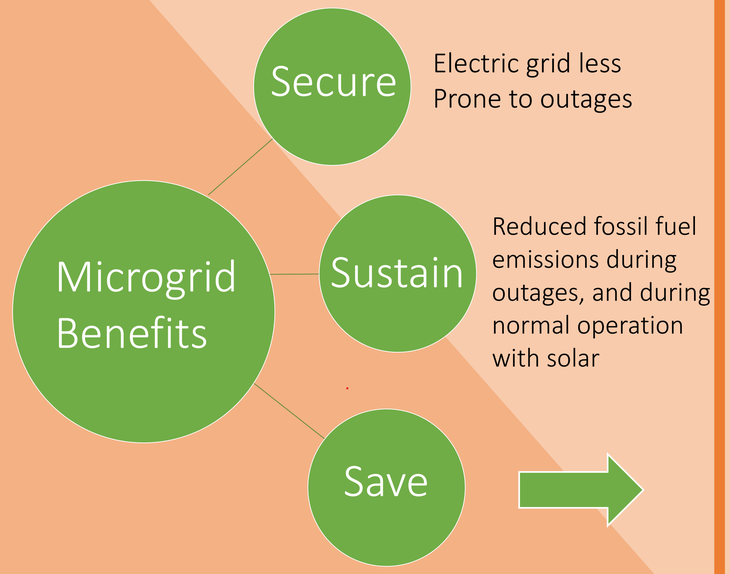
Investigating the Need for a Microgrid at WPI

By: Nathan O'Neill, Giovanni Larson Vasquez, Cassandra Youn, Nicholas Thornton, Kevin Zhou
Advisors: Prof. Derren Rosbach, Prof. David Medich PLAs: Gabriel Espinosa, Samuel Darer
gr-grid-resilience@wpi.edu

What is a Microgrid?

- A smaller, self-sufficient version of a macro grid
- They can generate their own clean power and store it as well
- The optimal model of a microgrid the AC-DC model, in which the grid is self-sufficient, but is also connected to a larger grid

Why WPI?



Electricity Cost

Cost without Microgrid	Cost with self-financed Microgrid	Cost with a NextEra Microgrid
4.2m/yr.	2.0m/yr.	2.0m/yr.
No Upfront	$35m Upfront	NextEra Covers

Methods

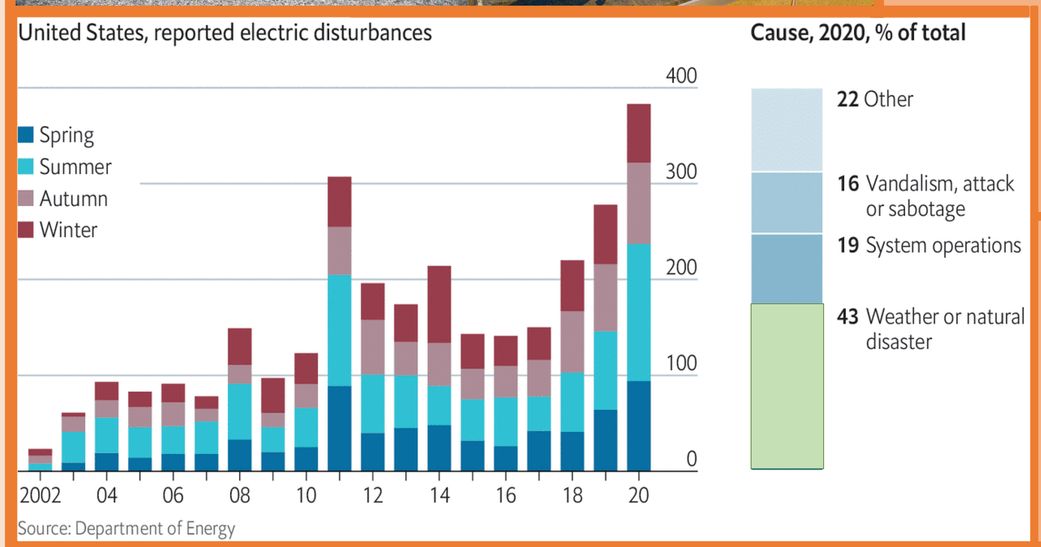
Case Studies

- Hurricane Sandy
- Hurricane Maria
- Texas Ice Storm

Resources

- NextEra interview
- Facilities Office Interview
- Weather Pattern Research
- WPI Energy Statistics

- WPI roof space with unexploited potential
- NextEra will use WPI's space to produce electricity
- NextEra promises WPI will pay less than they would with the grid, whether electricity prices go up or down
- Locked into contract 20-40 years



(NextEra Energy, personal communication, February 11, 2022)
(WPI Facilities Office, personal communication, February 7, 2022)
Calzadilla, Elizabeth. "FIU, FPL Unveil Innovative Microgrid and Virtual ControlRoom at College of Engineering & Computing."FIU News,Florida InternationalUniversity, 7 Jan. 2022
"Campus Microgrids Solve Energy Challenges in Higher Education." Edited byElisa Wood,Microgrid Knowledge, 15 June 2020
Beazley, Raymond "Ian", et al.Developing a Platform for DistributingInformation on Community and Renewable Microgrids in the United States.Worcester Polytechnic Institute and Climable.org, 16 Oct. 2020
Yin, M., Li, K., & Yu, J. (2022). A data-driven approach for microgrid distributed generation planning under uncertainties. *Applied Energy*, *309*, 118429. https://doi.org/10.1016/j.apenergy.2021.118429
Villanueva-Rosario, J. A.; Santos-García, F.; Aybar-Mejía, M. E.; Mendoza-Araya, P.; Molina-García, A. Coordinated Ancillary Services, Market Participation and Communication of Multi-Microgrids: A Review. *Applied Energy* 2022, *308*, 118332. https://doi.org/10.1016/j.apenergy.2021.118332.
Wu, T.; Wang, J.; Lu, X.; Du, Y. AC/DC Hybrid Distribution Network Reconfiguration with Microgrid Formation Using Multi-Agent Soft Actor-Critic. *Applied Energy* 2022, *307*, 118189. https://doi.org/10.1016/j.apenergy.2021.118189.
Magill, Bobby. "Microgrids: Sandy Forced Cities to Rethink Power Supply." *Climate Central*, 9 Sept. 2013, https://www.climatecentral.org/news/microgrids-hurricane-sandy-forced-cities-to-rethink-power-supply-16426.
Lantero, Allison. "How Microgrids Work." *Energy.gov*, U.S. Department of Energy, 17 June 2014, https://www.energy.gov/articles/how-microgrids-work
Hirsch, Adam, et al. "Microgrids: A Review of Technologies, Key Drivers, and Outstanding Issues." *Renewable and Sustainable Energy Reviews*, Pergamon, 3 Apr. 2018, https://www.sciencedirect.com/science/article/pii/S1364032118302128X
Aros-Vera, F., Gillian, S., Rehmar, A., & Rehmar, L. (2021). Increasing the resilience of critical infrastructure networks through the strategic location of Microgrids: A case study of hurricane maria in Puerto Rico. *International Journal of Disaster Risk Reduction*, *55*, 102055. https://doi.org/10.1016/j.ijdrr.2021.102055
Lugo-Alvarez, M., Broderick, R., & Ortiz-Rivera, E. I. (2020). Strategic placement and design of microgrids using nighttime imagery. *2020 47th IEEE Photovoltaic Specialists Conference (PVSC)*. https://doi.org/10.1109/pvsc45281.2020.9300903
Touili, N. (2021). Hazards, Infrastructure Networks and unspecific resilience. *Sustainability*, *13*(9), 4972. https://doi.org/10.3390/su13094972
On the impacts of power outages during Hurricane Sandy—a ... (n.d.). Retrieved January 20, 2022, from https://onlinelibrary.wiley.com/doi/am-pdf/10.1002/sys.21338
Shibboleth authentication request. (n.d.). Retrieved January 20, 2022, from https://ieeexplore-ieee-org.ezpv7-web-p-u01.wpi.edu/stamp/stamp.jsp?tp=&arnumber=7951071&tag=1
Remote Sensing | an open access journal from MDPI. (n.d.). Retrieved January 20, 2022, from https://www.mdpi.com/journal/remotesensing
Henry, Devanandham, and Jose Emanuel Ramirez-Marquez. "On the Impacts of Power Outages during Hurricane Sandy—A Resilience-Based Analysis." *Https://Onlinelibrary.wiley.com/Doi/10.1002/Sys.21338*, Systems Engineering, Vol 19 Issue 1, 22 Apr. 2016
Lacey, Stephen. "Resiliency: How Superstorm Sandy Changed America's Grid." *Resiliency: How Superstorm Sandy Changed America's Grid | Stanford Energy Journal*, 21 Oct. 2014, https://sej.stanford.edu/resiliency-how-superstorm-sandy-changed-america-s-grid.
Walsh, Bryan. "Hurricane Sandy Will Put a Rickety Power Grid to the Test." *Time*, Time, 30 Oct. 2012, https://science.time.com/2012/10/30/hurricane-sandy-will-put-a-rickety-power-grid-to-the-test/.