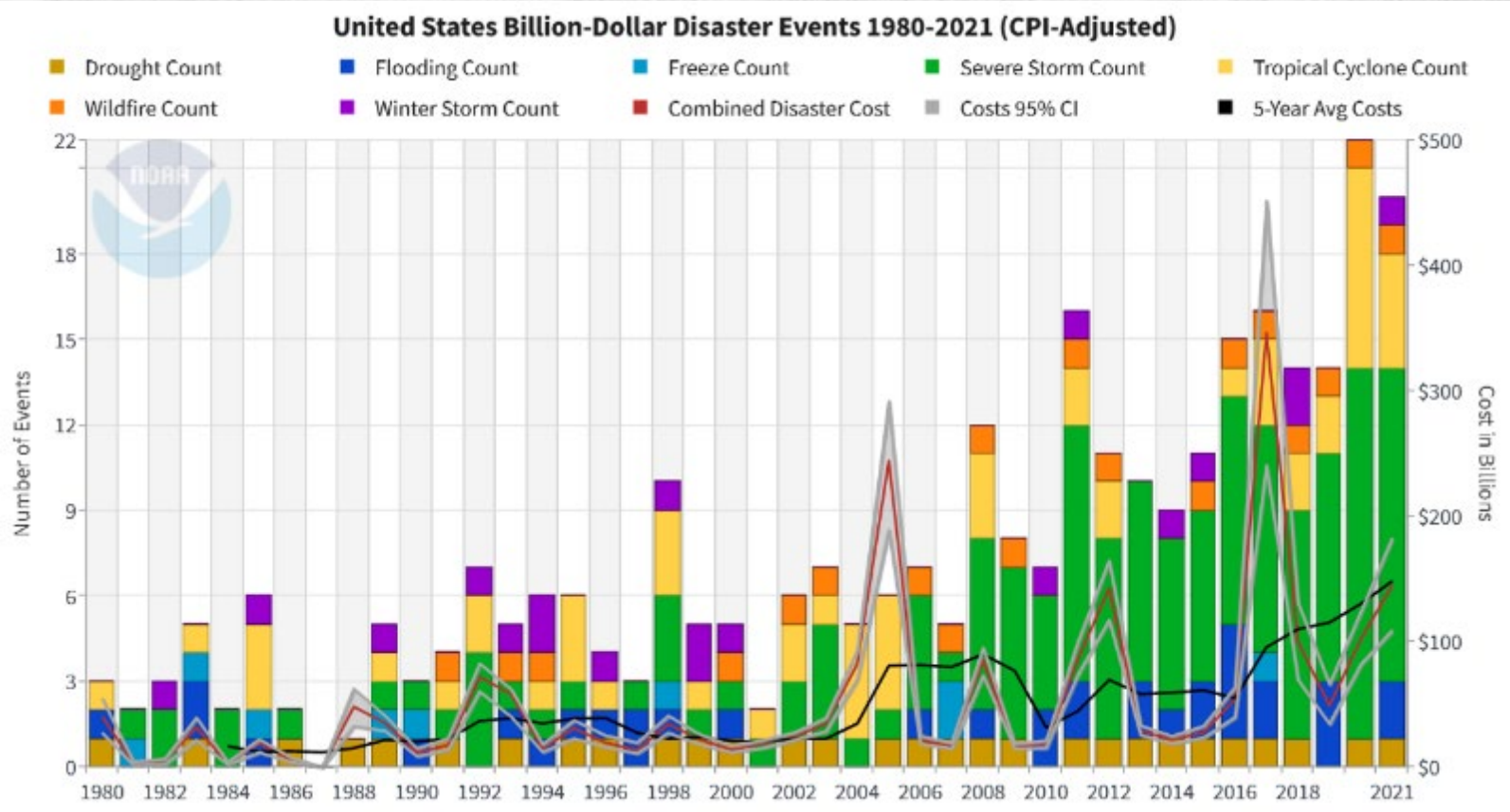
(*Science*, 2016)

Courtney Cochran

FORTIFYING THE GRID IN THE SOUTHEASTERN U.S. THROUGH MICROGRIDS: NAVIGATING AN UNCERTAIN REGULATORY ENVIRONMENT

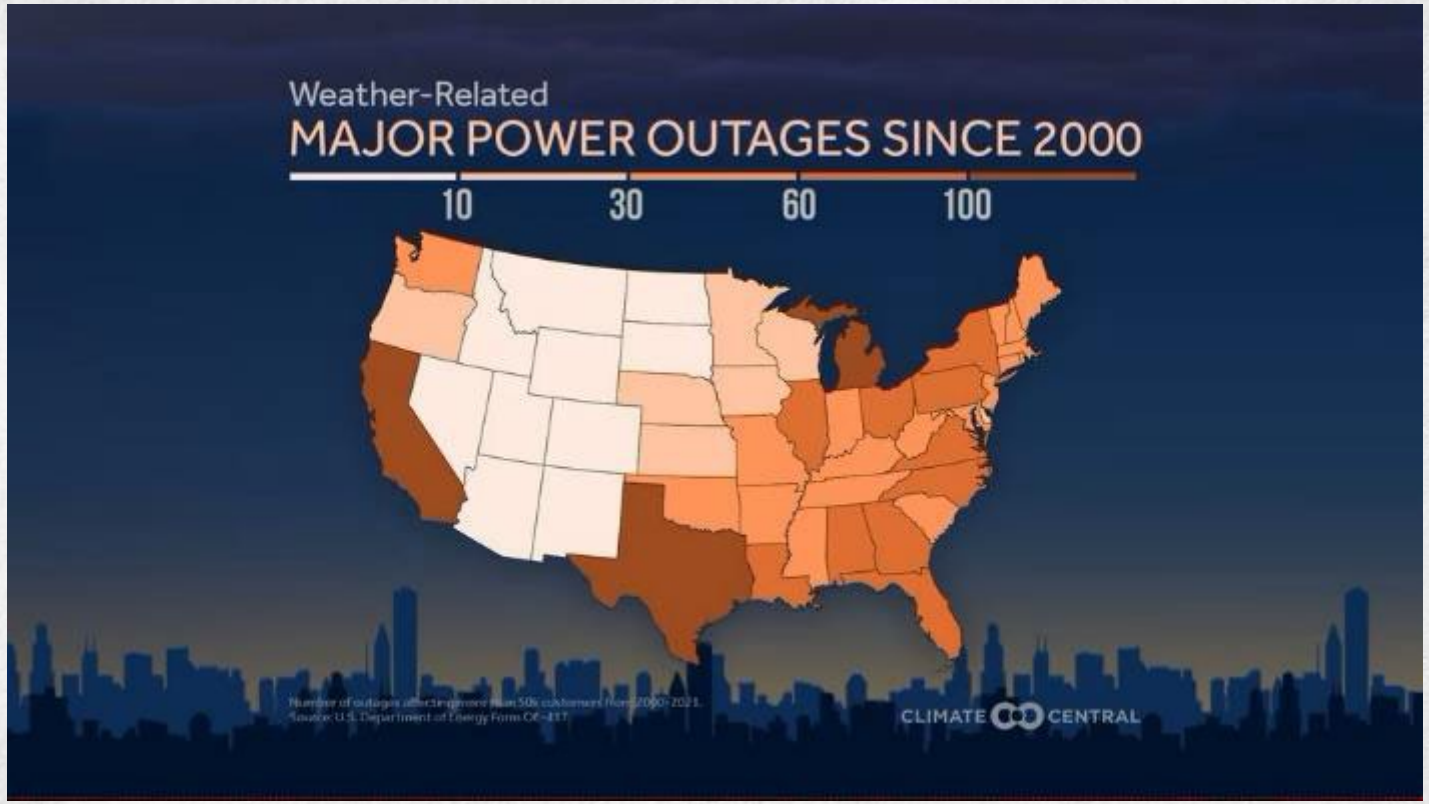
An Increasing Economic Toll of Extreme Weather Events



Disaster events exceeding more than $1 Billion (NOAA, 2022)

Between 2002 and 2021, the U.S. experienced 229 weather events that each caused more than $1 billion in damage, compared with just 94 such events from 1980 to 2001.

The Most Weather-Related Major Power Outages Occur in the Southeast



Weather-Related Major Power Outages Since 2000 (Climate Central, 2021)

Of the 1,542 weather-related power outages that occurred in the U.S. between 2000-2021, 474 occurred in the Southeast, more than in any other region of the U.S.

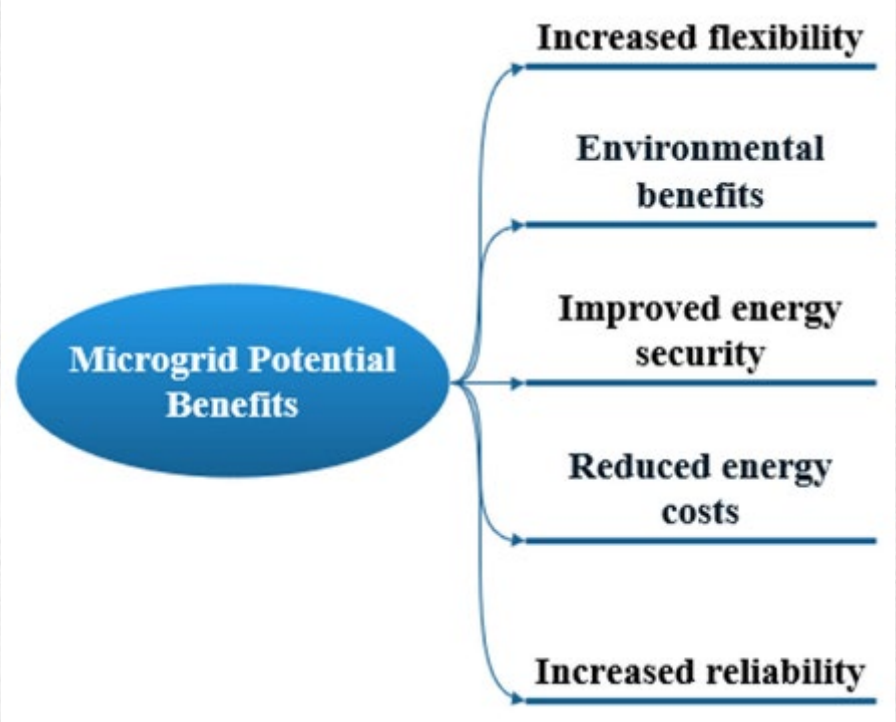
An Aging Grid

Damaged power lines photographed days after Hurrricane Ida ripped through Grand Isle, Louisiana (Reuters, 2021)

Damaged power lines photographed days after Hurrricane Ida ripped through Louisiana (New York Times, 2021)

Over 70% of grid infrastructure in the U.S. is more than 25 years old, making it more vulnerable to weather-related outages.

Microgrids: A Solution to Numerous Problems



Potential benefits of Microgrids (*Sustainability* Journal, MDPI, 2023)

Microgrids enhance grid resiliency in inclement weather and can aid in preventing cascading outages, guarding the grid against physical and cyber security attacks, and integrating more sustainable energy technologies.

What is a Microgrid?

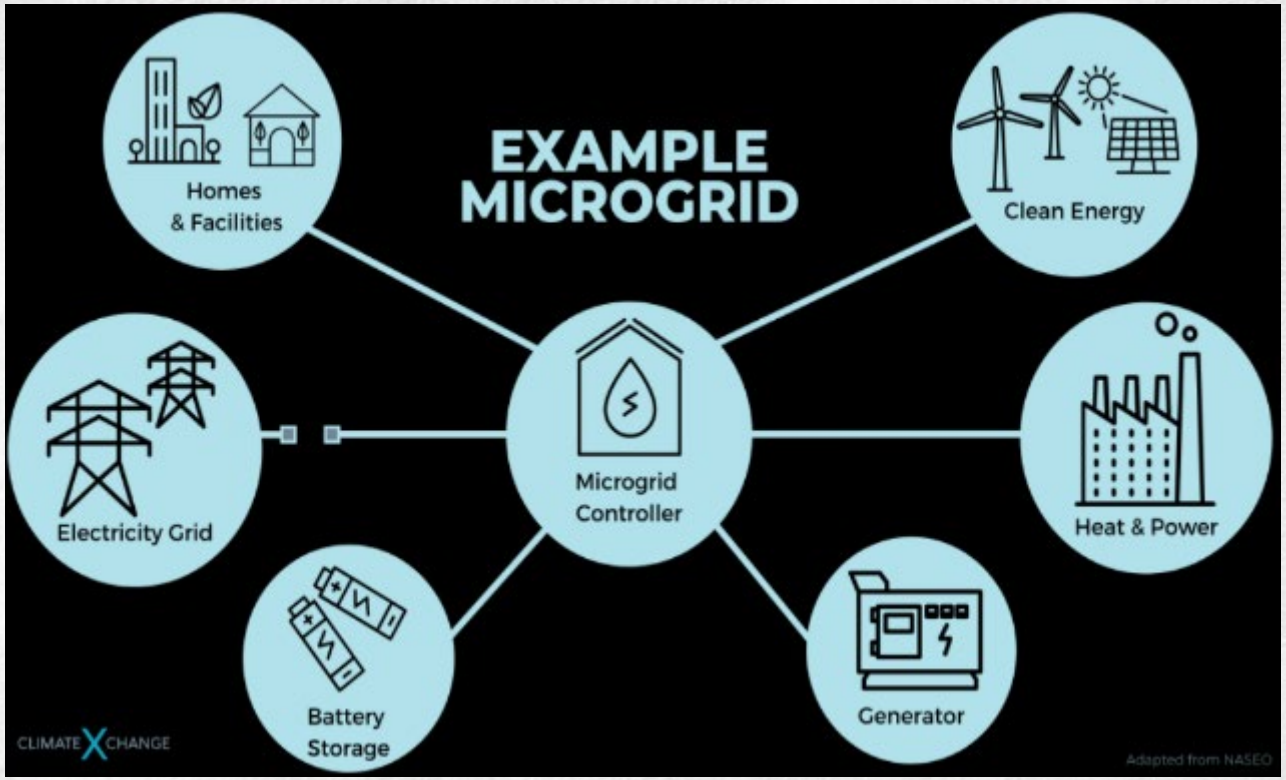
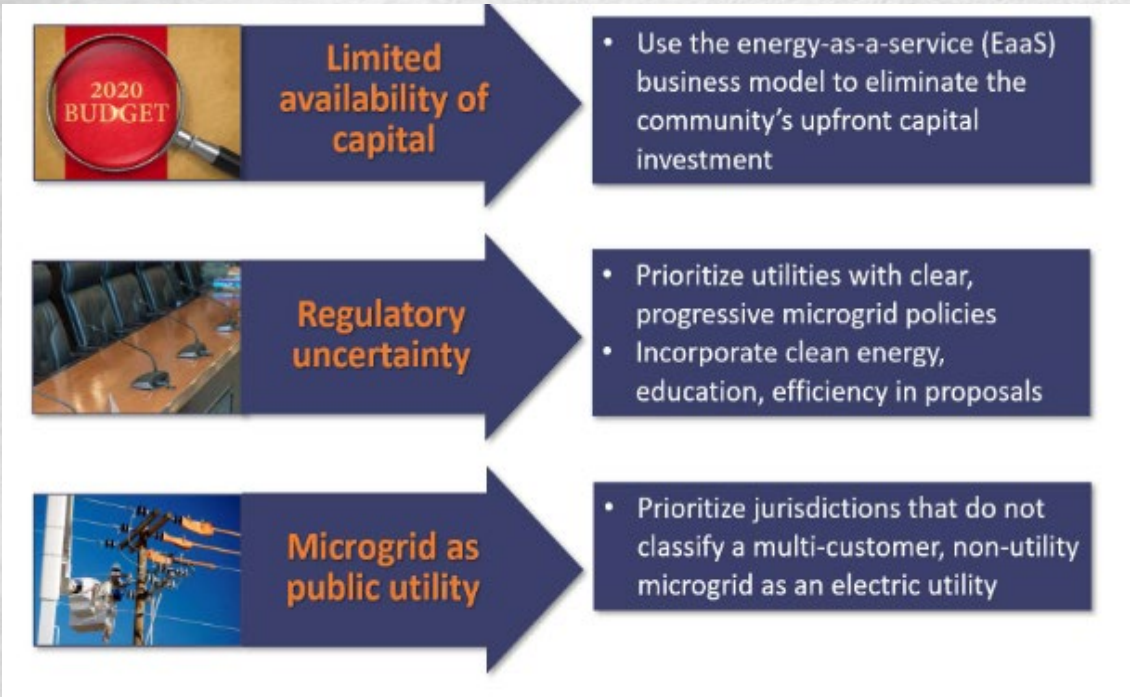
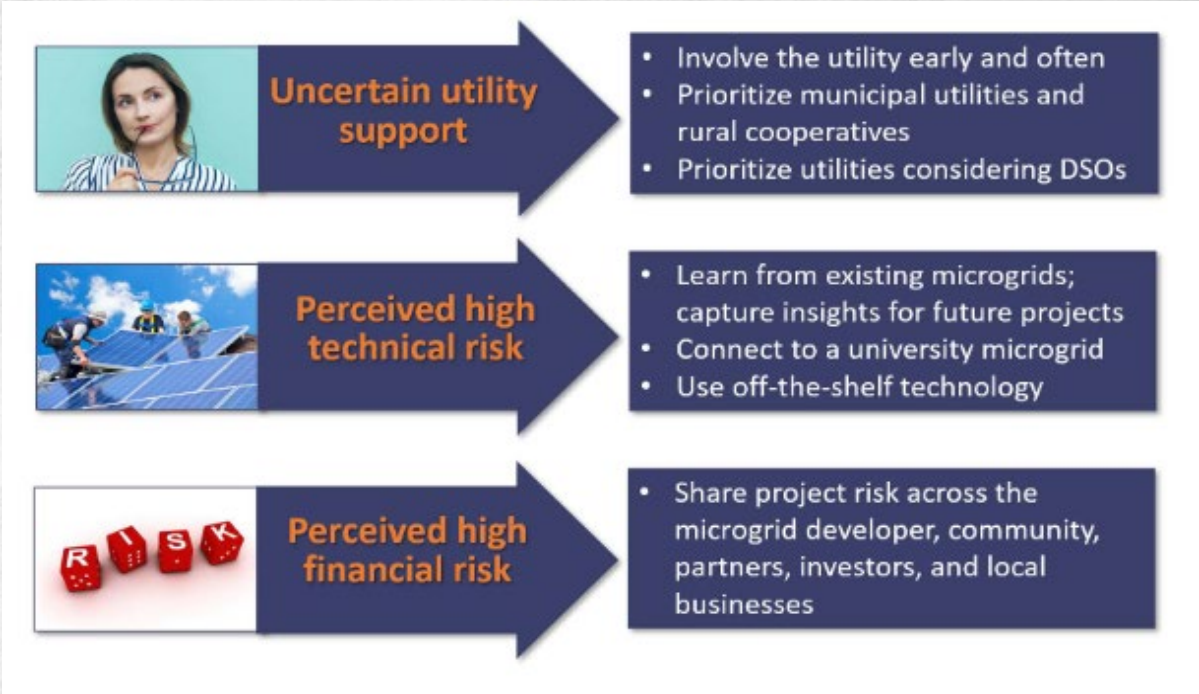


Diagram of an Example Microgrid (World Economic Forum, 2022)

Microgrids are a group of customers within defined electrical boundaries with the ability to disconnect and reconnect to the grid.

Obstacles

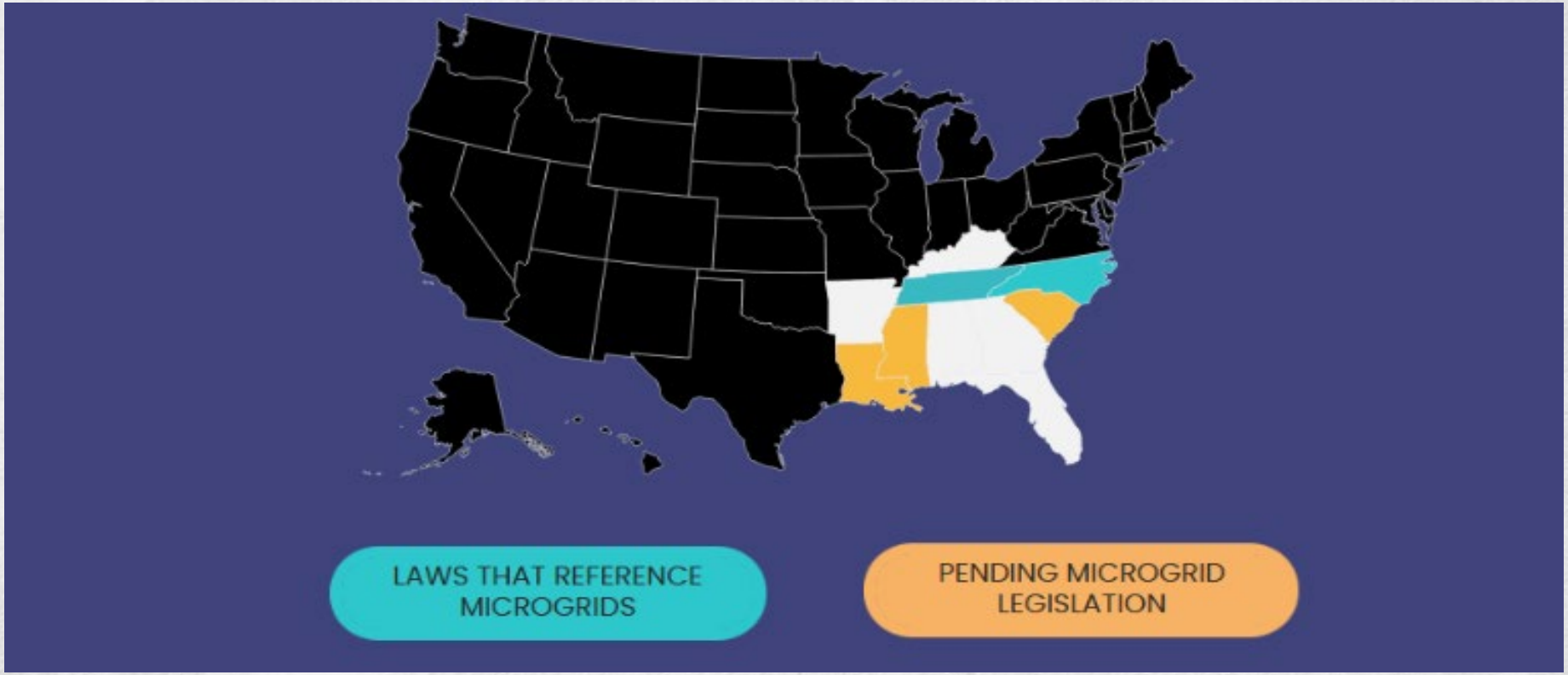




Barriers to Microgrid deployment and best practices (Hoffman Power Consulting, 2020)

There are several issues impeding more widespread microgrid deployment, largely due to investment costs and regulatory uncertainty.

Microgrid Laws in the Southeastern U.S.



Microgrid Laws in the Southeastern U.S. (National Conference of State Legislatures, 2023)

While many Southeastern states could benefit from more widespread implementation of microgrids, few to none have clear regulatory guidelines for their interconnection and operating procedures, creating a risk for investors.

Complexities of Regulating Microgrids

Multi-user microgrid owner-operator model spectrum (Pacific Energy Institute, 2020)

Microgrids are difficult for states to regulate due to their ability to integrate multiple energy technologies and their complex ownership structures.

Recommendation #1

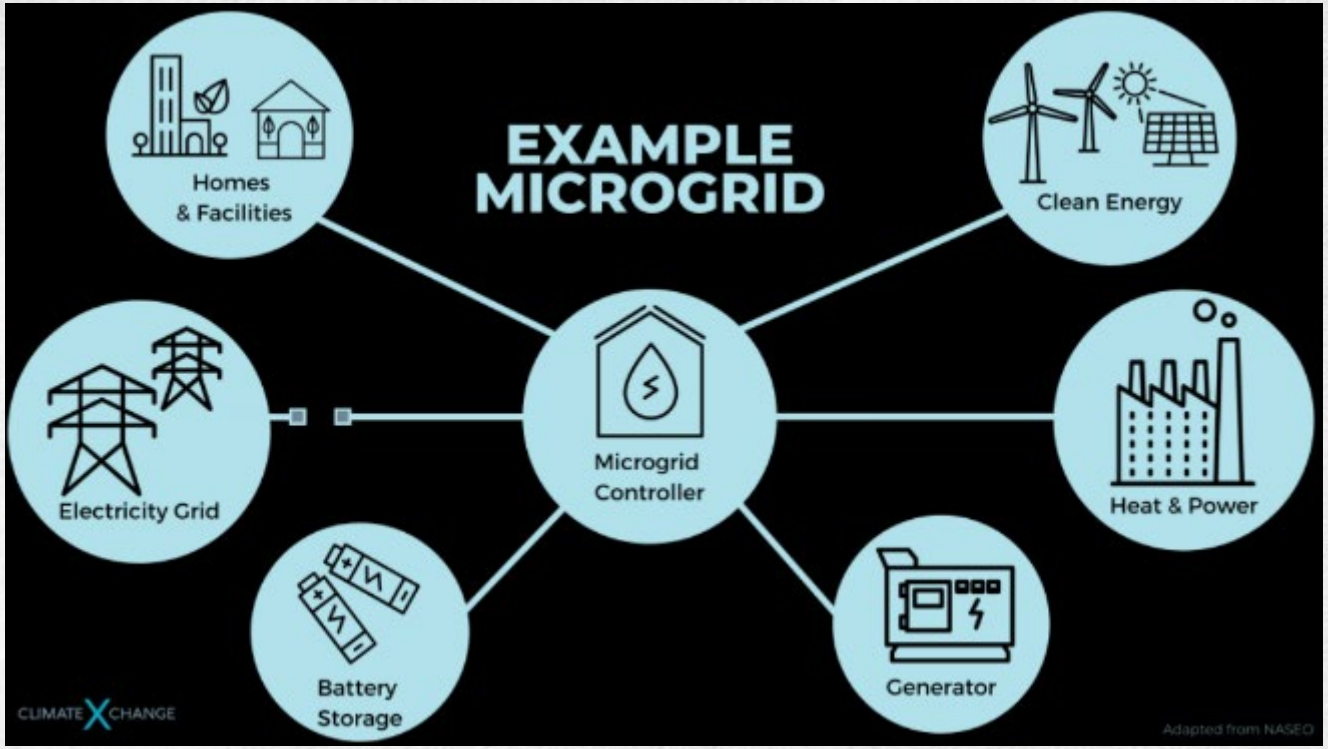
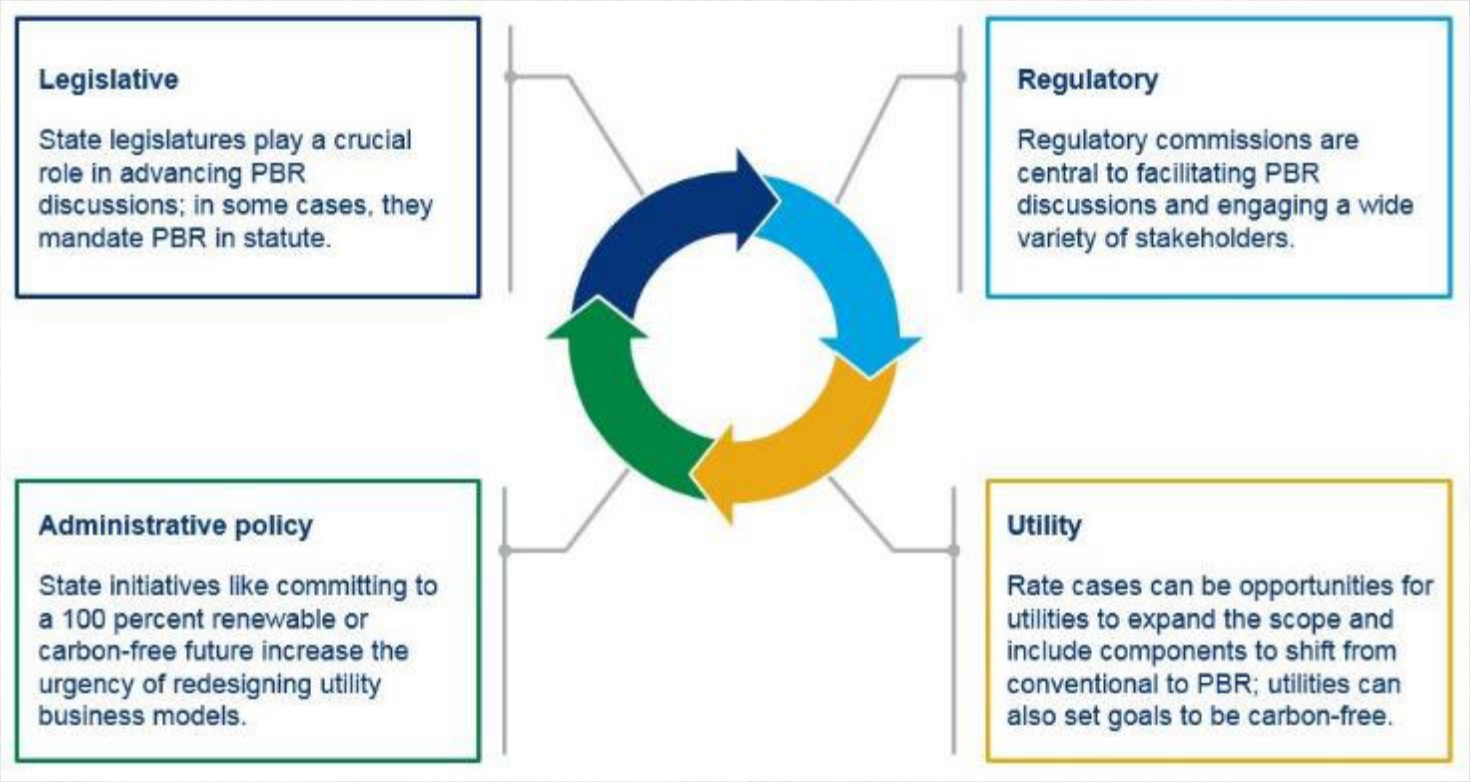


Diagram of an Example Microgrid (World Economic Forum, 2022)

State legislatures should pass legislation that formalizes the legal rights and definition of microgrids, directs utilities to create tariff arrangements to be approved by PUCs and PSCs, and requires PUCs and PSCs to create interconnection and technical requirements for microgrids.

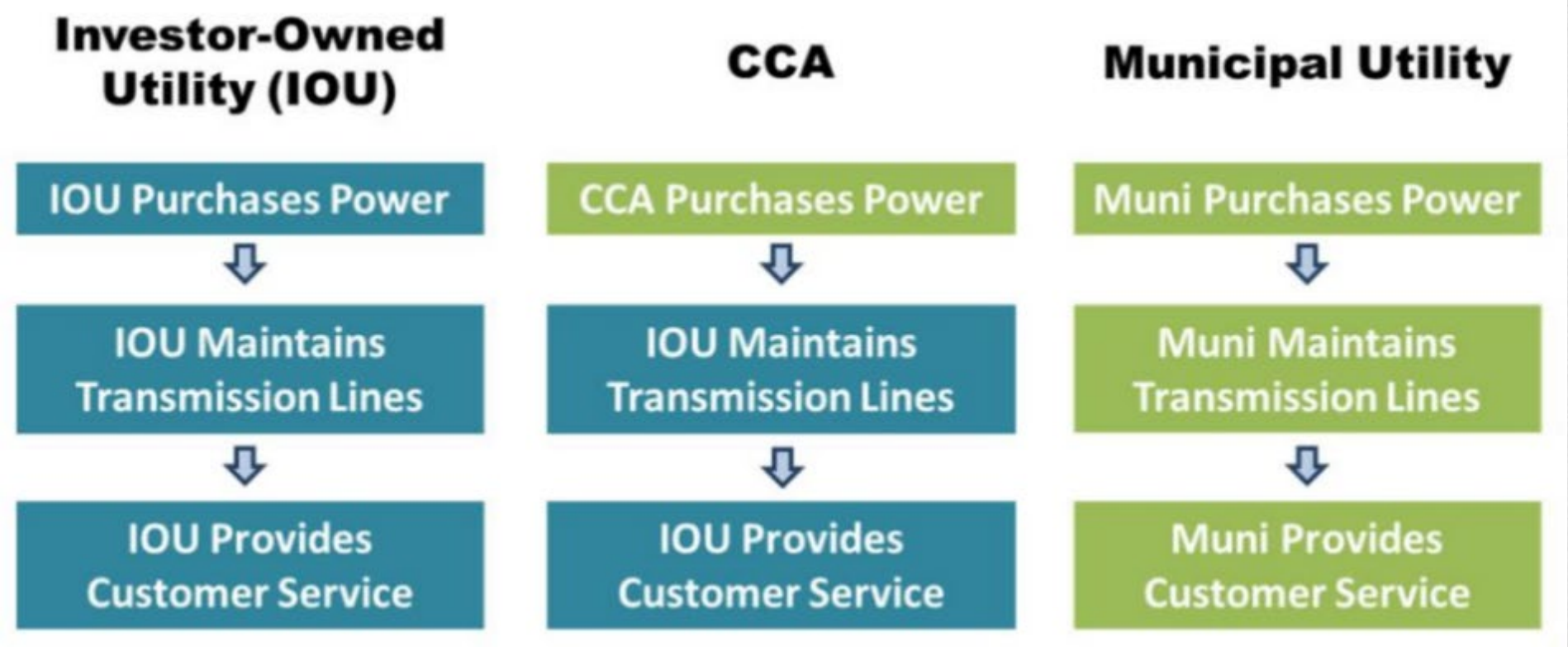
Recommendation #2



Drivers behind Performance-Based Ratemaking Activity (Wood Mackenzie Power & Renewables and EnerKnol, 2019)

States should consider mandating performance-based ratemaking (PBR) rather than cost of service (COS) ratemaking.

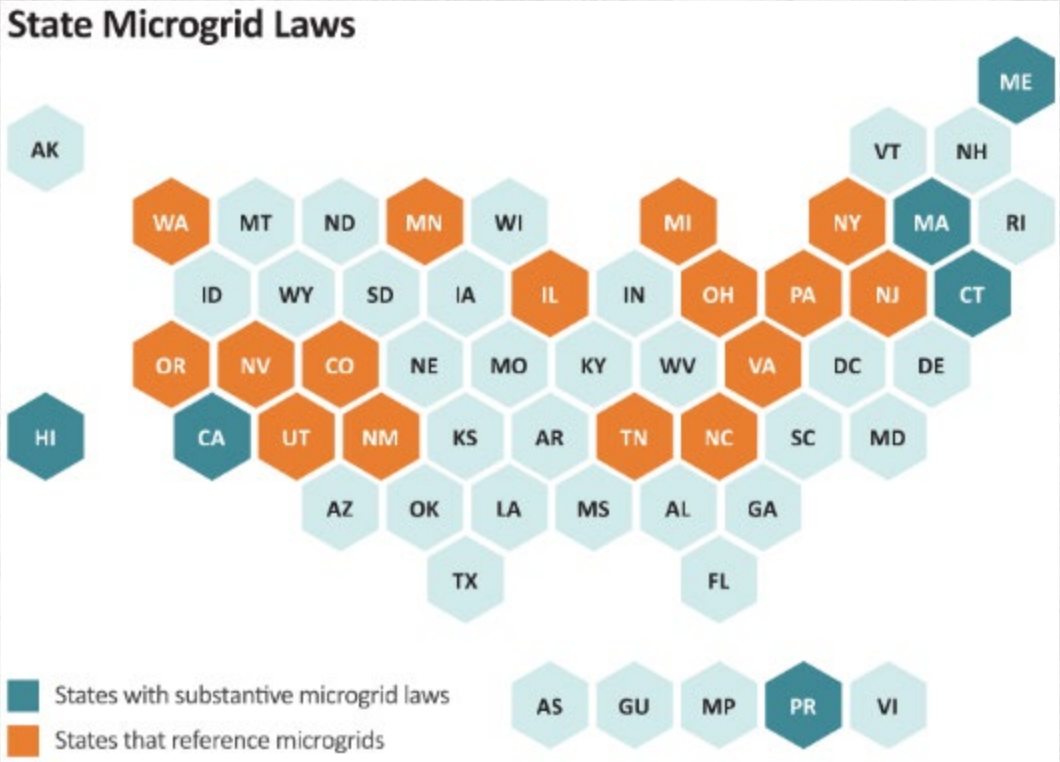
Recommendation #3



Community Choice Aggregation Strucutre (National Renewable Energy Lab, 2017)

States should consider creating legislation that authorizes community choice aggregation.

Exemplary State Microgrid Laws



State Microgrid Laws (National Conference of State Legislatures, 2023)

State legislatures can look to microgrid laws in California, Hawaii, Connecticut, Massachusetts, Maine, and Puerto Rico as examples.

Sources

Chavin, S. (2022, June 1). *Microgrid Regulation Challenges and Opportunities - Kleinman Center for Energy Policy*. Kleinman Center for Energy Policy. https://kleinmanenergy.upenn.edu/news-insights/microgrid-regulation-challenges-and-opportunities/

Clifford, C. (2023, February 17). *Why America's outdated energy grid is a climate problem*. CNBC. https://www.cnbc.com/2023/02/17/why-americas-outdated-energy-grid-is-a-climate-problem.html

Clifford, C. (2023, February 17). *Why America's outdated energy grid is a climate problem*. CNBC. https://www.cnbc.com/2023/02/17/why-americas-outdated-energy-grid-is-a-climate-problem.html

Cox, C., & Schmit, V. (2023, May 19). *Microgrids*. Vanderbilt Law School. https://law.vanderbilt.edu/academics/academic-programs/environmental-law/Microgrid-White-Paper.pdf

DuViVier, K.K. (2023, June 5). *Mobilizing Microgrids for Energy Justice*. Stanford Law School. https://law.stanford.edu/wp-content/uploads/2023/06/Publish_26-STLR-250-2023_Mobilizing-Microgrids-for-Energy-Justice.pdf

Executive Office of the President. (2013, August). *ECONOMIC BENEFITS OF INCREASING ELECTRIC GRID RESILIENCE TO WEATHER OUTAGES*. Department of Energy. https://www.energy.gov/articles/economic-benefits-increasing-electric-grid-resilience-weather-outages

Explaining Extreme Events from a Climate Perspective. (n.d.). American Meteorological Society. https://www.ametsoc.org/index.cfm/ams/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/

Feng, W., Jin, M., Liu, X., Bao, Y., Marnay, C., Yao, C., & Yu, J. (2018, October 15). A review of microgrid development in the United States – A decade of progress on policies, demonstrations, controls, and software tools. *Applied Energy*, *228*, 1656-1668. https://www.sciencedirect.com/science/article/abs/pii/S0306261918309644?fr=RR-2&ref=pdf_download&rr=7e83bceebf205aff

Financing Microgrids in the Federal Sector. (2020, August). Department of Energy. https://www.energy.gov/femp/articles/financing-microgrids-federal-sector

Hananel, S., & Chang, R. (2015, September 15). *Climate Change Threatens Electric Grid Reliability in the Southeast*. Center for American Progress. https://www.americanprogress.org/article/climate-change-threatens-electric-grid-reliability-in-the-southeast/

Hersher, R. (2023, January 9). *Climate change causes more severe weather, report finds*. NPR. https://www.npr.org/2023/01/09/1147805696/climate-change-makes-heat-waves-storms-and-droughts-worse-climate-report-confirm

Hirsch, A., Parag, Y., & Guerrero, J. (2018, July). Microgrids: A review of technologies, key drivers, and outstanding issues. *Renewable and Sustainable Energy Reviews*, *90*, 402-411. https://www.sciencedirect.com/science/article/pii/S136403211830128X

Kentucky Office of Energy Policy. (2020). *Southern Energy Profiles*. Southern States Energy Board. https://www.sseb.org/wp-content/uploads/2020/09/Southern_Energy_Profiles2020_web.pdf

King, D. E. (n.d.). *Regulatory Environment for Micro Grids*. Carnegie Mellon University. https://www.cmu.edu/ceic/assets/docs/publications/working-papers/ceic-05-08.pdf

McLaughlin, T. (2022, May 12). *Creaky U.S. power grid threatens progress on renewables, EVs*. Reuters. https://www.reuters.com/investigates/special-report/usa-renewables-electric-grid/

Muyskens, J., Osaka, S., & Ahmed, N. (2023, March 6). *How Americans heat their homes, from electric heat pump to natural gas*. Washington Post. https://www.washingtonpost.com/climate-environment/interactive/2023/home-electrification-heat-pumps-gas-furnace/

Nassif, A. B., Ericson, S., Abbey, C., Jeffers, R., Hotchkiss, E., & Bahramirad, S. (2022). Valuing Resilience Benefits of Microgrids for an Interconnected Island Distribution System. *Electronics*.

NREL Voices of Experience: Microgrid For Resiliency. (2020, November). NREL. https://www.nrel.gov/docs/fy21osti/75909.pdf

Nudell, T. R., Annaswamy, A. M., Lian, J., Kalsi, K., & D'Achiardi, D. (2018, September 26). Electricity Markets in the United States: A Brief History, Current Operations, and Trends. *Smart Grid Control*, 3-27.

Shea, D. (2022, June 10). *Microgrids: State Policies to Bolster Energy Resilience*. National Conference of State Legislatures. https://www.ncsl.org/energy/microgrids-state-policies-to-bolster-energy-resilience

Shea, D. (2022, June 10). *Microgrids: State Policies to Bolster Energy Resilience*. National Conference of State Legislatures. https://www.ncsl.org/energy/microgrids-state-policies-to-bolster-energy-resilience

Surging Weather-related Power Outages. (2022, September 13). Climate Central. https://www.climatecentral.org/climate-matters/surging-weather-related-power-outages

Vine, D. (n.d.). *Microgrids*. Center for Climate and Energy Solutions. https://www.c2es.org/content/microgrids/

Warneryd, M., & Karltorp, K. (2022). Microgrid communities: disclosing the path to future system-active communities. *Sustainable Futures*, *4*. https://www.sciencedirect.com/science/article/pii/S2666188822000132

Whittle, P. (2022, April 5). *Storms batter aging power grid as climate disasters spread*. AP News. https://apnews.com/article/wildfires-storms-science-business-health-7a0fb8c998c1d56759989dda62292379

Wu, S. (2021, October 11). *Atlanta community resilience project seeks to become model for energy equity | Greenbiz*. GreenBiz. https://www.greenbiz.com/article/atlanta-community-resilience-project-seeks-become-model-energy-equity

(*Science*, 2016)

Courtney Cochran

FORTIFYING THE GRID IN THE SOUTHEASTERN U.S. THROUGH MICROGRIDS: NAVIGATING AN UNCERTAIN REGULATORY ENVIRONMENT