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The Development Plan for Microgrids Encompasses Engineering, Economics, and Practical Knowledge

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***Abstract:** This article describes the progress of the microgrid development process, including the completion of the initial guideline. It shows the main points that need to be realized, developed and used for the operation of a microgrid; In other words, a microgrid is a distribution system with many electrical devices that can be connected to a large grid or operate independently. The paper also discusses different types of microgrids, provides methods for estimating their effectiveness, reviews microgrid performance and technology, and documents the microgrid pilot program.*

***Keywords:** Microgrids, Distributed Power, Photovoltaic Cell, Fuel Cell, Power Quality, Converters.*

1. INTRODUCTION

The first Technical Guide (TB), recently completed by another group, addresses the definition and definition of microgrids, the rationale for the use of microgrids in current industry and environmental management, and research on microgrid technologies and experiences. Operating microgrids provides many benefits to consumers and utilities, including improved energy efficiency, reduced overall energy consumption, reduced environmental impact, increased reliability, reduced losses, traffic congestion relief, energy management and operational safety, and more. Beneficial power infrastructure changes. It is worth noting that the drivers for microgrids vary around the world, with energy efficiency becoming a priority after natural disasters in the Northeastern United States and Japan, and microgrids being proposed as part of new smart projects in many countries.

This brief outlines how stakeholders can benefit from microgrid deployments and provides a framework for measuring these benefits. Benefits such as lower energy costs, slower investment, lower costs, additional services, and improved reliability can be used to create economic problems, as shown in specific examples. This framework considers impact as a measure of the impact of microgrids on performance and the cost-based benefits associated

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with these impacts. Although many of the described benefits can be achieved through other means, microgrids can deliver these benefits to multiple stakeholders in a unified manner.
Clearly, technology plays an important role in enabling microgrids. TB suggests a number of things that can be built into a microgrid to ensure the microgrid is viable and beneficial to stakeholders. Although some technologies, such as photovoltaic arrays, are well known, the focus is on the performance of low-energy devices (DERs) and their associated electronic equipment, as well as specific features of microgrids, such as managed data protection and communications technology. There is need Local government.
WG6.22 reviewed the methodology for assessing economic issues and presented two successful microgrid studies and practical applications, as well as other examples in the Annex. The evaluation addresses the details of the business case study, including microgrid technology, control systems, and operational procedures. Two notable work examples are planning work for the Boston Bar milligrid and Holme Rd in British Columbia, Canada. Microgrid in Preston, UK. This example includes the results of the economic analysis, and the impact diagram in Figure 1 shows how this connection impacts positive outcomes in terms of ultimately delivering results to stakeholders.

Microgrid Definition

Defining a Microgrid

Establishing the definition of microgrids and comparing it with other concepts and related concepts in the literature is the main task of WG6.22. The team took this mission very seriously; spent a lot of time reviewing existing content and discussing the key features of microgrids. Although there are disagreements on the terms, the general terms appear to be common in most of the two regulations regarding microgrids.

- Contains sources and sinks under local control.
- Can operate either grid-connected or islanded.

WG6.22 defines a microgrid as a power distribution system that includes load and auxiliary equipment, such as generators, storage equipment, and control equipment, operated voluntarily in management, coordinated when connected to the main project or island.

Qualifiers

Generators cover a wide range of potential energy sources suitable for microgrid use, including small-scale combined heat and power plants (CHP) burning fossil fuels or biomass, photovoltaic modules, small wind turbines, small hydroelectric plants and more.
The category of storage devices covers a variety of technologies, including electrical (e.g., superconducting magnetic energy storage), electrochemical (e.g., batteries), mechanical (e.g., flywheels), and thermal. In microgrid systems, thermal storage plays an important role in influencing the operation of the system. Additionally, whether the building is pre-cooled or heated depends on the load profile of the heating, ventilation and air conditioning system and therefore the electrical equipment requirement.

Load control such as lighting, pre-cooling or slow water use in microgrids is important due to their small size, as small generators change the climate more. Thus, both load control and storage can provide significant benefits to microgrids.

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There are Three Major Benefits of Microgrids:

- For example, to serve very heavy goods such as emergency services, provide a different level of power quality and/or reliability (PQR) than local utilities and must be able to provide a variety of services for their internal equipment.
- Use local resources for supplementary services (AS), such as small renewable energy or grid-connected electric car batteries, which are often not an option or difficult to manage with a central generator.
- Manage and protect the grid from changes in local renewable resources and loads, for example by managing supply profiles for the public electricity grid.

These terms do not specify the minimum survival time in island mode, but the idea is that the microgrid should be able to operate as an island control system for more than a few minutes.

Microgrids and the Smart Grid.

At the highest level, the grid has three components:

- For example, the efficiency of existing power lines can be increased by using synchronized phasors.
- Improve the interaction between the grid and the customer, for example by using smart meters and reducing time costs.
- The emergence of new decentralized areas such as microgrids and active distribution lines represents a new development that did not exist before.The focus of WG6.22 is microgrids, but it is important to review broader energy production as well.

Three Plus Microgrid Types:

Two main types of microgrids should be identified [3]. Consumer microgrids, or true microgrids (μ-grids), operate independently, usually downstream of a single connection. Many current demonstrations, such as the Sendai Microgrid in Japan, fall into this category. These microgrids are easy to understand because they fit well with our existing technology and management systems. Just as consumers have always had a lot of flexibility to manage their energy consumption on the meter side, restrictions on μgrid energy are also loose.

The integration of energy or community microgrids with traditional culture (called national grids (mggrids) in TB) presents special requirements and business models due to the integration of energy management systems and must comply with the needs of energy use or regulations. Change. Current examples of national grids include the Boston Bar and Borrego Springs microgrids in Southern California, and although there are no differences between microgrids, utility regulations must be considered as a whole.

Although there is no possibility of grid connection, the first demonstration sessions of microgrid technology are mostly demonstrated on RGrids, similar to the remote grids (RGrids) involved in the technology compared to microgrids. From a scientific perspective, rgrids are generally referred to as microgrids due to the relationship between them.
There are some representations of virtual microgrids (vgrids) that span DERs in different locations and are integrated into the grid to be presented as a single control point, and these are not specified in the TB.

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2. RELATED WORKS

Functionality and Technology

A. Introduction:

Some of the microgrid technology enablers are:

- DER consists of generation, energy conversion, storage and load management, including negative energy efficiency (DES), is used to control the power supply and renewable energy and the workload during operation, storage space is especially important in small electrical machines.
- The microgrid control and monitoring function is responsible for activating and making changes to different functions such as grid connection and islanding. They also deal with instantaneous power measurements, long-term power needs of internal electrical equipment and loads, and determine the relationship between grid connections and larger power plants (megagrids) based on specific goals (such as reducing operating costs). Energy needs or utilization of resources continued.
- Microgrid protection and automation is used to quickly identify and isolate faults occurring inside or outside the responded microgrid boundary, as well as ensuring the security and independence of assets in the microgrid. If you want to know more, please don't hesitate to ask.
- Communication and remote monitoring that enable internal and external control, protection and automation to work together to manage daily operations and/or use system control and protection.

B. Generating and Storage Technologies

- The initial source of electricity in a microgrid power plant is widely recognized and will not be discussed here. Photovoltaic (PV) systems are especially important for microgrids due to their low cost, reliability, long service life and uninterrupted operation suitable for field use.
- Extracting wind energy from large wind farms, often called utility-scale projects, has become standard practice on large grids. These power clock wind turbines typically range from a few hundred kilowatts to over 5 megawatts, with an increase towards higher power rates, particularly for onshore sea breeze. Although there is no specific small size for microgrids, they can be combined with turbines, but small wind turbines (less than 100 kW) and micro wind turbines (less than 5 kW) seem to be particularly important in terms of switching problems. Instead, microgrids can be built and operated based on resources that would create problems for megagrids, such as poor supply and variable supply. Although there are many extensions of the microgrid aimed at providing power quality and reliability (PQR) for sensitive products, it is worth noting that microgrids will be designed and operated in the future before providing lower power from the grid for commercial or environmental Standard PQR.
- Coal and gas generation fired at medium or high temperatures provide a good energy source for heat and combined heat and power (CHP), and their use is specifically designed for microgrids due to their high efficiency and energy density. Moreover, using waste energy for cooling using vacuum can replace the most expensive electricity, leading to good

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economic results. Rotary generators can be used normally with machines connected directly to the mains or disconnected from the inverter, making connection easier and allowing high power management. The gas turbine, on the other hand, can achieve up to 60% electrical efficiency compared to internal combustion engines or turbines, and has better features than thermal generators in terms of partial efficiency.

- Using DES units in conjunction with DG units is a way to overcome the limitations of many DG technologies in power transfer based on load and network usage. DES units can also improve quality of service, support critical equipment during downtime, and improve the power quality of sensitive equipment, including charging electrical outlets. Many technologies used for generation, storage, and transportation in microgrids are asynchronous and often involve direct current (DC) in energy generation, storage, or use. Connecting these devices via the electrical grid to an alternating current (AC) microgrid creates a low-voltage power supply, an important feature of microgrids. DC microgrids, on the other hand, show the potential for efficiency, energy efficiency and security.

C. Control Technology:

Microgrid systems can be controlled by a Microgrid Central Controller (MGCC), which is usually installed at the distribution center or local control center [4]. The MGCC communicates with the lower-level controller and then monitors the local DG and DES devices. Additionally, a simpler method such as sag control or agent systems can also be used to control the microgrid.

D. Microgrid Protection:

Protection concepts and strategies in microgrids will differ from those used in traditional distribution systems, especially when operating on an island. Compared to grid systems, microgrids have higher fault currents, higher voltages and tripping frequencies during the operating season. Therefore, low/high voltage keep-on and frequency keep-on arrangements as well as adaptive load shedding schemes are important to maintain the microgrid design. For this reason, voltage and frequency-based protection systems need to be configured differently in microgrids.

E.Communication for Microgrods:

To improve the performance of microgrids, effective communication-based control, protection and automation technologies are required for the coordination of multiple generation, storage and energy management equipment. A variety of communication technologies are available to meet these needs, and many vendors offer both wired and wireless options. Business and technology play an important role in choosing a particular technology over others.

3. METHODOLOGY

A. Introduction:

When justifying the use of microgrids in society, it is important to evaluate their impacts and evaluate the costs and benefits for stakeholders. Additionally, different areas affected by microgrids need to be identified and evaluated [7, 8, 9, 10, 11].

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B. Microgrid Stakeholder:

Stakeholders directly involved in the microgrid include microgrid owners or operators, distribution operators, microgrid participants, and individuals who may be affected by the microgrid. It is worth noting that these stakeholders are important in any microgrid.

C. Microgrid Ownership:

Three strategic models have been identified for microgrids: ownership by a distributor operator (DNO), ownership by existing customers or partners of user goods, and independent members. In all cases, the microgrid operates to the best advantage of the owner's participants. For example, in the case of DNO or utility ownership, a microgrid will deal with the main services of the distribution system, while in a cooperative model it will deal with the importance of the business or other benefits to the customer.

It's important to balance multiple needs in standalone mode. It has been argued that maximizing profits in this free market model can best serve the interests of all stakeholders by providing appropriate financial support. This means that impacts, benefits and costs can often be controlled through operational decisions. This evaluation is best accomplished through the use of commodity prices, such as incentives to reduce electricity purchases during periods of high demand or to switch to electricity when large grids are needed.

D. Microgrid Impacts:

Simply put, impact refers to the changes expected from the implementation of microgrid, including electricity, economy, and environment. Analysis of results requires classifying impacts into “known impacts” (predetermined) and “potential impacts” (the need to identify specific information and the adverse process through simulation or calculation)

E. Direct Benefits:

The direct impact of microgrids on technology and business can be broadly divided into increased efficiency, reduced emissions, and improved energy quality and reliability. The benefits of the latter include improving the reliability of supply to customers within and outside the microgrid, in part by reducing dependence on large grids and utilities, for example by reducing voltage fluctuations. Recently in the United States, efficiency has become an advantage of microgrids. Unfortunately, this development occurred after WG6.22 created the project. Unlike the concept of hope based on probability, resilience measures the ability to withstand cold weather and subsequent speed of recovery.

The collaboration of microgrid loads and utilities as a common entity can create economic benefits through more efficient use of energy business, energy resources, electricity and food supply are reduced, and more services are added to the grid. Additional services include reactive power and voltage control, energy storage, auto-start feature and large capacity frequency reserves.

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F. Indirect Benefits:

Operating microgrids can provide many indirect benefits that are not easy to measure, including environmental benefits such as reducing air pollution entering the grid due to the co-production of greenhouse gases and clean energy, reducing the physical space required to generate electricity, reducing external resources, etc. dependence location and cost of fuel and construction work.

G. Cost-Benefit Method:

WG6.22 offers ideas for assessing the economic situation and presents two case studies, one practical and the other focused on microgrids, with two additional examples in the accompanying text. The process begins with evaluating the content of business case studies, including microgrid technology and control systems (centralized, decentralized, and autonomous controllers) and operating frameworks (ownership, content management). Below is an in-depth application of previously developed methods for measuring results. Work examples presented include the famous Boston Bar national network in British Columbia, Canada and Holme Rd. There is a work plan for. µgrid in Preston, England. Boston Bar operates as a remote feeder that can operate independently using local services in the event of a major grid, while Holme Rd is a mixed residential and small commercial feeder that will add a cogeneration system to create a microgrid. These examples also show the results of financial analysis. The impact map below shows how this approach connects impacts and outcomes to ultimately deliver results to stakeholders.

4. RESULTS AND DISCUSSION:

In the case of the Boston Bar Association, all stakeholders benefit financially, including utilities, independent power producers (IPPs), consumers, and the public. IPP can save $1.9 million per year in energy costs and increase reliability by $175,000 [12,13,14].

The power plant increased the System Average Intermediate Frequency Index (SAIFI) from 2.32 events/year to 0.61 events/year, and the System Average Interruption Rate (SAIDI) from 2.32 events/year to 0.61 events/year. It reduced carbon emissions by 5,850 tons. 33.28 hours/year to 3.0 hours/year. The financial cost of these improvements is estimated at $117 thousand and $175 thousand, respectively. Customer benefits increase confidence worth $350,000 per year, while helping people reduce carbon emissions estimated to be worth $175,000 per year.

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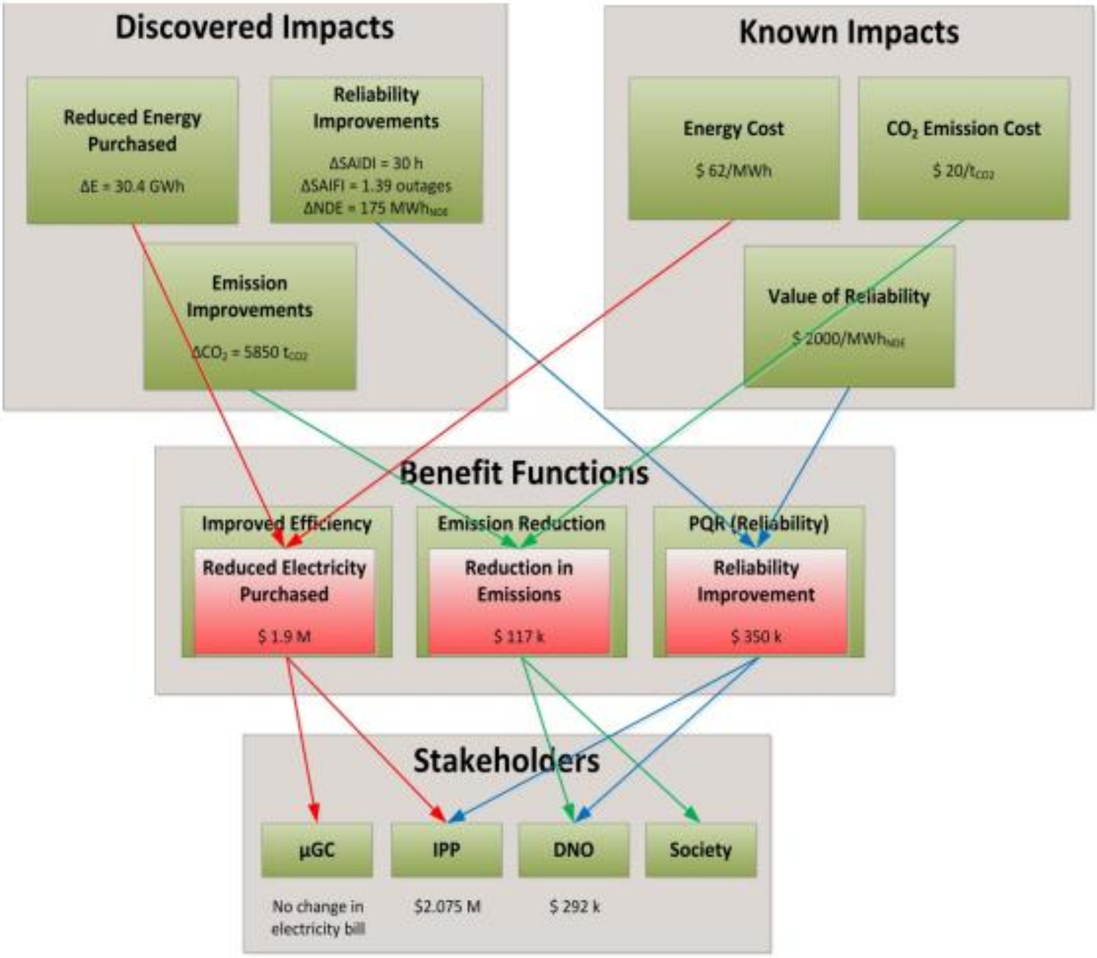

Figure: The impacts, benefits, and stakeholders of the Boston Bar Microgrid are demonstrated using the use case paradigm and quantified annually.

Search by Main Street. Research shows there is a strong market for Home Street. Microgrids, especially considering the energy benefits of coordinated management in response to immediate costs. If microgrids can benefit from providing services to other utilities, economic issues will become even more complex, especially if new regulations are introduced that support service capacity and reduced emissions. Over two decades, available results range from £2.4–3.5 M, with most results coming from microgrid organizations [15, 16, 17, 18].

5. CONCLUSION

The first document of WG6.22 summarizes the development of the relationship between the microgrid concept, the equipment and methods to be used for distribution, and general energy. This includes developing a business case, installing technologies to manage local producers and transport, and developing the Boston Bar and Holme Rd. It involves analyzing the results

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obtained from examples such as. Future papers, expected to be published by the end of 2015, will focus on developing a method for microgrid development.

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