Microgrid Training Session 5: Alternative Solutions to Microgrids

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August 3, 2022

Session 5: Alternative Solutions to Microgrids

Microgrids have advantages over other solutions; however, microgrids have their own costs in terms of finance and operations. This session will help attendees identify alternative solutions to specific issues.

Presenter

Bharat Solanki

- Employee of NREL, a laboratory of the U.S. Department of Energy
- 9 years of experience working in microgrid research and deployment
- Previously a microgrid technical lead for Siemens Canada
- Worked on several microgrid projects from the concept level to complete operating microgrid systems.

Microgrid Challenges

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Renewables:

- Reduce fuel usage
- Are variable
- Require a backup source
- Offer different sizes and types of distributed energy resources
- Have different communication/control structures, settings, and protocols.

Stability/control/interfacing:

- Weak grid
- Grid interaction + islanded modes
- Grid protection
- Use cases
- Optimization and forecasting
- Cloud-based solutions
- Integration issues.

Value of resilience:

- How to quantify benefit of 99.9%.

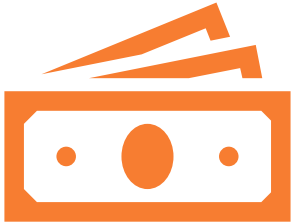
Regulatory/scoping:

- High renewable percentage
- Outside connections
- Synchronization
- Modularity, backward compatibility, and infrastructure base
- Scope limitation
- Cybersecurity
- Market interaction.

Sometimes It Doesn't Make Sense

- Microgrid versus business-as-usual versus infrastructure replacement/upgradation?
- What are the influencing factors ?
  - Economics
  - Logistics
  - Social/environmental
  - Footprint limitation
  - Technical
  - Timeline of the project.

Economics



- Cost versus benefits
- Life-cycle costs, replacements in certain years
- Capital investment is required. Costs include:
  - Distributed energy resources
  - Transportation/logistics
  - Installation and commissioning
  - Engineering procurement and construction
  - Balance of plant.

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Logistical Challenges

Remote communities often have limited access and lack proper transportation infrastructure. This might include:

- Winter roads and seasonal barges
- Access only by air, which has limited capacity to carry weight
- Limited local availability of heavy transport vehicles.

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Social/Environmental Challenges

- Location limitation—e.g., an airport, an animal sanctuary, or adverse weather
- Priority versus requirement
- Subsidized electricity
- Limited local resources to operate and maintain the microgrid
- Land requirement—big PV plants require a significant amount of land
- Environmental impacts—wind energy can have the potential to reduce, fragment, or degrade habitat for wildlife, fish, and plants.
- Public opinion—depending on the degree of visual impact, the public can strongly oppose the installation of PV and significantly hinder its implementation.
- Thermal runaway of battery system.

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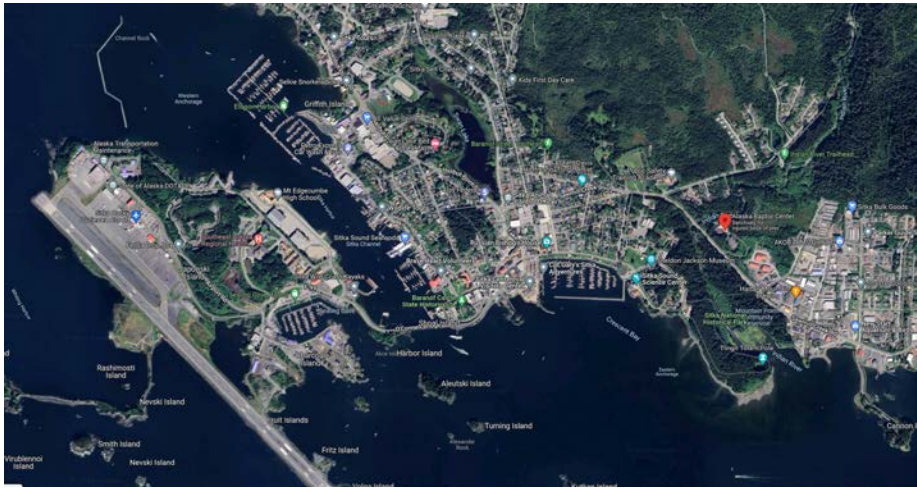

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What Are Alternative Solutions?

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1) Continue as is.
2) Replace aging infrastructure.
3) Upgrade substation/transformer/ electrical infrastructure to meet increased demand.
4) Implement radial-to-ring or parallel feeder configurations.
5) Connect with the grid.
6) Add diesel gensets or use mobile gensets.
7) Use distribution automation.
8) Improve efficiency.

Costs and Benefits of Alternative Solutions to Microgrids

2) Replace aging infrastructure:

- Cost comparison with microgrids: may be moderate to expensive
- May reduce probability of equipment failure but may not provide resilience during an outage
- May have less impact on existing grid infrastructure
- May have a longer life cycle than a microgrid
- May not improve sustainability
- Is a proven/mature solution
- Total time required to complete the project.

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Costs and Benefits of Alternative Solutions to Microgrids

3) Upgrade substation/transformer/electrical infrastructure to meet increased demand:

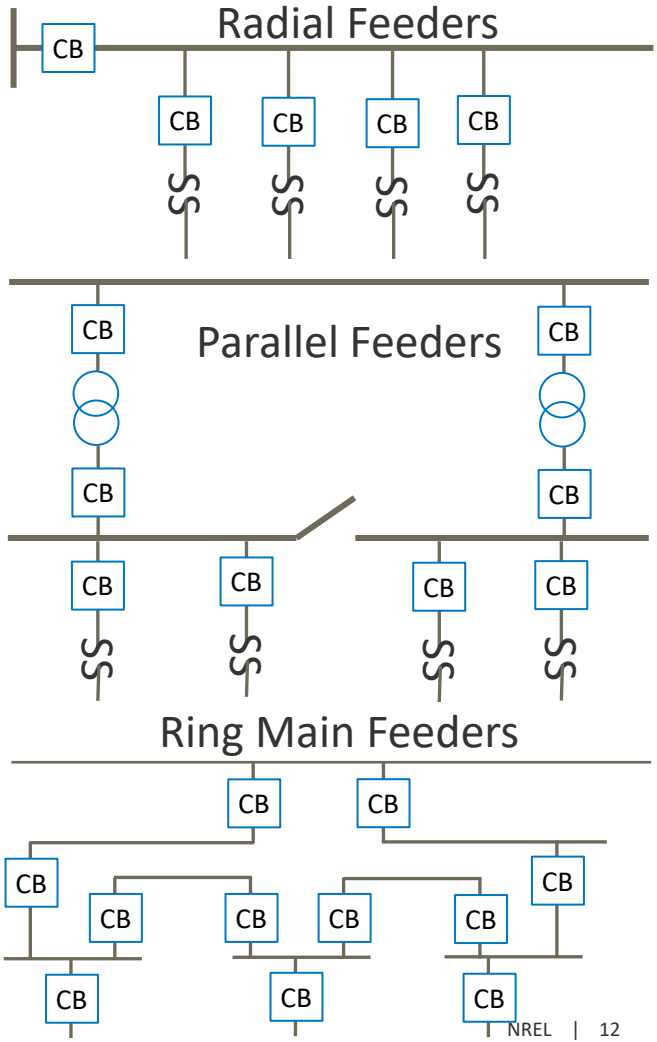
- Cost comparison with microgrids: may be moderate to expensive
- May reduce probability of equipment failure but may not provide resilience during an outage
- May have a larger impact on existing grid infrastructure
- May have a longer life cycle than a microgrid
- May not improve sustainability
- Is a mature solution
- Total time required to complete the project.

Photo by NREL

Costs and Benefits of Alternative Solutions to Microgrids

4) Implement radial-to-ring or parallel feeder configurations:

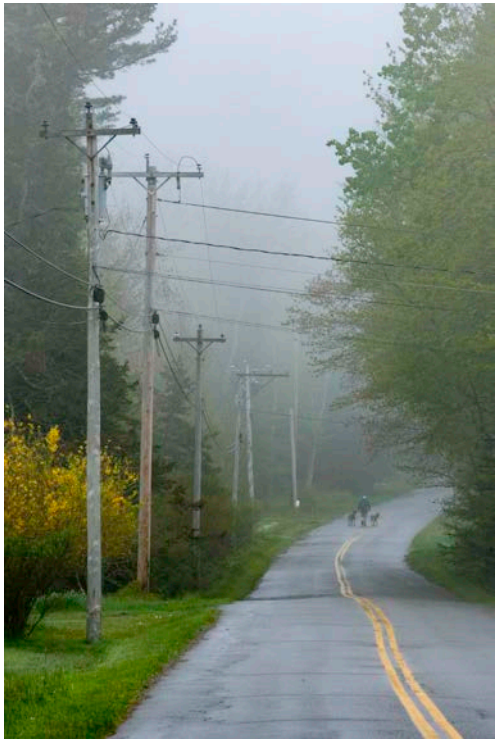
- Cost comparison with microgrids: may be moderate to expensive
- May reduce probability of outage
- Does not increase generation capacity
- May have a larger impact on grid infrastructure
- May have a longer life cycle than a microgrid
- May not improve sustainability
- Is a proven/mature solution.



Costs and Benefits of Alternative Solutions to Microgrids

5) Connect with the grid—i.e., for remote, off-grid communities:

- Cost comparison with microgrids: may be moderate to expensive
- May not provide resilience during an outage and has a higher probability of an outage
- May have a longer life cycle than a microgrid
- May have lower operational costs—no or minimal use of gensets and thus a low fuel cost and minimal required maintenance
- May be better than using diesel gensets—more sustainable
- Is a proven/mature solution.



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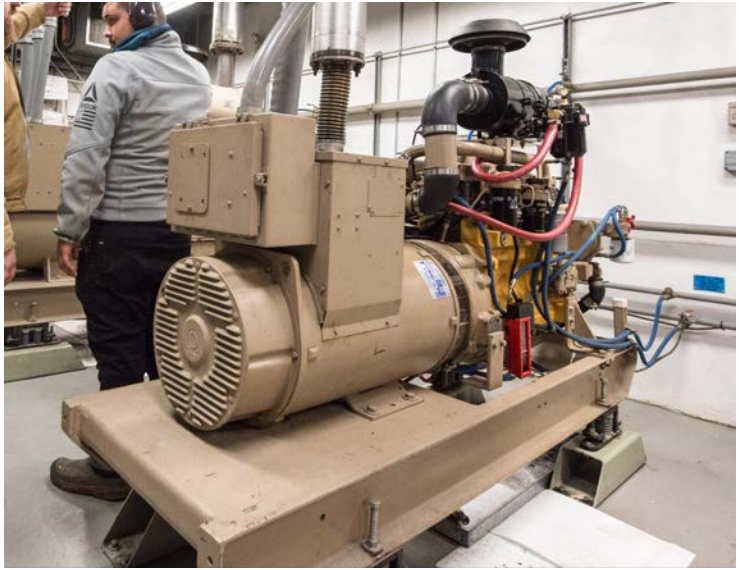
Costs and Benefits of Alternative Solutions to Microgrids

6) Add diesel/natural gas gensets or use mobile gensets:

- May be economic
- May provide resilience during an outage
- May have similar or longer life cycle as a microgrid
- May have less impact on the existing system
- May have higher fuel costs plus operation-and-maintenance costs
- Produces harmful emissions
- Is a proven solution
- Note that the California Air Resources Board has publicly discussed limiting/banning future diesel gensets.



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Costs and Benefits of Alternative Solutions to Microgrids

7) Use distribution automation

Digital sensors and switches with advanced control and communication technologies can automate feeder switching; voltage and equipment health monitoring; and outage, voltage, and reactive power management.

- May improve the speed, cost, and accuracy of key distribution functions to deliver reliability
- Improved asset remote fault indicators and cost savings to customers
- May be economic
- May have a longer life cycle
- May have a larger impact on existing system
- May not improve sustainability.

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Thank You!

Questions?