

# Can Technology Save Us?



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3. Thinking ahead to the November presidential election, what is the single most important issue in your choice for president?

	4/13/08	2/1/08	1/12/08	12/9/07	11/1/07	9/7/07
Iraq/War in Iraq	18	19	20	23	29	35
Terrorism/National security	5	5	4	9	5	6
Economy/Jobs	41	39	29	24	14	11
Education	2	2	2	1	2	1
Environment	*	1	1	1	2	1
Health care	7	8	10	10	13	13
Ethics/Honesty/Corruption in government	4	4	5	4	4	6
Immigration/Illegal immigration	4	4	4	5	5	5
Abortion	1	1	1	1	1	1
Morals/Family values	2	2	2	3	3	2
Federal budget deficit	*	*	*	*	1	1
Housing/Mortgages	*	*	*	*	*	*
Global warming	0	*	*	*	*	*
Social Security	*	*	1	1	2	1
Foreign policy	1	1	2	1	2	1
Iran/Situation in Iran	0	0	*	0	*	0
Taxes	*	1	1	1	1	1
Guns/Gun control	*	*	*	*		
None/Nothing	*	*	*	1	*	*
Other	7	6	10	7	9	7
No opinion	5	7	7	7	8	9

# Save Us From What?

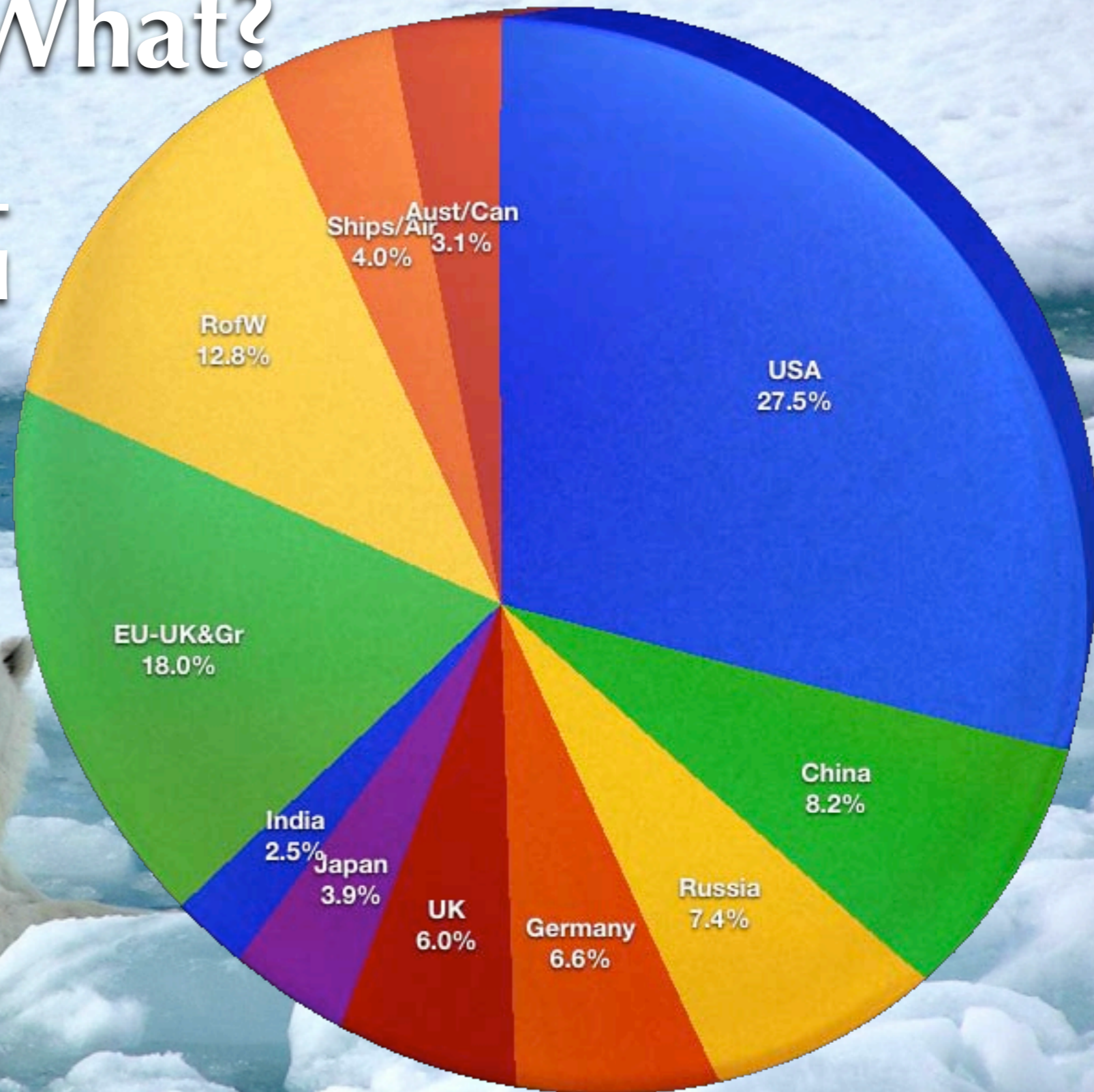
## ● Global Warming- Contribution Total Cumulative CO<sub>2</sub> 1750 to Present

April 19th,  
2008  
2:50 pm

It is hard to know what to fear most-  
global warming or government's  
response. The ethanol fiasco should  
make readily apparent that policy  
makers' priorities are local and  
political.

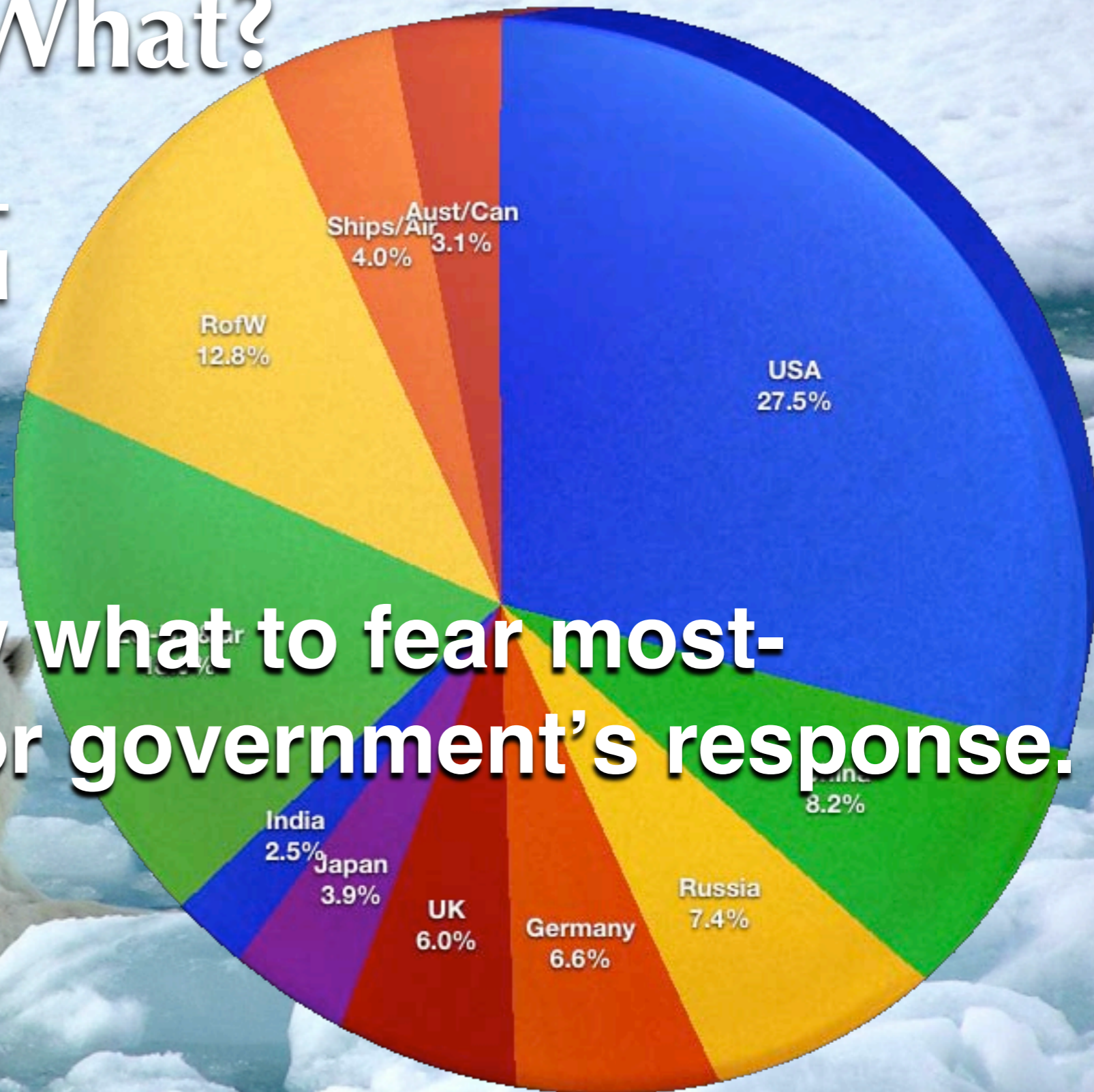
Create a market in carbon and don't  
subsidize any fuel. Government's  
role should be to stimulate  
technologies not prescribe "cures."

— Posted by PeterC



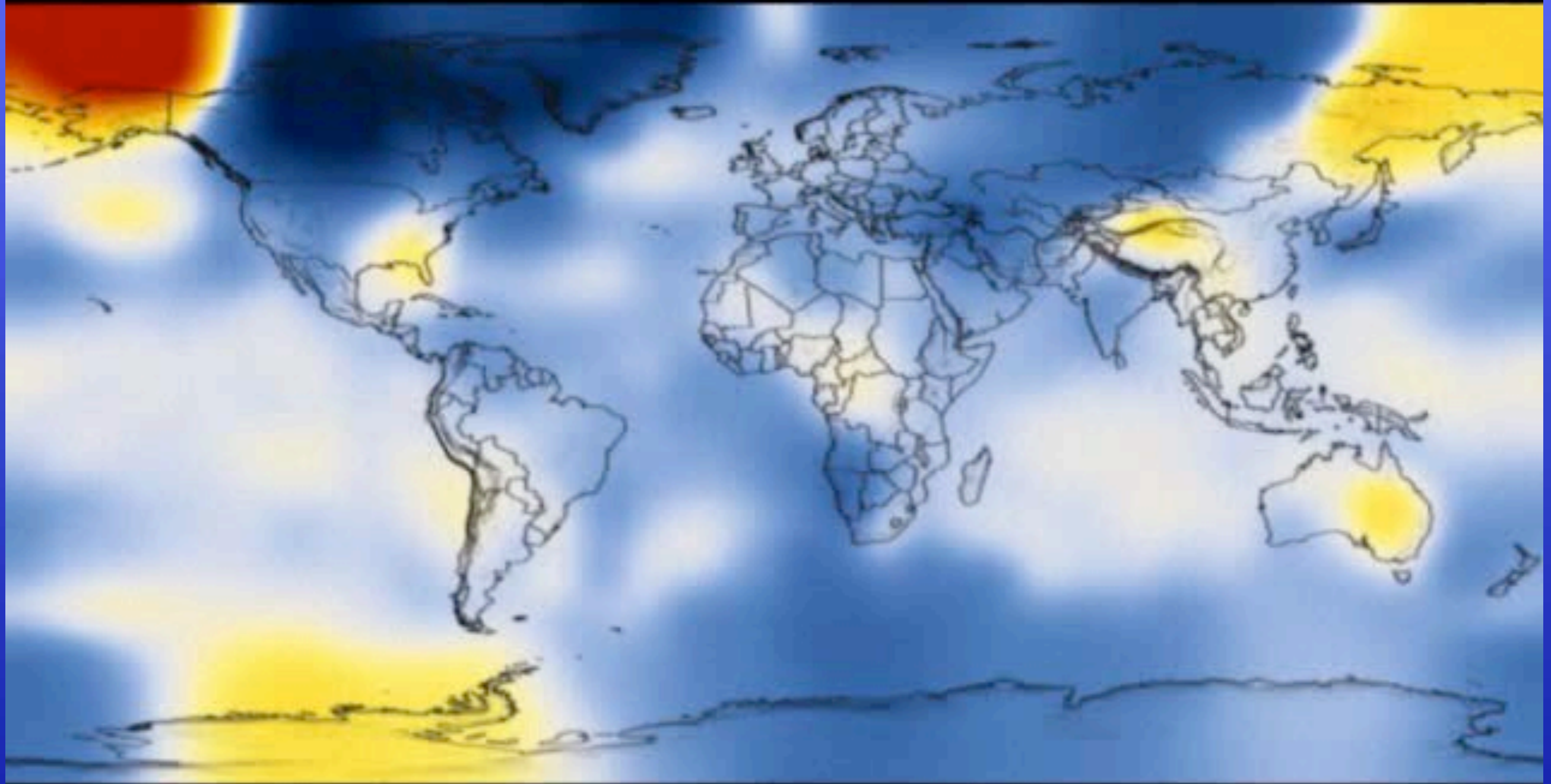
# Save Us From What?


● Global Warming-  
Contribution Total  
Cumulative CO<sub>2</sub>  
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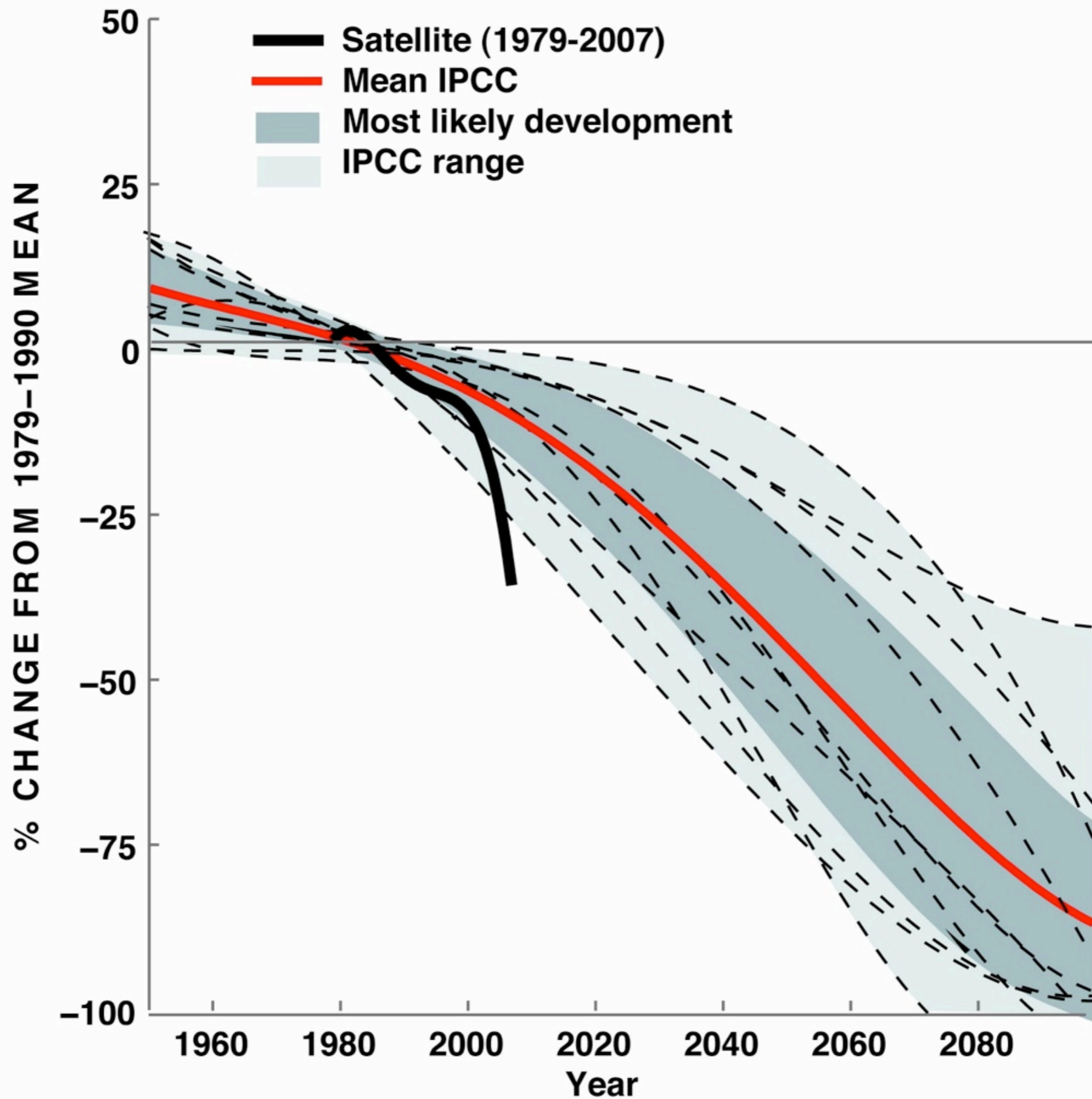


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global warming or government's response.

1884



 April 7, 2008- James Hansen, director of NASA's Goddard Institute for Space Studies, warned the world must urgently make huge CO<sub>2</sub> reductions, and that the European Union and its international partners must rethink targets for cutting CO<sub>2</sub> in the atmosphere because they have grossly underestimated the scale of the problem. Hansen says the EU target of 550 parts per million (ppm) of CO<sub>2</sub>—the most stringent in the world—should be slashed to 350 ppm. In the paper Hansen co-authored with eight other climate scientists, “Target Atmospheric CO<sub>2</sub>: Where Should Humanity Aim?,” submitted to Science magazine, his team used evidence from the Earth's history to estimate the sensitivity of the climate, which they say gives a much more accurate picture than using theoretical models. Hansen said, “If you leave us at 450ppm for long enough it will probably melt all the ice—that's a sea of 75 meters. What we have found is that the target we have all been aiming for is a disaster—a guaranteed disaster.”

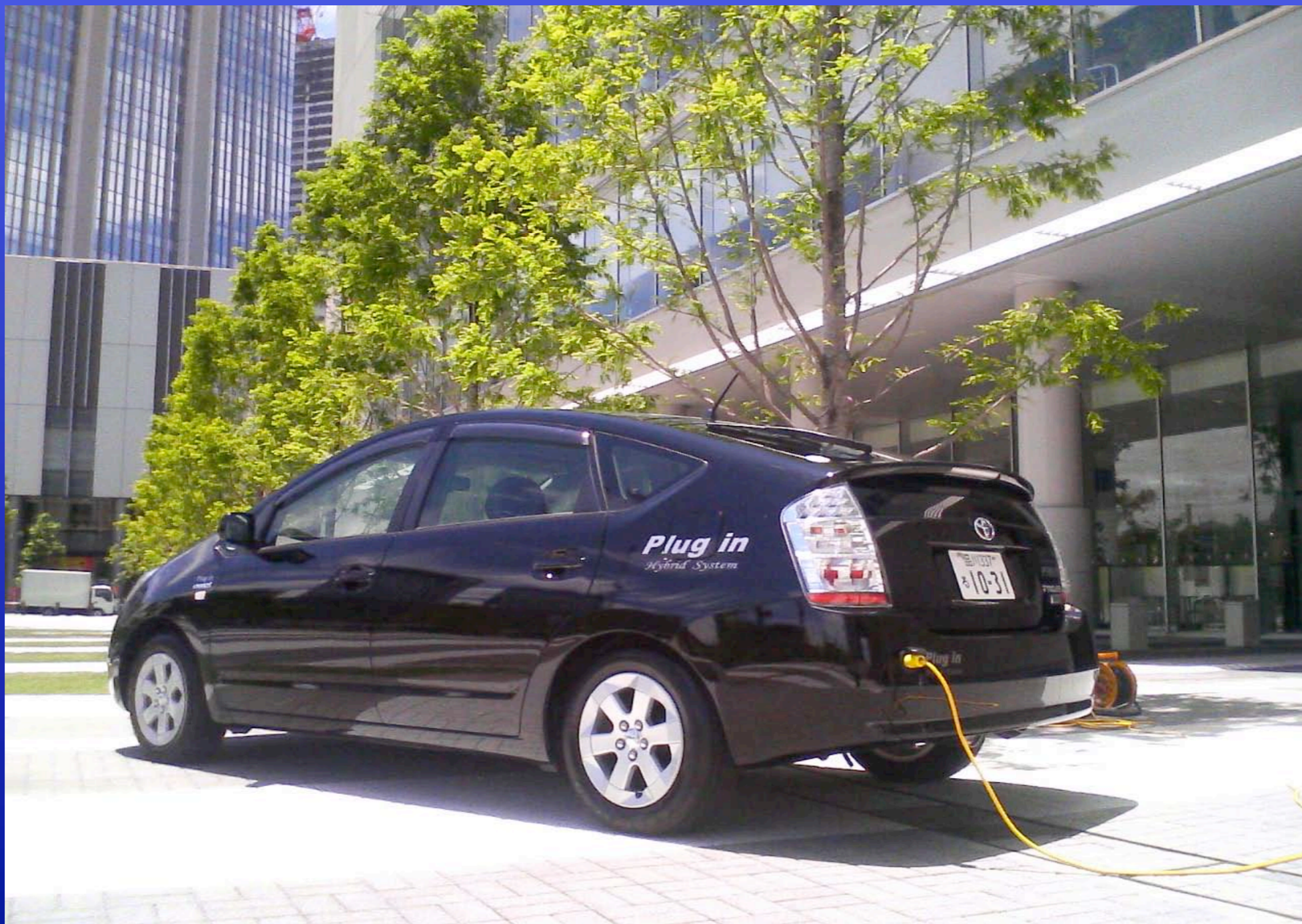


**Arctic sea ice loss compared to IPCC models**

# Can Technology Save Us?

## Technology Is Already Here!

### ● Electrification of Transportation





# Can Technology Save Us?

## Technology Is Already Here!

### ● Electrification of Transportation



# Chinese Electric Bikes and Scooters



# They Are Everywhere



# They Are Inexpensive

迎春 **特价** Bike

富丽鸽:	<del>2380</del>	2080元
中华海棠:	<del>1780</del>	1750元
锐捷:	<del>2380</del>	2000元
中华太子:	<del>2680</del>	2480元
美骑士:	<del>2580</del>	2280元
太阳雨:	<del>1980</del>	1780元

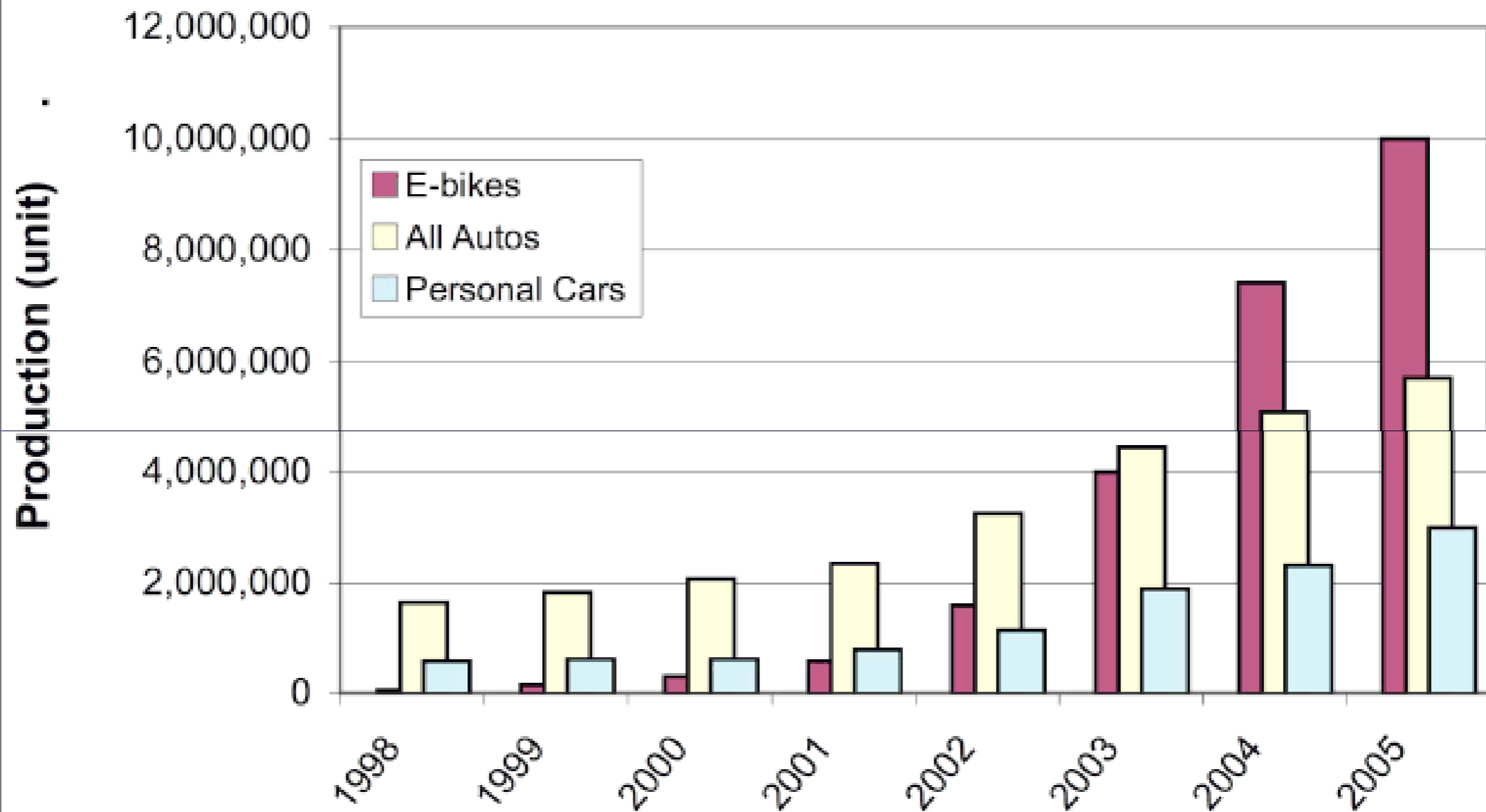
更多优惠 等你来拿  
金盾公司

大陆鸽电动自行车

中国科学院中科院三环国家投资  
电动自行车

# China E-bikes - 40+ Million In Less Than 10 Years

Figure 2: Production of E-Bicycles and Cars for the Domestic Market in China



Jamerson, F. and Benjamin, E., 2004 Electric Bicycle World Report, 7th Edition with 2005 update, 2005

# Renewable Energy

- Solar Water Heaters
- \$300-\$500 U.S.



# PV



- **15 MW Array Nellis AFB**
- **> 8 GW in 5 years**
- **2 GW/ Year Production**

# PV Future





# Concentrating Solar

- Competitive with Peaking Power
- Storage will Increase Capacity Factor > 80%.



# Hydrokinetics

- 25% of Off-shore Wave Energy @ 50% Efficiency = 80 to 100 GW New Capacity
- 90 GW New Hydro and Hydrokinetic Capacity Feasible



# Wind

- Buffalo Ridge, Minn. 55GW
- 140 GW Wind Inter-Connection Applications in RTOs Alone

WIND RESOURCES  
NEAR  
HENDRICKS



# Energy Efficiency

- Lighting
- My office - 50% savings above 1994 State of the Art System with new Retrofit



# Improved Quality and Productivity



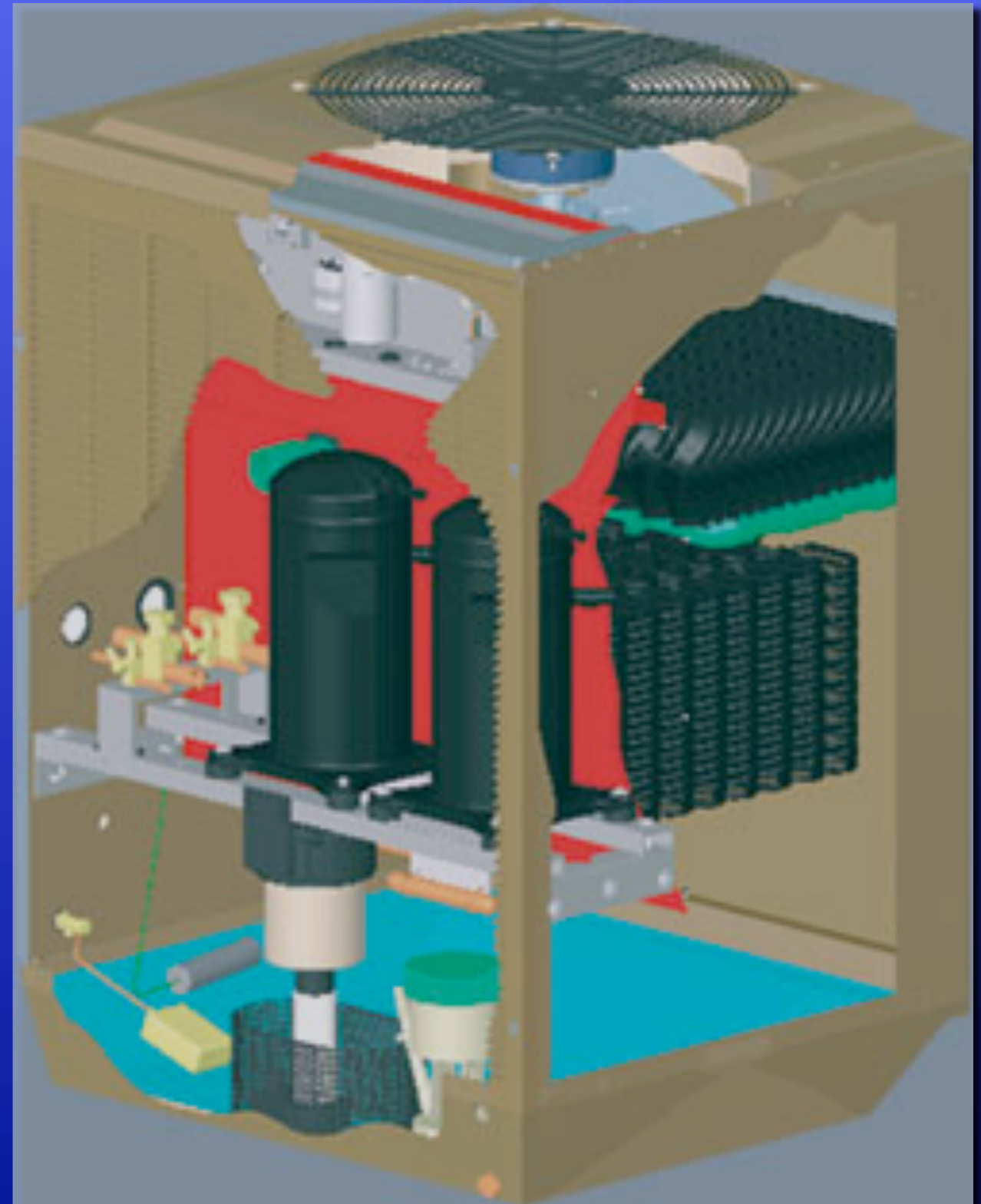
# Residential/Small Commercial AC

- 35% - 70% Savings over current SEER 13
- Buy down directly to Manufacturer EER 14.5
- 3000 + Mw Peak Savings in Ca with 6 year Program
- Market Transformation - \$4 Billion Transform U.S. Market



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# Waste Heat Recovery

- **Industrial Processes**

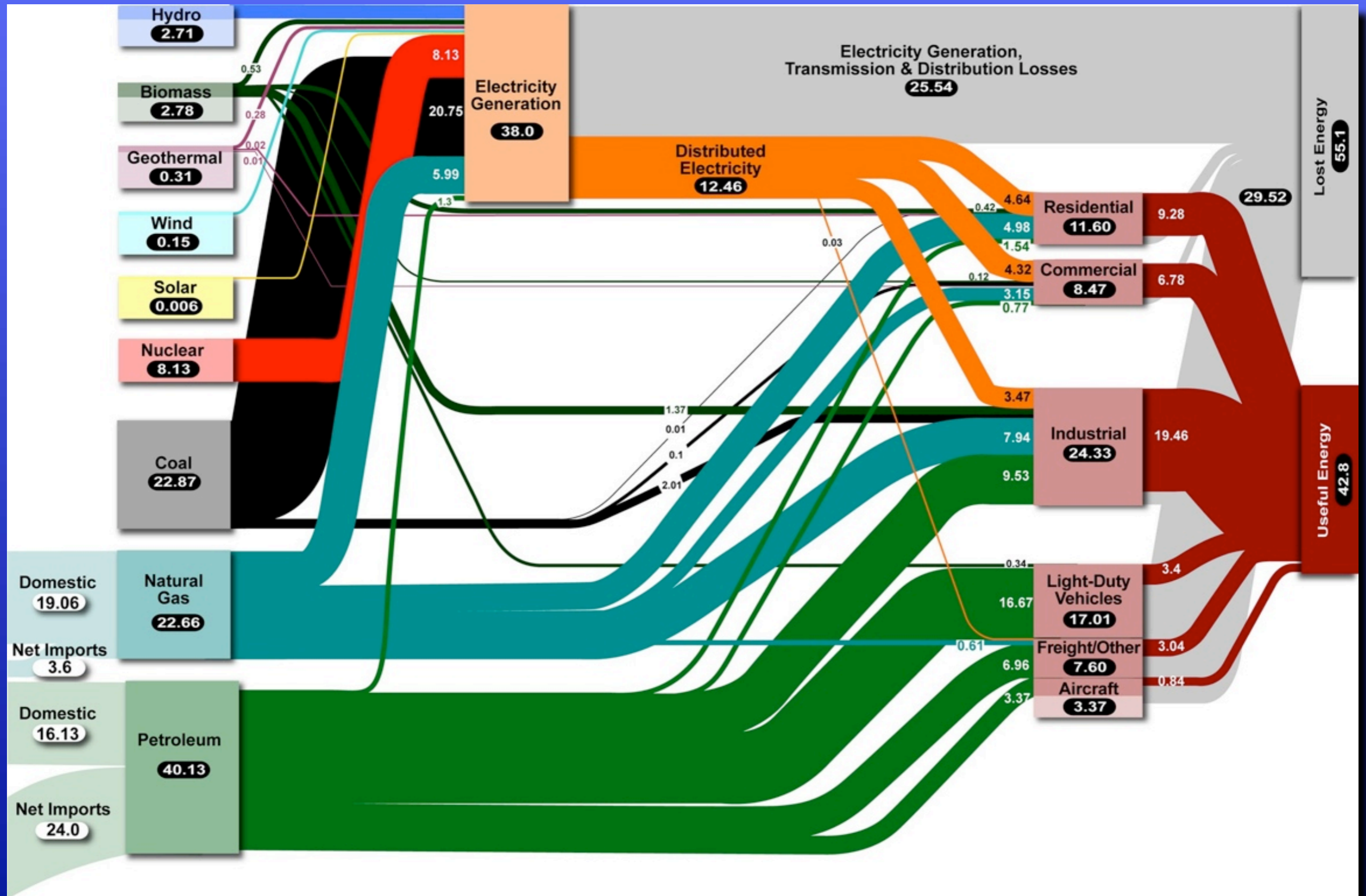
- **Wastes > 5 Quads of Energy**

- **Waste Heat Recovery Has No Emissions & Costs Less Than Avoided Cost of New Generation**





# Energy Flows U.S.



# Power Plant Efficiency & WHR

## Natural Gas Compressor Stations



- **“In the Fence” Generation**
- **Improved Reliability and Security**
- **Multiple Vendors**

# T&D Grid Efficiency

- **Grid Optimization Software**
  - **Increased Data Collection**
  - **Implementation nationwide could save consumers \$5-\$20 B per year**
  - **Save 20-30 GW of capacity**
- **Voltage Regulation 1% Savings**
- **Transformers 1-3% Savings**



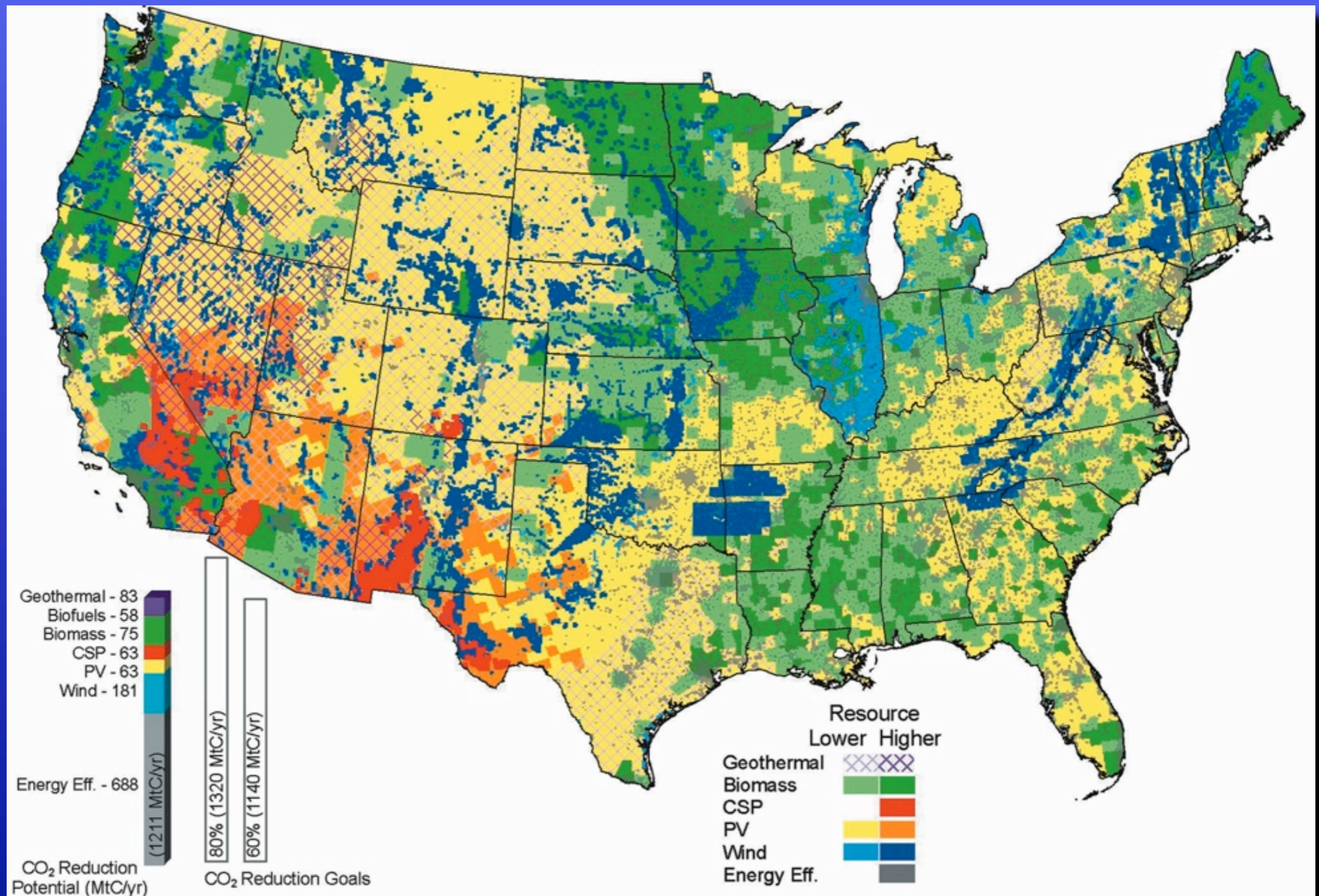
# Central Station Generation

## Efficiency

- VFD's
- Heat Recovery
- Digital Controls



# U.S. Carbon Reduction Emission Potential



# It Is Not The Technology

## It Is Us

- **Conflicting Regulatory Policies**

- March 31, 2008 - Nevada PUC Examines Third Party Ownership of Distributed Renewable Generation

- **Split or Conflicting Incentives**

- Landlord/Tenant- FERC Office Building

- **Lack of Authority, Motivation and Leadership**

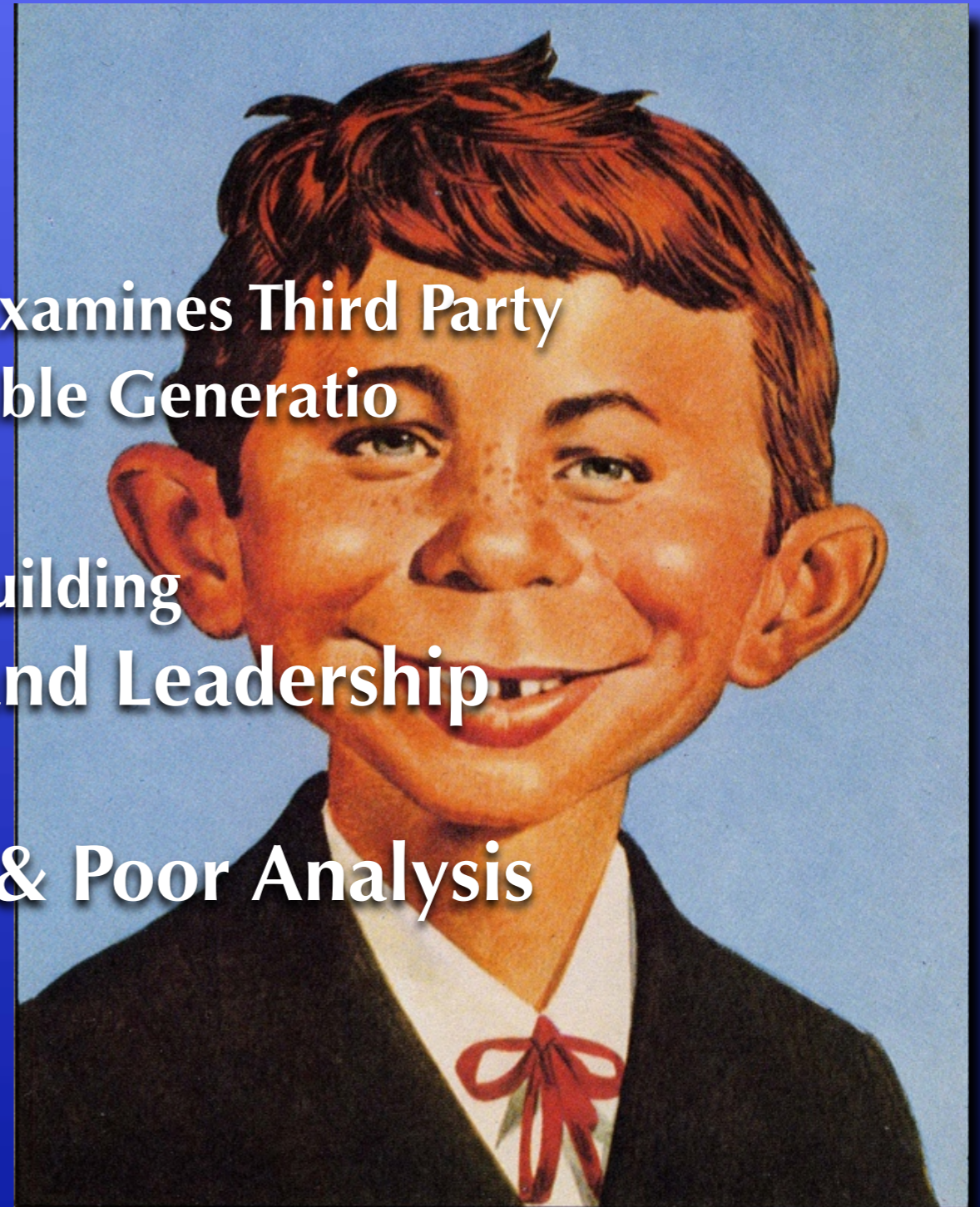
- DOE Transmission Story

- **Lack of or Wrong Information & Poor Analysis**

- PHEV

- Ethanol

- Infrastructure Opposition



“What’s me worry?”

# Wrong Information

## Recent Articles Have Suggested PHEVs:

### ● Will Require Massive Infrastructure Investment

("Hybrid Cars May Require Hundreds Of New Power Plants To Be Built, If Owners Charge Up During Peak Hours." Science Daily March 12, 2008, <http://www.sciencedaily.com/releases/2008/03/080312140123.htm>)

### ● Drain Our Water Supplies

("Plugging in to more water use- A big shift to electric vehicles could strain water resources in dry places", Environmental Science and Technology Online, February 20, 2008. [http://pubs.acs.org/subscribe/journals/esthag-w/2008/feb/tech/ee\\_waterplugin.html](http://pubs.acs.org/subscribe/journals/esthag-w/2008/feb/tech/ee_waterplugin.html))

### ● Even Increase Air Pollution

("Plug-in cars could actually increase air pollution", James R. Healey, USA TODAY, February 25, 2008, [http://www.usatoday.com/money/autos/environment/2008-02-25-plug-in-hybrids-pollution\\_N.htm](http://www.usatoday.com/money/autos/environment/2008-02-25-plug-in-hybrids-pollution_N.htm))

# Just Like Lipstick - Technology Used Improperly Can Be Ugly

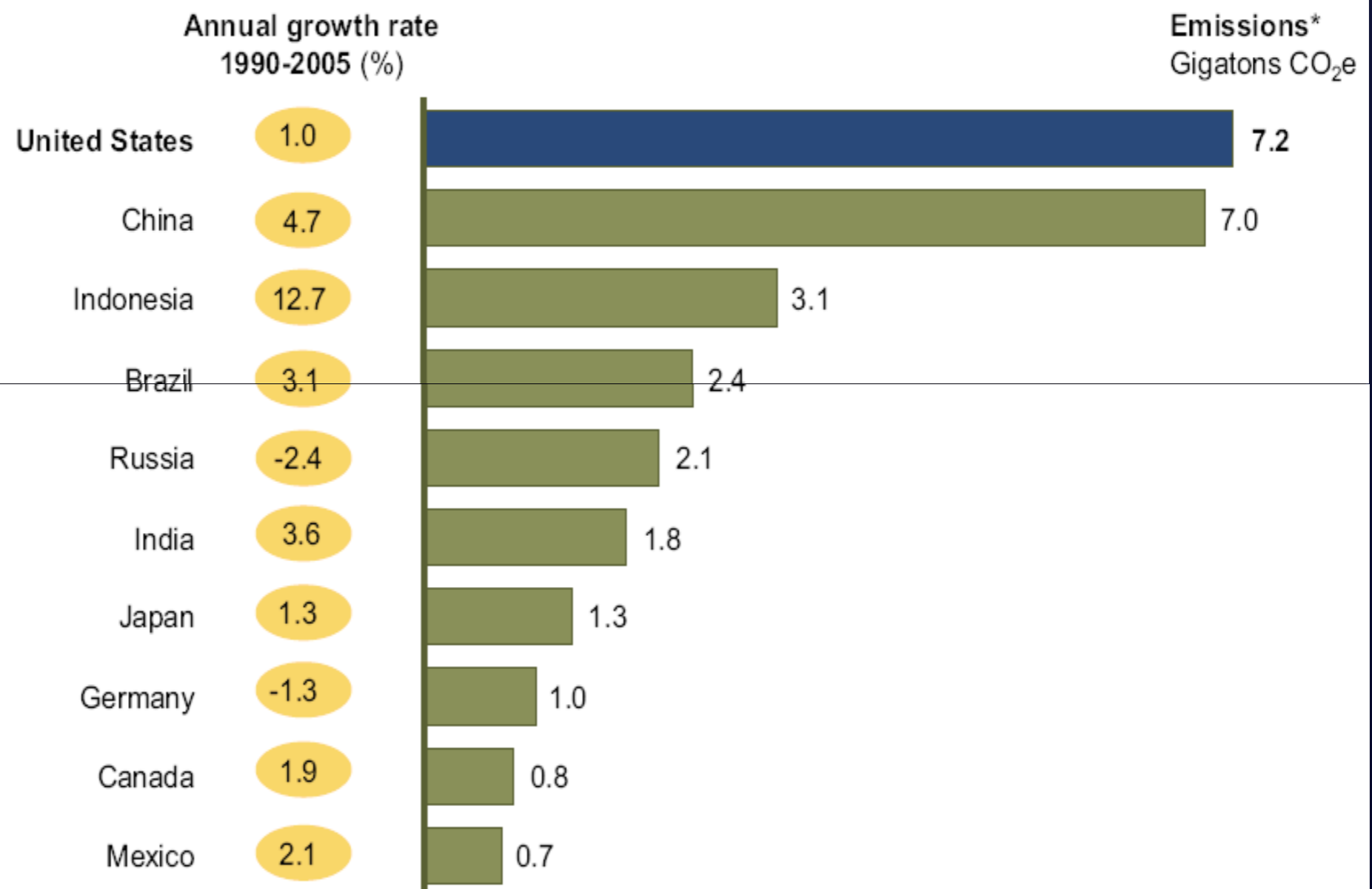
- **Corn Based Ethanol Problems**
  - **May Cause More GHG Emissions than Conventional Fuels (i.e. Oil/Gasoline)**
  - **Natural Gas -> Fertilizer -> Corn**
  - **Brazil and the Soybean Parable**
    - **> Corn = < Soybeans = < Pasture in Brazil = < Rain Forest**





# Who Are #3 and #4 in GHG Emissions?

## GHG EMISSIONS FOR SELECT COUNTRIES – 2005

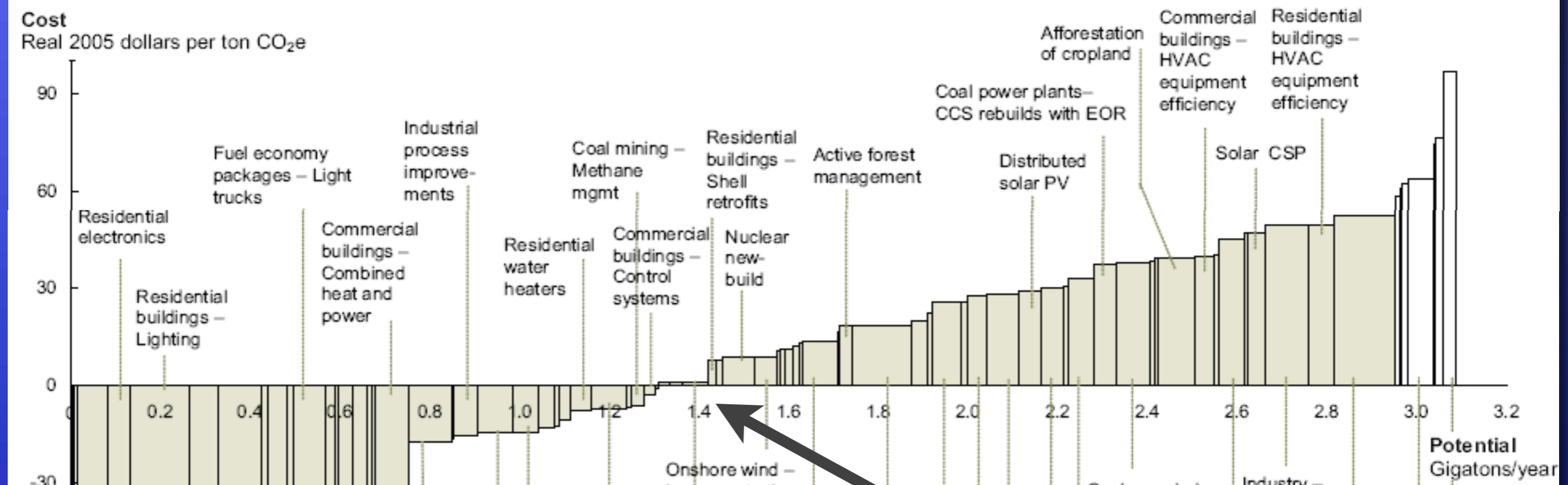


# The Conference Board Report by McKinsey and Company, November 2007

● **Conclusion:** The United States could reduce greenhouse gas emissions in 2030 by 3.0 to 4.5 gigatons of CO<sub>2</sub>e using tested approaches and high-potential emerging technologies. These reductions would involve pursuing a wide array of abatement options available at marginal costs less than \$50 per ton, with the average net cost to the economy being far lower if the nation can capture sizable gains from energy efficiency. Achieving these reductions at the lowest cost to the economy, however, will require strong, coordinated, economy-wide action that begins in the near future.

# The McKinsey Report Abatement Costs

## U.S. MID-RANGE ABATEMENT CURVE – 2030



Does not count 1.3 Gigatons of Waste Heat Recovery

Does not count T & D Efficiency Improvements

Does not count Power Plant Efficiency Improvements

1.4 Gigatons to Here

# Will We Save Ourselves?

- IPCC scientists write: There is high agreement and much evidence that all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers.
- Thus: If energy efficiency and decarbonization lagged from 2000 to 2007, it's NOT because new technology wasn't developed. It's because we didn't deploy the energy-efficient and low carbon technologies we had.

# How Much Time Do We Have?

- When the November 2007 IPCC report was released, IPCC head Rajendra Pachauri said “If there’s no action before 2012, that’s too late. What we do in the next two to three years will determine our future. This is the defining moment.”

# Will the World Follow Us If We Lead?



# Who Will Lead Us?

Alex Washburne:

I'm turning 21 tomorrow and I just wanted to thank everybody for this world that my cohorts and I will be inheriting. Thank you for showing that productivity is clearly more important than sustainability, disregarding the truth that infinite growth is impossible.

Thank you ... for your tasteless disregard of the truth that the reckless and wasteful resource consumption of the United States adds up to over 22% of the world's carbon dioxide emissions, the highest per-capita in the world (if it's not because of our "wealthy" lifestyle in the west, then why is it?).

Thank you for raising me in a country with such blatant disregard for scientific evidence is institutionalized and manifested in [administration] "modifications" of the EPA's report on Global Warming. Last but not least, I would like to thank everybody for a lesson in biology: humans, homo sapiens, appear to be no different than rabbits in regulating their population dynamics and resource consumption. Prepare as we overshoot our carrying capacity (though some predict that we already have) and die back, just like any other animal out there.

And people say humans are smarter than the rest?

One would think we'd live up to our name, "wise man", and use our insight about the way things work in order to prevent such catastrophes. Thank you for proving otherwise. I can't wait to deal with the global problems handed down to my generation. Thank you.



**Technology Can Save  
Us , But Who Will  
Lead Us?**