

Introduction to Microgrids

Introduction to the

Consortium for Electric Reliability Technology Solutions
Berkeley 2005 Symposium on Microgrids

Faculty Club, U.C. Berkeley

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by

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CERTS
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

Why Microgrids? Why Now?

- I. Can growing electricity demand be met by central station power systems alone?
- II. Can growing electricity power quality and reliability requirements be met?
- III. Can we capture more waste heat?
- IV. What might a mixed scale power system look like?
- V. What is a microgrid?

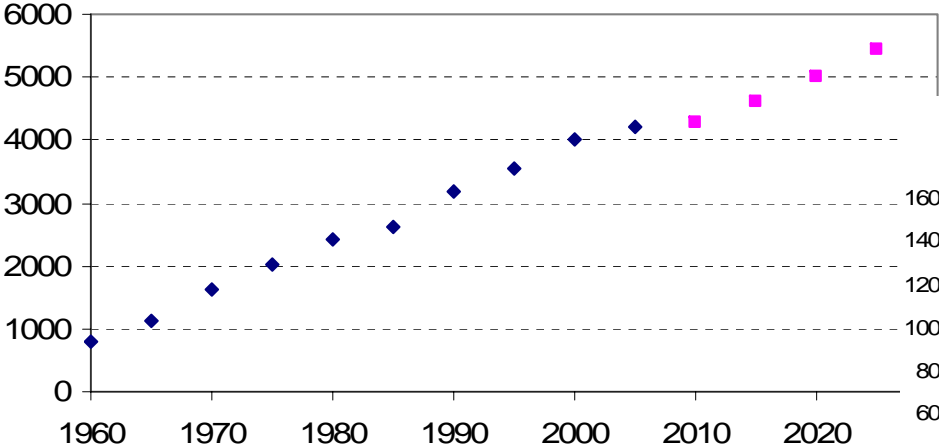


I. Can growing electricity demand be met by central station power systems alone?

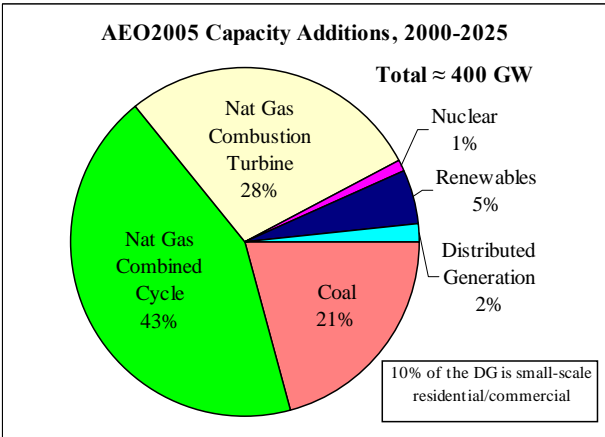
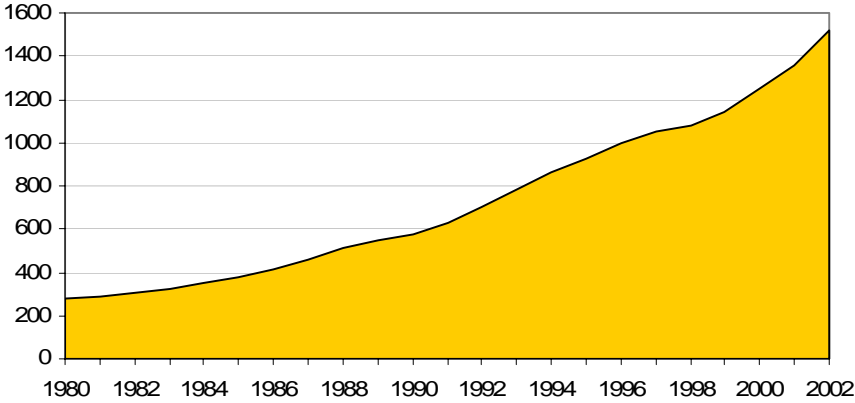


We use more and more electricity.

US Electricity Generation (TWh)



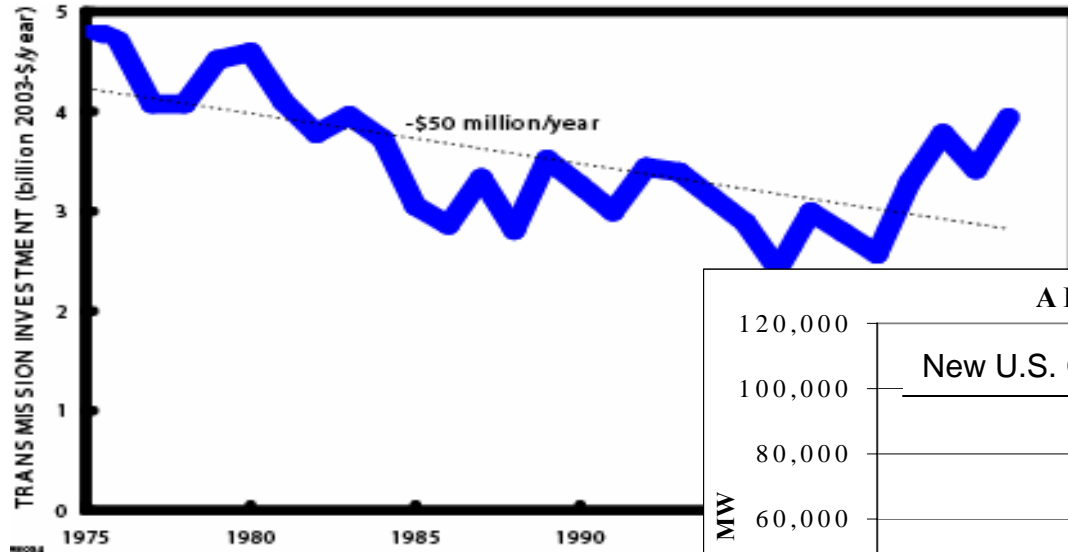
Electricity Consumption in China (TWh)



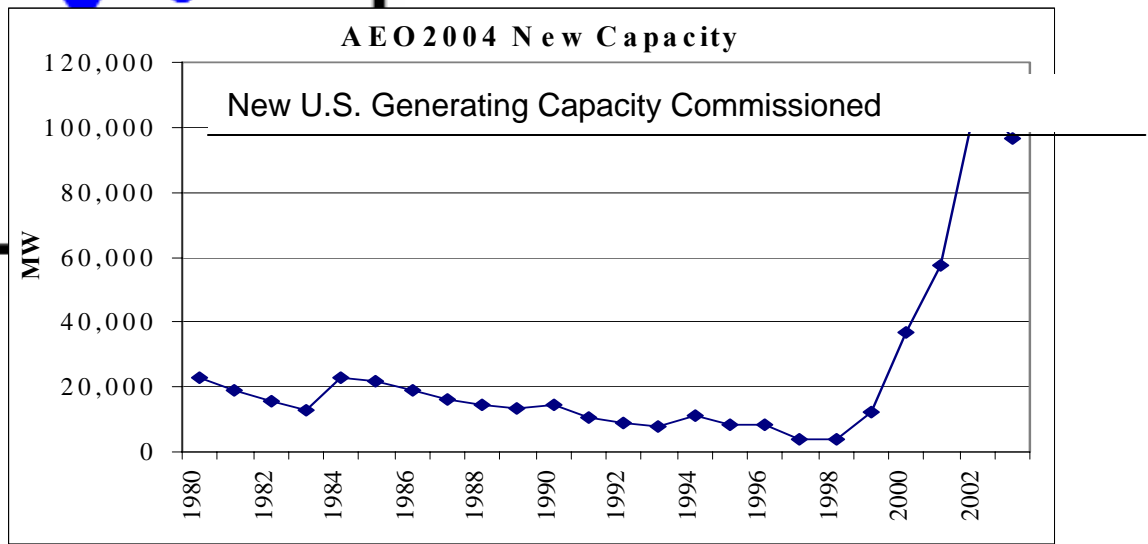
source: Annual Energy Outlook 2005, Energy Information Administration.



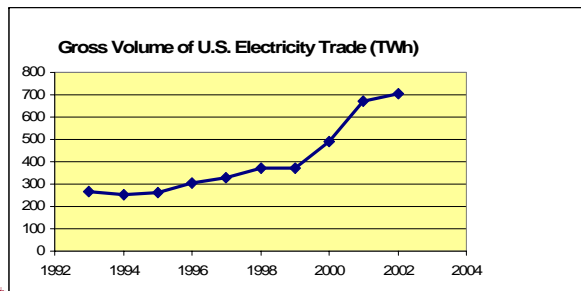
It Could Be a Rough Ride.



source: Hirst, Eric, *U.S. Transmission Capacity: Present Status and Future Prospects*, Hirst Consulting, Bellingham, WA, June 2004, pg. 7.



source: US Energy Information Administration, Annual Energy Outlook 2004



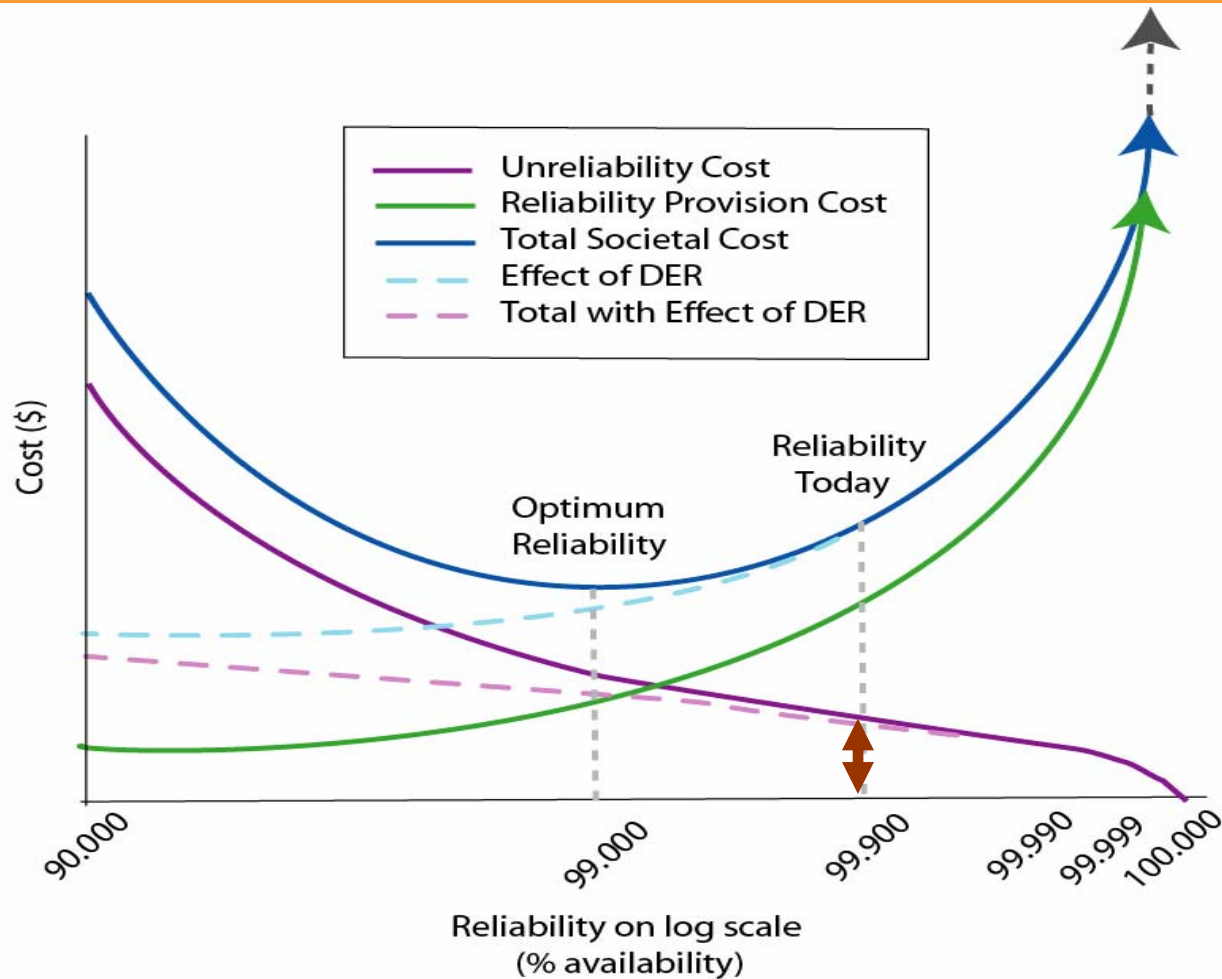
source: Energy Information Administration, *Electric Transmission in a Restructured Industry*, 2004



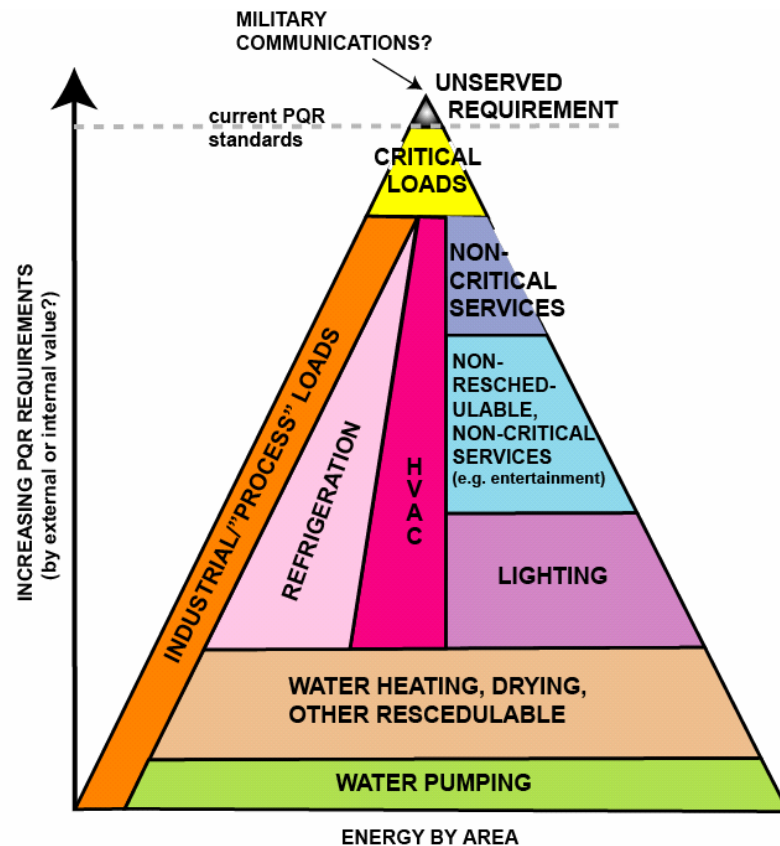
II. Can growing electricity power quality and reliability requirements be met?



What Does Power Quality and Reliability Really Cost?



A First Energy Pyramid

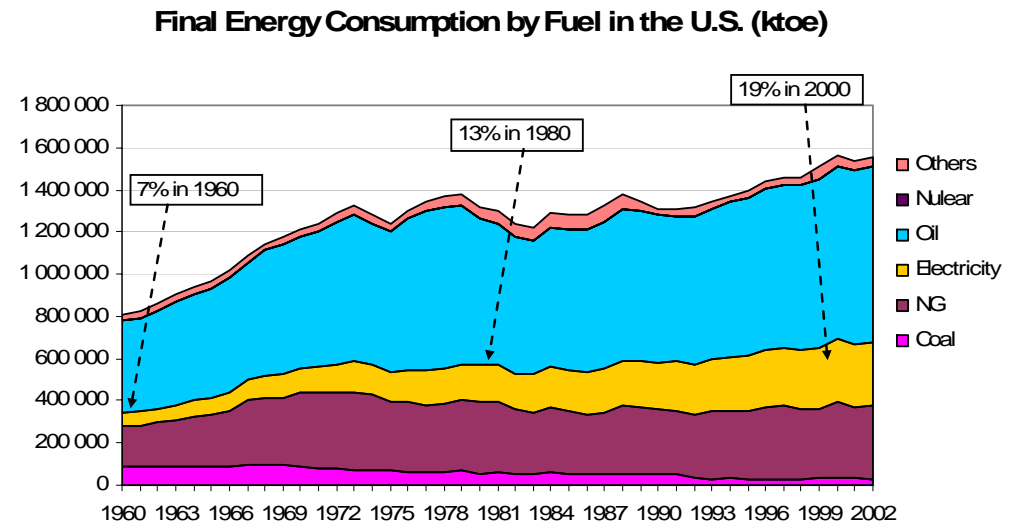
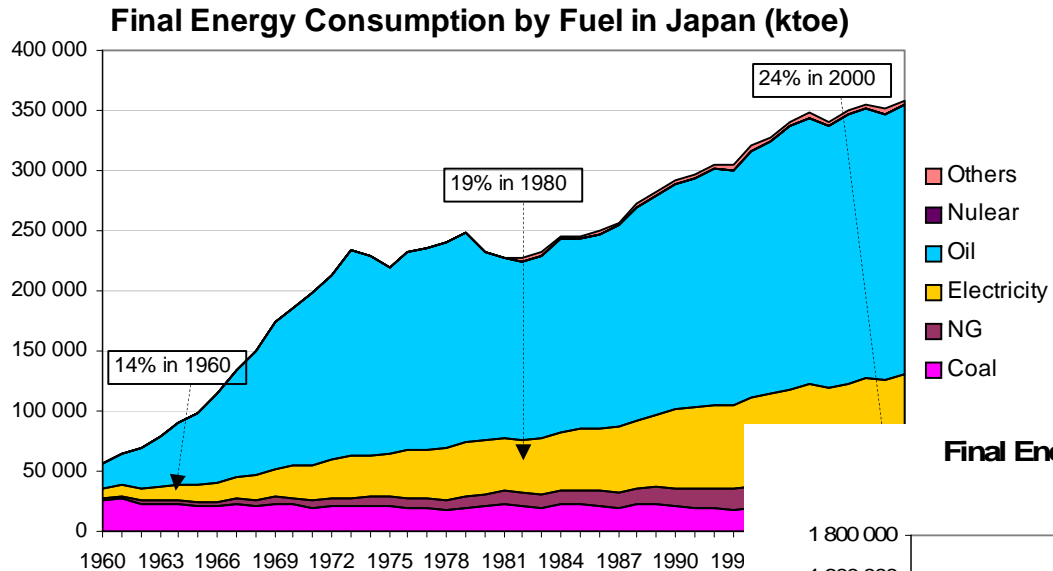


- highly sensitive loads are small
- most demanding PQR requirements are not met
- categories cover a range of PQR requirements
- need new categories

III. Can we capture more waste heat?

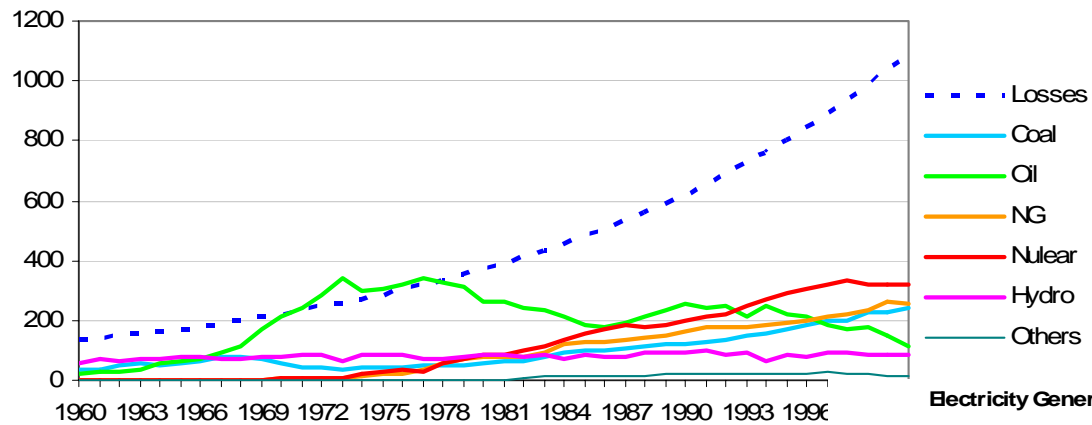


Developed Economies Use More Electricity

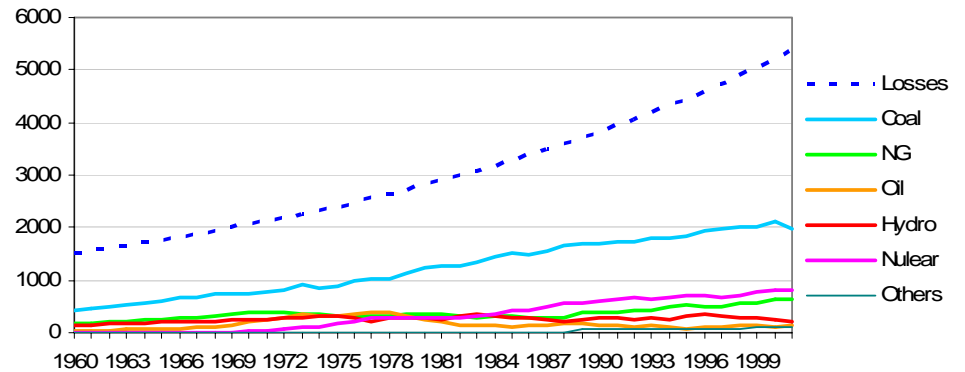


More and More Heat is Wasted.

Electricity Generation By Fuel in Japan (TWh)



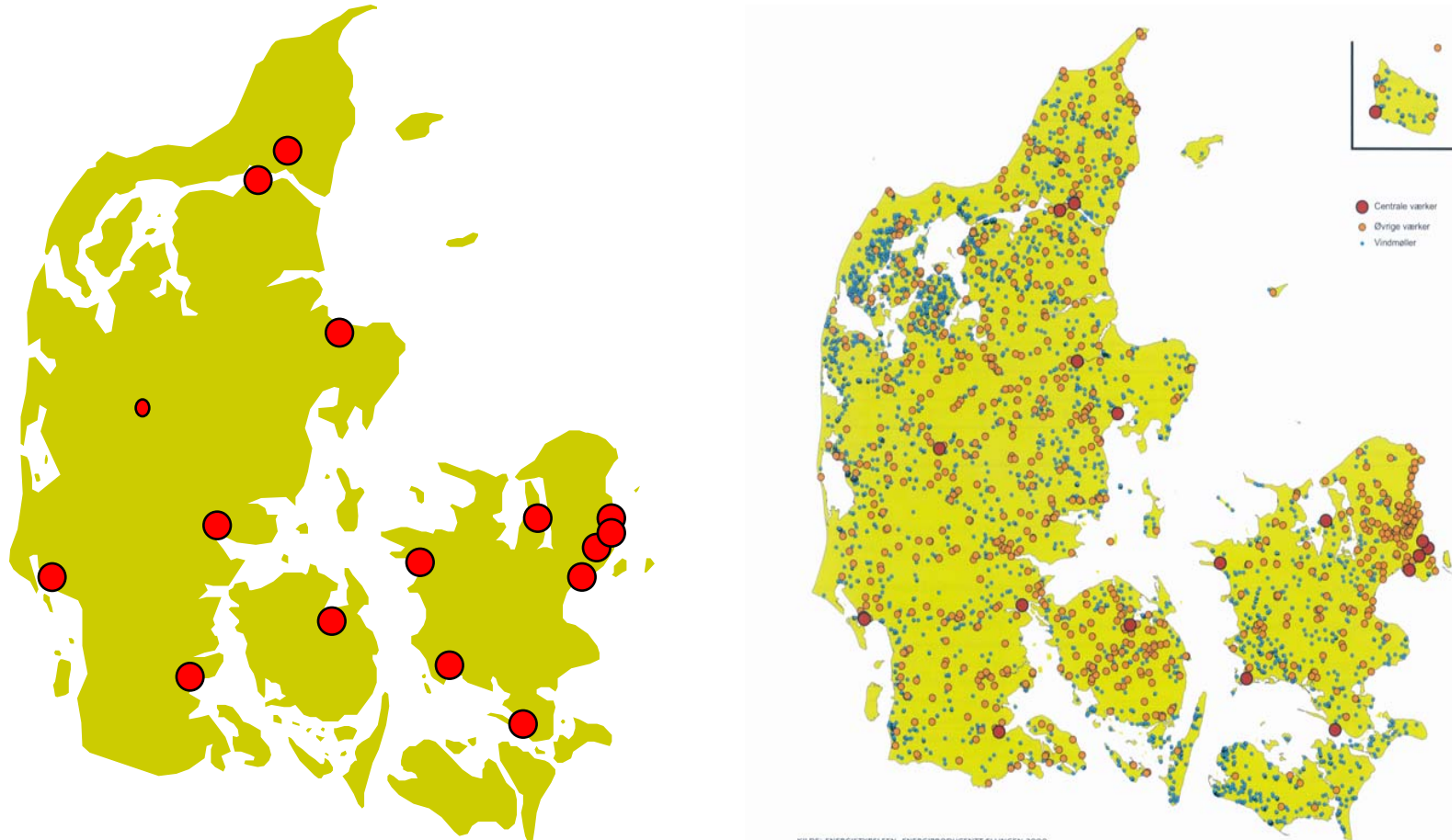
Electricity Generation By Fuel in the U.S. (TWh)



IV. What might a mixed scale power system look like?



Development of Danish Power System (1980-2000)



KILDE: ENERGISTYRELSEN, ENERGIPRODUCENTTÆLLINGEN 2000,
VINDMØLLEKOORDINATER, KORT & MATRIKELSTYRELSEN 2001

source: Eltra (grid operator of western Denmark)

V. What is a microgrid?



My Power System.



Northern California
off-grid PV
installation

Key Microgrid Feature is Local Control.

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control room at Fort Bragg, NC