DANOVO ENERGY SOLUTIONS
A QUANTA SERVICES COMPANY

DEVELOPMENT LIFECYCLE AND END-TO-END SERVICES

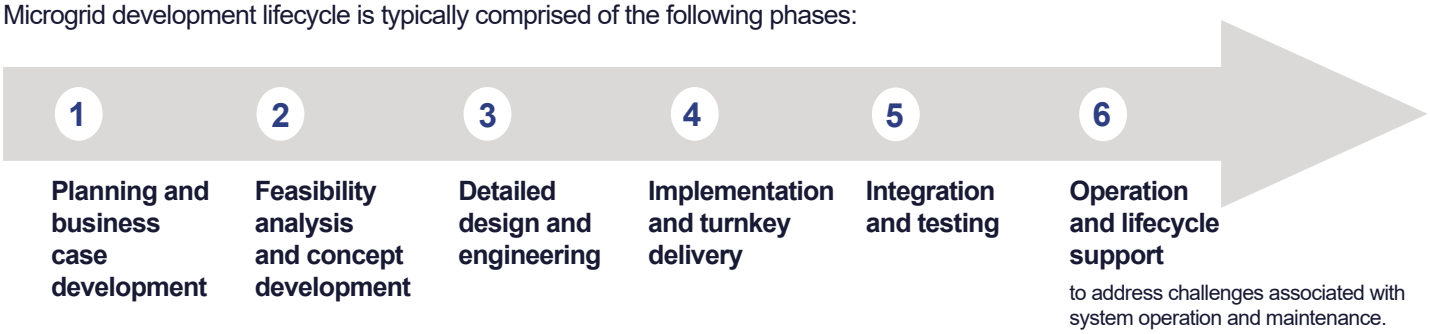
MICROGRID ENGINEERING AND INTEGRATION SERVICES

Microgrids are modern energy solutions that enhance resiliency, optimize energy costs, and integrate distributed energy resources (DERs) for critical facilities and infrastructure.

Key drivers for microgrid development include reliability and resiliency enhancement, grid flexibility, premium power quality, energy cost optimization, emission reduction, and renewable portfolio growth.

Applications include utility distribution systems, military installations, campuses, commercial and industrial facilities, and community microgrids.

Microgrid development lifecycle is typically comprised of the following phases:



We provide end-to-end solutions and services for planning, design, testing and integration of microgrid projects to assist utilities, developers, and critical infrastructure operators. We have supported the development of several high-profile utility-scale, commercial-type, and government-sponsored microgrid projects during the last several years. Our industry experts provide a wide range of engagement at all stages of the microgrid project lifecycle and our offerings include:

1 PLANNING AND BUSINESS CASE

- Economic analysis including cost-benefit analysis (upfront and annual)
- Generation mix selection
- Energy plan
- Business model development.

2 FEASIBILITY ANALYSIS

- Reliability and load analysis (including energy dispatch)
- Generation sizing
- Conceptual design and electrical system arrangement
- Technology selection.

3 SYSTEM ENGINEERING

- Microgrid engineering studies
- Protection and control system design
- Functional requirements and specifications
- Microgrid sequence-of-operation and control strategies
- Real-time hardware-in-the-loop (HIL) testing.

4 TURNKEY

- Procurement
- Installation and implementation
- Site management and performance verification testing
- Support of factory acceptance testing (FAT).

5 IMPLEMENTATION AND INTEGRATION

- Microgrid control system
- Protection, control, and automation settings
- Commissioning and testing.

6 AFTER-DEPLOYMENT SUPPORT

- Training
- Operations and maintenance support
- Master Service Agreement (MSA).

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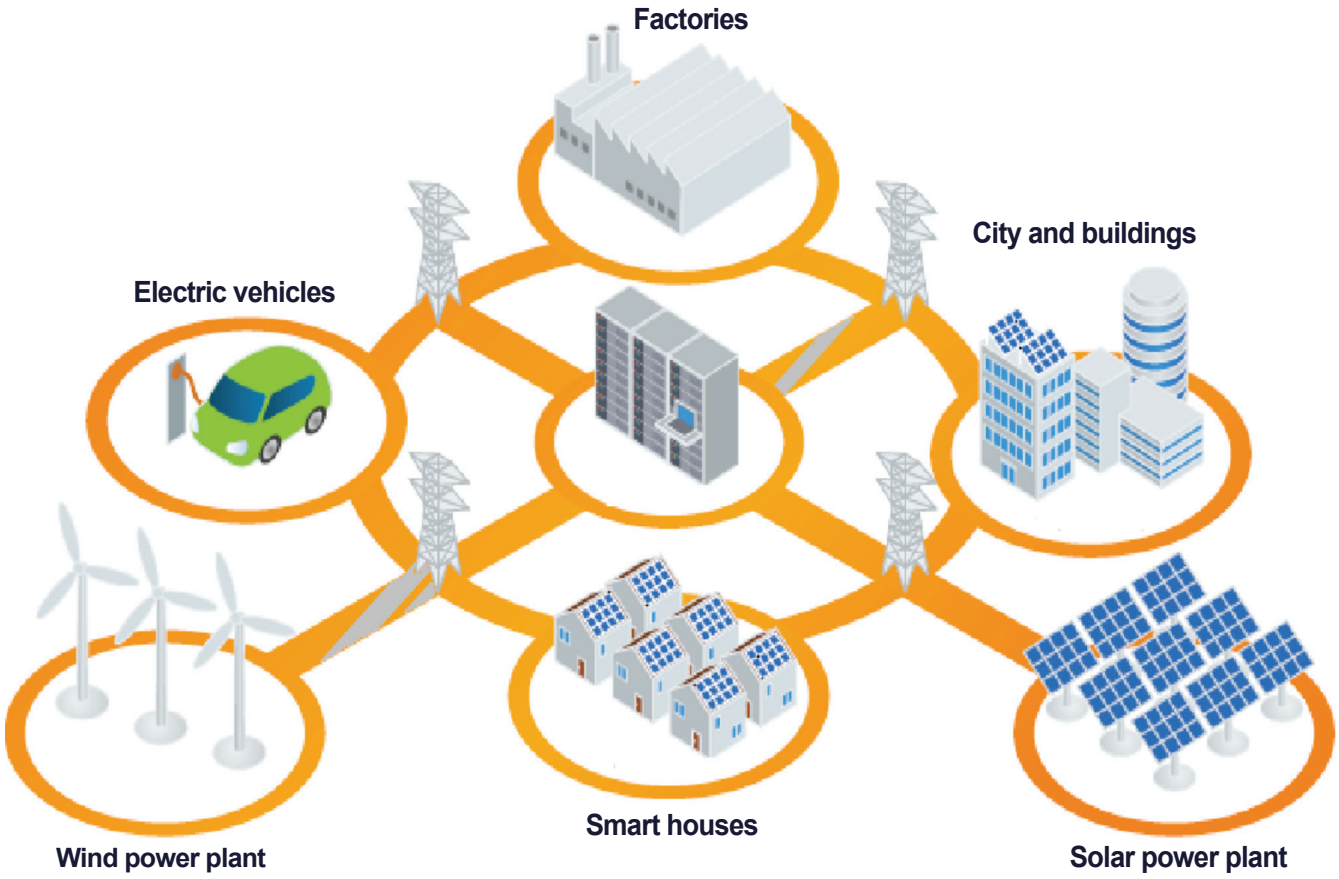

Figure 1. Pictured: Example microgrid ecosystem

Proper design of the control and automation systems for a microgrid with various types of DERs and advanced technologies is a critical aspect that directly affects the project success. Our practical experience and insight into understanding of various microgrid applications come from involvement in feasibility studies, systems design, technology selection, testing, field deployment, and operational analysis of several microgrid projects.

MICROGRID ENGINEERING AND CONSULTING SERVICES

We offer a wide range of engineering and consulting services in the area of microgrids, including:

- Microgrid feasibility, cost-benefit, and reliability analyses
- Microgrid design, technology selection, optimal planning, and electrical system arrangement
- Microgrid modeling and simulation for transient, dynamic, and steady-state performance studies
- Microgrid protection and control design and engineering studies, including defining the basic and advanced protection schemes and control functions for microgrids
- Testing of the microgrid protection and control systems both in the field or in the laboratory (using real-time hardware-in-loop)
- Development of functional specifications, operating strategy, and sequence of operation
- Procurement and operations and maintenance support.

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