



MICROGRIDS



Worldwide Microgrid Development: The Evolving Power Supply Paradigm

by

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Outline



- definition of microgrids
- philosophy of distributed power systems
- imitations of centralized systems
- universal power quality and reliability and heterogeneous PQR
- limitations of centralized systems
- microgrid example, Sendai, Japan



What is a “Microgrid?”



U.S. Department of Energy Microgrid Exchange Group:

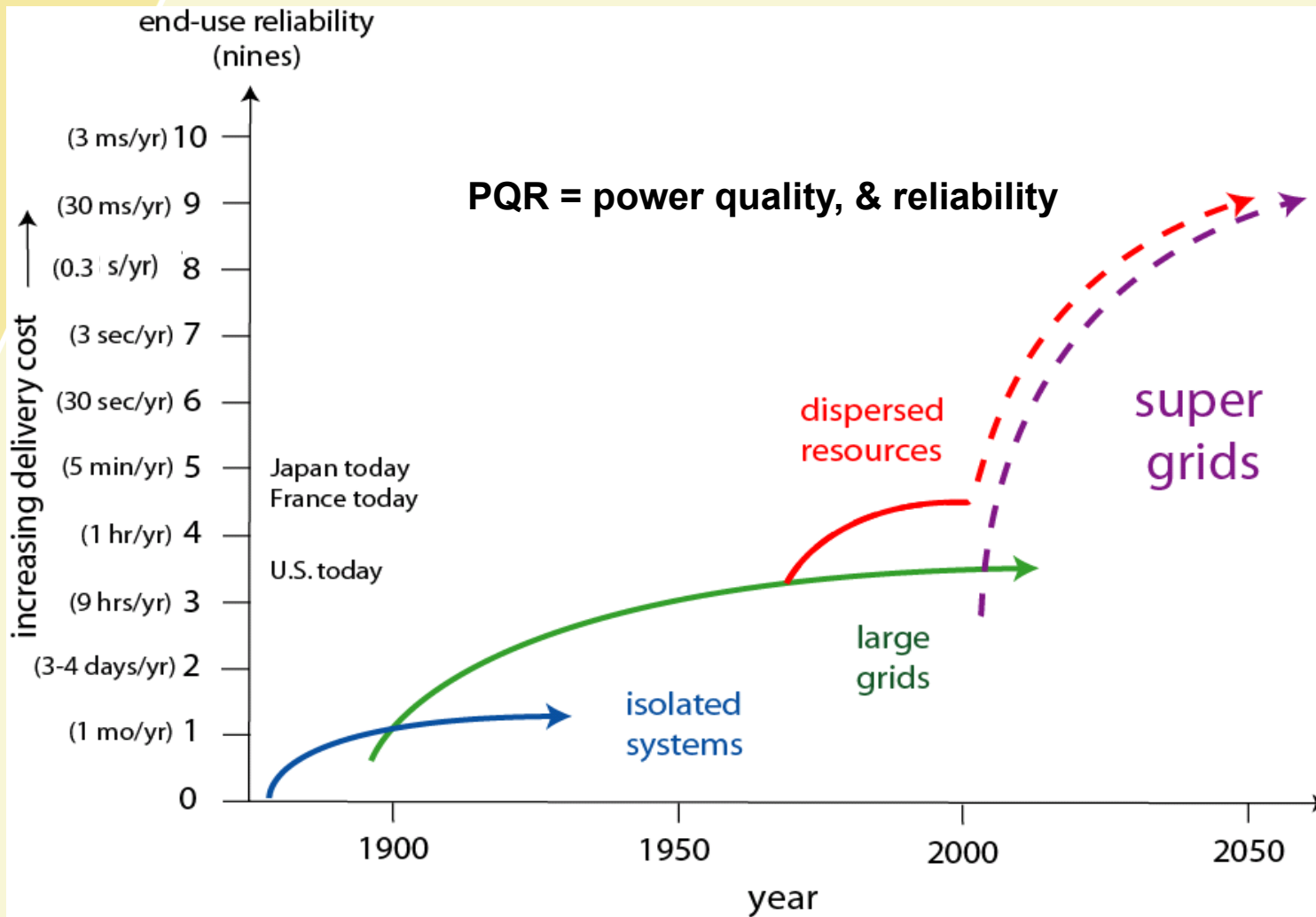
A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

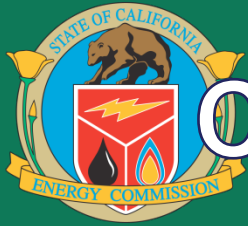
likely CIGRÉ C6.22 Working Group Definition:

Microgrids are electricity distribution systems containing loads and distributed energy resources, (such as distributed generators, storage devices, or controllable loads) that can be operated in a controlled, coordinated way either while connected to the main power network or while islanded.



Supergrid Vision





Centralized Paradigm Limits

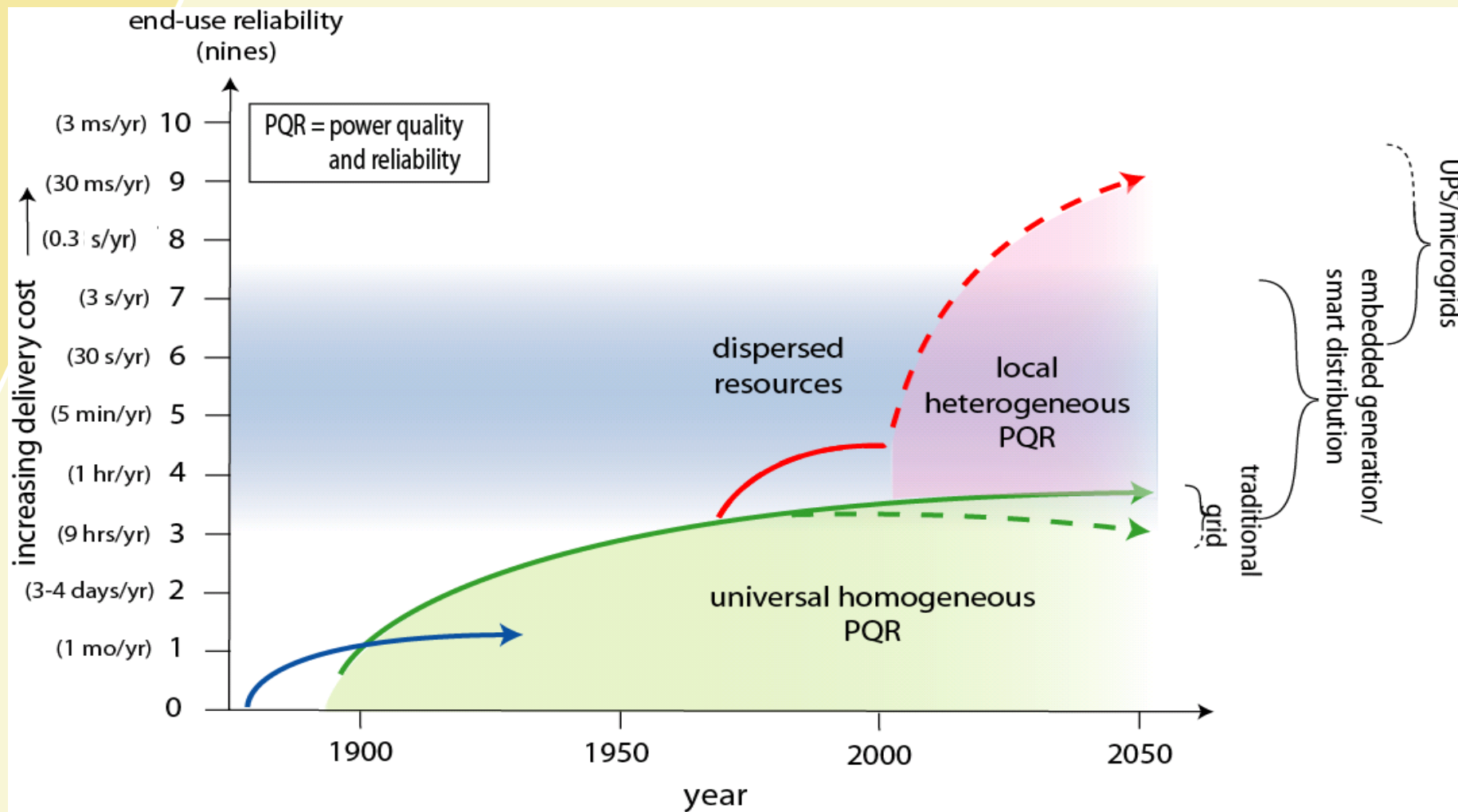


- conflicting policy objectives
 - generation competition (equipment stress, volatile markets)
 - connection of intermittent renewables
- load growth (transportation electrification, heating, ...)
- environmental constraints (carbon, water, etc.)
- centralized generation heat loss
- infrastructure interdependency
- reliability is costly for a fundamentally insecure system
- restricted expansion of centralized system
- DC sources and sinks, heterogeneous power quality
- plug-in electric vehicles a potential game changer
- grid paradigm vs. internet paradigm



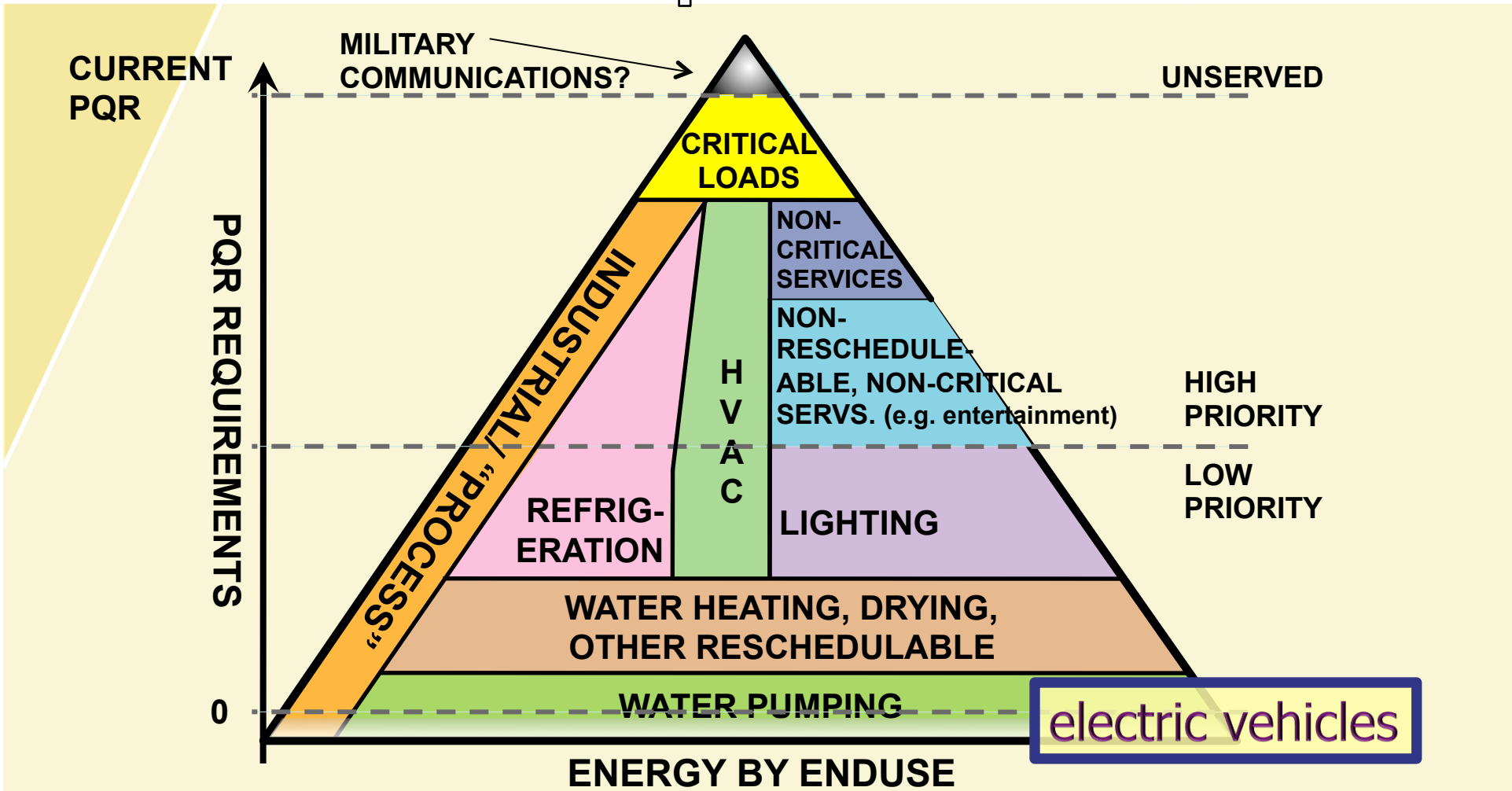
Dispersed Vision

(distributed control & heterogeneous service)



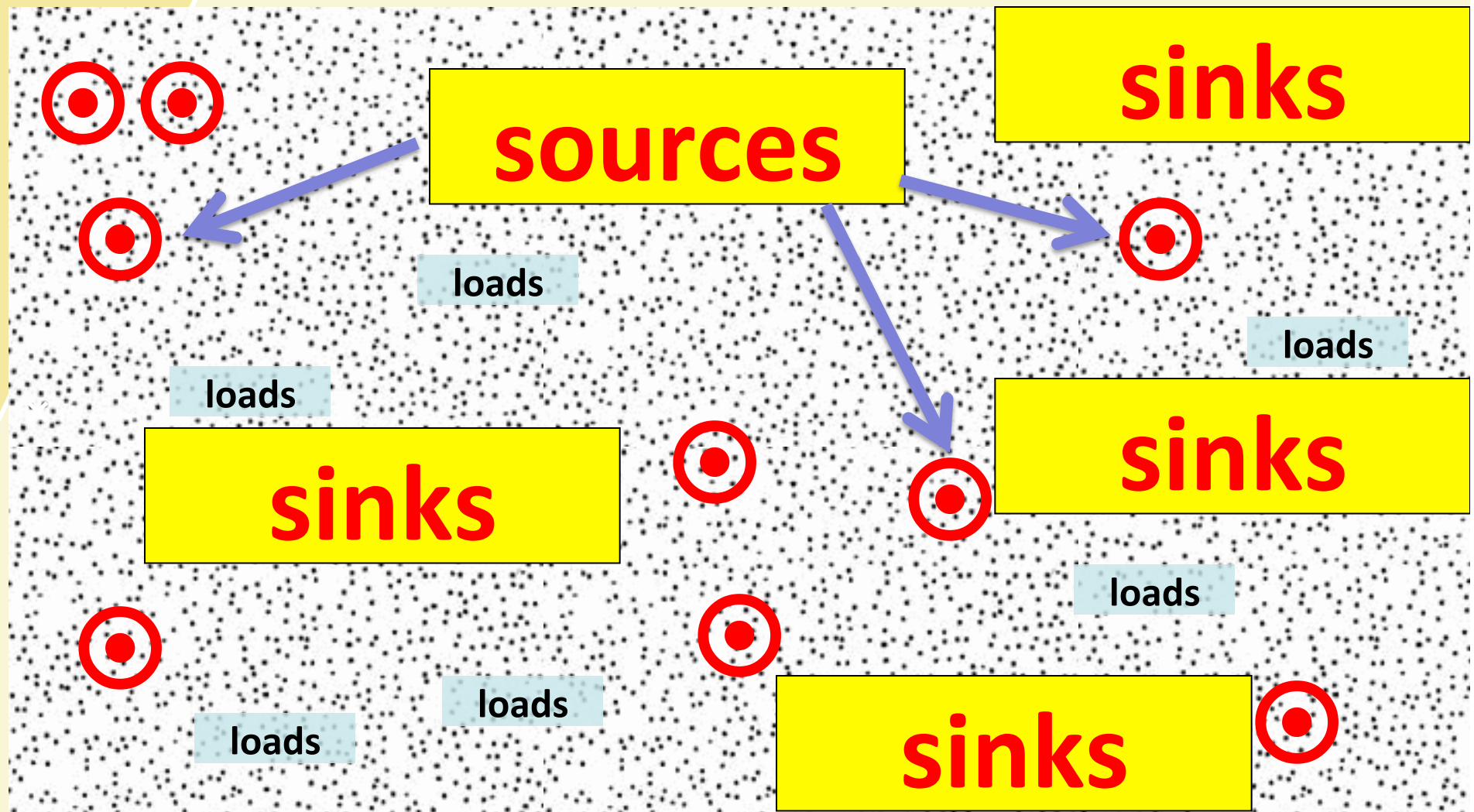


Loads Disaggregated by PQR Requirements



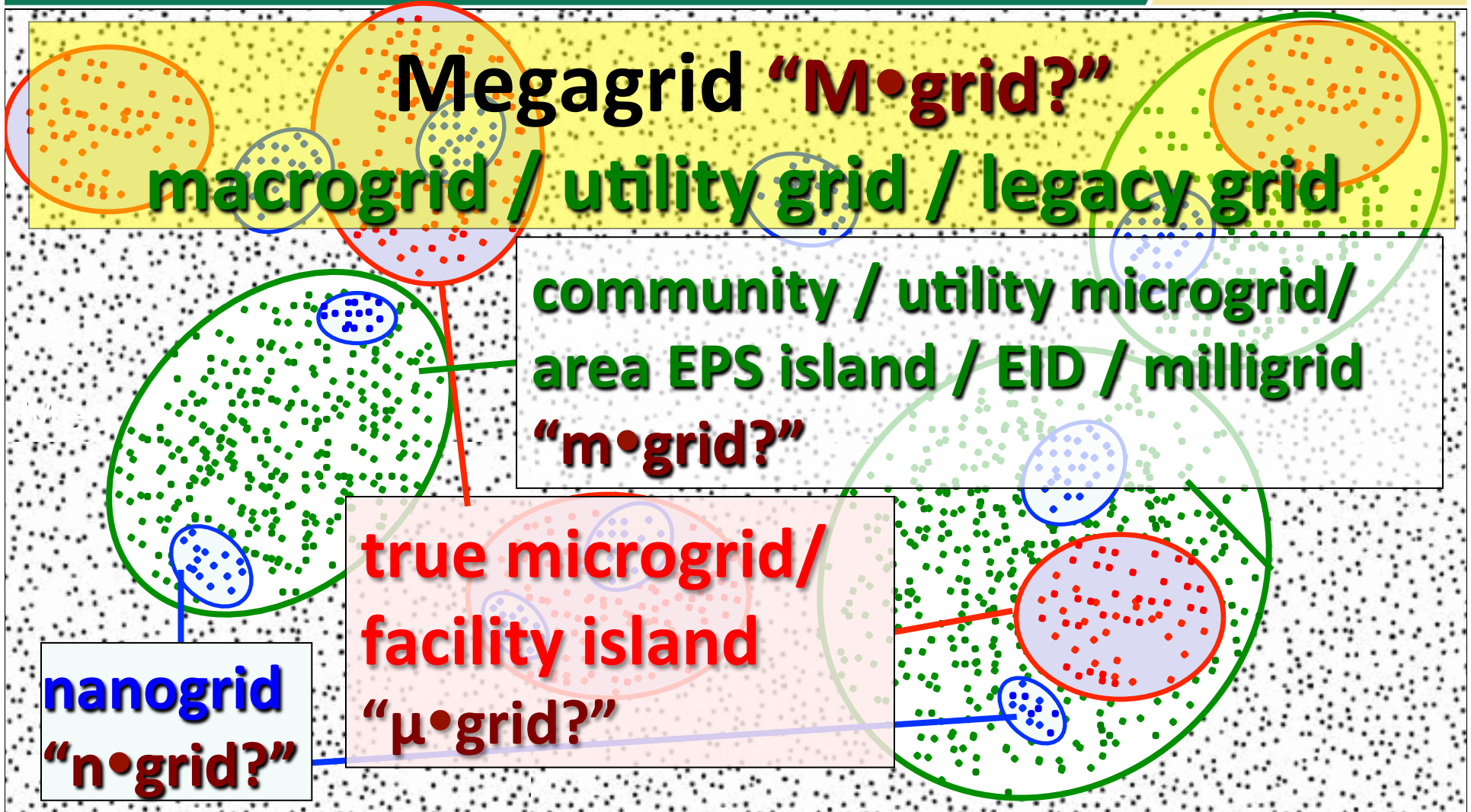


Historic Landscape





Zoom on Possible Landscape



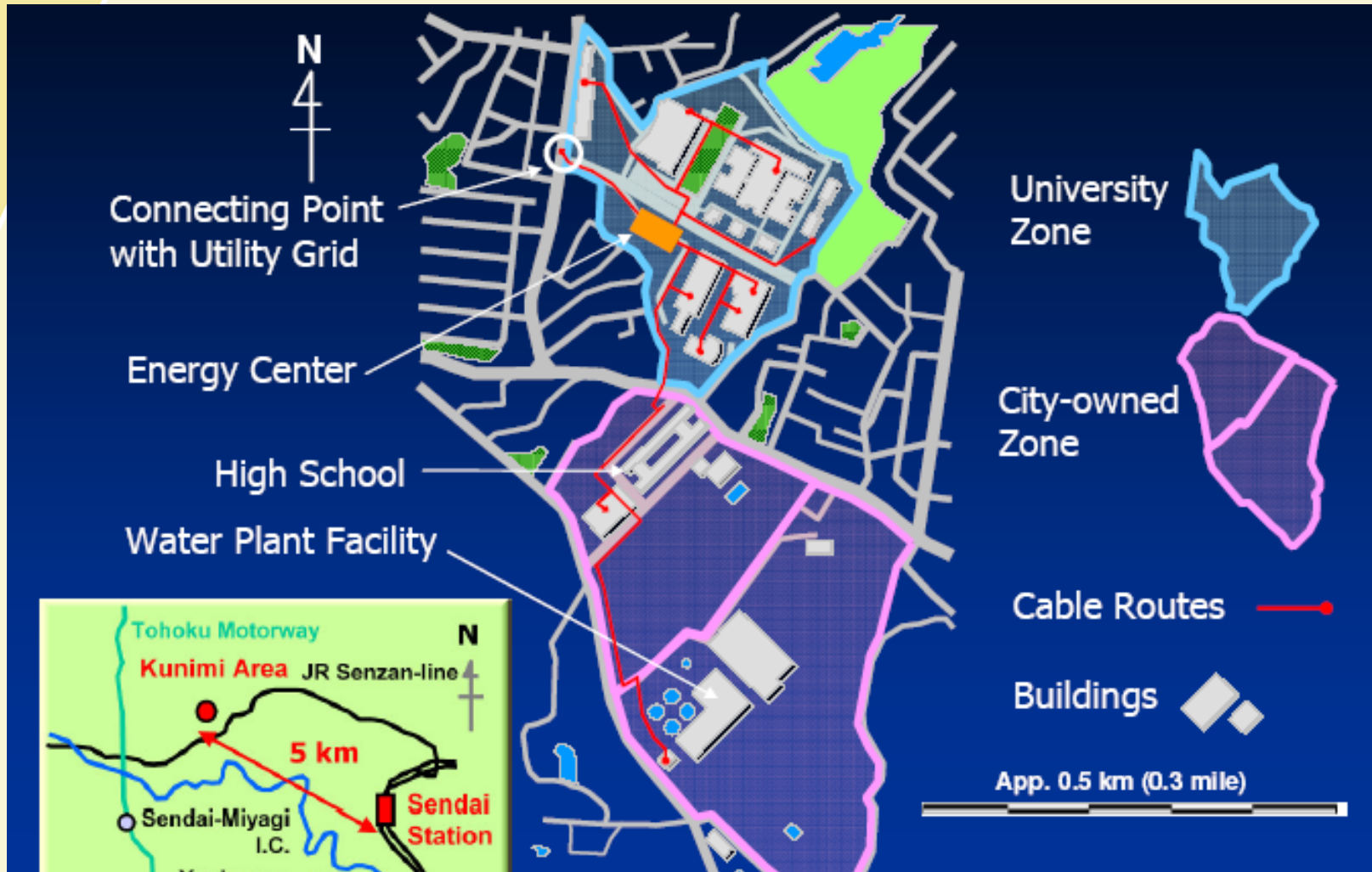


Sakura at Sendai μ Grid





Sendai Project Pictures



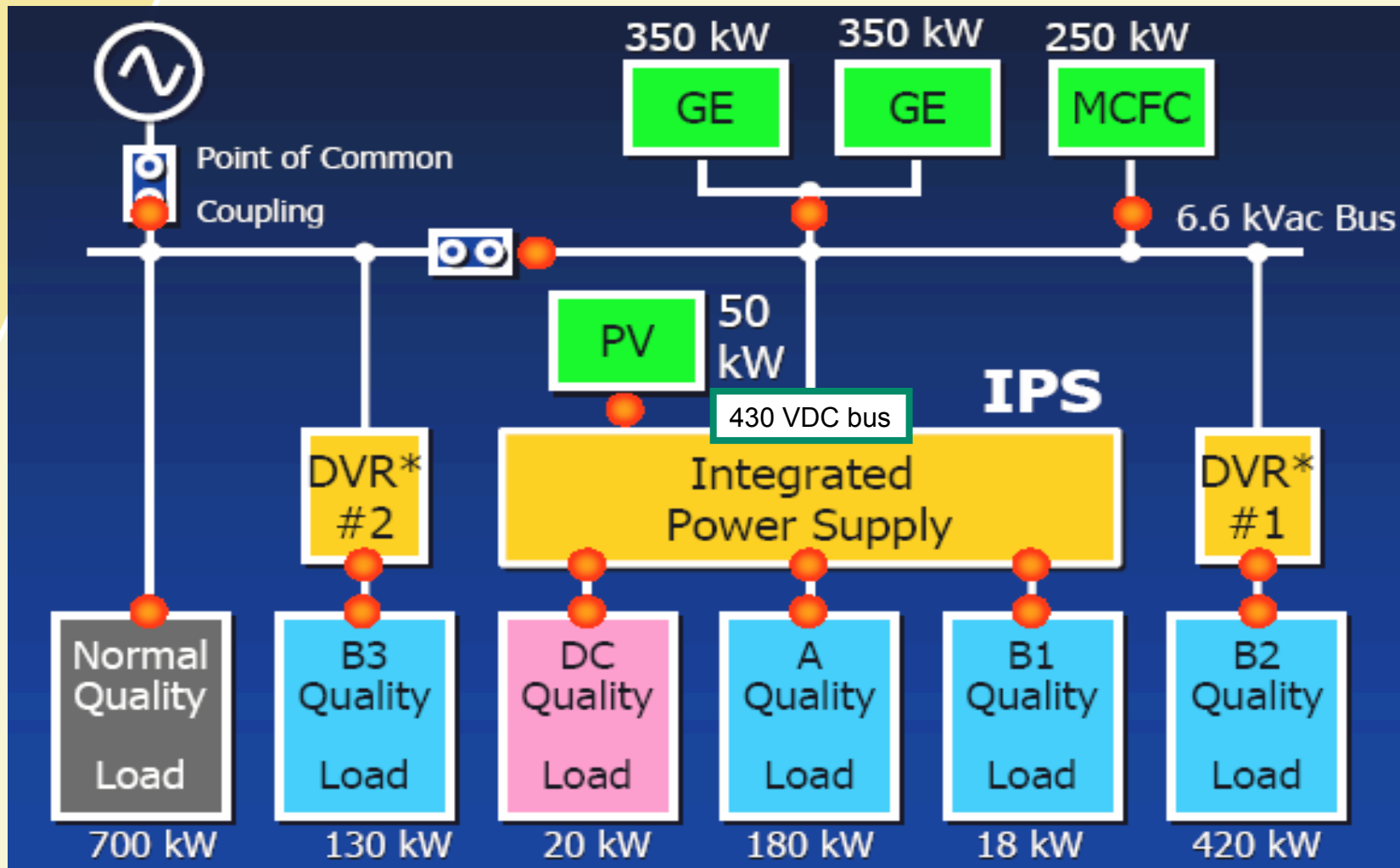


Sendai Project Pictures





Sendai Project Schematic





Thank you!

<http://www.youtube.com/watch?v=3XuCJBvq6Sk>

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