IMAGINE International Microgrid Assessment: Governance, INcentives, and Experience

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A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

—*U.S. Department of Energy Microgrid Exchange Group, 2010*

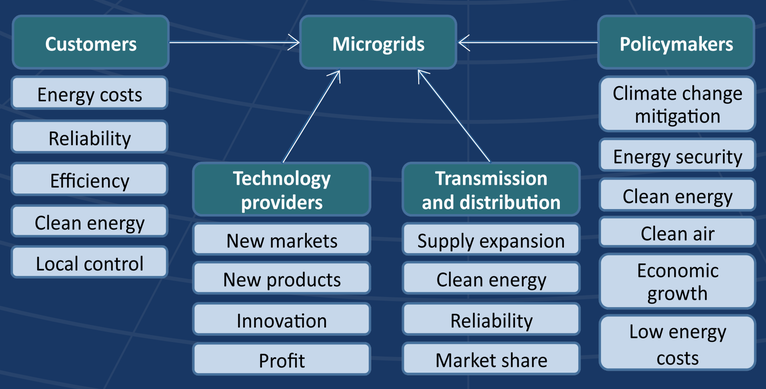

Figure 1. Drivers for microgrids across four stakeholder groups

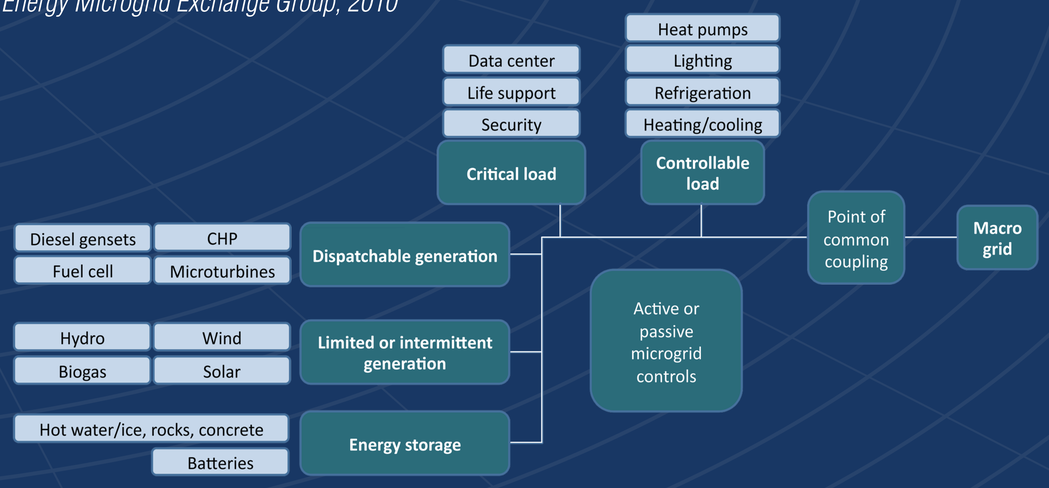

Figure 2. Overview of the main components in a common microgrid

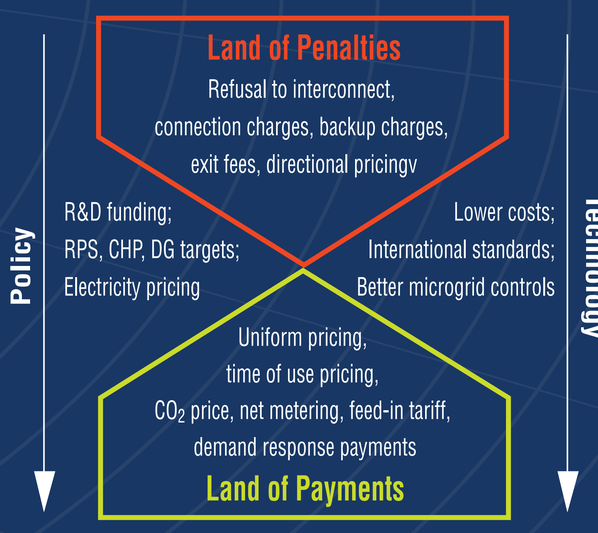

Figure 3. From penalties to payments using policy and technology

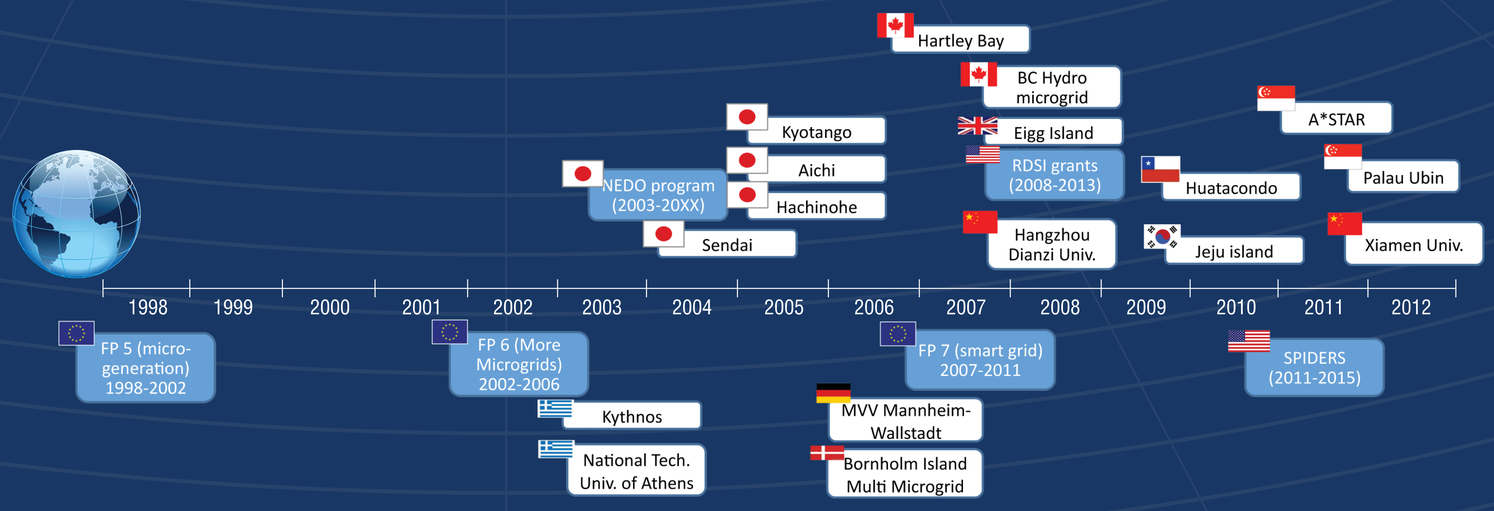

Figure 4. Timeline of microgrid programs (blue) and select projects (white) to date

Economic Benefit	Regulatory/ Utility Barrier	Resolution
Reduce Energy Costs	Increased service charges or exit fees	Disallow unwarranted increases in charges due to loss of UoS revenue
	No time of use pricing	Create time of use or real-time pricing scheme
Sell Excess Power to Utility	Interconnection charges	Apply a fair and cost-effective interconnection review process
	No compensation provided	Mandate utility purchase of excess power
	Directional pricing used	Consider uniform pricing
	Net-metering not allowed	Mandate net-metering, consider allowing provisions for a mixture of supply technologies
Participate in DR Markets	No compensation provided	Create incentive payments for DR (interruptible tariffs or contracts)
	Capacity limit set too high	Lower capacity limit so microgrids of all sizes can participate
Increase Use of Renewable Energy	No incentives for renewable energy	Consider RPS or feed-in tariff policies
Reduce CO_2 Emissions	No CO_2 price	Consider carbon pricing policy

Table 1. Valuing the economic benefits of microgrids

CASE STUDY 1: SANTA RITA JAIL MICROGRID

- **Technologies used:** Iron-phosphate battery, fuel cell, back up diesel generators, solar PV (rooftop and tracking), islanding switch
- **Secrets of success:** Role of local government entity Alameda County; diversity of partners involved: local utility (PG&E), technology providers (Satcon and S&C Electric), an engineering services company focused on renewable energy and CHP (Chevron Energy Solutions), and multiple laboratories (University of Wisconsin, LBNL, and NREL); involvement of LBNL to optimize the economics and risk involved in the project through data collection and analysis
- **Lessons learned:** Battery cost very high and only made possible by government grants, but useful for ultra-high reliability applications

CASE STUDY 2: SENDAI MICROGRID

- **Technologies used:** fuel cell, gas gensets, batteries, solar PV, microgrid control system, now CHP
- **Secrets of success:** Involvement and support of local city government
- **Lessons learned:** Consider CHP from the start (was added in second phase of project but would have had benefited the project from the start); heterogeneous power quality is possible

Recommendations for Establishing a Microgrid Program: from Demonstration to Deployment

1. Research and demonstration program / Set the foundation

- Set a goal for the R&D program based on the microgrid benefits and functions sought
- Promote results-oriented R&D program based on overall goals
- Allow for post-demonstration analysis (and matrix for scoring achievement against goals)

2. Field demonstration projects / Create initial successes

- Ensure project's economic viability
- Include customer microgrids
- Match technology with end-use requirements
- Integrate energy functions: CHP and CCHP

3. Policy support / Incentivize deployment

- Develop standards and processes for interconnection of microgrids
- Consider modifications to electricity rate design (time of use, demand charges, distribution charges, etc.)
- Inventory current incentive policies and analyze gaps for widespread microgrid deployment