Multi-user Microgrid Straw Proposal

6/17/2015 Update | edited by Travis Sheehan, Boston Redevelopment Authority

1 Goal Statement

To develop a straw proposal business model which enables multiple owners of commercial real estate and/or institutional buildings to achieve greater resiliency, reduce GHG emissions, and lower total cost of energy through energy services from a "microgrid"- defined here as a local energy system producing and distributing electric and thermal energy.

2 Straw Proposal

The straw proposal outlines the desired outcomes of a microgrid, technologies that would be included in a microgrid, proposed business agreements, and a description of roles and responsibilities for each stakeholder in the microgrid.

In general, the straw proposal outlines the technology transfer of microgrid solutions from campus energy services into districts with mixed types of end users—including commercial real estate and institutional buildings—referred to here as a "multi-user microgrid".

3 Introduction

For decades, groups of buildings, typically owned by a single entity, have enjoyed the financial benefits of producing their own power—electricity, heating, and cooling. For the most part, these systems use cogeneration technology to achieve a lower total cost of energy. With the addition of islanding capability, microgrids enhance the on-site energy reliability as well as backing up the electric distribution grid—offering places of refuge for vulnerable populations in the event of a natural disaster and resultant extended utility grid outage. An islandable grid which provides competitively priced power can also be a lower-carbon source of energy compared to the electric utility grid depending on the regional mix of electric generation resources and the mix of resources used to power the microgrid. Historically, these benefits have accrued to corporate, university and medical campuses because these campuses are owned by a single entity and capital decision making yields sophisticated energy management solutions. In contrast, these benefits do not accrue to districts with multiple end users because (a) end users are not accustomed to district scale capital planning and (b) state statutory and regulatory structures do not directly address multi-user energy districts.

Multi-user microgrids face many challenges:

- End users, such as commercial real estate developers, perceive new energy management concepts as high risk
- Electric distribution utilities exercise caution when interconnecting distributed generation to the grid in order to maintain system stability and safety; new concepts such as islandability of districts within the distribution grid must also be carefully scrutinized

The series of Boston Microgrids Workshops, held between March and July of 2014, explored these opportunities and challenges of a multi-user microgrid through a multi-stakeholder process. This straw proposal is a product of those workshops, and will be further refined based on the input from the June 29, 2015 USDN multi-city multi-stakeholder workshop.

4 OUTCOMES

This straw proposal outlines an approach to attain three desired outcomes:

1. enhanced resiliency,
2. reduced GHG emissions, and
3. lower total cost of energy for end users.

There may be many ways to achieve each outcome individually, but microgrids are one way to accomplish all three goals simultaneously in the commercial and institutional real estate sector.

RESILIENCY: Microgrids should enable a city to bounce back quicker from a shock to the system than it does currently. Enhanced resiliency would achieve (a) enhanced business continuity and (b) enhanced life safety for vulnerable populations. Continuous power supply in its current incarnation is typically achieved at the building scale through redundant feeder connections and backup diesel generators. Key resiliency-related features of a microgrid include:

- ability to island;
- ability to isolate & serve critical loads;
- recovery for essential services to support a community through an extended outage; and
- enhanced reliability & power quality.

REDUCE GHG EMISSIONS: This includes integration of generation assets such as cogeneration and renewables (potentially with storage) that achieve a lower total GHG emission profile of all end uses combined within the microgrid compared to a business-as-usual case of electric and fuel inputs to a single building. Key GHG emissions reductions features include:

- renewables integration
- green buildings and up-front load reductions
- cogeneration, combined heat and power (CHP)

LOWER TOTAL COST OF ENERGY: This is the value achieved by consuming energy that is efficiently produced and locally consumed. Many campuses enjoy lower electricity and thermal costs because the efficient cogeneration of heat and power often yields a competitive lower total cost of energy compared to business-as-usual electric and gas inputs into a single building. End Users should see reductions in the combined capital and operating costs associated with conventional cooling, heating and power compared to a microgrid solution. In most cases, the economic savings comes from nearly “free” thermal energy, demand response services, and lower capacity charges and the ability to participate in ancillary services and other wholesale markets.

5 PROPOSED TECHNOLOGY MIX

Distribution Assets within the point(s) of Common Coupling: A local electric distribution network will (a) serve as a the platform for locally interconnected generation assets and loads; (b) enter into island mode to provide continuous power supply in times of macrogrid outage; (c) provide an interface with the macrogrid to optimize demand response capabilities; and (d) provide ancillary and distribution level services[1]. A local thermal distribution network will optimally utilize waste heat sources and thermal generation resources to distribute the lower cost cooling and heating energy to all end users.

Generation Assets: A portfolio of generation assets within the microgrid will (a) economically produce energy to meet peak thermal loads of end users; (b) in the case of CHP, economically produce electric energy[2] as a compliment to end-use thermal demand; (c) in the case of renewables and thermal/electric storage,[3] produce energy that can be consumed within the microgrid, reduce peak demand and, where applicable, utilize net metering and participation in ancillary services and other wholesale markets; and (d) where appropriate, produce excess thermal energy that can be exported (e.g., to a district thermal system), which may increase CHP sizing.[4]

Communications Assets: A portfolio of communications assets that include advanced metering infrastructure functionality, SCADA, load management and resource optimization capability, and appropriate interface with the macrogrid. It will also include the necessary protections for cyber-security.

6 BUSINESS AGREEMENTS & SCENARIOS

Each jurisdiction (DC, NY, and MA) will have various push and pull factors that inform the agreements required to enable multi-user microgrids. The USDN Microgrids Workshop will focus on a single business agreement depicted by a diagram and a table similar to the samples below. The USDN Microgrids Workshop will utilize group scenario planning to work through the “deal makers” and “deal breakers” of the proposed scenario.

The Scenarios below are two of the many business agreements possible from this microgrid straw proposal. These options are suggested because they minimize the number of enabling contracts required to accomplish the deployment of multi-user microgrids.

[1] Ancillary services may include any applicable services in Ancillary Services Markets. Distribution level services may include voltage control and feeder loading relief.

[2] When excess electric energy is generated by serving thermal loads, it may be exported to the macrogrid.

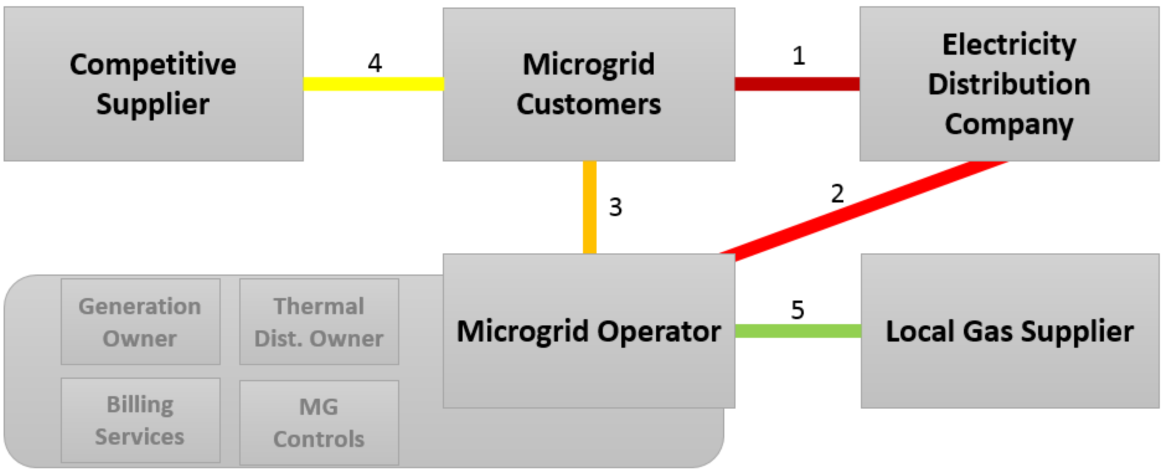
[3] A battery energy storage system (BESS) should be included in the microgrid to: (1) power essential services to support a community through an extended outage under conditions where diesel backup generators are unavailable for any reason (e.g., fuel has run out, emission constraints) and therefore intermittent PV is only source of electricity and (2) provide frequency and voltage support, including buffering PV.

[4] In addition to thermal-following CHP and other clean energy, some other gas-fired generation may be needed to meet critical loads in island mode, but the goal should be for total emissions to be lower than a base case with no microgrid and no DG.

6.1 Scenario 1:

The image below describes the structure of contracts between microgrid stakeholders where a 3rd Party Energy Development Company acts as the "Microgrid Operator" and owns the energy assets except the electric distribution wires, which are owned by the local electric utility.

6.1.1 Scenario 1 Contractual agreements diagram



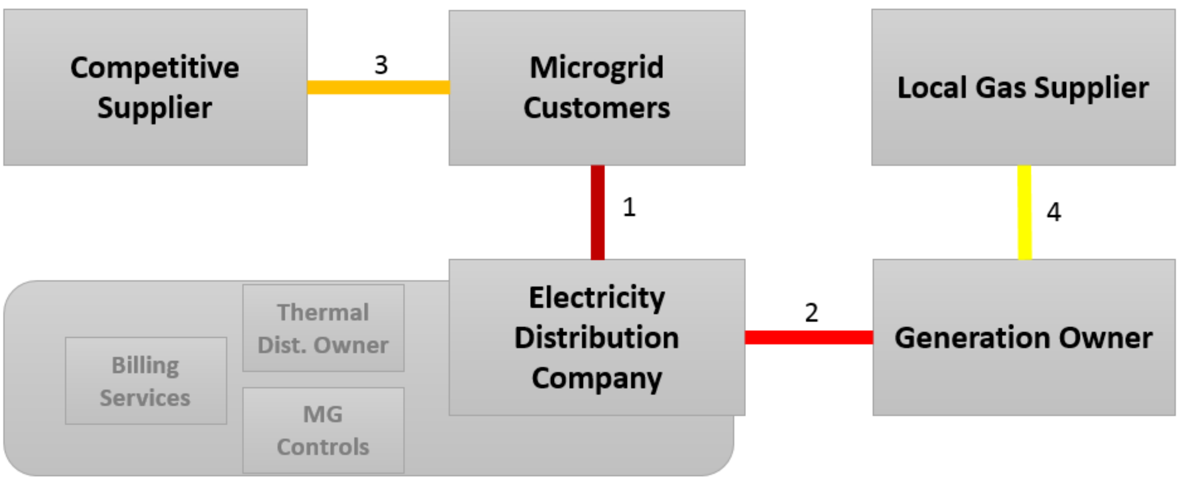
6.1.2 Scenario 1 Contractual agreements table

1	**Distribution Company**	**Microgrid Customers**	• DISCO owned wires used in delivery of electric power and DISCO charges customers pursuant to tariffs and 'Microgrid as a Service' Fee • Some transmission & distribution charges may not apply to power generated within the MG
2	**Distribution Company**	**Microgrid Operator**	• MG Operator provides some T&D-related services to DC (e.g., voltage & frequency control, distribution capacity deferral) • A special contract is used to (a) define innovative services and charges (b) formalize communication & control protocols, including for islanding (c) power export to the macrogrid
3	**Microgrid Operator**	**Microgrid Customers**	• MG Operator enters into thermal PPA agreement with MG Customers • MG Operator sells thermal energy to MG Customers • Includes protocols to optimize the market value of generation, storage & load management resources dispatched by MG Operator
4	**Competitive Supplier**	**Microgrid Customers**	• Competitive Suppler can provide electric energy supply for MG Customers through competitive supply contract
5	**Local Gas Supplier**	**Microgrid Operator**	• Local Gas Supplier and Microgrid Operator enter into firm gas supply contract

6.2 Scenario 2:

The image below describes the structure of contracts between microgrid stakeholders where The Electricity Distribution Company acts as the "Microgrid Operator" and owns the energy assets except the electric generation.

6.2.1 Scenario 2 Contractual agreements diagram



6.2.2 Scenario 2 Contractual agreements table

1	Distribution Company	Microgrid Customers	• DISCO owned wires used in delivery of electric power and DISCO charges customers pursuant to conventional tariffs and 'Microgrid as a Service' Fee • DC enters into thermal energy PPA agreement with MG Customers • DISCO bills customers for delivery of electric and thermal energy, some transmission & distribution charges may not apply to power generated within the MG
2	Distribution Company	Generation Owner	• Generation Owner provides some T&D-related services to DC (e.g., voltage & frequency control, distribution capacity deferral). • A special contract is used to (a) define innovative services and charges (b) formalize communication & control protocols, including for islanding (c) power export to the macrogrid for electricity and thermal energy
3	Competitive Supplier	Microgrid Customers	• Competitive Suppler can provide electric energy supply for MG Customers through competitive supply contract
4	Local Gas Supplier	Generation Owner	• Local Gas Supplier and Generation Owner enter into "firm gas supply" contract

7 PROPOSED ROLES AND RESPONSIBILITIES OF MICROGRID STAKEHOLDERS

These proposed roles and responsibilities are meant to be consistent with both of the scenarios described above. They are divided into two lists—things that an entity "will" do in all of the most likely multi-user microgrid scenarios, and things that they "may" do depending on the particular multi-user microgrid scenario.

ELECTRIC DISTRIBUTION COMPANY (DISCO): The incumbent distribution company will own electric distribution hardware. The DISCO will do the following:

- ensure that the interconnection of any local generation assets are safe and reliable
- distribute locally produced electricity within the microgrid.
- distribute power from the macrogrid into the microgrid, to individual customer meters and/or to the PCC.

The DISCO may:

- recover from Microgrid Participants and/or MG Manager the cost of distribution-related capital expenses and operating expenses unique to the microgrid (Service Fee or Microgrid as a Service Contract)
- serve as the Microgrid Operator
- own or manage battery energy storage systems as a distribution resource, if it is not used to sell energy, capacity or reserves into competitive markets outside the microgrid
- own the thermal distribution assets
- implement islanding technology to ensure isolation of a predefined area of the grid, where existing distribution lines exist

GENERATION OPERATOR (INCLUDING END USERS WITH BUILDING-SCALE ELECTRIC GENERATION OR STORAGE TECHNOLOGIES): The Generation Operator will:

- develop the generation assets and develop the cost recovery scheme through rate agreements for the electricity and thermal energy supplied with the Microgrid Manager, DISCO, or end users
- produce and supply electric power into the microgrid distribution network
- produce and supply thermal power into the microgrid distribution network
- collect electricity supply revenues from the Microgrid Manager, DISCO, or end users
- engage in an interconnection procedure with the DISCO and Microgrid Manager, allowing access and control of the generation assets for cost optimization, reliability, and safety

A Generation Operator may:

- supply electric power without having to enter the wholesale market with the assumption that a locally produced kilowatt hour will be cheaper than a retail kilowatt hour

MICROGRID OPERATOR: The Microgrid Operator will:

- perform communications and supply and demand optimization for the microgrid

The Microgrid Operator may:

- be the DISCO or a DISCO subsidiary
- be a private entity that meets defined criteria
- be the single point of contact between the DISCO, generators, and loads/end users
- own generation and serve as dispatch control and entrant in the energy market (ISO New England)
- manage building owned generation and keep records used for billing End Users
- manage competitive supply purchasing and contracts on behalf of the Microgrid Customers

THERMAL DISTRIBUTION COMPANY (TECO): The TeCO will

- enter into a Power Purchase Agreement with end users
- distribute reliable and safe thermal energy to end users
- set rates to recover the cost of the distribution assets with end users

The TeCo may:

- be any of the stakeholders or a sister company or subsidiary of any of the stakeholders
- provide financing and develop the thermal distribution assets

MICROGRID CUSTOMERS: Microgrid Customers will:

- be billed by the DISCO pursuant to conventional tariffs
- enter into a Power Purchase Agreement with the thermal energy provider

The Microgrid Customers may:

- enter into a competitive supply contract with a Competitive Supplier
- enter into an agreement with the Microgrid Operator for services such as the contracting and competitive supply, bulk power purchase, and any ancillary services revenue collection from in-building energy generation
- enter into a special rate agreement or special contract such as a Microgrids as a Service contract
- own generation assets and (a) gain revenues from ancillary services and local distribution support (b) net meter their electricity and thermal energy produced
- abrogate the right to retail choice for a *dedicated volume* of electricity coming from the microgrid (internal vs externally sourced power)