Framing the topic

- **If a microgrid cannot island, it is not a microgrid.**
- **Purpose of microgrid, sustain critical operation, cost savings, optimization, provide utility benefits, availability, user options, provide new sources for economic development, energy efficiency, promote renewable energy**
- **With 99.9999% availability, islanding is not necessary most of the year.**

- ## What is covered
- **Building**, (Residential, Commercial, Industrial), **campus/community** (Residential, Commercial, Industrial), **Regional/cities/county/states, Military bases,**
- **Remote** (Residential, Commercial, Industrial)?
- Independent or aggregate microgrids
- Tie energy with transportation, fuel, thermal as part of the microgrid. Interdependent.
  - What is the load? Load types? Pumps, buildings
  - Start with individual building microgrid -> go to group of buildings -> go to campus -> go to region
- How will microgrids co-exist with grids, utilities, other generators over time
- What is the financial case/justification of microgrids (plays well with the system) as they evolve? Utility still has to provide the capacity for microgrid?
- Focus on microgrids that build on existing infrastructure
- ## What is not covered
- Full green field projects

Current Technology Status

- **State of the Practice (use case or architecture) what has been done 5 years and more?**
- Use case:
  - See yesterday
- Architecture:
  - Information
    - Building automation
  - electrical
    - Interconnect agreements FERC (Maybe state of the Art if interconnecting with other microgrids)
    - Transfer switch for independent generation to the grid verse parallel generation
    - Building facilities
    - Static transfer

- **State of the Art (what is being done within the last 5 years)**
- Electrical
  - Using IEEE 1547
  - Islanding intermittent renewables
  - Ancillary services
  - Energy storage
  - Prioritized/tiered loads
  - Seamless microgrid transition

  Information
    - Demand management
    - Automated management
    - IEEE 2030

    Financial

    PPA, Subsidies, DOE research funding, DOD demonstrations, business cases have not been commonly accepted, not as critical facilities

- Current R&D activities

Needs and Challenges

- What is needed and why
  - Water, Thermal, Transportation
    - Enterprise model that incorporates all utilities
    - Interdependences with the electrical system
  - Electrical
    - Common interconnection agreement
    - Accommodate possible generation interconnections (basic generation requirements physical and information requirements)
    - Does IEEE 1547.1-.8 apply for each use case?
    - Characterization/prioritization of generation and loads
    - Flexible architecture to allow choices for interconnection
    - Constraints for customers to lead to a given architecture
  - Information
    - OSI seven layer model: physical…
    - NIST model
    - IEEE 2030 may not apply to each use case
    - Transparency needed for customers and for utilities (how much is needed?)
    - Applying incentives from utilities for customers to behave desirably

    Develop relationship with NIST to standardize microgrid architecture
- What are challenges
  - Water, Thermal, Transportation
  - Electrical
    - Built in environment is a challenge to work with
    - Without a legacy system, installing a new system can be costly
    - Lack of a long term plan to invest, develop a microgrid target

    Customer Acceptance
  - Information
  - Costs
    - Some sites have inexpensive electricity so microgrid capabilities do not make a business case

R&D Scope

- Description of the R&D scope responding to the challenges and needs
  - Defining an ideal microgrid architecture then reducing cost
    - Customers will work with utilities so both will choose best features for each in a microgrid
    - Identify all priority use cases
  - Action plan on how to transition an existing grid to achieve a better performing system that incorporates microgrids
    - Consider stakeholders (utilities, customers, markets…) each one has a different definition of what a better performing grid is
    - Optimization
    - What is the balance between distributed verse centralized
    - **Building**, (Residential, Commercial, Industrial), **campus/community** (Residential, Commercial, Industrial), **Regional/cities/county/states, Military bases,**
    - Work with utility to define a long term plan
  - Define interfaces to reference existing standards (interconnection verse communication verse information) or develop new standards
    - Information is the data
    - Communication is the energy network

R&D Metrics

- Milestones (within life of the project 1-5 years)
  - Define a base case microgrid
  - Define the use cases and identify stake holders
    - Get stake holder input
  - Define microgrid elements (actors)
    - Description of the requirements
  - Define interfaces to reference existing standards (interconnection verse communication verse information) or develop new standards
    - Information is the data
    - Communication is the energy network

- Outcome
  - Characterize the performance
    - Efficiency, cost, security, environmental, power quality, reliability, availability, stability, flexibility, scalability, economics
  - Quantify the outcomes
    - Compare to existing microgrids
    - Compare to base case
  - Recommend policy and regulatory changes

R&D Metrics

- Milestones (within life of the project 1-5 years)
  - Identify partner organizations
  - Benchmark existing architectures
    - Define current state -> the stages to get where desired-> desired state, long term plan with the utility
  - Road map
- Outcome
  - What percentage of power served from microgrids
  - Performance relative to existing *Efficiency, cost, security, environmental, power quality, reliability, availability, stability, flexibility, scalability, economics, SAIFI, SAIDI, demand response, peak shaving, transmission congestion reduction,* verses desired