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# Renewable Energy: Back to the Future?

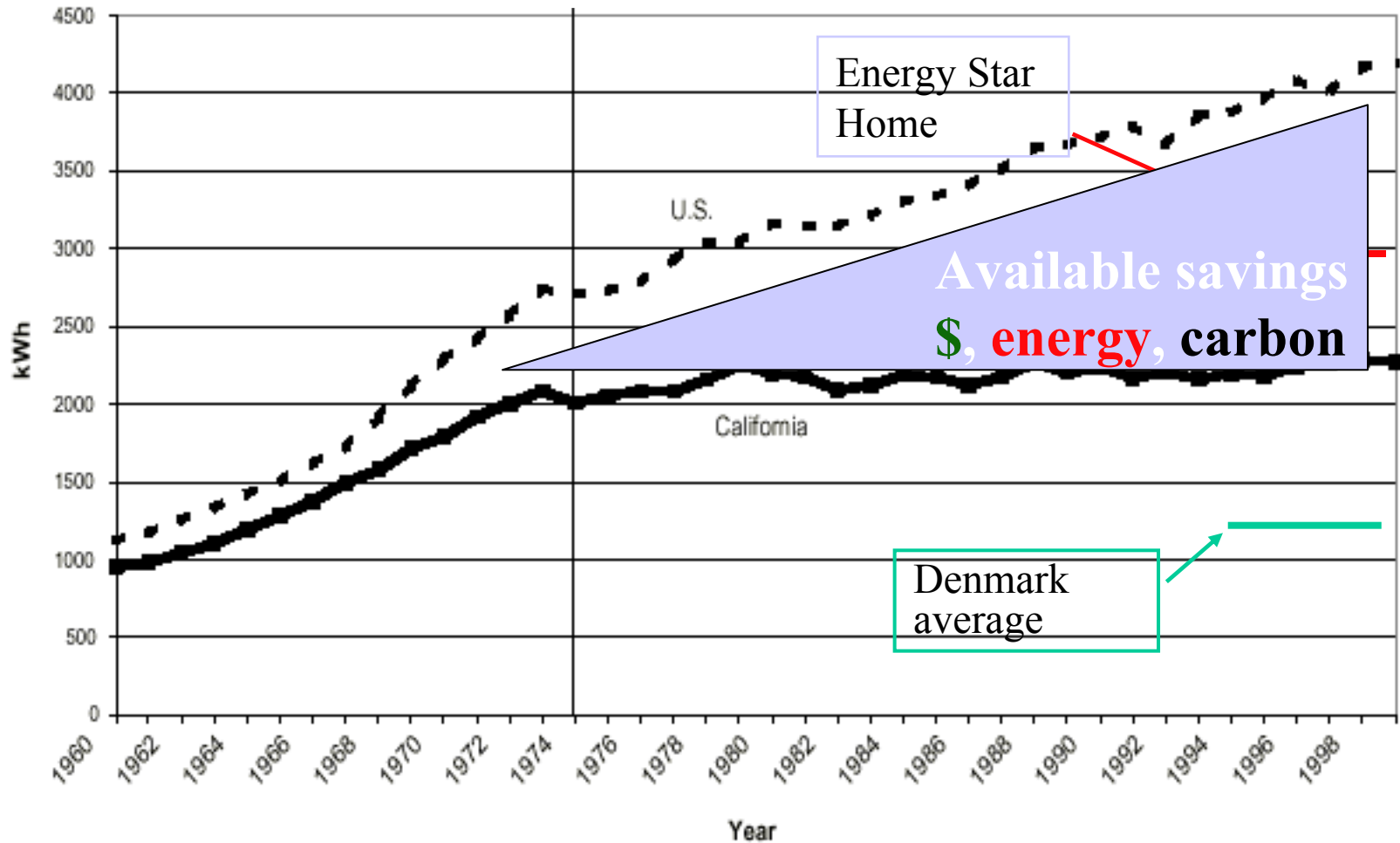
Daniel M. Kammen

Co-Director, Berkeley Institute of the Environment

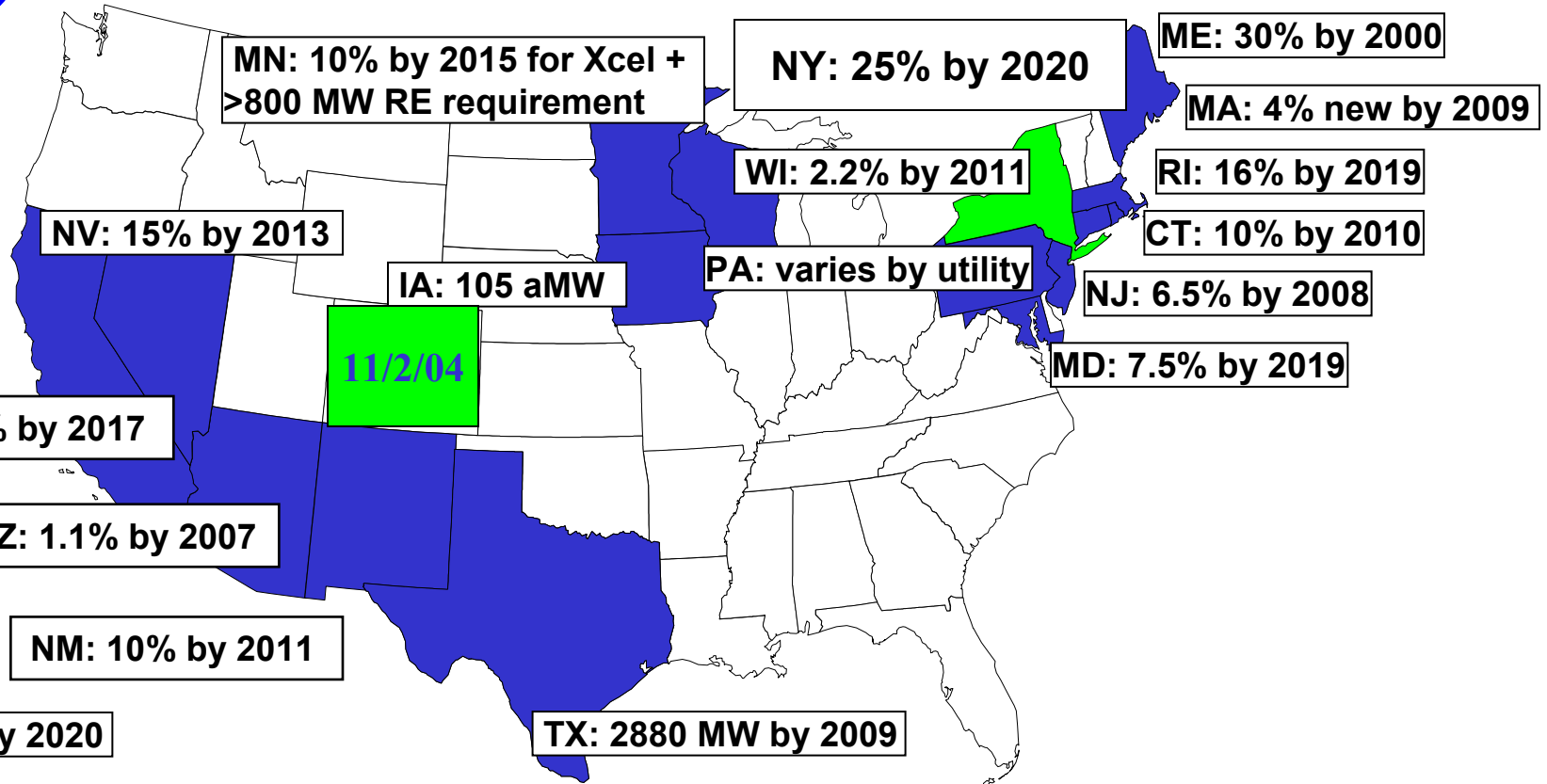
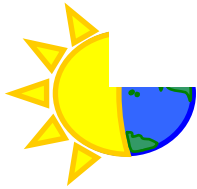
Professor, Energy and Resources Group & Goldman School of Public Policy

University of California, Berkeley

# U. S. Residential Electricity Use (kWh/capita, 1960 - 2000)

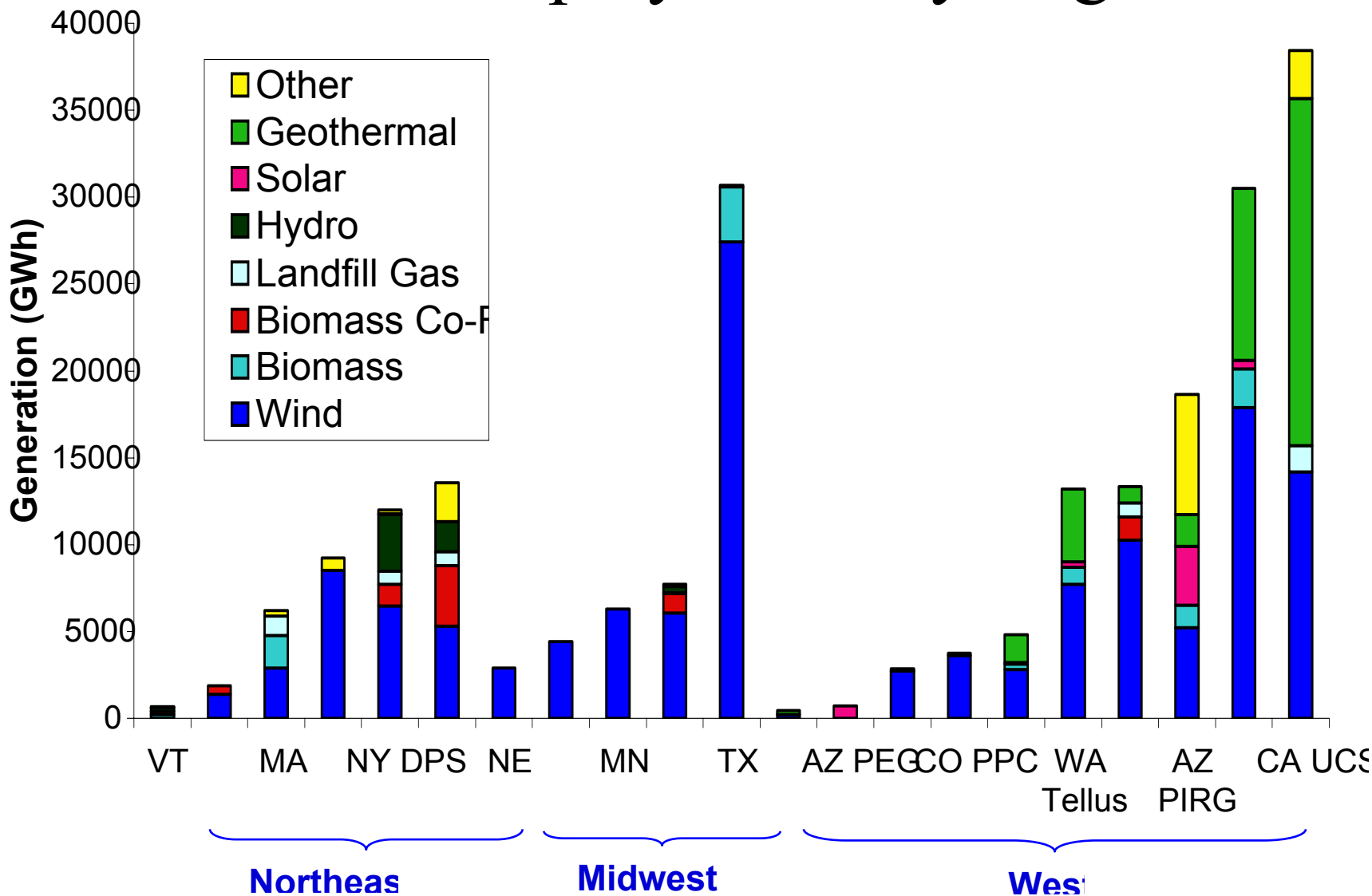


# State Renewables Portfolio Standards and Mandates in 17 States + DC

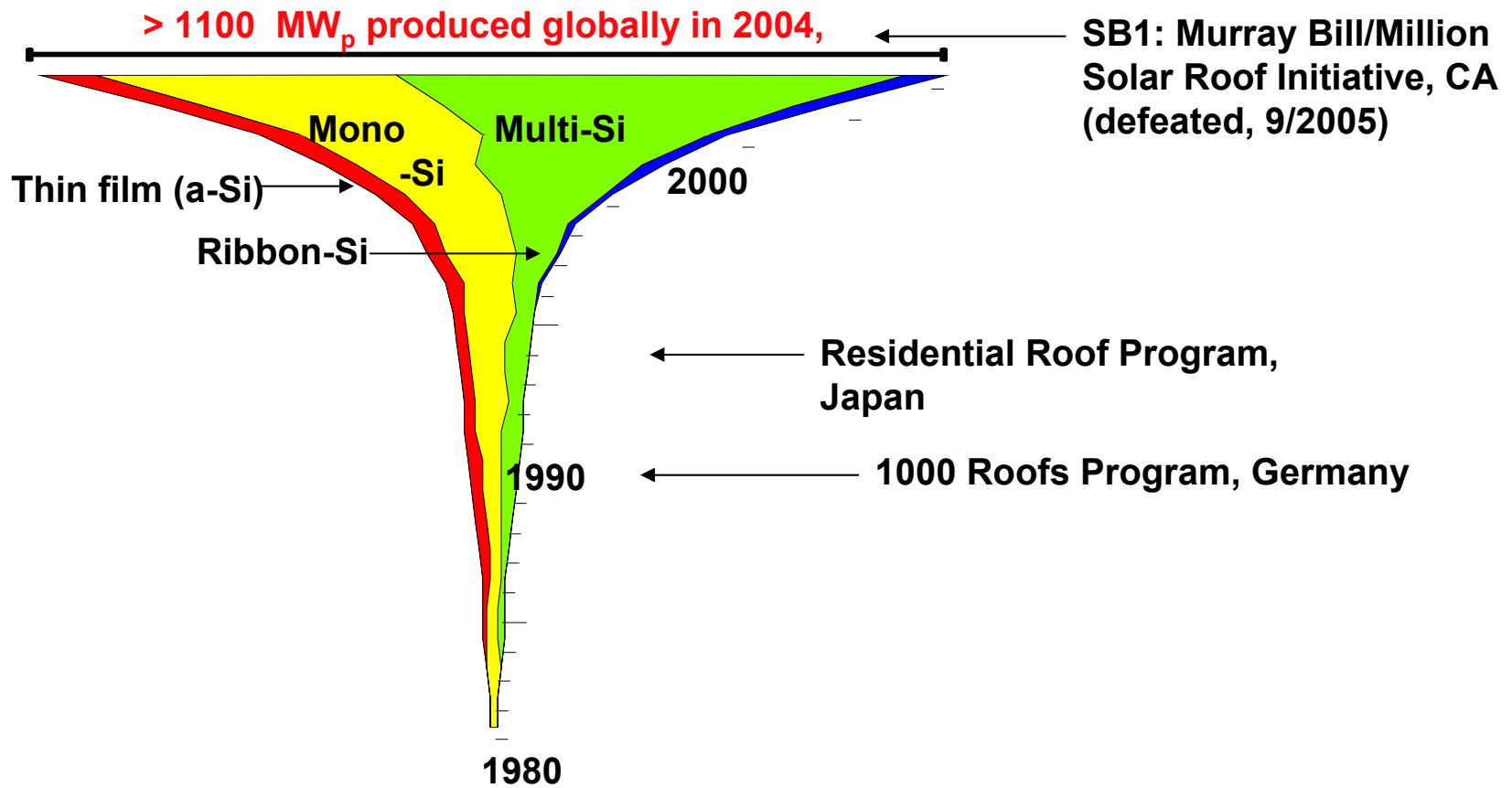
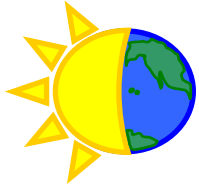


- Renewable energy “goals” established in Illinois and Minnesota
- RPS being considered in many other states (e.g., VT, WA); potentially revised in others (ME, PA, WI); and national RPS is being discussed (by some)

# RPS Deployment: By Region



# Expansion of Global Solar Industry: 20% Growth Per Year for 10 years



# Solar Energy for Many Applications

Moscone Center: 675,000 W



Kammen home: 2400 W

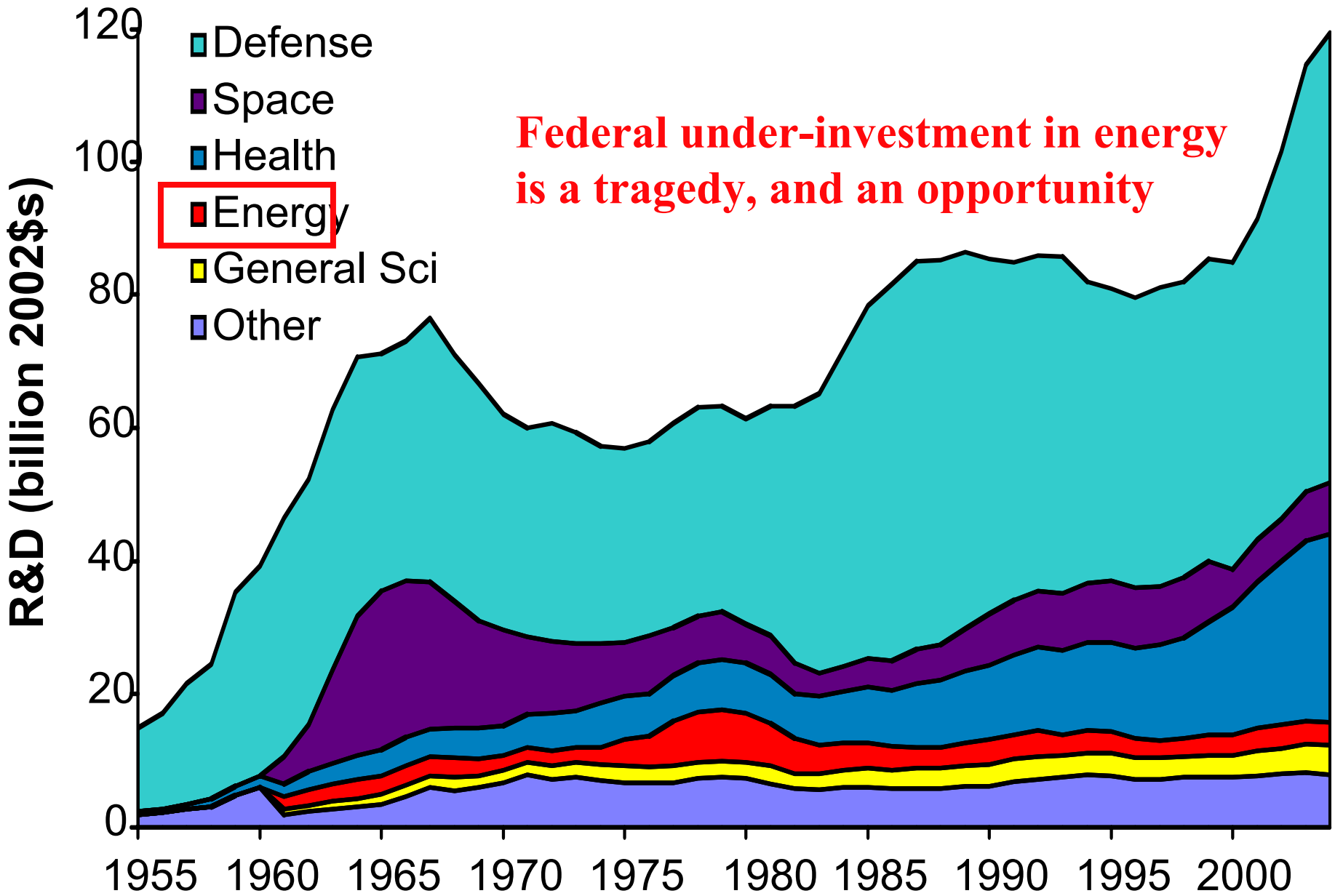


**Key finding: Investment in solar energy research and deployment pays dividends for *many* applications and for businesses *across scales*.**

Kenyan PV market:  
Average system: 18W



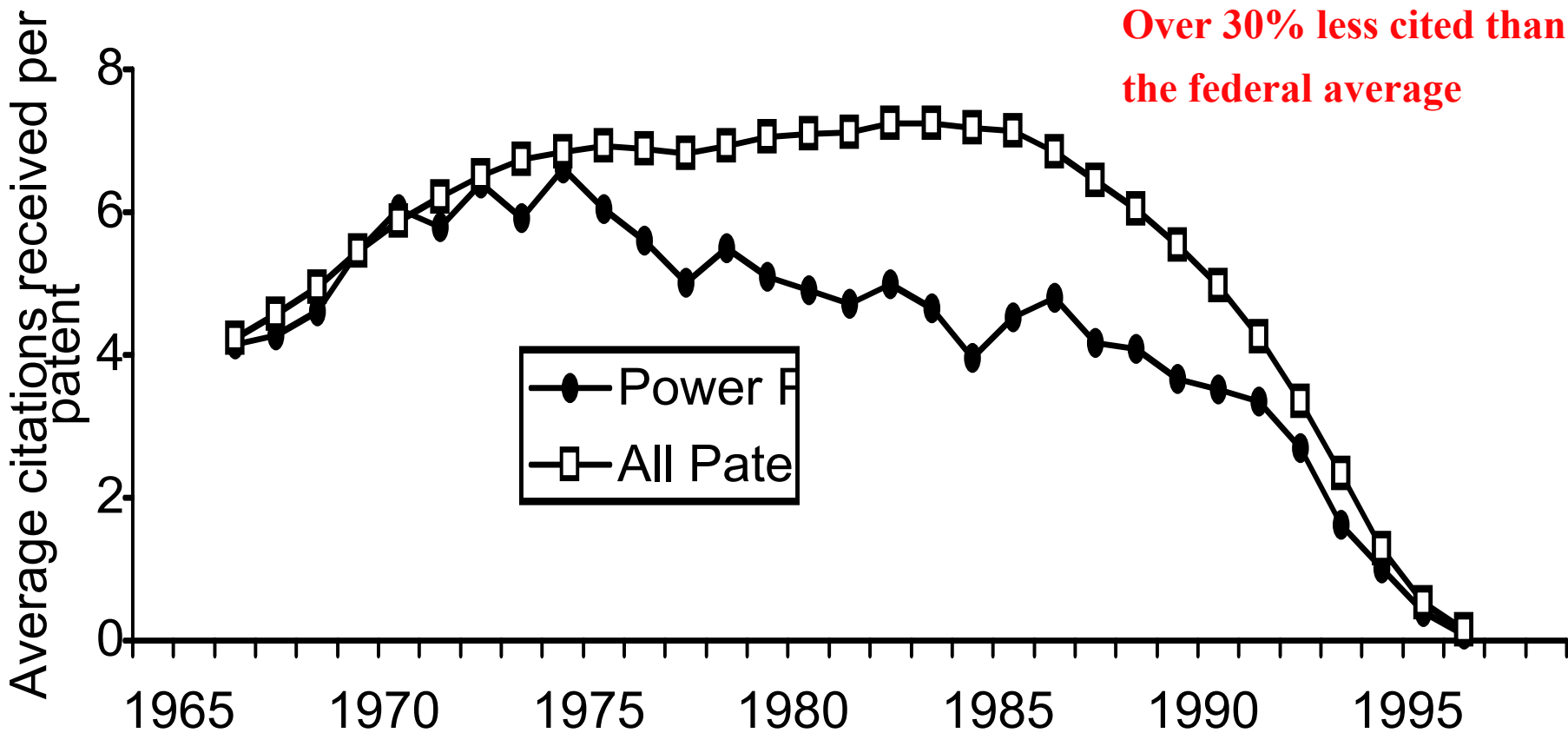
# Federal R&D Investments, 1955 - 2004



**Federal under-investment in energy is a tragedy, and an opportunity**

# Citations Receive "Energy Sector" v

**Energy patents:  
Over 30% less cited than  
the federal average**





UNIVERSITY OF CALIFORNIA  
BERKELEY



REPORT OF THE  
RENEWABLE AND APPROPRIATE ENERGY  
LABORATORY

**Putting Renewables to Work:  
How Many Jobs Can the  
Clean Energy Industry  
Generate?**

by

**Daniel M. Kammen  
Kamal Kapadia  
Matthias Fripp**

of the  
Energy and Resources Group &  
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APRIL 13, 2004



Finding:

Investments in energy efficiency and renewables creates 3 - 5 *times* more jobs than similar investments in fossil fuel energy systems

Report  
available

at: <http://socrates.berkeley.edu/~rael/papers.html>

1942...

When you ride **ALONE**  
you ride with Hitler!



Join a  
**Car-Sharing Club**  
**TODAY!**

2002...

When you ride **ALONE**  
you ride with bin Laden



What the Government **SHOULD** Be Telling  
Us to Help Fight the War on Terrorism

**BILL MAHER**

# A QUICK COMPARISON OF SEVERAL NEW AND EMERGING "GREEN" VEHICLES AS YOUR PRIMARY, URBAN CAR

CONVENTIONAL VEHICLE (CV): Ford Focus



HYBRID ELECTRIC VEHICLE (HEV): Toyota Prius

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV): "Prius Plus"



PROTOTYPE ALL-ELECTRIC VEHICLE (EV):

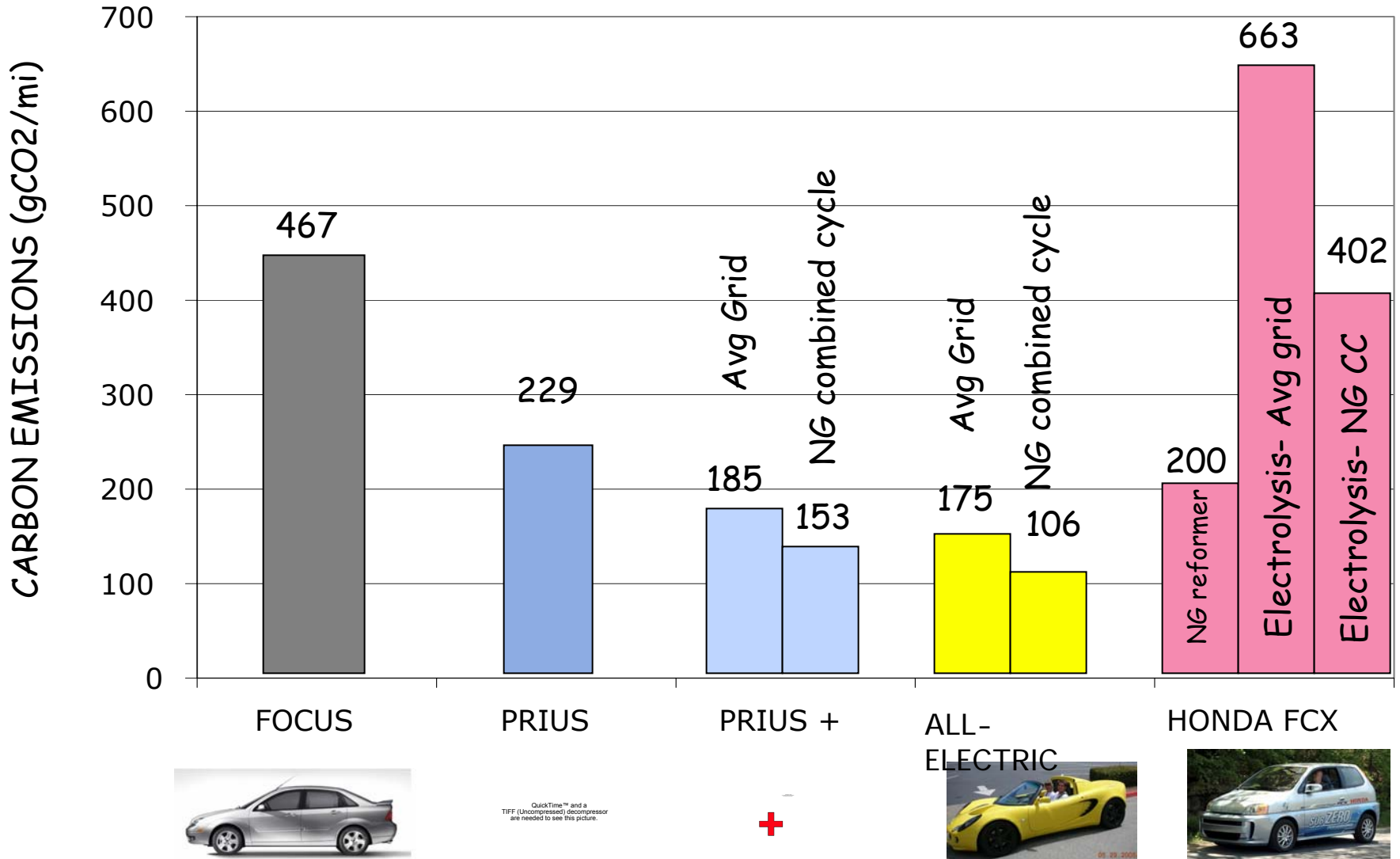


FUEL-CELL, HYBRID ELECTRIC VEHICLE (FCHEV): Honda FCX

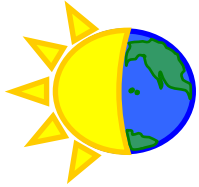


gil masters 6-26-05

# CARBON EMISSIONS FOR THE FIVE VEHICLES:



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

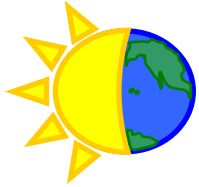


# Key Areas for Action

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- **Establish a set of energy challenges & prizes**
  - Zero energy buildings
  - 200 mpg vehicles
  - Super-efficient appliances, etc. ...
- **Build on California AB 1493 with aggressive California clean vehicle standards**
- **Reflect the value of clean and secure energy in mainstream economic analysis**
- **Apply Occam's Razor: implement a carbon tax (er, fee) and an emissions trading system**



# Renewables: by Source

