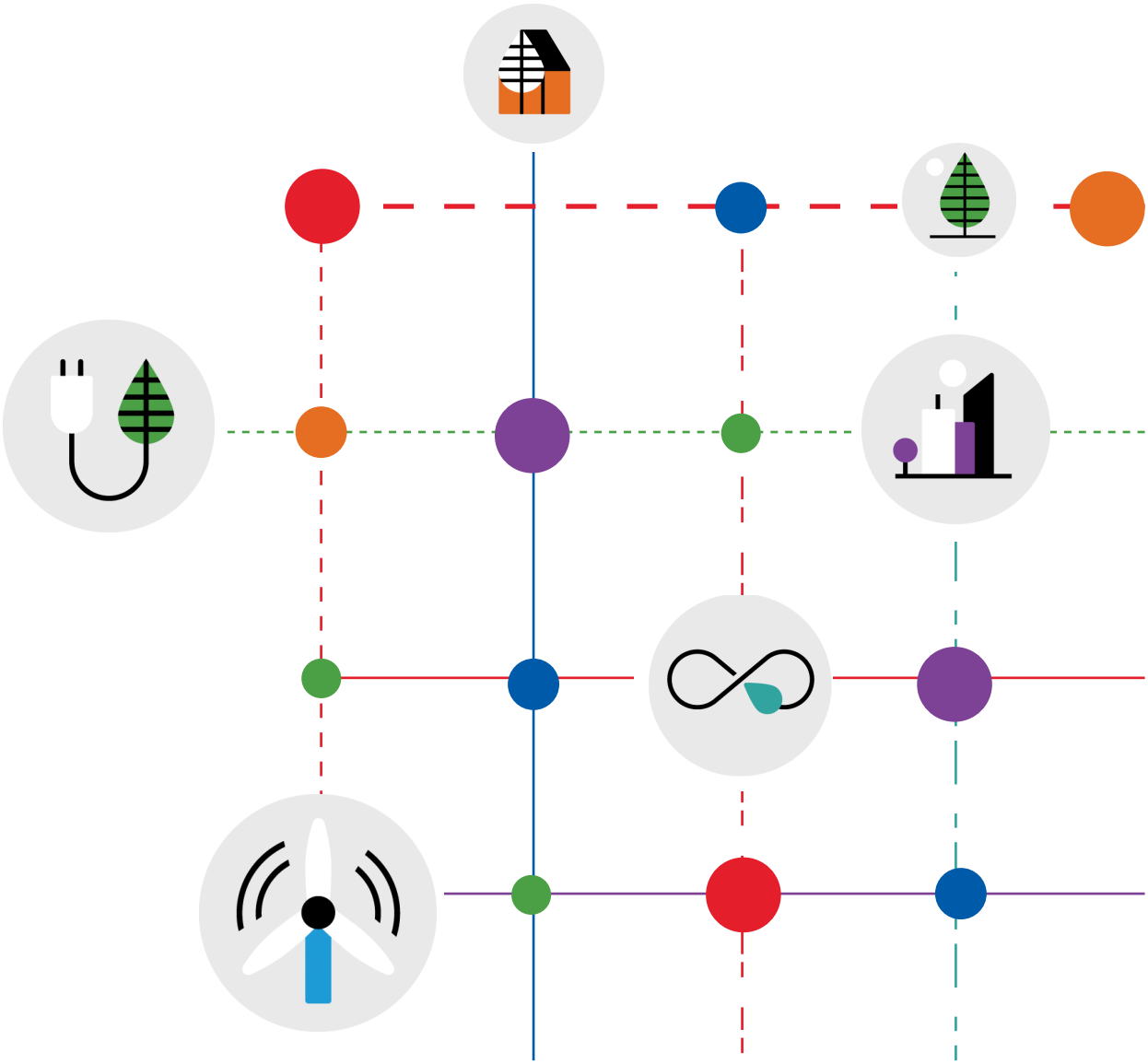
ARUP

Cuyahoga County Utility & Microgrids

Request for Information (RFI)



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Arup is a thought leader in integrated energy systems–enhancing resilient energy systems for communities and critical infrastructure.

At the center of our experience is the planning, design, and operational support of microgrids to help ensure reliability in the face of growing hazards.

Arup US, Inc. (Arup) understands that Cuyahoga County is working to enhance the resilience and security of their electrical distribution system, while also increasing the installation of renewable energy via solar photovoltaic (PV) generation, battery energy storage systems, and leveraging smart controls and microgrids. With this understanding, we are submitting this response to your June 8, 2022 Request for Information (RFI) for Cuyahoga County Utility and Microgrids. Arup's response to this RFI aligns with the County's aspirations for a sustainable development of electric energy systems through thoughtful technical planning and phasing, development of business models and tariffs, coordination with regulators, and large-scale utility construction works.

Within this RFI response Arup hopes to clearly demonstrate the following:

– We bring an industry leading approach which considers resilience, sustainability, and economics together.

– We have extensive, hands-on experience with the design/build delivery process for large infrastructure projects. We have delivered projects that transformed the built environment such as the Doyle Drive replacement which was a $1.1B project requiring new bridges, tunnels, and electrical distribution to support the replacement of the aging bridge and roadway.

– We are leaders in the design and planning of advanced microgrids, in particular those leveraging renewable energy sources and Battery Energy Storage. For example, we have supported a confidential client on early stage planning and development of a multi-use district microgrid serving over 12M sf^2 of office and residential spaces which uses solar + storage to reduce energy costs for residents and to enhance resilience.

– Our team of Power Systems Engineers are familiar with the advanced controls required to integrate automation, power monitoring, billing, control, and protection together in a microgrid.

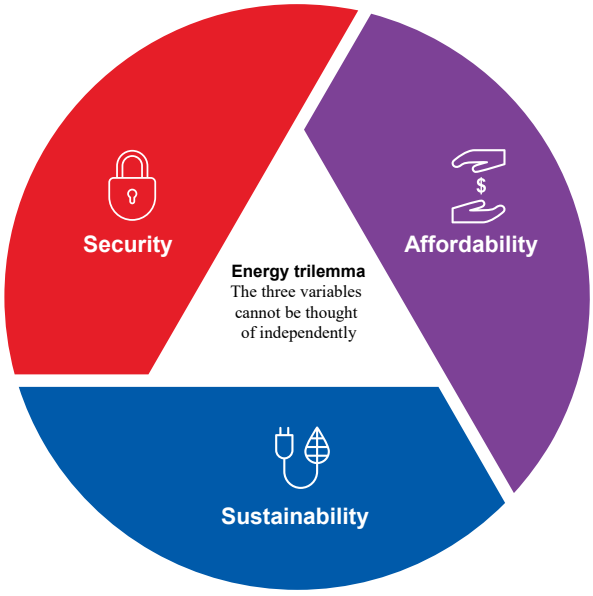
We would be very happy to meet with Cuyahoga County to discuss any part of our RFI response, should it be of interest to you.

Approach to resilience, sustainability, and economics

Arup views energy through the lenses of security (resilience), affordability (economics), and sustainability.

By analyzing the impact an energy project has on these three metrics, a more holistic assessment of overall project benefits can be provided. Through our microgrid work, we understand that all project decisions have a bearing on each metric, and that no decision can be made in isolation. Our approach to microgrid planning relies on developing solutions which optimize each of these options separately, then compares and contrasts them to come to a solution which best meets our client's specific needs.

In particular, for a community microgrid such as the one Cuyahoga County has envisioned, developing microgrid business models and tariff structures are essential. These must appropriately compensate the individual property and resource owners for their on-site generation, while also incentivizing resilience benefits for the whole system in order to create a self-sustaining, long-lasting microgrid.



About Arup

Founded in 1946, Arup is one of the world's leading engineering and infrastructure consultancies, with over 17,000 staff working in 89 offices (including Boston, New York, and Chicago) across 33 countries. Arup has a depth of experience in microgrid planning, design, and construction that includes both technical and commercial support. Having worked with owners, developers, city and state agencies, port authorities and transportation operators, Arup keenly understands microgrid drivers. We welcome the opportunity to bring advanced technical expertise, project design and construction experience, commercial support, and procurement advisory to Cuyahoga County.

Design/Build experience

We have experience working on both the Owner's side and the Contractor's side of large Design/Build infrastructure projects. This experience helps us to understand the key elements of the project which must be defined at the outset by the designers to minimize delivery risk and ensure satisfactory outcomes. We also understand how to work with Contractors to help plan their delivery, check and verify progress and compliance with design documents, and troubleshoot and address opportunities for cost reduction and risk mitigation throughout the construction and project lifecycle.

Leaders in the planning and design of microgrids

Arup has designed numerous microgrids across the United States, including two of the largest in California—Apple's new corporate headquarters and the John Wayne Airport.

Apple Park

Located in Cupertino, CA, Apple Park is designed as a 20+ megawatt-scale microgrid to shave peak loads, reduce energy costs, and decrease carbon emissions. Furthermore, the microgrid provides resilience in case of an outage by operating in "island mode" independently of the grid. Power supply is provided by the 13MW rooftop solar array, biogas fuel cells and a large-scale lithium-ion battery energy storage system for grid stabilization.

John Wayne Airport

This microgrid's generation capacity will be approximately 10MW, with 8MW of battery storage. It will include "black start" capability and is designed to ride through outages and power quality issues on the main grid. The system will have the ability to support all sources of airport loads, including two daily load spikes: one in the morning as the airport is opening, and one in the evening at peak capacity.

In addition to the above, we are in the early planning and scoping stages of several utility-scale microgrids for new developments with peak demands of 40MW and comprised of a network of distributed solar PV and BESS systems which operate separately to optimize energy costs for individual buildings when the grid is present, and in concert to provide resilience benefits when grid power is lost. We are working closely with the developer and local utility to realize these projects. We are also working with the developer and the City on one of these projects which is considering a municipal ownership model similar to what Cuyahoga has envisioned.

The following table summarizes some of our key microgrid projects.

Project	Location	Technologies/Capacity
John Wayne Airport Microgrid	Santa Ana, CA	CHP, solar, storage – 10.4 MW
Apple Park Microgrid	Cupertino, CA	13 MW Photocells 5 MW Fuel Cells 5 MW BESS
LAX Central Utility Plant	Los Angeles, CA	8 MW, 1.6 million Gallons Thermal Energy Storage 19,560 operating tons from chillers 8.48 MW Co-Gen, 90,000 lbs/hr steam, Medium Voltage, 4.16 kV power distribution
Martha's Vineyard Transportation Authority Microgrid	Martha's Vineyard, MA	600 kW Photovoltaic 600 kWh BESS 350 kW diesel generator
Brookville Bus Depot PV Microgrid	Silver Spring, MD	2 MW Photovoltaic 4.3 MWh BESS 1.8 MW Natural Gas Generators
Confidential Downtown Residential and Commercial Development	San Jose, CA	40 MW Load 12 M ft² served 12 MW Photovoltaic 12 MW BESS
Confidential Tech Campus	Bay Area, CA	1.25 MW Photovoltaic 2.5 MWh BESS

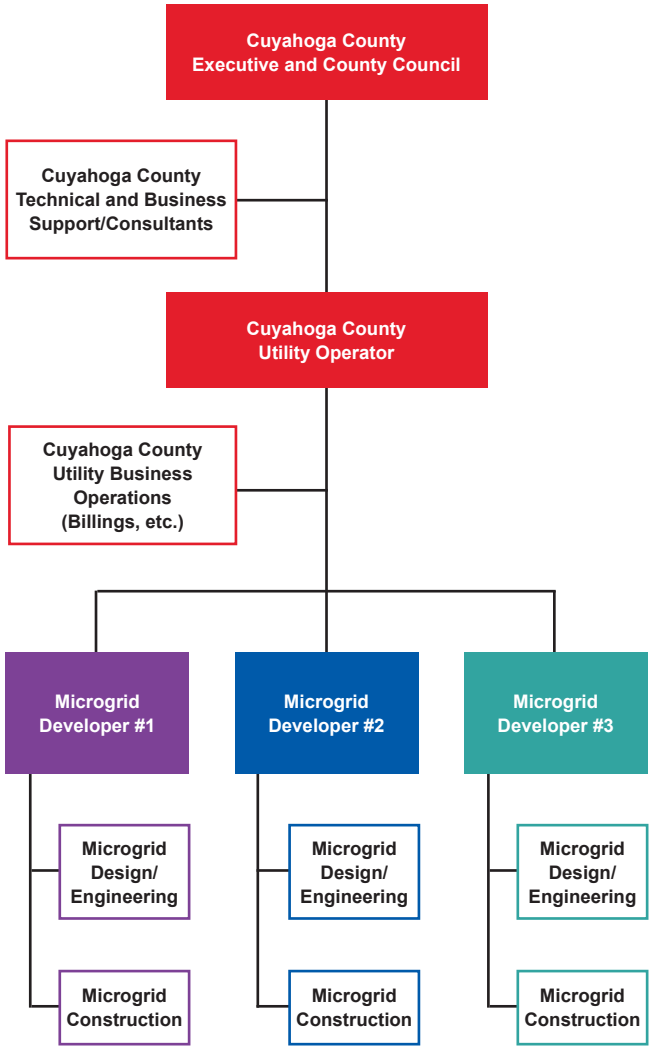
Team role's in the Cuyahoga County Microgrid

Based on our understanding of the RFI, Cuyahoga County intends to develop the utility as a series of interconnected microgrids, either on single sites or larger, multi-customer districts. We have developed the following diagram to support the explanation of our suggested approach.

The teaming model to the right is consistent with the roles envisioned in the original RFI, while allowing for more than one on-site developer backed by municipal-level utility oversight and responsibility including the interconnectedness between various microgrids to ensure maximum benefit and flexibility.

This model allows for consumer choice of on-site energy systems and flexibility in approach by site developers, while allowing the County Utility Operator to develop robust interconnection and operational requirements and standards. The County Utility Operator is also responsible for managing the overall operation and obligations of the utility, while leveraging the distributed, on-site resources wherever possible.

The roles defined in the organizational chart are further defined on the following page.



Cuyahoga County Executive and City Council

The County Executive and City Council are responsible for ensuring that the County Utility is enabled to meet the overall goals for the project of reduced energy costs, increased resilience, and easier access to renewable energy for all rate-payers. They are also responsible for the formation and initial development of the operating structures, legal requirements, and remits for the utility. This group is will ensure that a viable business model exists for the County Utility, and for the initial development and comparison of customer rates to the baseline.

Cuyahoga County Utility Operator

The Cuyahoga County Utility Operator is responsible for the day-to-day operations of the utility including oversight of the Operation and Maintenance of the distribution system, ensuring certain level of resource adequacy, and technical operations of the distribution system. The County Utility Operator is also responsible for system-level planning of future upgrades to meet changing load, and the review and approval of new service requests and interconnection applications for distributed energy systems. The County Utility should also lead the solicitation, qualification review, and selection of Microgrid developers where such solicitation is considered crucial. Microgrid developers may elect to work directly with commercial or industrial off-takers or real estate developers outside any solicitation. At the outset, the County Utility Operator will also develop the standards for utility service within its territory, and create the microgrid operating principles which customer, developer, and/or utility owned distributed generation resources (DER) must adhere to. These standards will govern everything from construction standards and materials, to metering requirements, to microgrid control interfaces and operating requirements. They will also be responsible for the development of all electricity tariffs to be used within the system.

Microgrid Developers

Microgrid developers are responsible for the identification of microgrid projects, either through direct engagement with potential customers, or when approached by a potential site. It is anticipated that microgrid developers will also partner with real estate developers during early planning phases of new construction projects.

Microgrid developers will also oversee the design and construction of each microgrid, and ensure compliance with County Utility standards and requirements. They will also be responsible for entering into microgrid-as-a-service (MaaS) contracts with their direct customers. Ultimately each microgrid developer should be accountable for the economic performance of their microgrids within the tariff structures laid out by the County Utility.

We have identified the following key challenges/opportunities in the development of the Cuyahoga County Utility and Microgrid.

- In the model outlined above, the County Utility is responsible for purchasing all existing electrical distribution assets within the utility's territory at fair market value. The County will also be responsible for operating the utility in a more traditional manner until sufficient "in territory" microgrids and generating resources are setup. Phasing of both technical considerations and business models during this time will require detailed planning.
- Development of a fully stand-alone utility alongside an integrated collection of microgrids will be unlikely to provide sufficient generating assets to not require an external connection to the macro grid to ensure adequacy of supply when needed, especially in peak durations.
- Furthermore, ensuring reasonable costs for County residents and businesses may require additional assessment and new business models to protect rate payers from the risk of cost overrun. Developing forward-looking tariff structures will be critical in ensuring that customer rates are managed, and that the microgrid is able to meet the overall goals of sustainability, resilience, and cost effectiveness.
- Initial capital required for the development of a County Utility, procurement of existing distribution assets, and the hiring of initial staff and consulting teams may pose a funding challenge for the short-term. Existing and proven financial instruments such as Green Bond and other alternative financing opportunities should be leveraged to manage the funding.
- Space and land for renewable resources and energy storage may be limited, which requires the consideration of existing thermal sites within the county for some repowering and converting them to green energy micro-hubs to re-enforce the county reliability standard.
- A detailed review of the state and federal regulations is needed to understand any regulatory barriers that may need consideration. In some states, regulations do not support integrating various customers onto one microgrid.
- Technological challenges should not to be discounted, albeit some may be passed along to the microgrid developers to offer solutions. Some challenges impacting reliability include:
  - Fault and short circuit currents in microgrids may be very low if dominated by inverter-based resources requiring a different form of protection and control schemes (digital relays). The total short-circuit current capacity of a microgrid in islanded and grid-tied modes is also different, posing another challenge.
  - Balancing generation and load in a microgrid (microgrid frequency), especially when islanded, can be a major challenge and any variations in load and generation can have major impacts on the microgrid stability.
  - Specialized controls need to be developed for microgrid operations. Those are critical in the island mode operations. Developing standards for interoperability across multiple vendors may prove challenging, and such systems may need to be sole-sourced which could challenge public procurement laws.

Arup can support the Cuyahoga microgrid through support of many of the activities, responsibilities, and challenges laid out above.

Additional optional questions

Arup has provided responses to select questions below. We are more than happy to discuss any of these responses further with the County.

Vision

a. What is your vision as to how the County Utility could fit into the emerging energy ecosystem?

The County Utility could support the emerging energy ecosystem by developing rates and tariffs which support new renewable energy systems. For example, in lieu of providing net metering credits, the County should consider incentivizing energy storage combined with a centralized dispatch signal. This would allow the whole energy utility to leverage traditionally non-dispatchable, renewable energy systems, while needing to use less fossil fuels for generation when renewable energy is not present. Although many markets support energy storage through demand response, they do not have adequate financial signals to incentivize BTM energy storage dispatch to support grid operations. In this manner, the utility could leverage the low-cost of renewables with the resilience and flexibility gains of energy storage.

Similarly, there may be additional opportunities to incentivize non-energy resources such as demand response or energy efficiency upgrades to reduce the burden on the county utility – thereby passing on operational costs to the end users.

b. How might the County Utility improve services compared to traditional systems?

As described above, the County Utility could use the opportunity to develop more forward-looking utility tariffs, which incentivize renewables, resilience, and grid support functionality of Behind-the-Meter (BTM) resources. This is something which is difficult to do in a traditional utility due to the legacy of existing agreements and tariff structures which cannot be easily changed.

At the same time, the County Utility could leverage advances in microprocessor-based equipment, real-time communications, and data analytics to facilitate a faster response to outages, provide better preventative maintenance, and clearer communication and control to end customers. These changes are typically difficult to complete at a traditional utility due to the legacy of existing equipment, procedures, and processes.

c. How would you propose building a system in a manner that constrains costs based upon available loads, yet is flexible enough to adapt to new end users who are attracted to the system?

This is a strength to the structure set out above. By using a County Utility Operator to develop the microgrid operating principles, interconnection standards, and utility tariffs, the County can develop a utility and microgrid approach which manages costs, while ensuring consistency and oversight. Allowing the microgrid developers to seek out customers within the service territory and develop their own financing and commercial terms, within the confines of the microgrid tariffs, allows them to be adaptable and flexible to new technologies, customer needs, and economics.

d. How might your approach be different for new developments, such as industrial or commercial parks, versus existing customers? Would you envision merging district energy or transportation or hydrogen into the development?

This model would allow for, and potentially encourage, development of all the above, by allowing the microgrid developers to agree to their own commercial terms with their customers. Development approaches to new or existing developments would be similar, although new developments could be better planned on a district scale, and new infrastructure installed more cost-effectively.

Business Economic Models

a. How do you envision revenue flowing through the various entities?

Although further development is required, the likely model would include traditional utility bill payments from end-users to the County Utility for purchased energy. On-site energy systems would likely involve customer payments to each microgrid developer for energy produced on site.

c. What process would you take with the County to design customer billing (i.e., tariffs) in a fair and transparent way?

Tariffs need to be built up in a way that ensures energy costs for all customers are on par with the business-as-usual alternative they are currently receiving. Tariffs should also be set up to support on-site load management (through demand response, energy storage, or on-site generation) in support of the larger grid operations. Development of new and novel tariffs is an opportunity for Cuyahoga to be a national leader in this space.

d. What types of tariffs are needed to support the County initiative?

Tariffs need to be developed to support the following:

– Customers with no on-site generation

– Customers with on-site generation or storage

<u>Recommended tariffs</u>

– Tariffs to support EV charging

– It is recommended that all tariffs include Time-Of-Use (TOU) pricing to help support development of energy storage and load management systems to help manage grid operations

<u>Optional tariffs</u>

– Tariffs for service at differing voltage levels (primary, secondary, etc.)

Organization Models

a. Would you be willing to contract directly with the County to be responsible for the full scope of this initiative?

As a design and consulting firm, Arup would be willing to contract directly with the County to help frame the operational requirements and business cases of the microgrid, or to serve under the County Utility to develop the microgrid operating principles and/or utility standards. We look forward to the opportunity to speak with you on this exciting undertaking.

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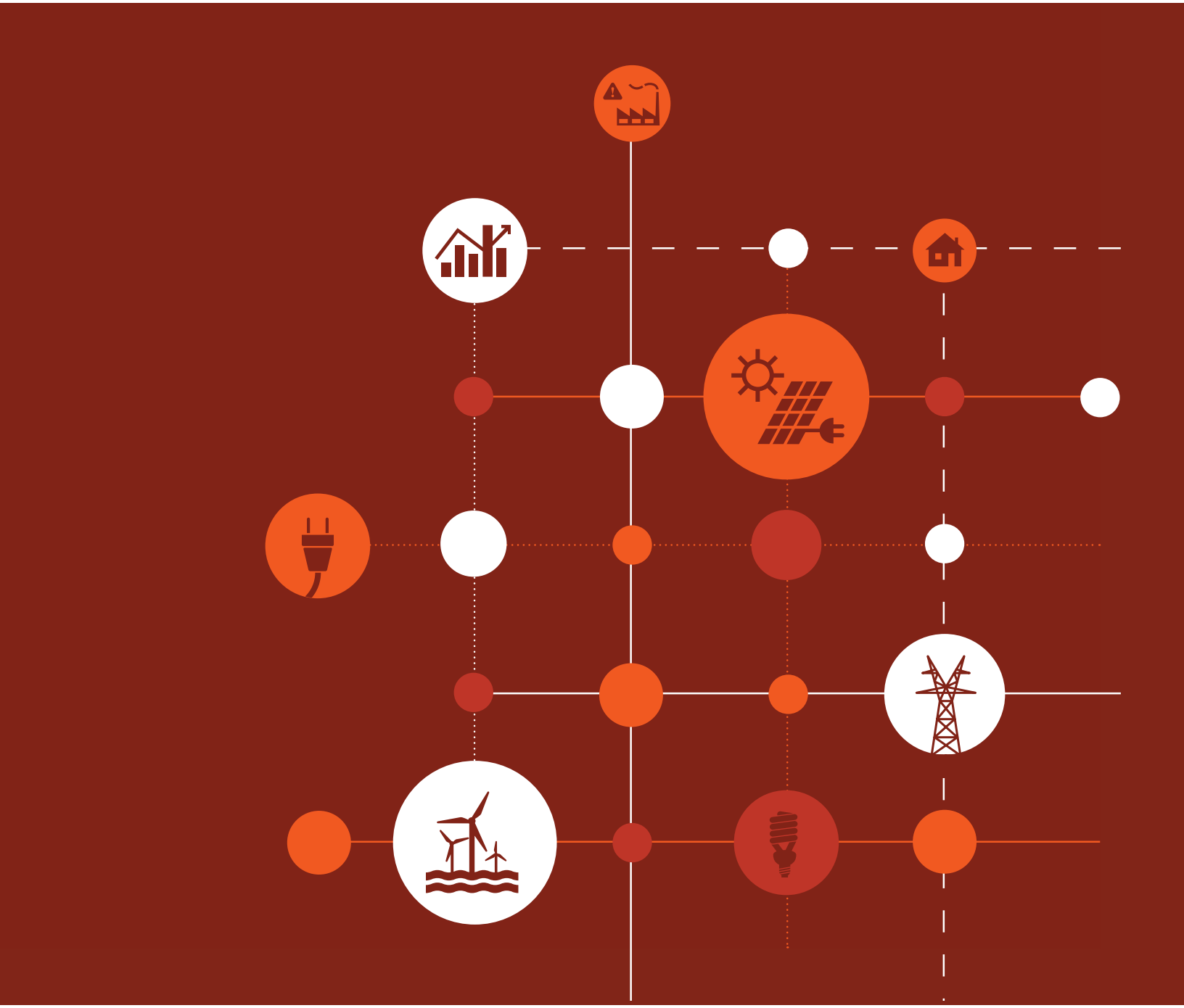

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Approach to resilience, sustainability, and economics

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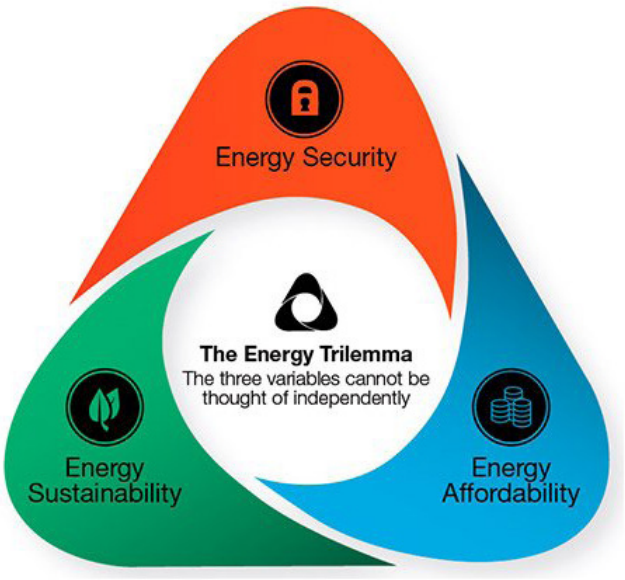

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Team role's in the Cuyahoga County Microgrid

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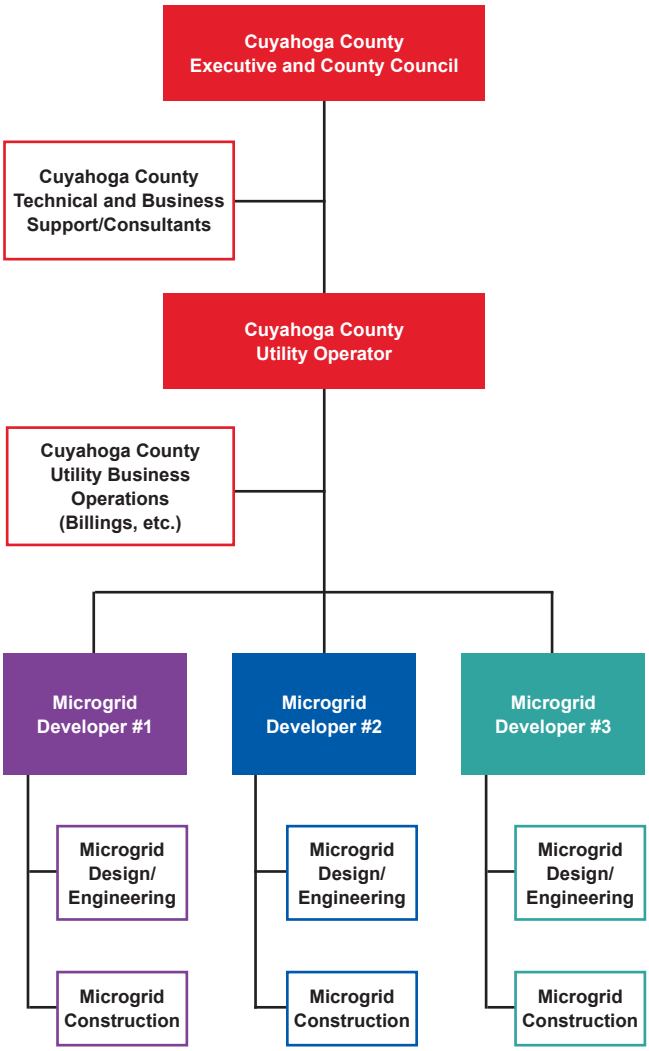

This model has roles which are consistent with those envisioned in the original RFI, however it allows for more than one on-site developer, backed by municipal-level utility oversight and responsibility including the interconnectedness between the various microgrids to ensure maximum benefit and flexibility that the system can offer. This model allows for consumer choice for their on-site energy systems and flexibility in approach by site developers, while allowing the county utility to develop robust interconnection and operational requirements and standards. The county utility is also responsible for managing the overall operation and obligations of the utility, while leveraging the distributed, on-site resources wherever possible. These roles are further defined on the following page:

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Key Challenges

We have identified the following key challenges/opportunities in the development of the Cuyahoga County Utility and Microgrid.

- In the model outlined above, the County Utility is responsible for purchasing all existing electrical distribution assets within the utility's territory at fair market value. The County will also be responsible for operating the utility in a more traditional manner until sufficient "in territory" microgrids and generating resources are setup. Phasing of both technical considerations and business models during this time will require detailed planning.
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- Furthermore, ensuring reasonable costs for County residents and businesses may require additional assessment and new business models to protect rate payers from the risk of cost overrun. Developing forward-looking tariff structures will be critical in ensuring that customer rates are managed, and that the microgrid is able to meet the overall goals of sustainability, resilience, and cost effectiveness.
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Arup can support the Cuyahoga microgrid through support of many of the activities, responsibilities, and challenges laid out above.

Arup has provided responses to select questions below. We are more than happy to discuss any of these responses with the County in future.

Vision

a. What is your vision as to how the County Utility could fit into the emerging energy ecosystem?

The County Utility could support the emerging energy ecosystem by developing rates and tariffs which support new renewable energy systems. For example, in lieu of providing net metering credits, the County should consider incentivizing energy storage combined with a centralized dispatch signal. This would allow the whole energy utility to leverage traditionally non-dispatchable, renewable energy systems, while needing to use less fossil fuels for generation when renewable energy is not present. Although many markets support energy storage through demand response, they do not have adequate financial signals to incentivize BTM energy storage dispatch to support grid operations. In this manner, the utility could leverage the low-cost of renewables with the resilience and flexibility gains of energy storage.

Similarly, there may be additional opportunities to incentivize non-energy resources such as demand response or energy efficiency upgrades to reduce the burden on the county utility – thereby passing on operational costs to the end users.

b. How might the County Utility improve services compared to traditional systems?

As described above, the County Utility could use the opportunity to develop more forward-looking utility tariffs, which incentivize renewables, resilience, and grid support functionality of Behind-the-Meter (BTM) resources. This is something which is difficult to do in a traditional utility due to the legacy of existing agreements and tariff structures which cannot be easily changed.

At the same time, the County Utility could leverage advances in microprocessor-based equipment, real-time communications, and data analytics to facilitate a faster response to outages, provide better preventative maintenance, and clearer communication and control to end customers. These changes are typically difficult to complete at a traditional utility due to the legacy of existing equipment, procedures, and processes.

c. How would you propose building a system in a manner that constrains costs based upon available loads, yet is flexible enough to adapt to new end users who are attracted to the system?

This is a strength to the structure set out above. By using a County Utility Operator to develop the microgrid operating principles, interconnection standards, and utility tariffs, the County can develop a utility and microgrid approach which manages costs, while ensuring consistency and oversight. Allowing the microgrid developers to seek out customers within the service territory and develop their own financing and commercial terms, within the confines of the microgrid tariffs, allows them to be adaptable and flexible to new technologies, customer needs, and economics.

d. How might your approach be different for new developments, such as industrial or commercial parks, versus existing customers? Would you envision merging district energy or transportation or hydrogen into the development?

This model would allow for, and potentially encourage, development of all the above, by allowing the microgrid developers to agree to their own commercial terms with their customers. Development approaches to new or existing developments would be similar, although new developments could be better planned on a district scale, and new infrastructure installed more cost-effectively.

Business Economic Models

a. How do you envision revenue flowing through the various entities?

Although further development is required, the likely model would include traditional utility bill payments from end-users to the County Utility for purchased energy. On-site energy systems would likely involve customer payments to each microgrid developer for energy produced on site.

c. What process would you take with the County to design customer billing (i.e., tariffs) in a fair and transparent way?

Tariffs need to be built up in a way to ensure energy costs for all customers are on par with the business-as-usual alternative they are currently receiving. Tariffs should also be setup to support on-site load management (through demand response, energy storage, or on-site generation) in support of the larger grid operations. Development of new and novel tariffs is an opportunity for Cuyahoga to be a national leader in this space.

d. What types of tariffs are needed to support the County initiative?

Tariffs need to be developed to support the following:

– Customers with no on-site generation

– Customers with on-site generation

<u>Recommended tariffs</u>

– Tariffs to support EV charging

– It is recommended that all tariffs include Time-Of-Use (TOU) pricing to help support development of energy storage and load management systems to help manage grid operations

<u>Optional tariffs</u>

– Tariffs for service at differing voltage levels (primary, secondary, etc.)

Organization Models

a. Would you be willing to contract directly with the County to be responsible for the full scope of this initiative?

As a design and consulting firm, Arup would be willing to contract directly with the County to help frame the operational requirements and business cases of the microgrid, or to serve under the County Utility to develop the microgrid operating principles and/or utility standards. We look forward to the opportunity to speak with you on this exciting undertaking.