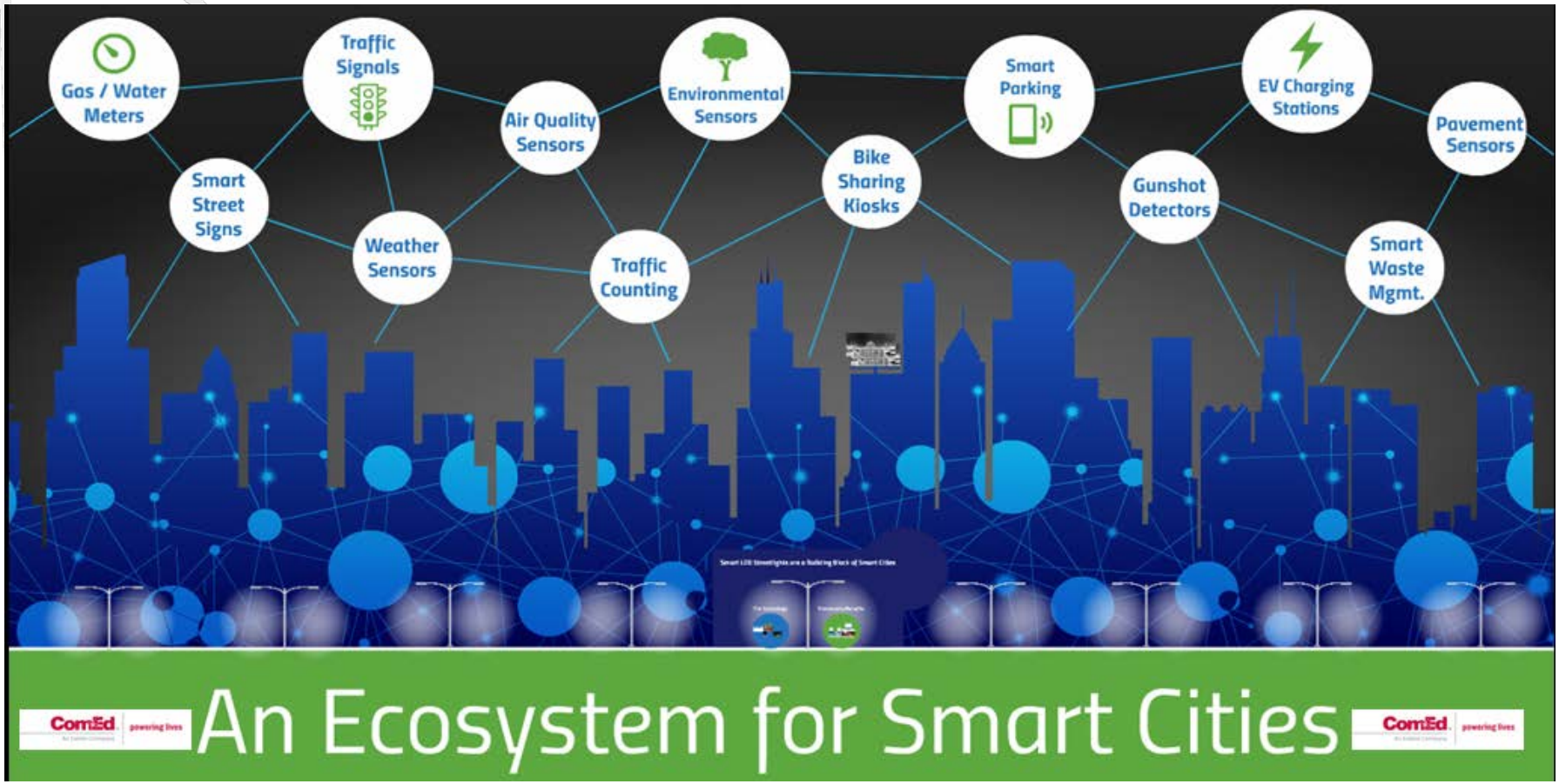
SMART CITY



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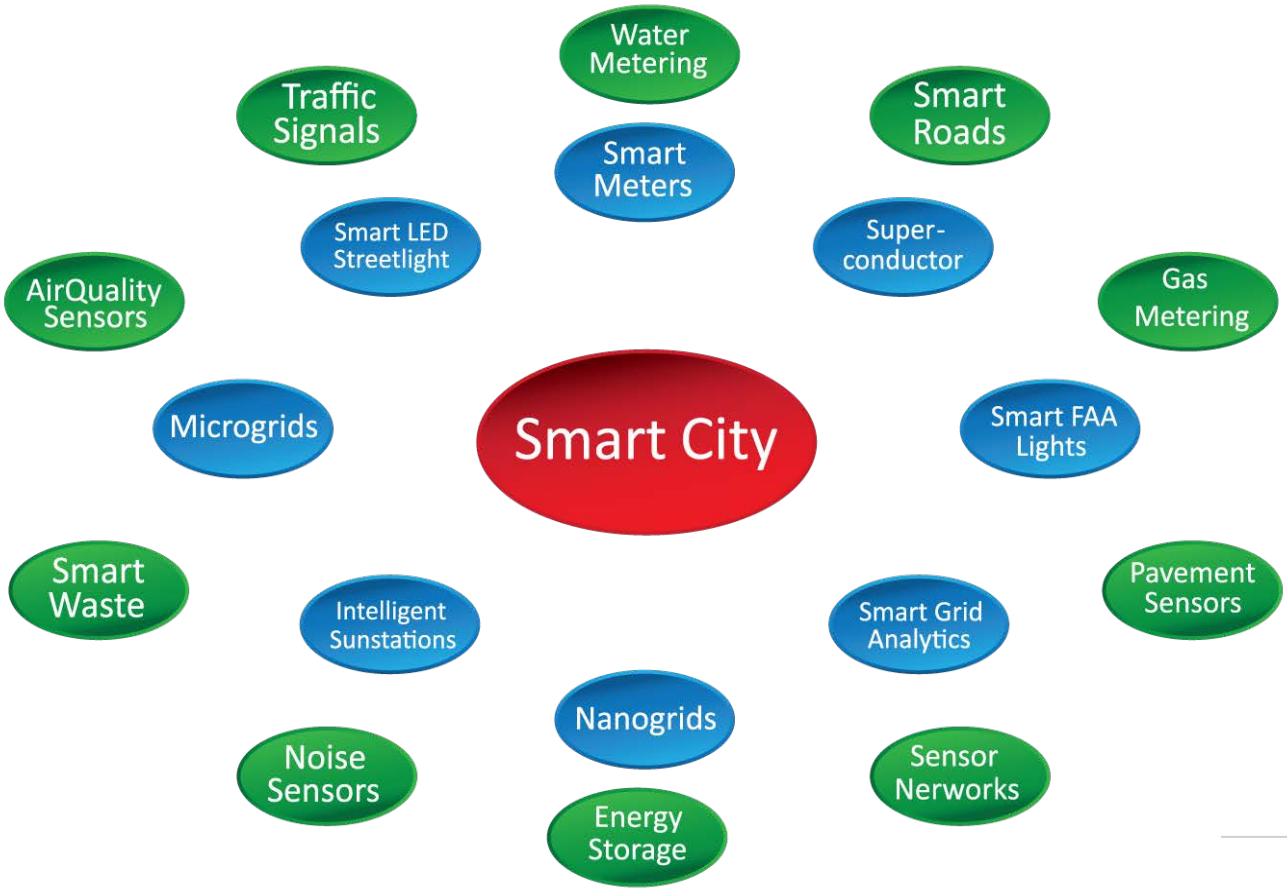
MICROGRIDS IN SMART CITIES

- Microgrids are part of the Smart City:
  - Enhanced livability through added resiliency and reliability
  - Enhanced workability through added resiliency and reliability
  - Enhanced sustainability through renewables and reduced transmission and distribution losses



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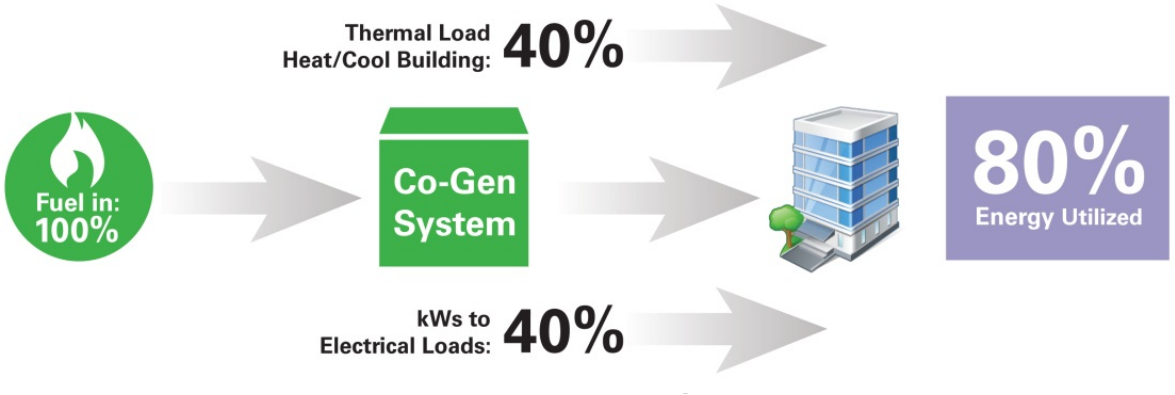
MICROGRIDS IN SMART CITIES

- Microgrids are building blocks of resilient and sustainable Smart Cities.
- Microgrids provide an opportunity for Smart Cities to achieve sustainable energy delivery systems.
- Microgrids can also deliver Smart Cities substantial energy, economic, and environmental benefits.
- Microgrids utilize variety of generation assets:
  - Energy can be generated by the local distributed generation (including renewables), while strengthening grid resiliency, and optimizing efficiency.
  - Combined heat and power (CHP) based generation is a fitting for Smart Cities as it serves both electrical and heating needs of buildings.



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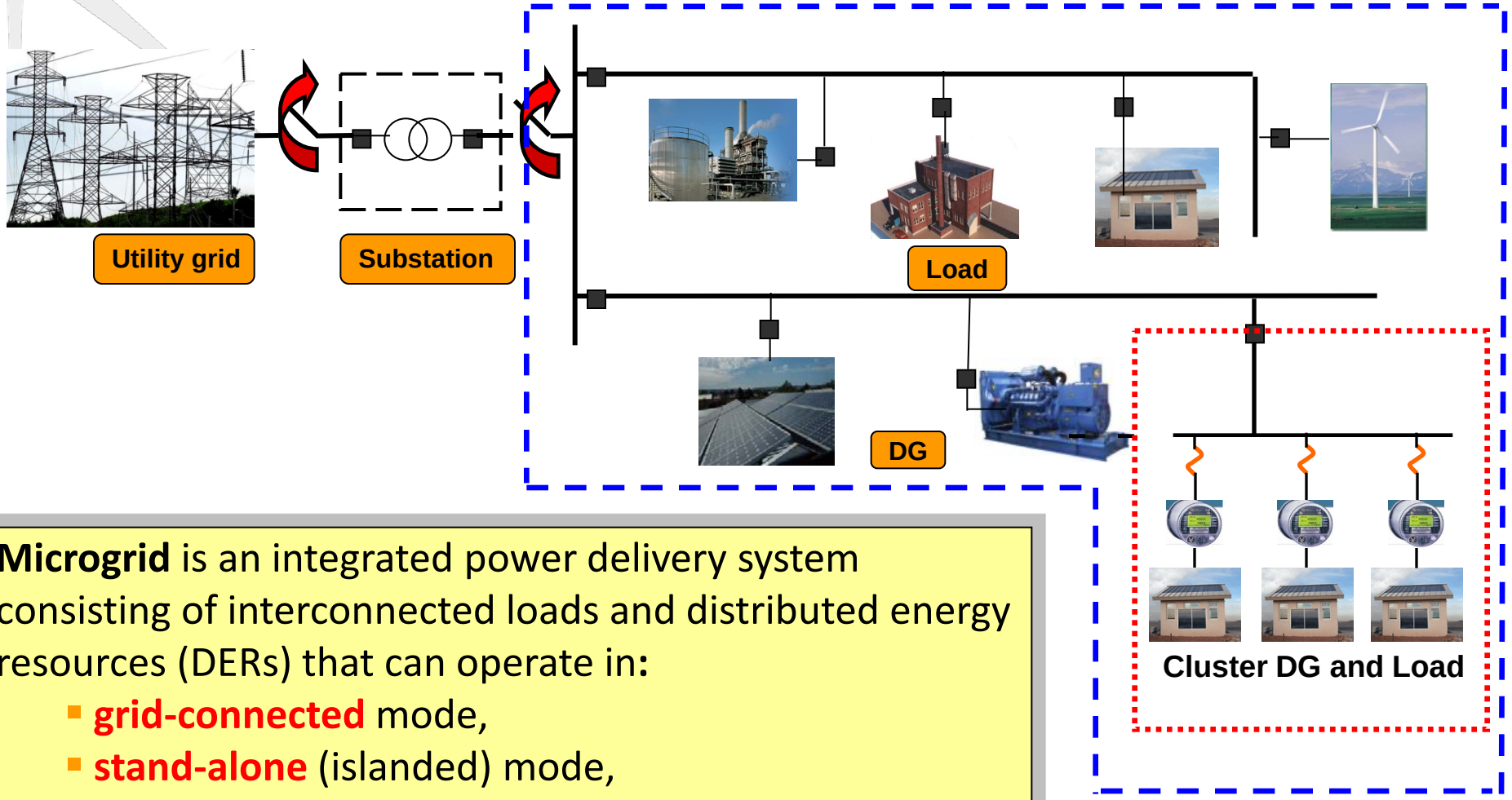
DRIVERS FOR MICROGRIDS

- Electric utilities are facing significant challenges:
  - Stressed and aging Infrastructure
    - Climate change resulting in increased weather volatility
    - Grid security and resiliency
    - Constrained delivery of gas and power
    - Increasing utilization of natural gas
  - Increasing customer expectations and segmentation
    - Cleaner, more affordable, more reliable, and secure energy
    - Lower tolerance for outages
  - Internet of Options
    - Increase in big data driving an increase in customer options
- Microgrids are a potential solution for utilities facing these challenges.

SIMPLIFIED MICROGRID



Microgrid is an integrated power delivery system consisting of interconnected loads and distributed energy resources (DERs) that can operate in:

- **grid-connected** mode,
- **stand-alone** (islanded) mode,
- **ride-through** between the above modes.

- Operates within clearly defined boundaries
- Appears as a single controllable entity w.r.t. to the grid

Definition: DOE Microgrid Exchange Group

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COMMUNITY MICROGRID

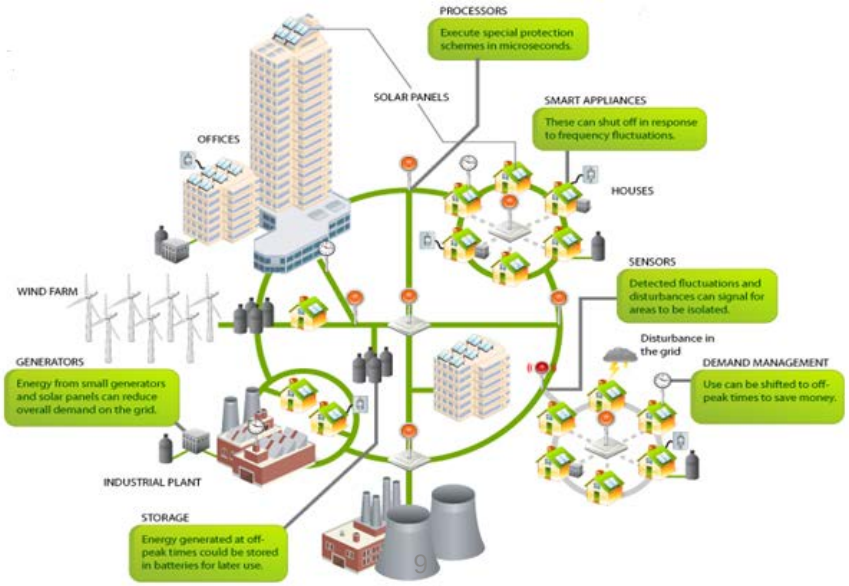
Evaluation of a potential project could cluster two microgrids in a community

ComEd is evaluating Chicago's Bronzeville neighborhood for implementation of a potential microgrid

- The potential location is adjacent to Illinois Institute of Technology (IIT) which has a microgrid
- Would create the first clustered microgrid in the world.
- Location is a great cross section of the City of Chicago, with a diverse set of critical loads
  - High tech manufacturing
  - Educational facilities
  - Police headquarters
  - Healthcare and senior residences
  - Other private residences

MICROGRID CONTROLLER

- U.S. Department of Energy announced $8 Million in grant funding to improve grid resiliency
- DOE awarded approximately $1.2 million to ComEd and it's partners to develop and test a commercial-grade microgrid controller capable of managing two or more interconnected microgrids
- ComEd's project includes a diverse mix of facilities and critical loads, including police and fire department headquarters, major transportation infrastructure, healthcare facilities for seniors, and private residences



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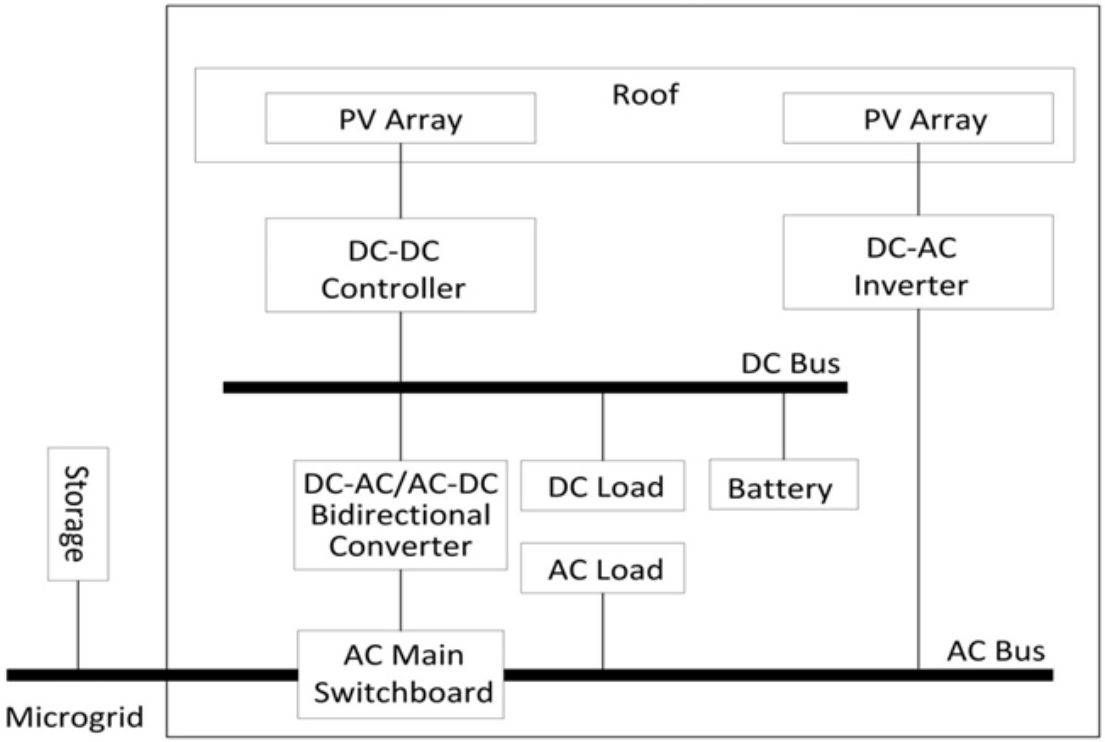
MICROGRID – FUTURE APPLICATIONS

- Future microgrid deployments will focus on locations with critical infrastructure, such as police stations, hospitals, and airports.
- Clustering multiple microgrids would improve reliability, resiliency, and power quality.
- Other potential applications could be business districts, universities, and park districts.
- Premium service – customer willing to pay more for improved reliability/resiliency

MICROGRID – FUTURE APPLICATIONS

- Hybrid microgrid and nanogrid systems:
  - Combine AC and DC architecture
  - Robust integration of DC based Distributed Energy Resources (DERs) – PV, Fuel Cells, Battery Energy Storage Systems
  - Improved building efficiency through reduced conversion losses – up to 20% for commercial buildings.

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