An Examination of Microgrids as a Form of Energy Generation Decentralization

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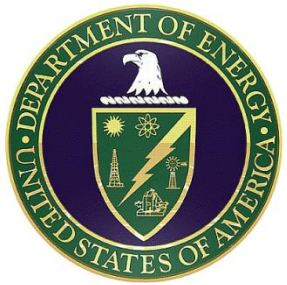
Methods of Research

- Review of literature pertaining to economic viability, reliability, and efficiency.

- Professional and technical research journals, white papers, and government studies



- IEEE Xplore
- IEEE Transactions
- JEE
- DoE

Current Research

Economic

-Cost of outages

-Minimizing return on investment period

-Minimizing initial capital

Efficiency

-CHP

-Generation and load placement

Reliability

-Minimizing outage duration and frequency

-Power quality

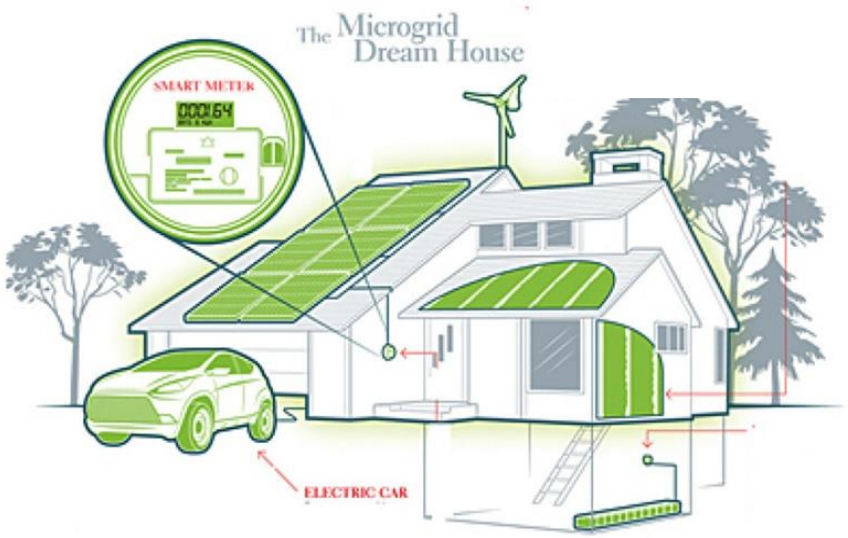
Economic Evaluation of Microgrids

- Cost-effective Applications of Microgrids
  - Peak shaving[1]
    - Real-time data and communication between ratepayers and utilities
  - Uninterrupted power source during grid outage
    - Average cost of outages in the United States is $79 billion annually [2]

Economic

- Components of microgrids and distributed generation rapidly approaching market parity

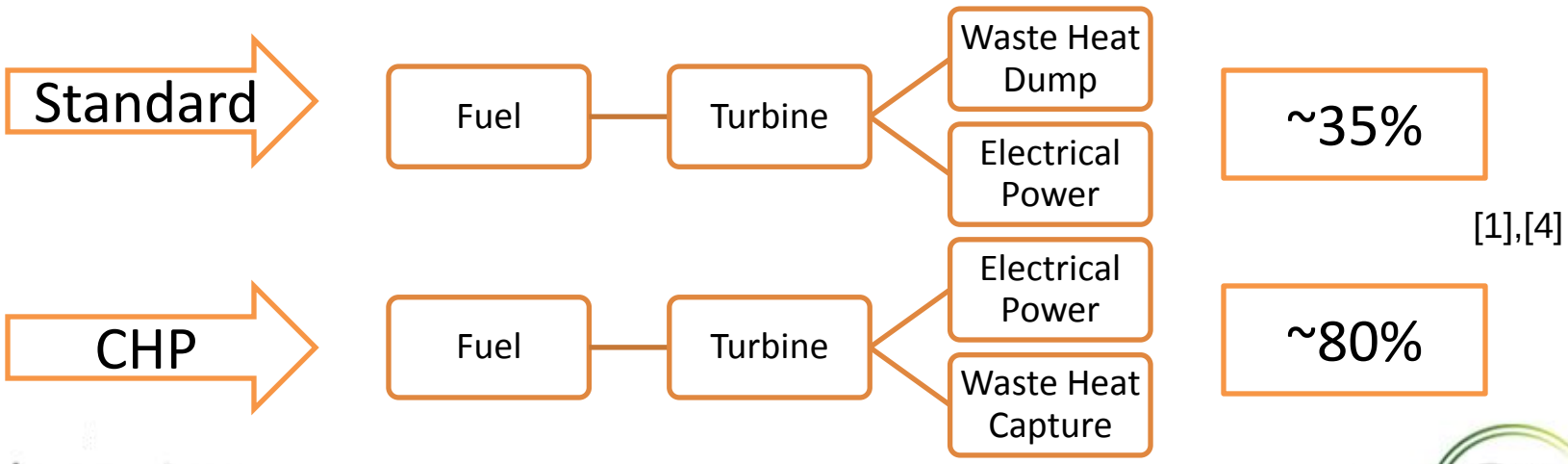
- Geographic location of implementation effect on RoI calculation [3]



Residential microgrid shown to have reasonable return on investment

Efficiency

- Microgrids allow for increased efficiency of generation and distribution
  - Enhanced control over loads and generation sources
    - Digital Energy Management Systems (EMS)
- Combined Heating and Power



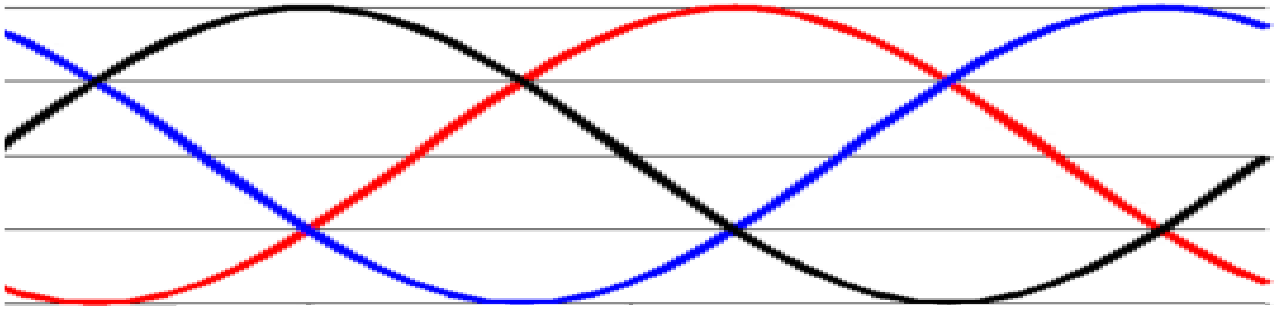
Reliability

- Increasingly unpredictable superstorms offer unquantifiable opportunities for microgrids
  - The need for constant power in hospitals, labs, schools, and many factories

- The Consortium for Electronic Reliability Technology Solutions (CERTS) microgrid model
  - Meets all interconnection standards and automatic islanding standards (IEEE 1547) for distributed energy resources (DER)

Reliability and Quality

- Additional benefits of the EMS:
  - Real-time monitoring of real and reactive power as well as frequency
  - Various industries require high quality power
    - Without a continuous, high quality power, it is very possible to damage more sophisticated equipment



Three-Phase Power

Conclusion

- Economy
  - ➢ Avoided outage costs
  - – Use of microgrids as peak shaving tool
    - Becoming residentially viable
  - – Assessment of geographical viability
- Efficiency
  - ➢ CHP is a predominant factor in efficiency equation
  - – EMSs afford operators greater control over generation mechanisms
- Reliability
  - ➢ Islanding capabilities provide continuous power
  - – Enhanced power quality through EMS Future Research

Future Research

- Modularization of microgrid components
  - Minimize custom field engineering
- Energy storage for rapid load/fault response and renewable availability smoothing
  - Facilitates spectrum of DER
- Failure mechanisms within the grid in order to identify ideal microgrid projects
  - Locate fiscally responsible potential microgrids

Thank You

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References

[1] R. H. Lasseter, “Microgrids and Distributed Generation,” *Journal of Energy Engineering,* Vol. 133, No. 3, pp. 144-149, September 2007.

[2] Kristina Hamachi LaCommare and Joseph H. Eto, “Understanding the cost of Power Interruptions to U.S. Electricity Consumers,” *Lawrence Berkeley National Lab*, pp. 41, Sep. 2004.

[3] Douglas E. King and M. Granger Morgan, “Customer-Focused Assessment of Electric Power Microgrids,” *Journal of Energy Engineering*, Vol. 133, No. 3, pp. 150-164, Sep., 2007.

[4] Kurt Yeager, “Striving for Power Perfection,” *IEEE Power & Energy Magazine,* pp. 29-35, Nov./Dec. 2008.