

# The CERTS Microgrid and the Future of the Macrogrid

1

*paper presented at the*

## ACEEE 2004 Summer Study on Energy Efficiency in Buildings

*Asilomar Conference Center, Pacific Grove CA*

23 August 2004

by

Chris Marnay & Owen Bailey

[C\\_Marnay@lbl.gov](mailto:C_Marnay@lbl.gov) - +1.510.486.7028

[OCBailey@lbl.gov](mailto:OCBailey@lbl.gov) - +1.510.486.5462

[der.lbl.gov](http://der.lbl.gov)

research supported by the Distributed Energy Program of the U.S. Dept of Energy (and the California Energy Commission)



**CERTS**  
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

# Outline

---

- I. The CERTS Microgrid
- II. Distributed Energy Resources  
Customer Adoption Model (DER-CAM)
- III. NBVC Port Hueneme Building 1512 Study
- IV. Limitations of the Macrogrid
- V. “The” Correct Level of Reliability
- VI. Conclusion

combined heat and power (CHP) (the missing 27%) (cooling!)  
& reliability and power quality (PQR)  
can/should we make a paradigm shift to a more dispersed power system?



---

# I. "The CERTS Microgrid"



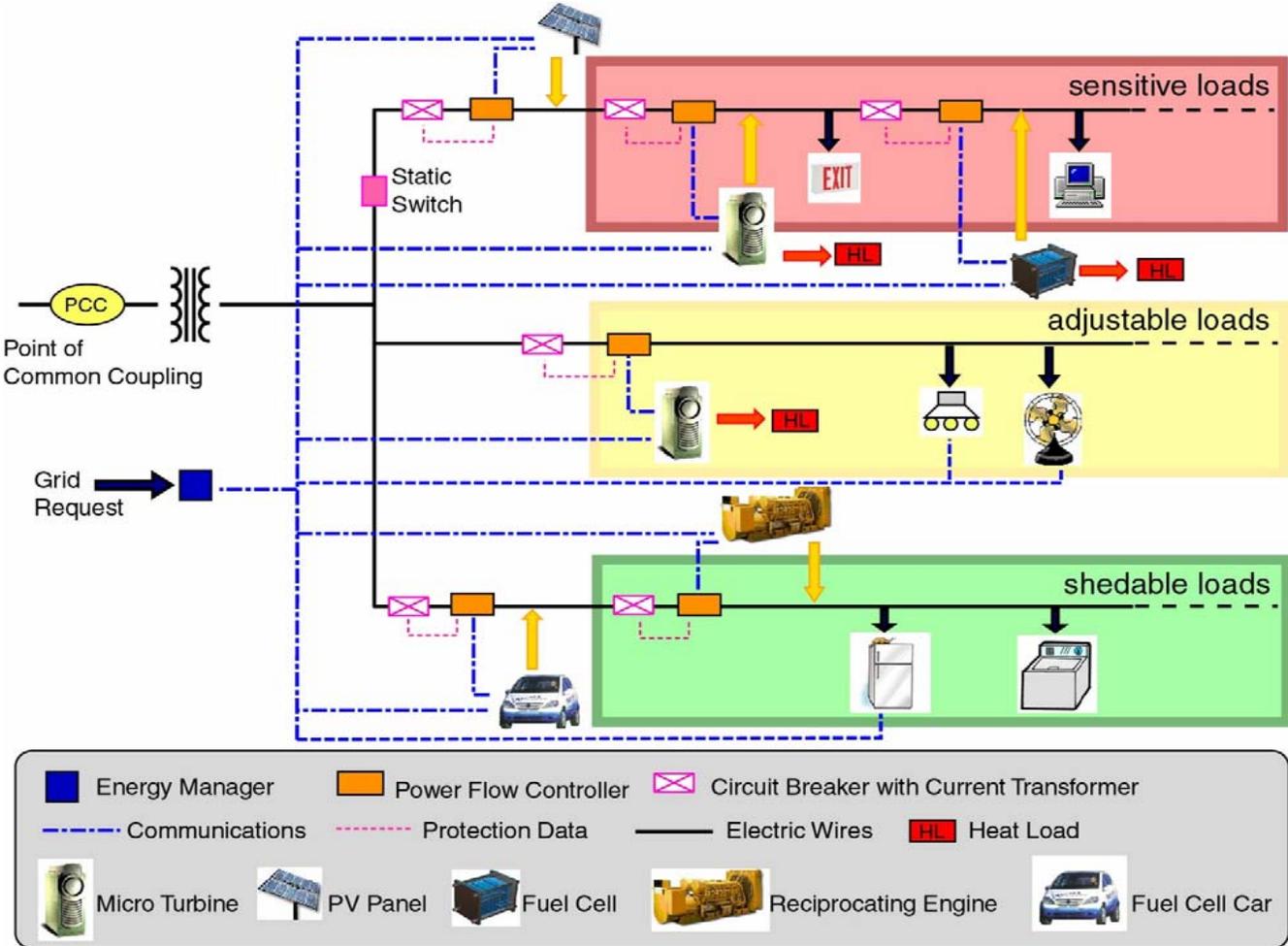
# The CERTS Microgrid is ...

---

- controlled by “customers” based on internal requirements subject to the technical, economic, and regulatory opportunities and constraints faced.
- designed and operated to jointly provide heat and power and heterogeneous power quality and reliability.
- a cluster of small (e.g. < 500 kW) sources, storage systems, and loads which presents itself to the grid as a legitimate entity, i.e. as a *good citizen*.
- interconnected with the familiar wider power system, or *macrogrid*, but can island from it.
- controlled by local intelligent inverter like power electronic devices.



# Example CERTS Microgrid

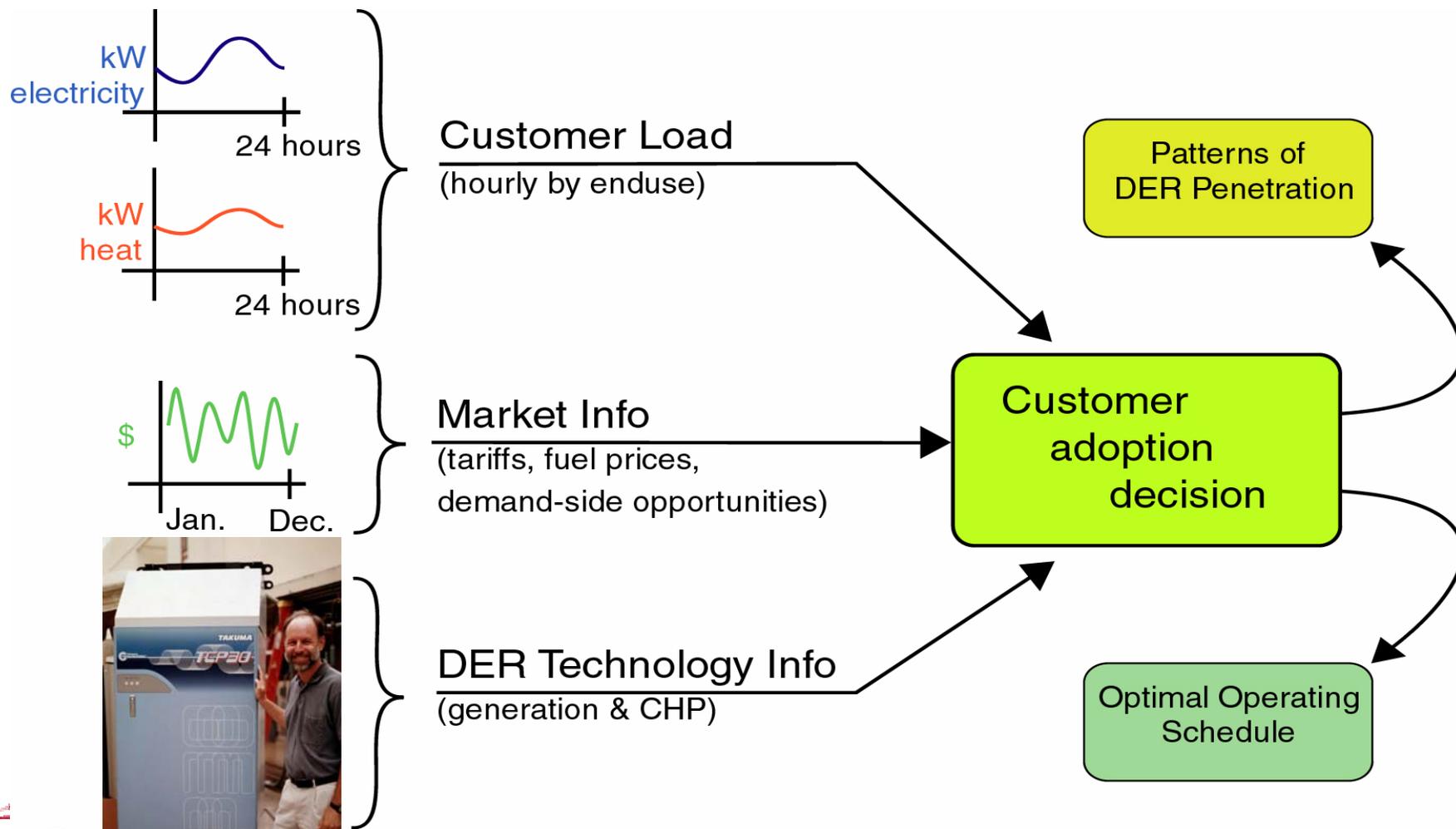


---

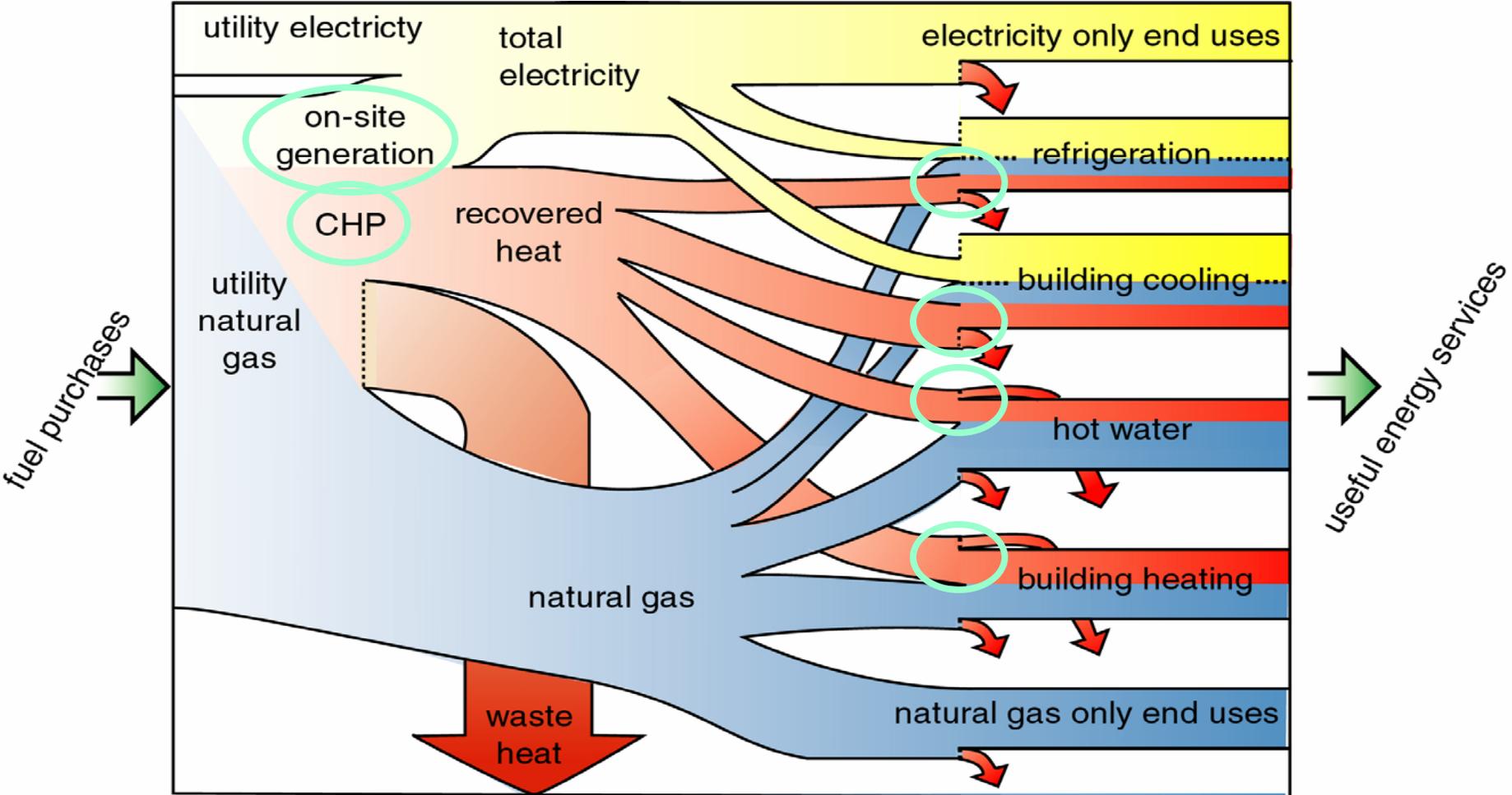
## II. Distributed Energy Resources Customer Adoption Model (DER-CAM)



# DER Customer Adoption Model (DER-CAM)



# Energy Flows Incorporating CHP



○ technology adoption decisions



---

## III. NBVC Port Hueneme Study



# Building 1512, Port Hueneme



NEX, Commissary, food court,  
etc. (13 000 m<sup>2</sup>)

big elec. consumer (3500 MWh/a)

one solution: install

-300 kW NG engine abs. cool.

-100 kW NG with CHP

-300 kW PV

annual bill savings: 25%

overall energy eff.: 35%→73%

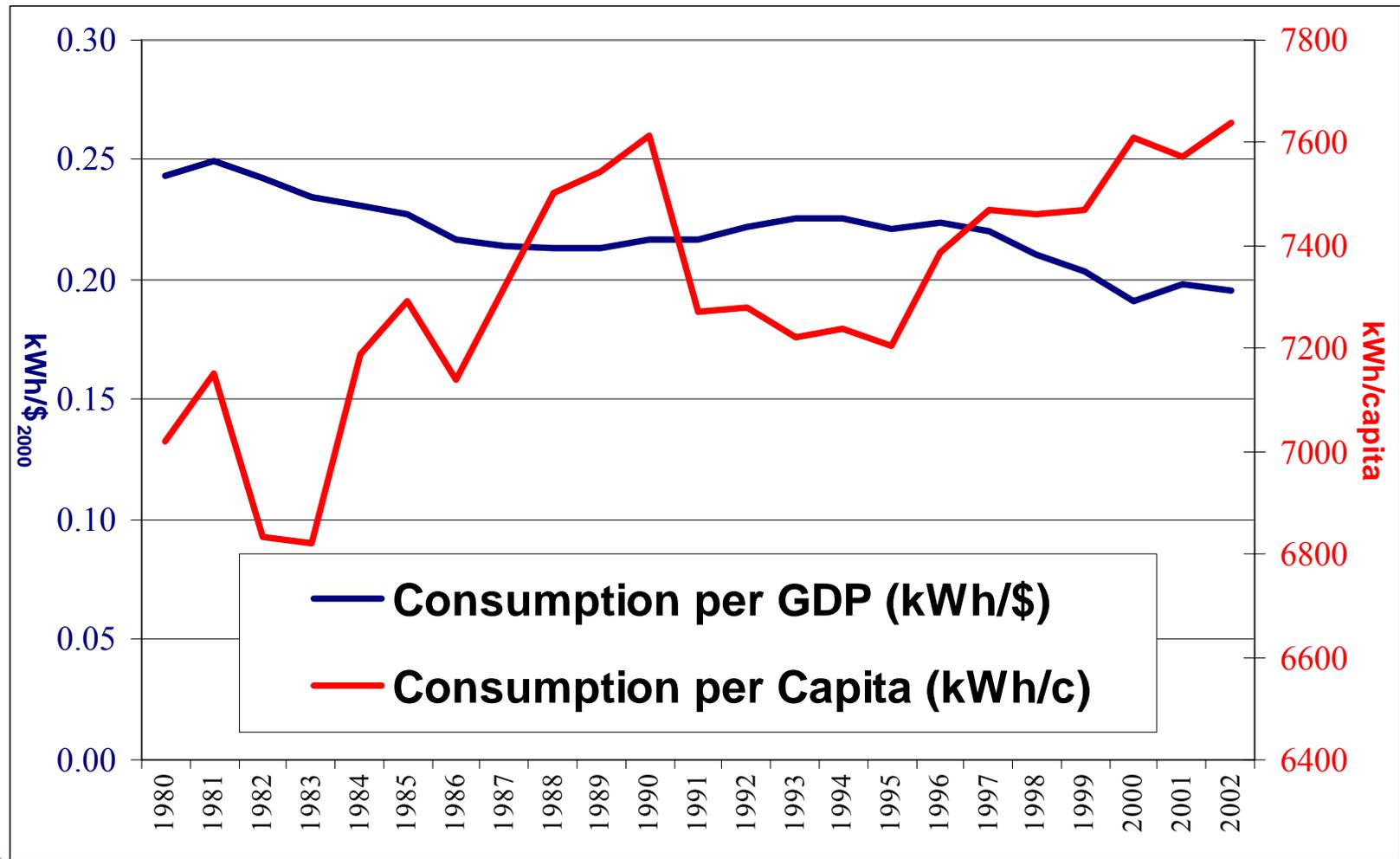
C emissions: 612 t/a→ 376

---

## IV. Limitations of the Macrogrid



# California Electricity Use



# Limits of Current Power System

---

- efficiency limits (losses, carbon, CHP)

-----

- restrictions on power system expansion
  - siting, environmental, rights-of-way, etc.
- centralized power system planning
- volatile bulk power markets
- economics drives operates closer to limits
- insecure system
- multiple infrastructure interdependencies
- electricity a multi-attribute commodity

-----

- heterogeneous power quality and reliability (PQR)



# Lessons from 2003 Blackouts

---

- summer of 2003 saw a series of outages: northeastern U.S. and Canada, Italy, London, Sweden
- U.S.-Canada blackout left system intact
- yet it took 3 days for full service restoration
- interdependent systems are vulnerable



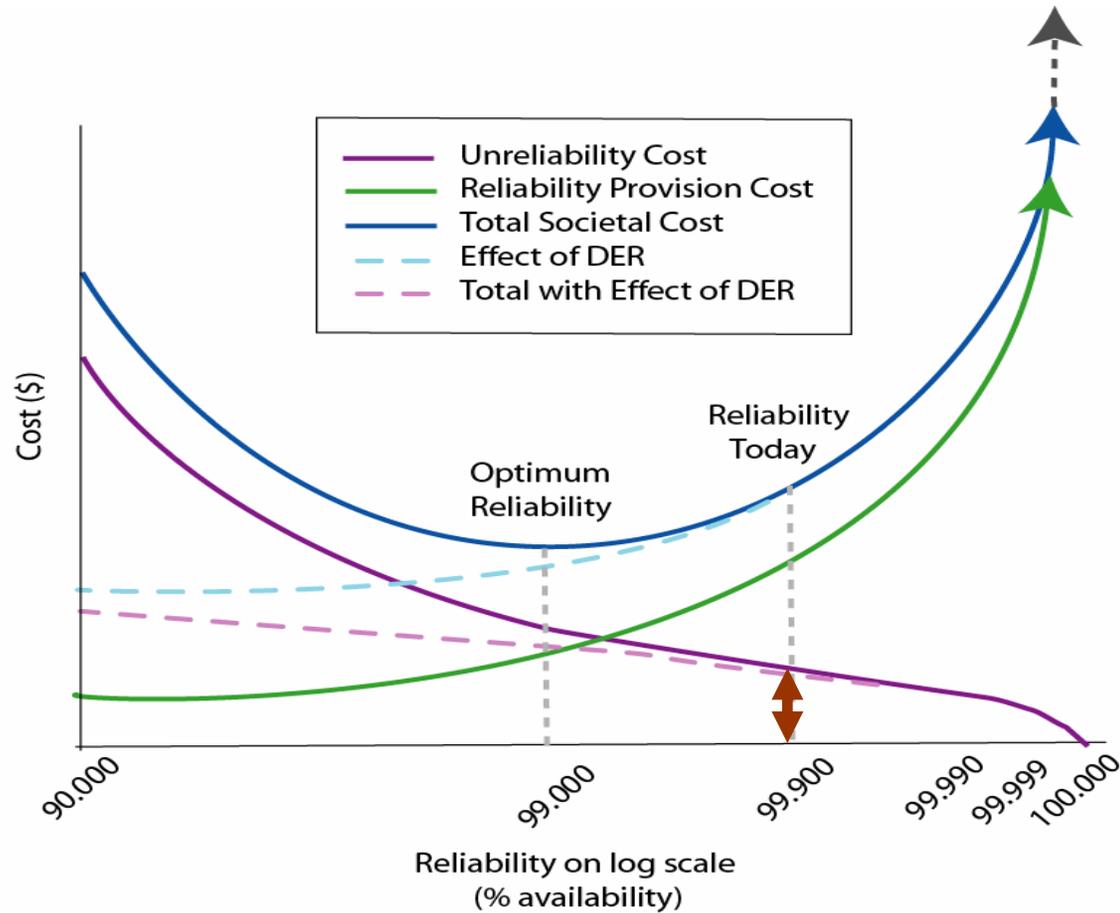
---

## V. "The" Correct Level of Reliability

- universal service reliability (homogeneous)
- end use reliability (heterogeneous)

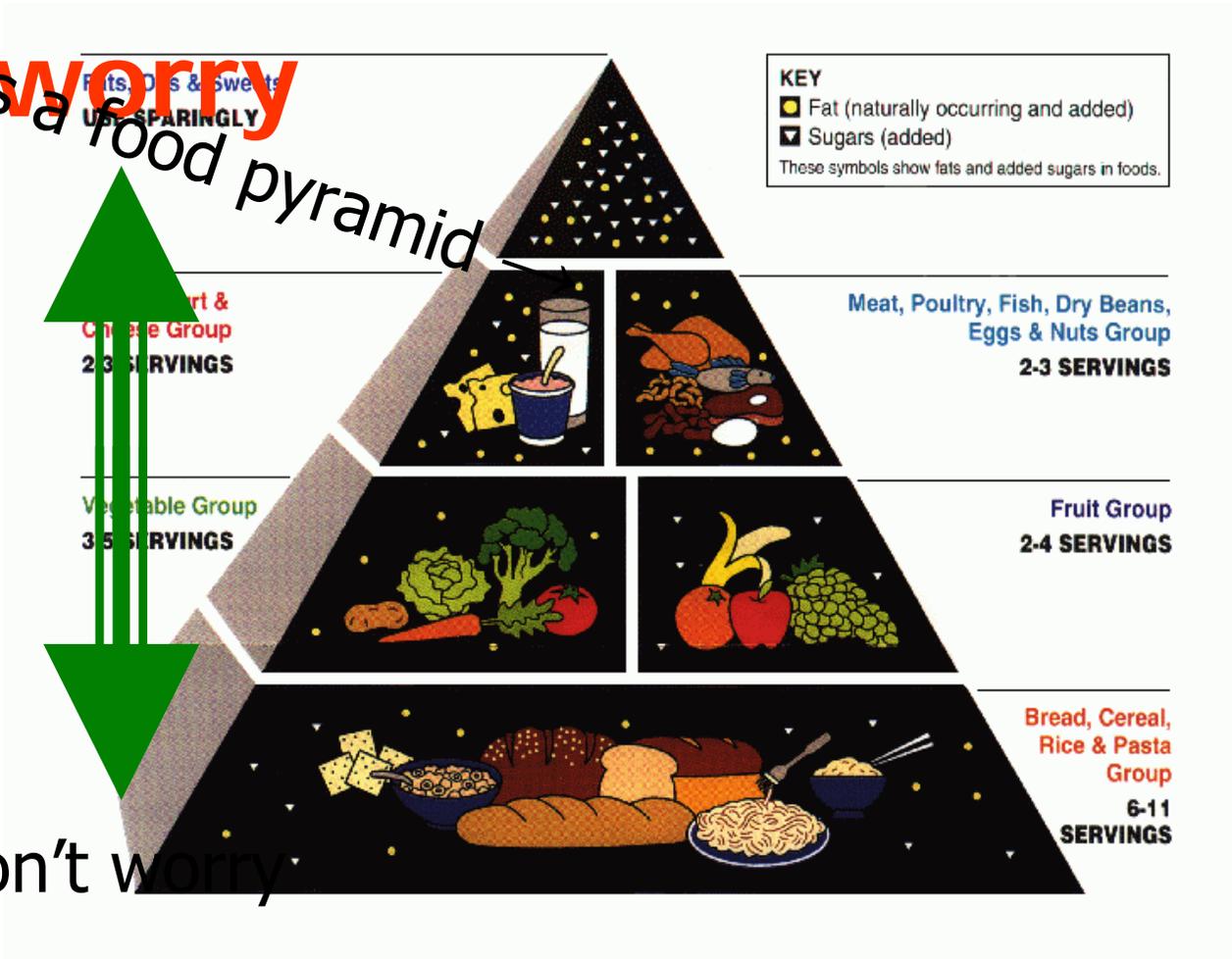


# The Optimal Universal Level of Electricity Supply Reliability



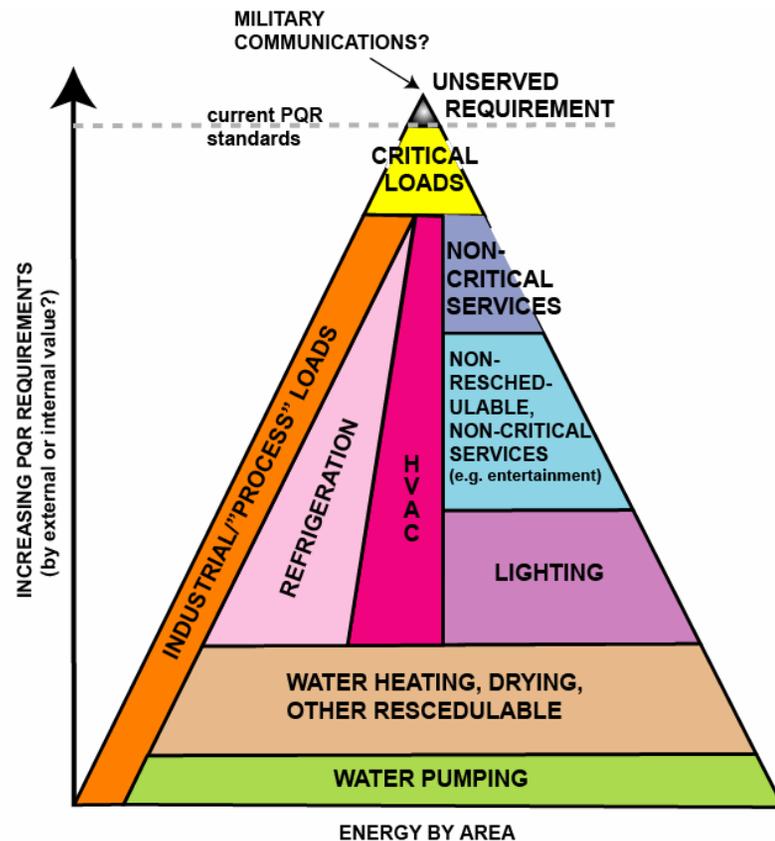
# Why a Pyramid?

This is a **worry** food pyramid



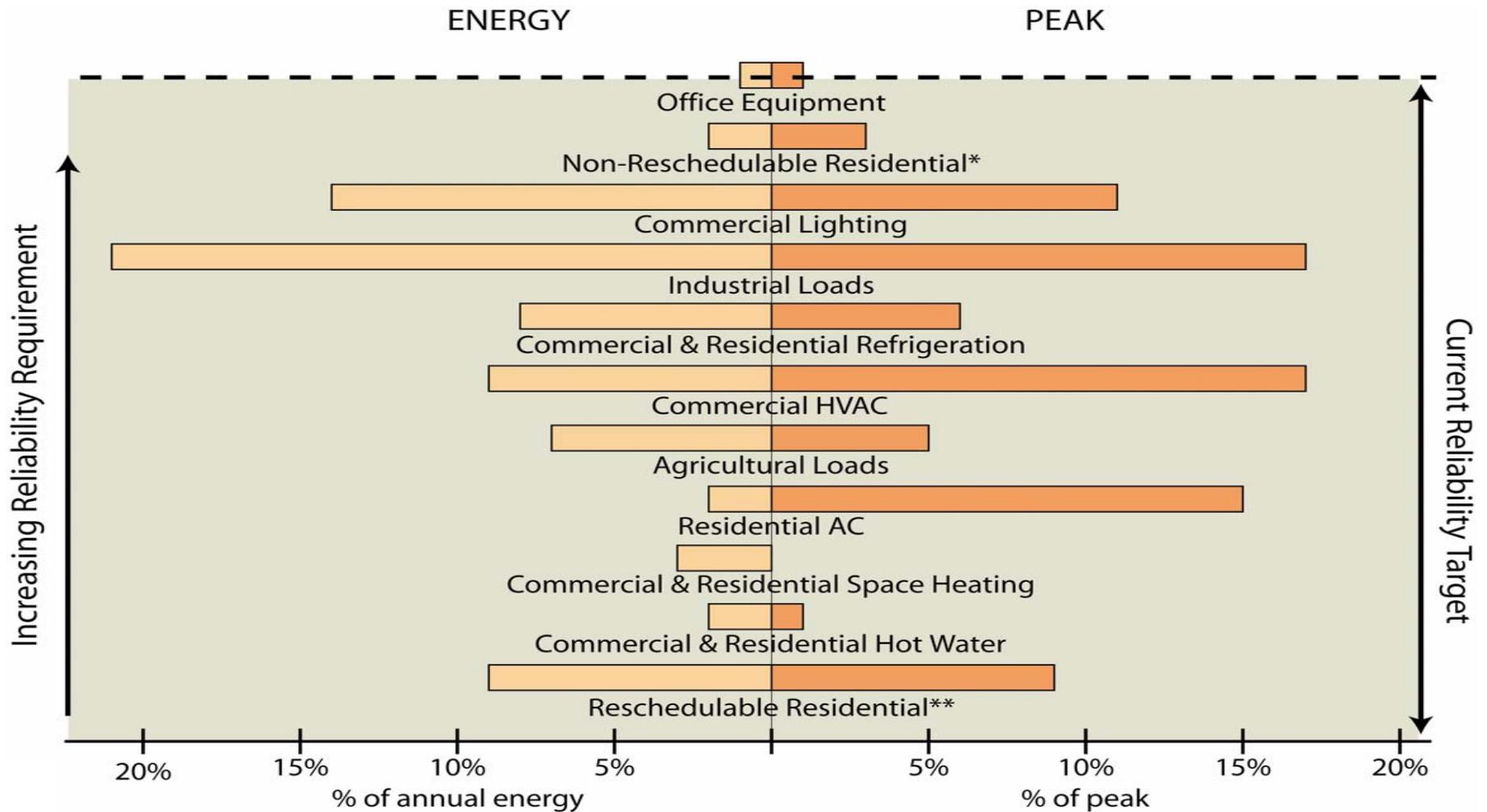
don't worry

# 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

# 1999 California Electricity Consumption by End-Use



\* includes cooking and TV

\*\* includes dryers, pools & spas, freezers, dishwashers, waterbed heaters, and clothes washers

source: Brown & Koomey, Energy Policy 2003

# Conclusions

---

- CERTS Microgrid is one DER technology
- power conversion local to loads in microgrids  
(e.g. CERTS Microgrid) can deliver a cost, efficiency, and reliability gain
- DER-CAM begins systemic analysis of building energy systems, i.e. directly considers CHP
- our understanding of other issues, notably reliability is rudimentary
- many other issues to consider  
(come to our informal session Tue at 2 pm)

