CONCORD ENGINEERING

MICROGRIDS FOR WATER AND WASTEWATER TREATMENT

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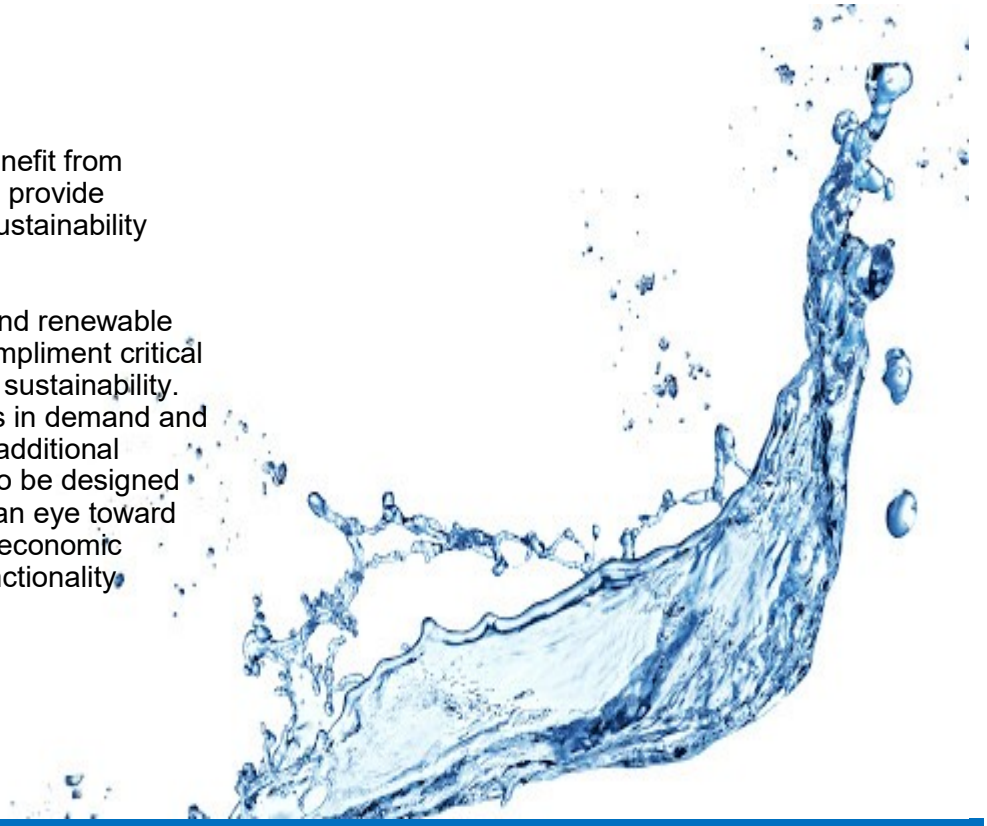
Summary

Water and Wastewater Authorities can benefit from microgrids that improve energy resiliency, provide tangible economic benefit and underpin sustainability goals.

The right microgrid that offers resiliency and renewable energy can enhance energy reliability, compliment critical operations, mitigate risk and contribute to sustainability. Authorities may even use these resources in demand and curtailment response programs to create additional revenue streams. But a microgrid needs to be designed for specific mission driven purposes with an eye toward both function and economic benefit – the economic benefits often multiply with the level of functionality designed into the microgrid.



MULTI-DER MICROGRID VERSUS BACKUP POWER

Mission Resilience: Onsite backup generation, energy storage, biogas to energy and microgrids are types of Distributed Energy Resources (DER) that can provide onsite power to a Water or Wastewater Treatment Utilities during a grid outage. Self-sufficiency: For some, it will make sense to provide as much of their own power as possible to save money and ensure resilient onsite energy. These DER systems will typically include generation and storage capabilities with advanced microgrid controls that support island operation in the event of a loss of grid services. Traditional gas engine or diesel engines that provide power in the event of a grid outage is technically a microgrid—but perhaps not the most advanced type that incorporates load management, economic transactions and incorporation of other DER like solar or energy storage.

Operational Resilience: DERs act as resources that ease pressure on both local facility and the supplying grid. In doing so, they help mitigate rolling blackouts and local grid instability and congestion. At times of locational power prices or grid congestion, a microgrids might generate power and sell it to the grid. When the microgrid has this capability, it provides operation resiliency and flexibility to the host. This attribute is valuable as the energy regulatory world shifts toward rewarding grid transactive services. While providing attributes such as energy savings, economic arbitrage, power quality smoothing, fast transition to island capable microgrid operation, the value of a microgrid far exceeds the lower cost of traditional backup power.

Economic Transactions: Traditional backup power is a low cost means to achieve resilience and support the function of a Water Authority. But limits the ability to transact with grid and in some ways is simply a sunk cost. As part of microgrid and control system that allows for economic dispatch, the onsite generation assets can reduce overall energy expense and provide revenue through Curtailment and Ancillary Services. Onsite generation — particularly renewable energy like wind, solar, or even geothermal — provides sustainable options. An Authority can consume as much of the clean energy onsite as possible and then sell some, or all, of the excess back to the grid, when local net metering rules allow and the economics are right.

Distributed Energy Resources - Making the Microgrid

Distributed Energy Resources or “DER,” are the backbone of a microgrid. Think of solar panels, storage, or back-up generators. A key benefit offered by multiple DER is operational and economic flexibility.

For instance, DER operation can be designed for economic benefit such as running only during periods of high peak power demand when the cost of grid supplied energy is high. Or the DER can be designed for specific mission purposes such supporting heavy electric loads during loss of a grid outage, providing uninterruptible power, local distribution support for voltage and frequency stability. Ideally the DER are designed and optimized for both outcomes.

Traditional diesel backup generation is an insurance policy. An important insurance policy but mostly a sunk cost. Existing backup generation can be configured as anchors to the microgrid. With the right emissions controls and microgrid control capability, they can be dispatched by the microgrid controller for economic benefit.

Natural gas fired engines have the benefit of extended run time without the risk of disruptions in trucked supply of fuel like seen with diesel generation.

PV solar, batteries, fuel cells can be optimized and integrated into the DER mix with each having their specific attributes contributing to a flexible system. For instance, PV solar provides electricity at below grid pricing. Batteries can be implemented for various attributes such as local voltage and frequency stability, demand and peak shaving and grid ancillary benefits when available.

DER combined with a control system allowing the Authority to be grid connected during normal “blue sky” operation or disconnected during “black sky” events is a true microgrid. A microgrid that can economically transact with the grid and optimize energy use within the facility is an added benefit and one of the primary goals of a microgrid.

NON-FIRM MICROGRID

A descriptive term that refers to a microgrid that would not have extended run time distributed generation such as internal combustion engines. Such a microgrid may have renewable energy DER such as PV solar or PV solar coupled with battery storage. While providing attributes such as energy savings, economic arbitrage, power quality smoothing, fast transition to island capable microgrid operation, such a microgrid would not and could not support operations in the event of an extended grid outage.

FIRM MICROGRID

A “Firm” microgrid simply is anchored by one or more DER that have capability for extended run time and capacity to hold heavy inductive loads often required for critical Water and Wastewater operations. DER such as gas or diesel fired internal combustion engines or turbines are proven and reliable. Other technologies such as fuel cells can anchor the Firm microgrid. All DER (engines, storage, CHP, PV solar, UPS) can be integrated into a hybrid microgrid that would provide the highest level of resilience and economic benefit to a Water or Wastewater Authority.

Resilience and Risk Mitigation

As proven by recent weather events and foreshadowed by future climate trends, the vital services provided to our communities by water and wastewater Authorities can be compromised by loss of grid utility services. Even backup power systems relying on diesel fuel can be at risk at the supply logistics of fuel delivery can be impacted leading to the diesel generators running out of fuel.

PV solar systems as standalone entities are not resilient when the grid goes down. And battery storage is both expensive and reliant on a source of electricity to charge after they have discharged – sources of energy that may be available during a prolonged disruption in the grid or due to lack of diesel fuel when a diesel generator is to charge the battery.

The threats to the utility grid will only continue to intensify due to aging distribution systems and lack of investment. Increasingly powerful weather events, particularly in vulnerable urban and low lying areas will continue to pose mounting challenges to Water and Wastewater Treatment Authorities. Microgrids are a proven means to mitigate these risks.

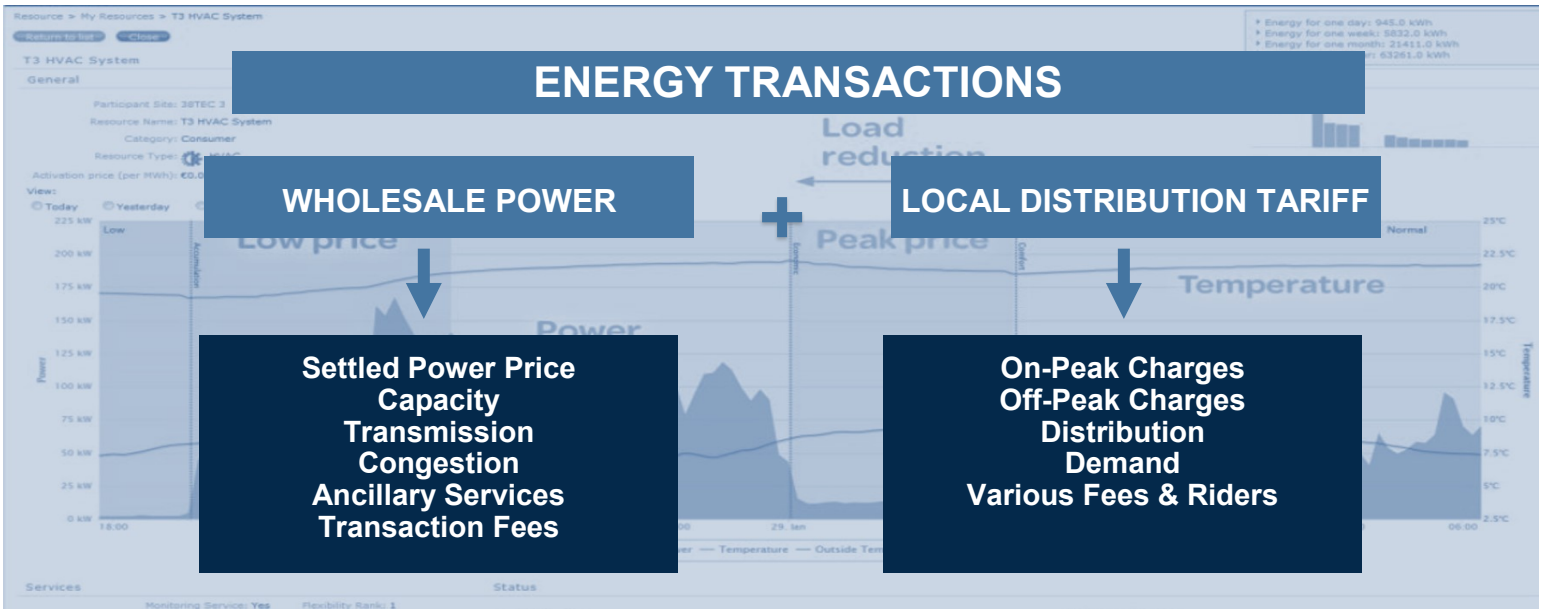
Revenue and Hedging

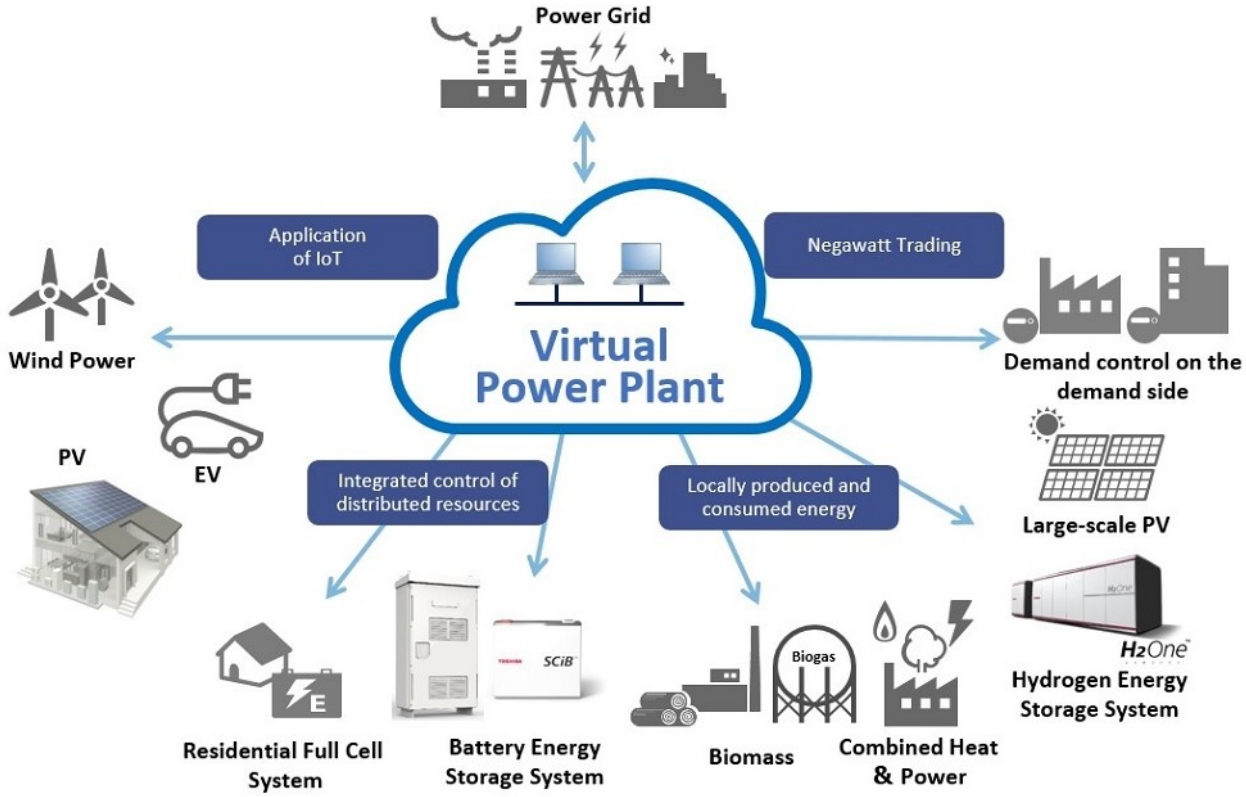
Energy savings through onsite generation reducing the grid import power is a straight-forward known benefit. But by participating in eligible demand and curtailment management programs, a microgrid can provide direct revenue to an Authority.

In addition, microgrids with demand and load management control can provide significant reduction to the cost of wholesale power by reducing the Capacity and Transmission cost components within a wholesale power contract.

Advanced microgrid controllers can use the benefit of external information - local and future energy pricing, weather forecasting, internal load and demand usage – to optimize the operation of the microgrid DER as well as curtail and optimize operations within the facility. Such capability allows an Authority to hedge and reduce demand and usage when periods of electricity cost or demand or high.

As two-way energy transactional markets and tariff change – as expected – a flexible and properly designed microgrid with the right control platform can provide an Authority with multiple benefits serving multiple needs.





Virtual Power Plants

As the Federal Energy Regulatory Commission, regional ISO's (such as PJM) and local distribution system operators sort out the benefits and commercial structure for distributed generation resources, a Water or Wastewater Authority that has multiple and disparate distributed generation assets will be able to combine their assets into a cohesive system to supply grid services. This is a distinct and real possibility for economic benefit. The concept is often referred to as a "Virtual Power Plant" describes a system of geographically dispersed resources (often batteries or generators) that are connected through software that monitor economic opportunities and dispatch the DER at opportune times.

Separate sites – say pumping stations - each with their own distributed generation, could provide supply or demand from various points on the grid at the same time, having a bigger impact together than they would individually. The market for this is evolving, but the vector is headed to Virtual Power Plants being a tangible market offering. The technology is mostly in place – transparent market signals and compensation for attributes are not far behind and within PJM, aggregation can be accommodated by working with Curtailment Service Providers (CSP).

Environment, Social and Governance

A microgrid combining renewable energy into the mix of DER can provide significant reduction in the carbon footprint of an Authority and contribute towards Environment Social and Governance (ESG) goals. Coupled with biogas at a wastewater treatment facility, a microgrid combining the carbon benefit of PV solar with the carbon benefit of biogas can be a strong environmental statement that also provides functional benefit to the Authority.

The 2019 NJ Energy Master Plan has provisions that will accentuate the benefits of microgrids that contribute towards achievement of the States goals of 100% clean energy by 2050. Within the plan are stated strategies including

- Accelerating Deployment of Renewable Energy and Distributed Energy Resources
- Maximizing Energy Efficiency and Conservation, and Reducing Peak Demand

Onsite distributed generation build through a microgrid are ideal vehicles for participating in achieving the goals of this plan.

PEER Certification

Performance PEER is the first ever rating system that drives market transformation in the power and energy sectors. Through certification, PEER recognizes industry leaders for improving efficiency, day-to-day reliability and overall resiliency. The PEER process and certification is for all power systems and microgrids and includes guidance for utilities. PEER assess and evaluate an energy system across multiple criteria and assigning a relative score

⇒ Resiliency
⇒ O&M
⇒ Energy Efficiency
⇒ Grid Services
⇒ Innovation
⇒ Regional Priority

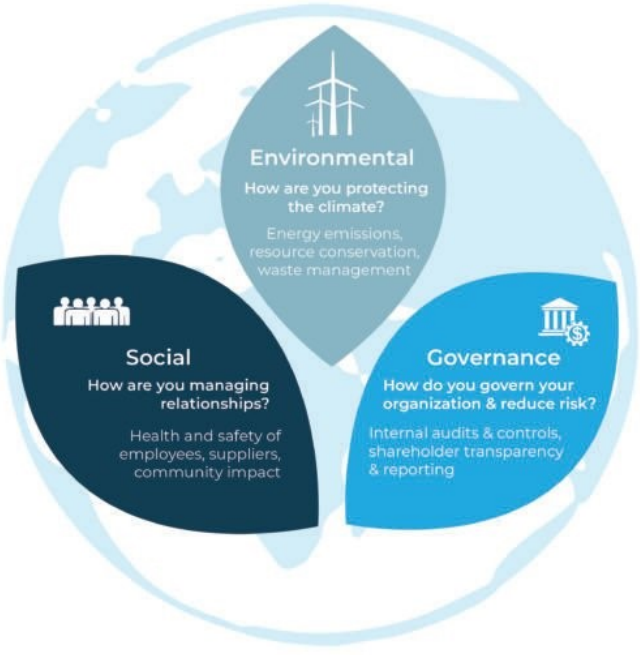
Assigning a score PEER certification can become a tool with which to demonstrate value to stakeholders, identify opportunities for improvement and implement those (including through clean energy procurement), and contribute to ESG policies.

ESG for Water and Wastewater Authorities

The ***Environmental*** component might focus on a municipal authority's energy use impact on the environment—for example, its energy use and contribution to green house gas emissions. Is the Authority taking advantage of the renewable energy assets available to mitigate it's impact on green house emissions. Are energy conservation and demand management practices in place or investments being made? It also might focus on the risks and opportunities associated with the impacts of climate change on the Authority, its mission and community.

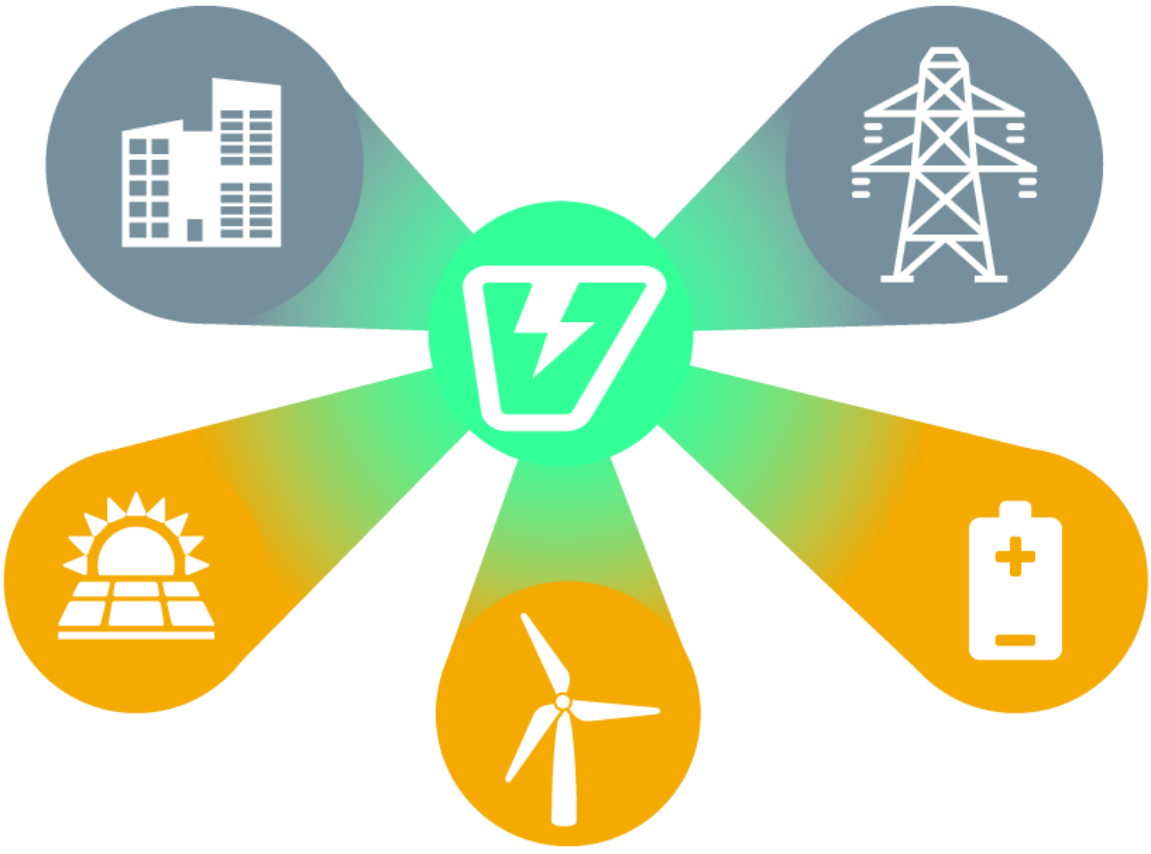
The ***Social*** component might focus on the company's relationship with the local community served — Greenhouse gas regulation, decarbonization objectives, and shifting public perceptions may create risks to business as usual al business model at risk Water Authorities may need to find new ways use and produce while simultaneously lowering their carbon footprint

The ***Governance*** component might focus on issues such as how the Authority operates or is run — for example, transparency and reporting of energy use metrics, compliance or progress toward state goals for energy policy, community stakeholder input, and the



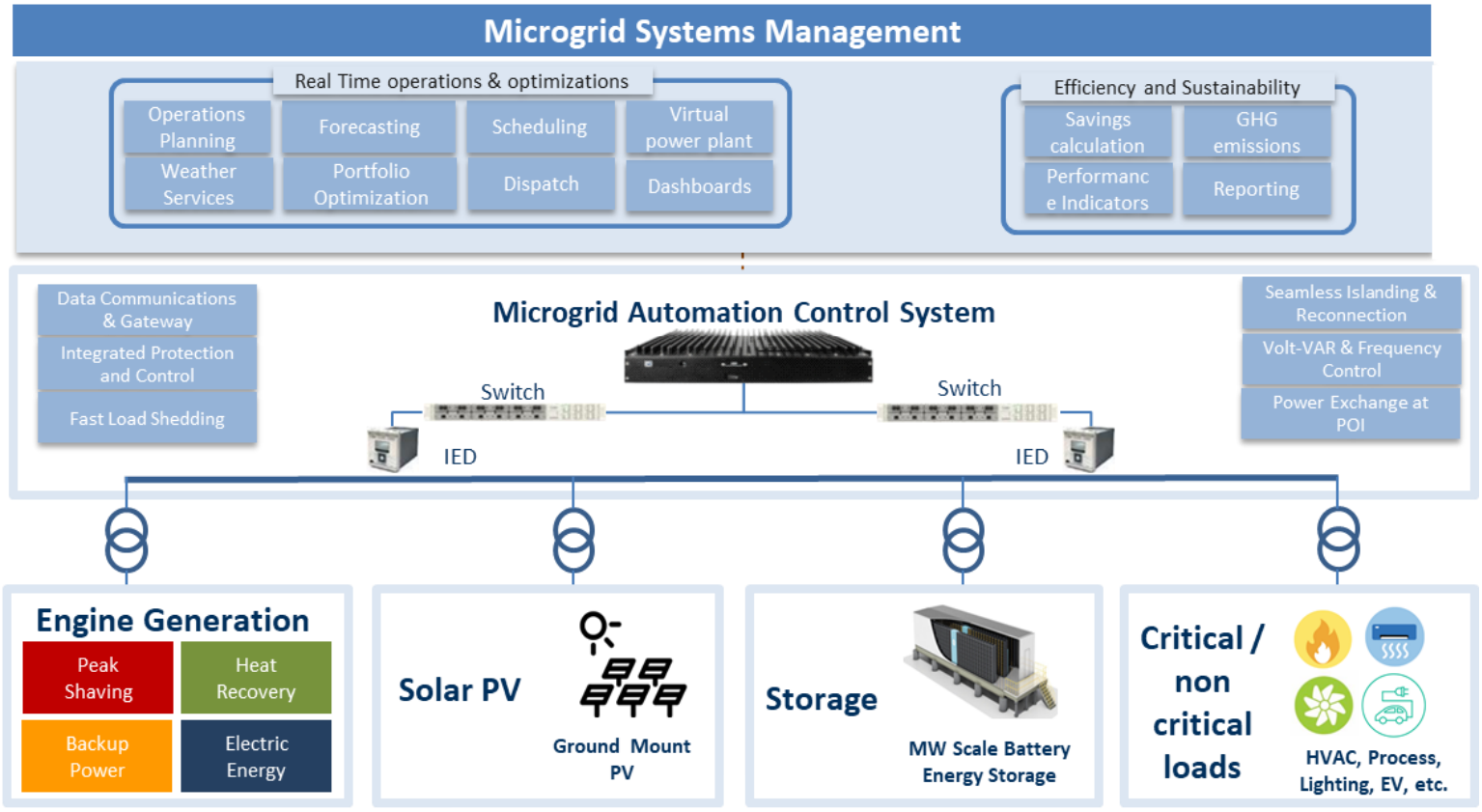
Microgrids Require Specialty Design Services

The design of a microgrid is tricky with sophisticated electrical engineering required to model the system design, engineer the systems and support startup and commission being a premium. Making multiple onsite Distributed Energy Resources (DER) such as engine generators, PV solar arrays, battery storage work in concert requires specialized experience and capability. A multi DER microgrid also needs to work cohesively with the infrastructure within a facility supporting critical activities. Large inductive loads developed by pumping systems and various unit operations within the facility need to be considered when designing the capabilities and response of the microgrid. A microgrid intended to provide resiliency that trips or fails when needed has failed in its primary intended purpose.



Putting a Microgrid Into Place

Multiple options for resilient and environmentally beneficial microgrids are possible. Concord Engineering is an experienced integrator and designer of microgrid systems. Coupled with our capability to broker energy supply contracts we can bring a unique solution to a Water Authority or Private Operator. Concord maintains collaborative relationships with all major microgrid platform providers, DER OEMs and entities that can offer Microgrid or Resiliency as a Service offerings.



Concord Engineering Group, Inc. is a full-service engineering, energy consulting and commissioning firm. For over 30 years, we have been designing innovative and resilient Distributed Generation and Microgrids for our clients and markets including:

- Mission Critical Department of Defense
- Government
- Healthcare
- Higher Education
- Commercial and Industrial

Concord's approach is to be technology and platform agnostic – that is, we design and deliver projects based on their own merit and create an design to best suit the project technical, economic and mission needs.

For more information call (856) 427-0200 or visit www.concord-engineering.com.