



Microgrids

An Emerging Paradigm for Meeting Building Electricity and Heat Requirements Efficiently and with Appropriate Energy Quality

by

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Outline



- a microgrid definition
- competing power system visions
- summary of microgrid demonstrations In Japan
- Sendai Project
 - heterogeneous power quality
- Hachinohe Project
 - central control, private feeder, 100 % renewable
- Kyoto Project at Kyotango
 - virtual microgrid, biogas
- Aichi Project at Nagoya Airport
 - multiple fuel cells, biogas, NAS battery



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What is a Microgrid?



A **controlled** grouping of energy (including electricity) sources and sinks that is connected to the macrogrid but can function independently of it.

main benefits to developers of microgrids:

- pushing efficiency limits by heat recovery (CHP)
- creating a more favorable environment for efficiency and small-scale renewables
- providing heterogeneous power quality and reliability (PQR)

other societal benefits include:

- avoiding macrogrid investments
- hardening of supply
- curbing generator market power, etc.

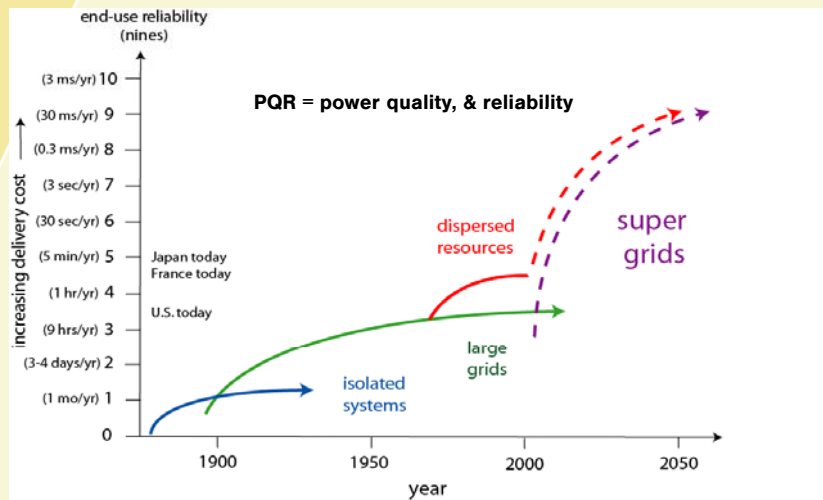


competing power system visions





Supergrid Vision



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Supergrid Vision Limits



- centralised power system heat loss
- multiple infrastructure interdependencies
- perfection impossible or at least very expensive
- restrictions on power system expansion (siting, environmental, rights-of-way, etc.)
- volatile bulk power markets
- economics drives operation closer to limits
- need to accommodate intermittent resources
- insecure system



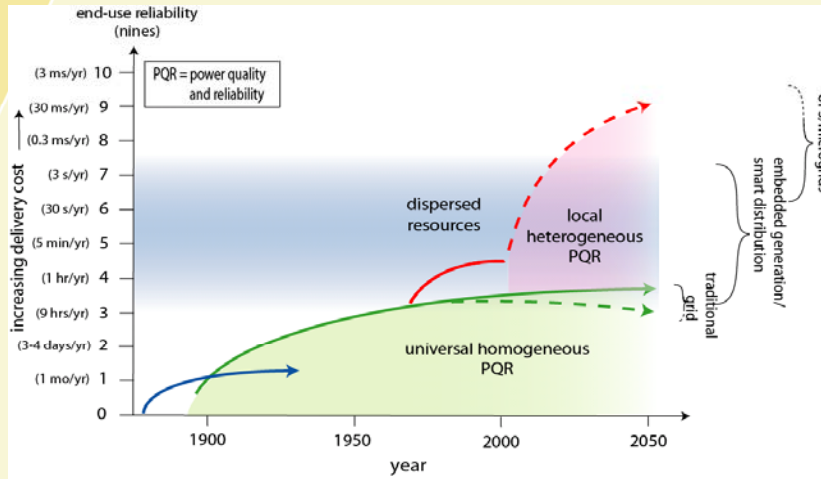
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Dispersed Vision

(distributed control & heterogeneous service)



summary of projects in Japan





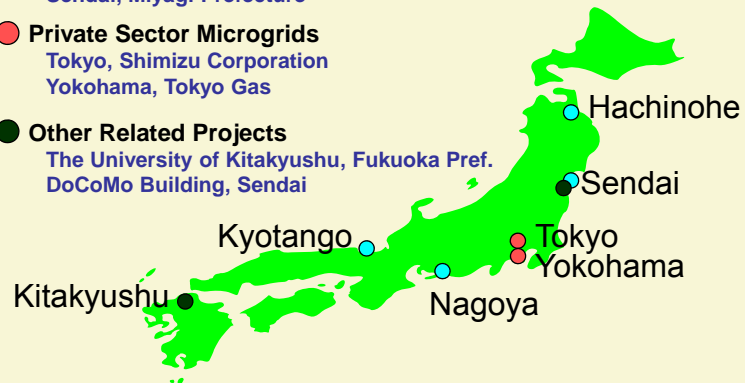
Microgrid Project Sites



- NEDO Microgrids**
Nagoya, Aichi Prefecture
Hachinohe, Aomori Prefecture
Kyotango, Kyoto Prefecture
Sendai, Miyagi Prefecture

- Private Sector Microgrids**
Tokyo, Shimizu Corporation
Yokohama, Tokyo Gas

- Other Related Projects**
The University of Kitakyushu, Fukuoka Pref.
DoCoMo Building, Sendai



Sendai Project





Sakura at Sendai Microgrid



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Sendai Project Power Plant



Here is DC Demo system in this building.

- PQCR Integrated Power Supply
- PV Panels 50 kWp
- Gas Gen-sets 350 kW X 2
- DVRs 200 kVA, 600 kVA
- MCFC 250 kW

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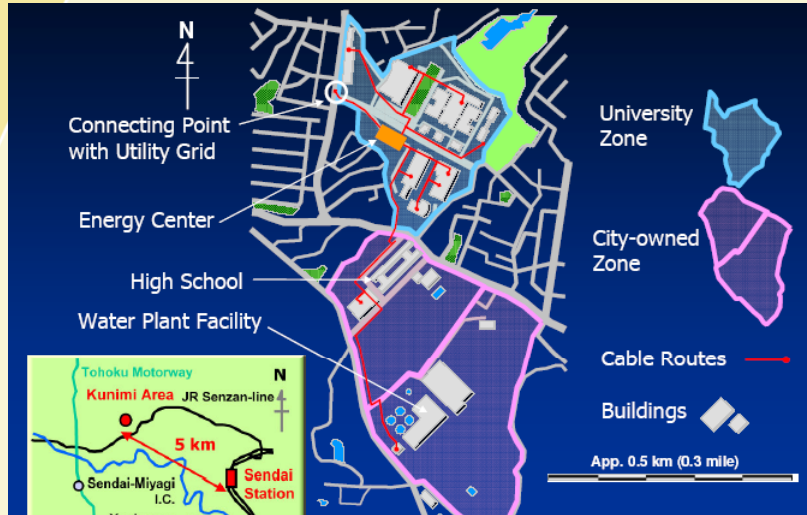


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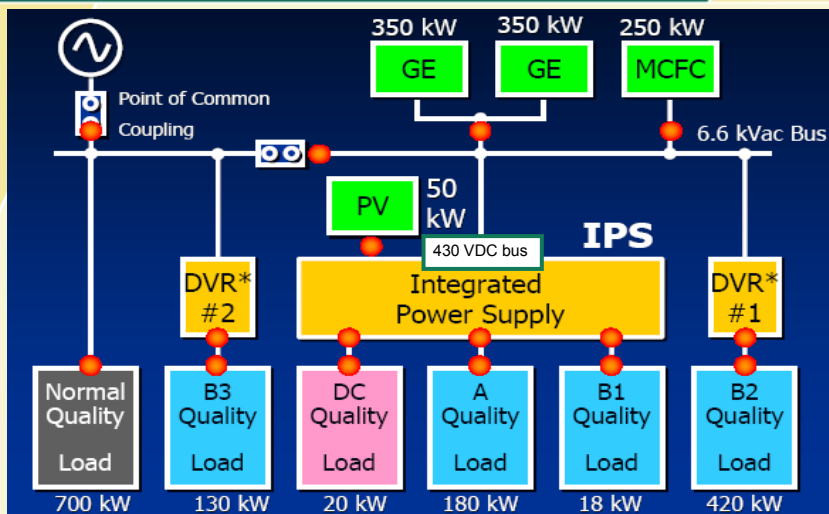
Sendai Project Pictures



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Sendai Project Schematic



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Sendai Project Pictures



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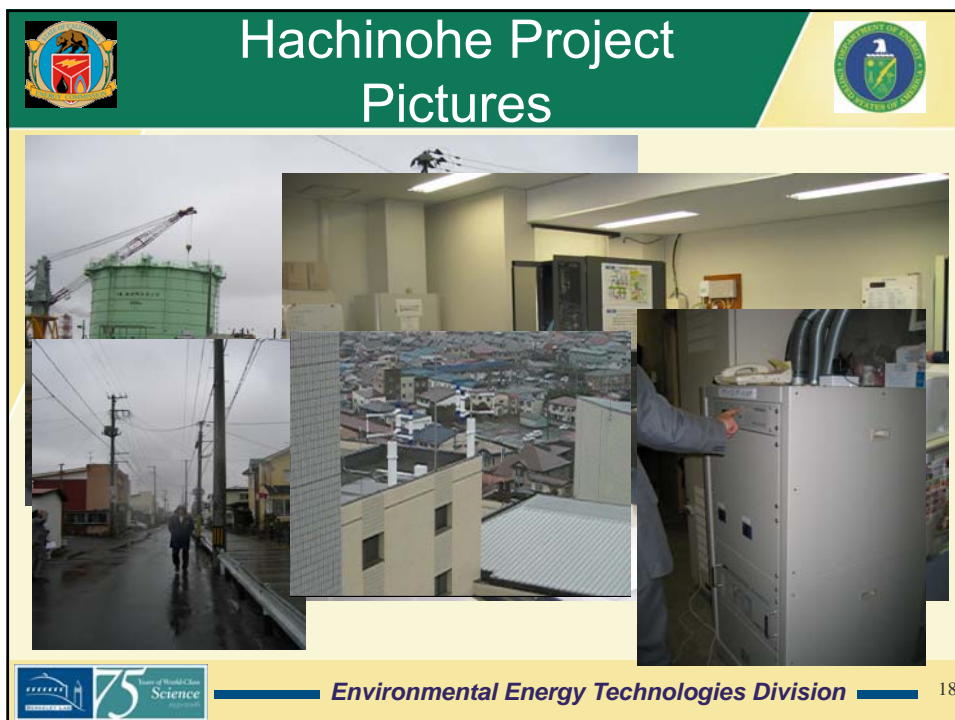
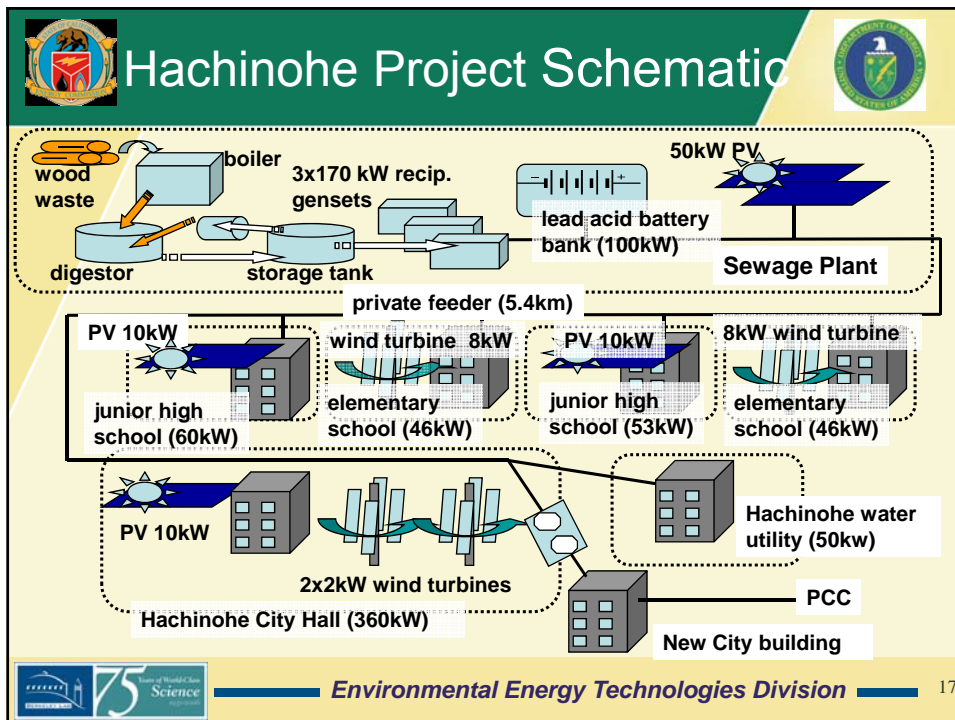


Hachinohe Project



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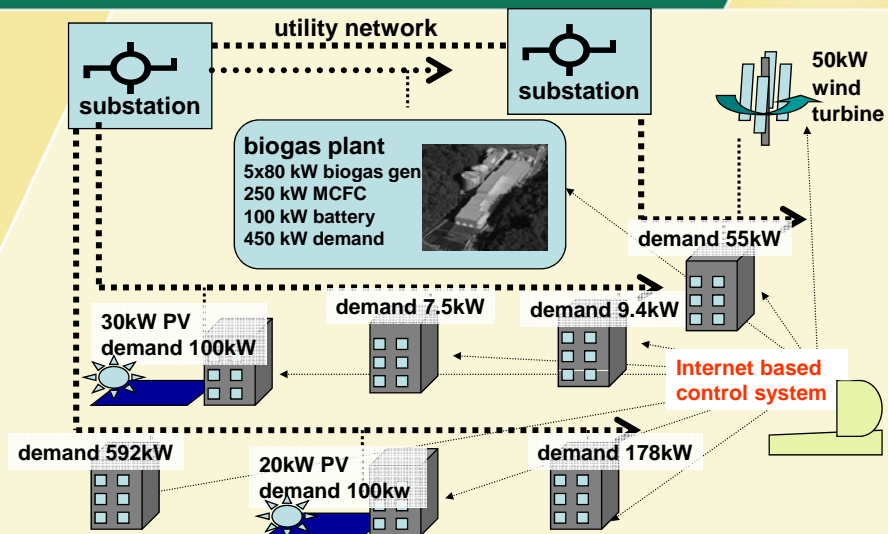




Kyoto Project at Kyotango



Kyoto Project Schematic





Kyotango Project Pictures



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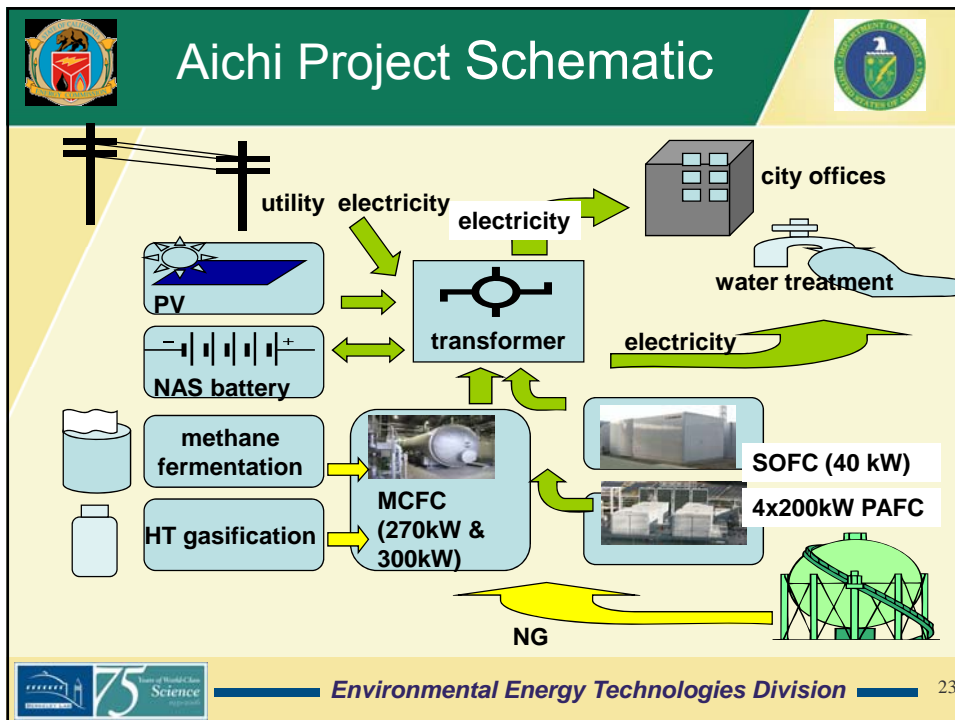


Aichi Project at Nagoya Airport



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The End



Power Quality Services



Category	DC Power	AC Power						
		Quality A	Quality B					
			B1	B2	B3			
Interruption	No	No	Less than	Less than	Less than			
Requirements	Voltage fluctuations	Kinds of Quality	Capacity of Converter	Consumers		Area		
	Voltage imbalance			Quality A	200kVA		Hospital (MRIs) Laboratory (Servers)	University
	Voltage harmonics			Quality B1	20kVA		Nursing Care Facilities (Lightings, Pcs)	University
	Frequency variations			Quality B2	600kVA		High school Water plant (Induction Motors et.al)	City-owned
	Voltage dip			Quality B3	200kVA		Nursing Care Facilities	University
	Outage			DC	20kW		Energy Center (Servers, Lightings, Fans)	University
	Backup time			Normal Quality	—		Nursing Care Facilities Training Center, Dormitories	University
	Mark ✓ : With compensation - : Without compensati							