Net Zero and Net Positive: status and potential

COG BUILT ENVIRONMENT AND ENERGY ADVISORY COMMITTEE MEETING

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- Overview Of Net-zero Building’s Current Status
- Similarity and Difference
- Case study

Net Zero Energy Building Status

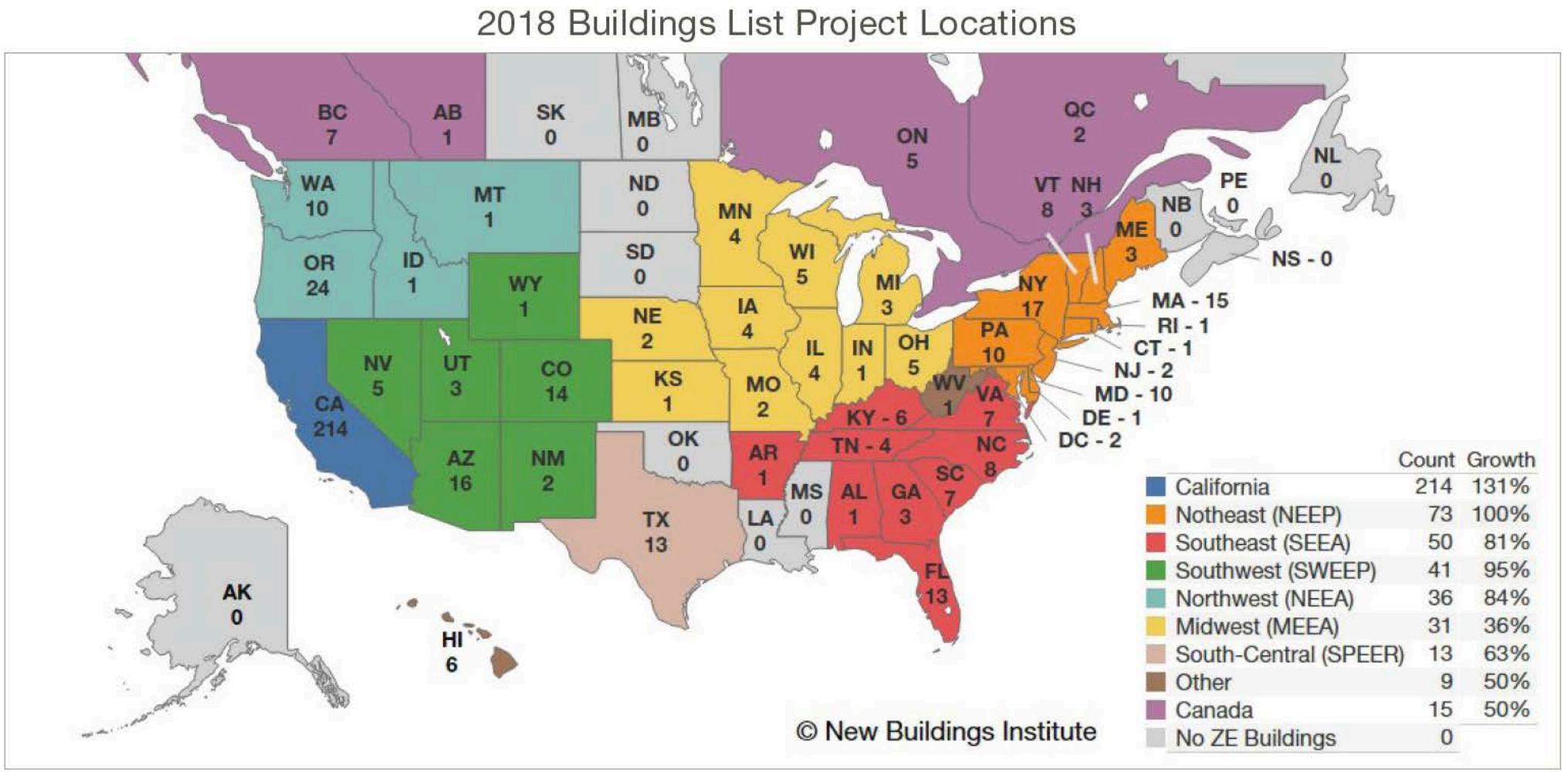
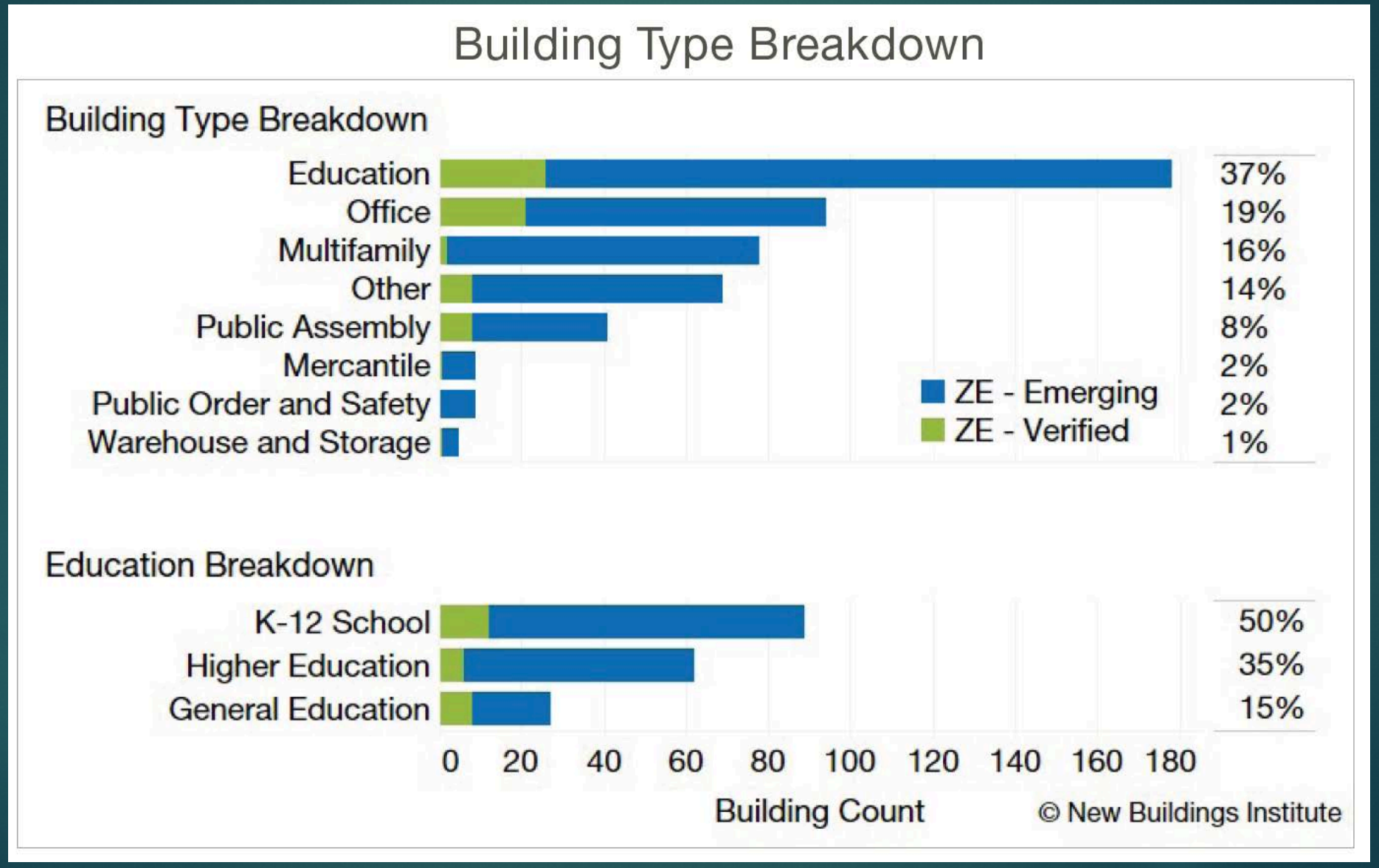


Fig 3. ZE Projects by region and state/province. The legend shows regional growth trends in projects since our 2014 List.

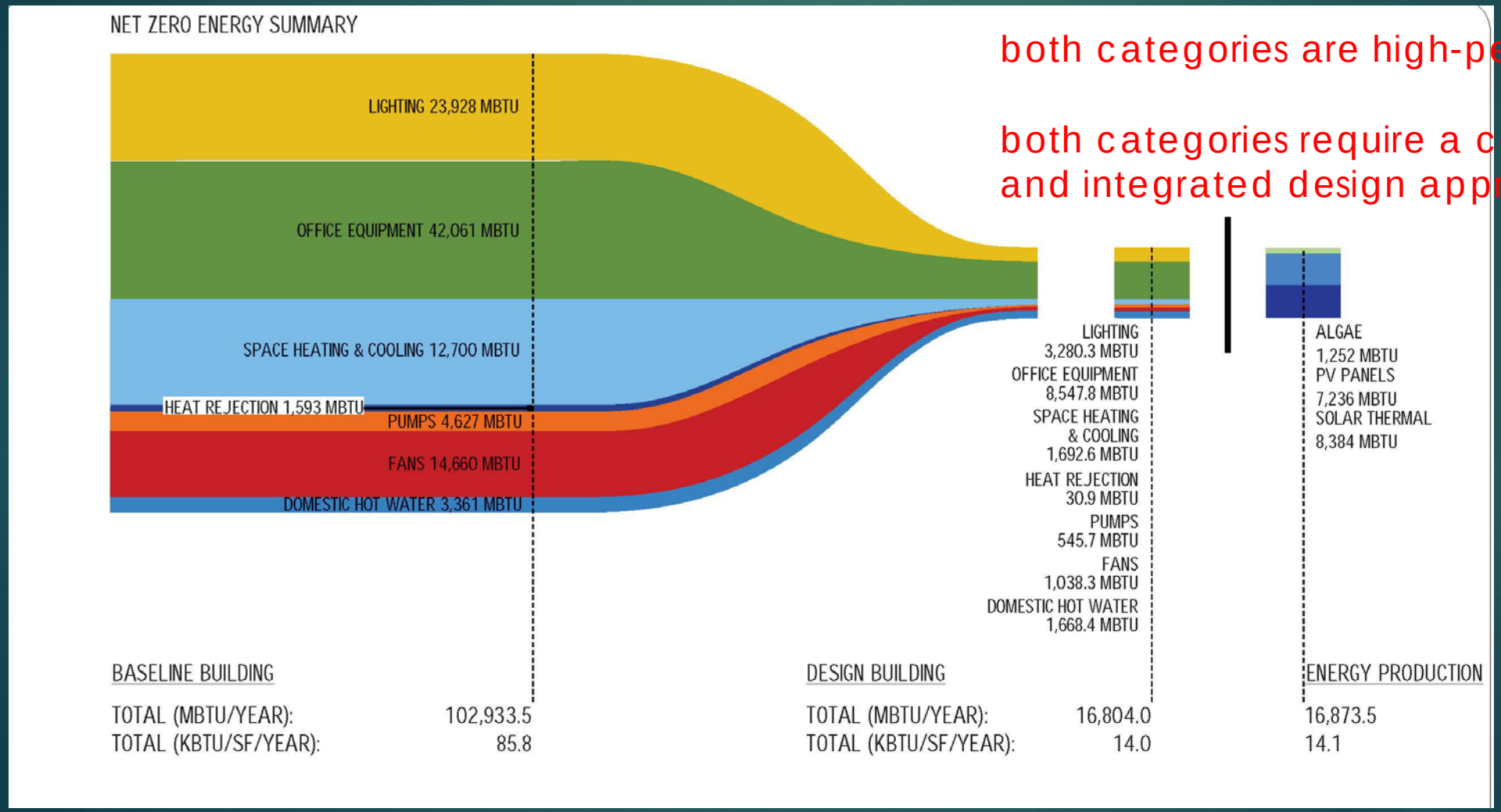
5 The 2017 ACEEE State Energy Efficiency Scorecard is the eleventh annual ranking of states on their efficiency policy and program efforts, and can be found at: http://aceee.org/state-policy/scorecard

Net Zero Energy Building Status



Similarity between net-zero building and net-positive building

The steps required to achieve net-zero and net-positive are similar .



both categories are high-performance building

both categories require a comprehensive and integrated design approach

Difference between net-zero building and net-positive building

- Systematic approach

Net-positive building is a system-based approach linking the performance of several buildings. The linkage among the buildings requires well-planned energy infrastructure that involves a series of partnerships—among building owners, operators and users—which makes net-positive building more feasible in large institutions, since the building's owner and operator is essentially one entity.

- Energy offset

The net-positive building might not be able to completely cut off the external power supply; however, by utilizing the minimal amount of external energy, individual building within a net-positive network could generate a large quantity of clean power to offset the energy consumption needed from other buildings within the same network.

Net-positive Building Definition

The European Commission defines a net-positive energy building as one that “on average over the year produces more energy from renewable energy sources than it imports from external sources.

This definition is comparable to net-zero energy building, but without boundary limitation.

While following many of the same principles and technologies as net-zero building, the notion of net-positive energy building introduces two new perspectives: ***network or district***; ***alternative energy resources*** other than renewable energy.

Case Study: Rochester Institute of Technology

88,000 gross square foot

four-story

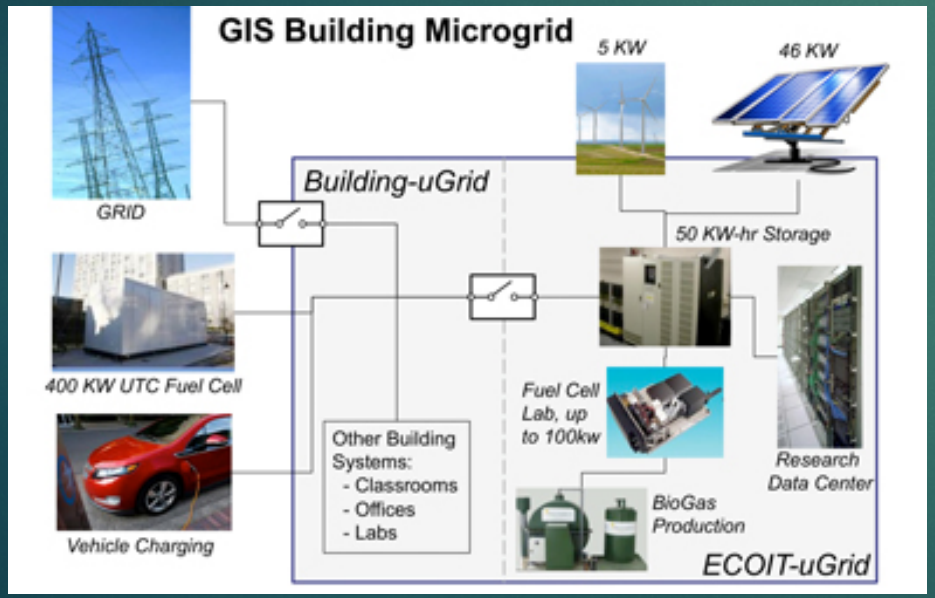
Case Study: Rochester Institute of Technology

- 400 kW phosphoric acid fuel cell
- 40 kW photovoltaic array
- Vertical-axis wind turbines with a combined capacity of 3 kW
- 56 kWh lithium-ion battery storage system
- Eight geothermal wells
- Electric-vehicle charging stations.

The nearly 1500 sensors deployed throughout the building provide insight into real-time performance for educational and research purposes.

https://www.lechase.com/company-services/sustainable-building/featured-project/

Case Study: Rochester Institute of Technology

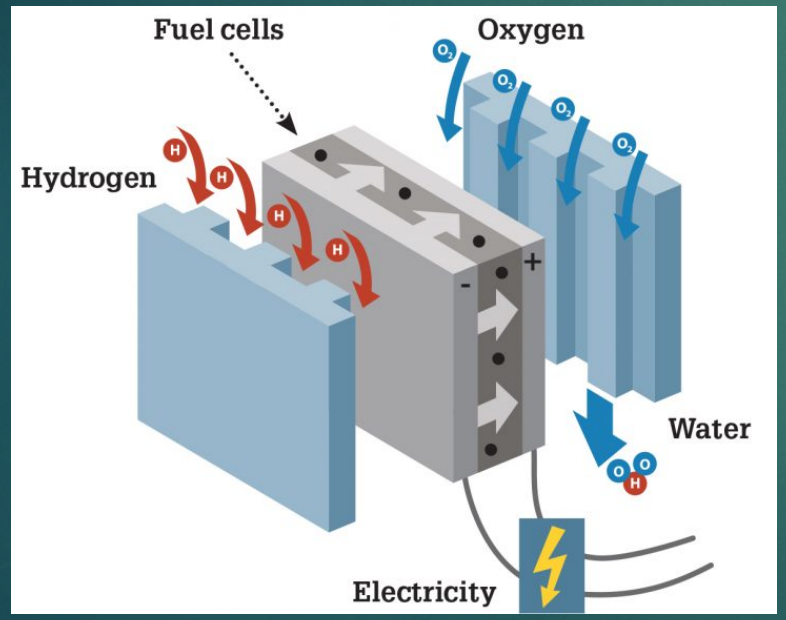


Microgrid Testbed

integrates energy production and storage resources within a single microgrid that can be operated in isolation from the utility grid.
Existing energy resources include: wind turbines, solar panels, fuel cells, and a 50 kWh battery bank.
Building circuits can be connected dynamically to provide different loading or usage patterns on the microgrid, and other energy assets can be readily added to the existing infrastructure.

http://www.rit.edu/gis/research/facilities/testbeds/microgrid-testbed

Case Study: Rochester Institute of Technology



Alternative energy resource: Fuel cell

The building was constructed with the ability to supply all its own electricity through a combination of distributed energy systems in, on and around the building, powered by a fuel cell installed in the basement.

The fuel cell power makes it possible for the building to become net-positive. The fuel cell system is also equipped with high- and low-grade heat capture systems, allowing the fuel cell to run at around 90 percent efficiency.

http://www.rit.edu/gis/research/facilities/testbeds/microgrid-testbed

Conclusion

1) the network, instead of “individual” buildings
2) the dynamic energy offset within the network, instead of static balance

The following model is proposed to represent the possible approach to the new framework: A net-positive index.

The Net-positive Index = $(E_p - E_c) \times F_b \times F_p$

E_p: Sum of individual buildings’ energy consumption

E_c: Sum of individual buildings’ energy production

F_b: Boundary factor (defined by numbers of the buildings, total occupancy, and total area)

F_p: Environmental factor (Defined by alternative energy impact, renewable energy impact, infrastructure cost, etc.)

Thank you