

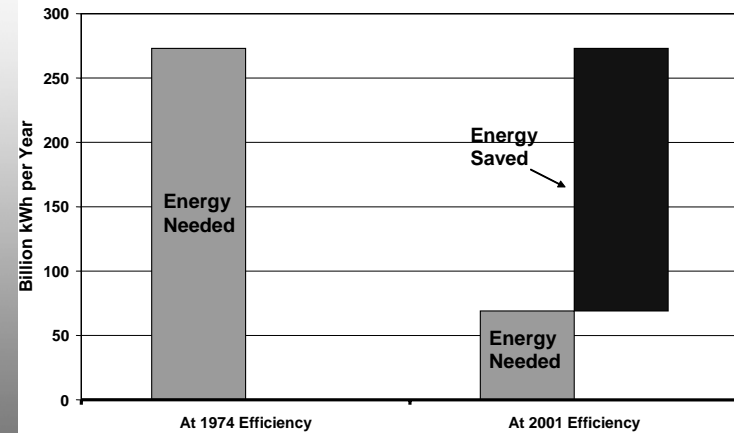
Considerations for MIT Research on Enabling an Energy Efficient Society



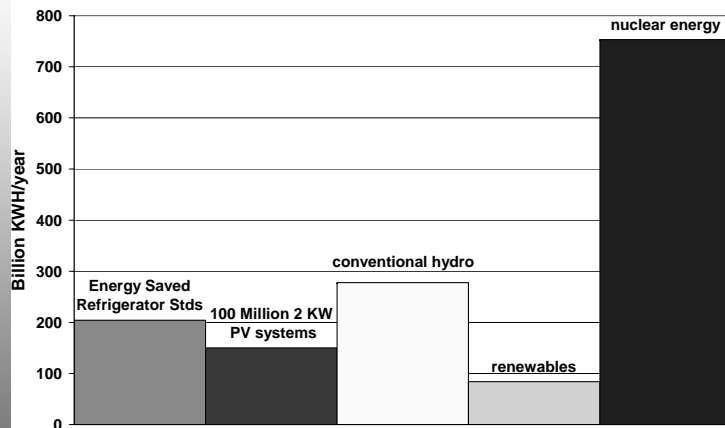
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Enabling an Energy Efficient Society



Refrigerator Energy Use: 75% has been saved



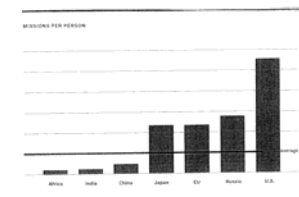
Energy Saved vs Energy Generation in Billion KWH



The Urgency of Efficiency Today

1980-2007 energy use and policy:

- Has created irreconcilable energy supply and demand – with economic and political consequences.
 - 2004-2008 – the first *demand-driven* price shock.
- Has brought us to the brink of *unmanageable, irreversible* climate change.



What we do in the next three years will determine our future. This is the defining moment.

Rajendra Pachauri, Chairman, IPCC, 2008

MIT's Energy Initiative (MITEI)



Exploring Energy efficiency *as a resource strategy*

= *Explicit Actions with Predictable impacts*

- beyond the market/technological progression *that would happen otherwise.*

How Does Efficiency Stack up?
... i.e. by comparison,

How *Large, Clean, Cheap, Safe, Quick?*



Efficiency in US Homes and Buildings

(71% of all electricity, 54% of all natural gas)

Potential:

- Est. *50%+ Savings at Lower Cost over 20 years.*
- *Without sacrificing comfort or function,*

Technology Examples:

- Home Central AC tune-ups can displace 25000 MW (25 plants) for \$12B
- CFL's in "recessed cans" will save 5% overall (LED's 7%)
- Modulation/storage can reduce peak load AND ENERGY USE by 25%.

Deployment Methods (examples):

- Smart Grid: Pricing/AMI, and info/behavioral technologies,
- Rebates/Direct-install: funded by utilities, carbon cap-and-trade,
- New building codes, upgrade on transfer, appliance standards.

New Laws/Regulations that *Enable Energy Efficiency*

- \$50 B in Economic Stimulus
- MA "Green Communities" : Efficiency
 - "All-cost effective efficiency"; should dramatically raise utility budgets
 - Community-based programs
 - Smart Grid pilots.
 - Building Codes
- "Global Warming Solutions"
 - regulating carbon emissions across all sectors of the economy.
- "Forward Capacity Market" – efficiency can play!
- Lost Base Revenue Adjustment – aka Decoupling

BIG NEWS: Policymakers are Embracing New Alternatives to meet Resource Needs.

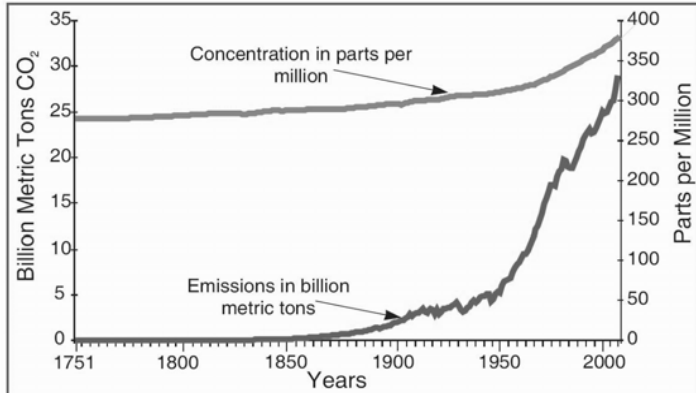


Questions:

- 1) *Did we notice* that things have changed?
- 2) *Do we know how* to fix this Energy Mess?
- 3) *Will we?*



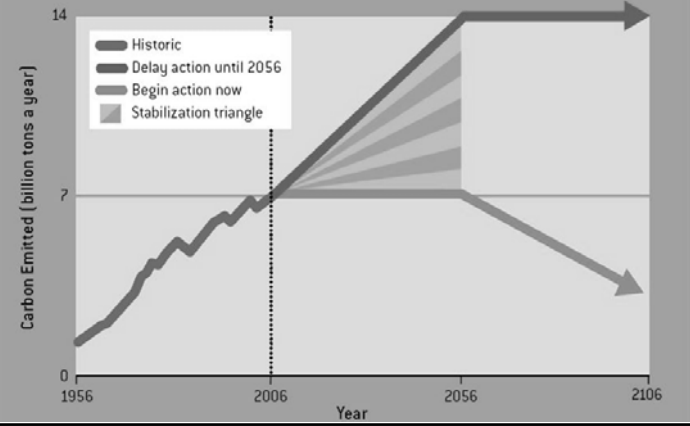
Carbon Dioxide Emissions and Carbon Dioxide Concentrations (1751-2004)



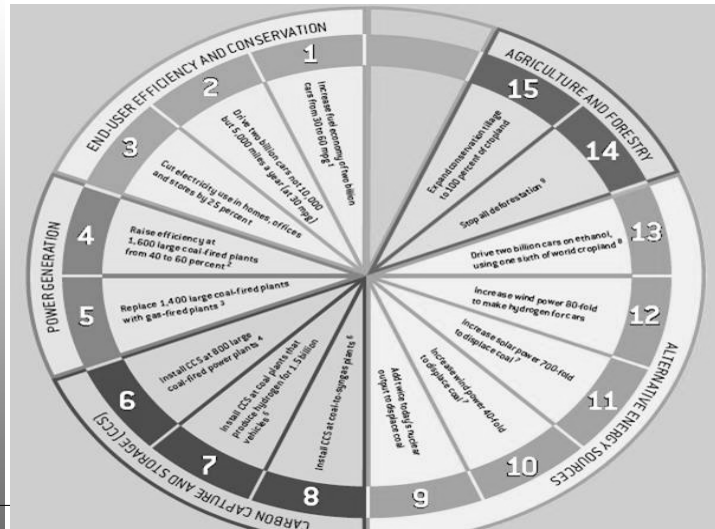
Source: Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center.

CO2 Stabilization Wedges – Socolow 2006

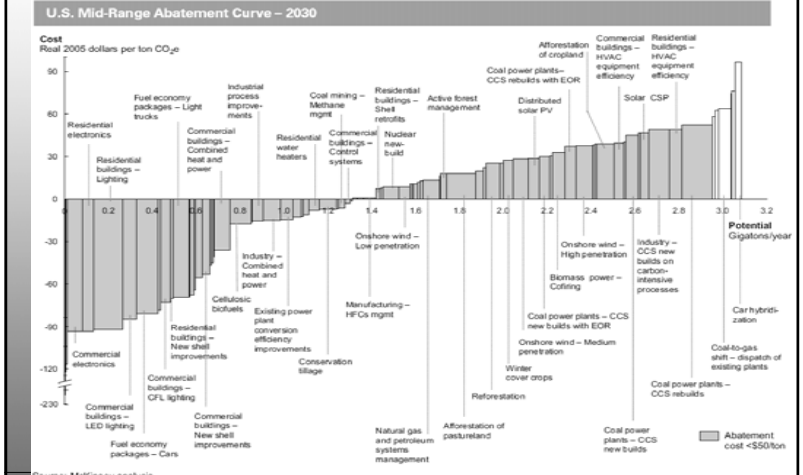
ANNUAL EMISSIONS
In between the two emissions paths is the "stabilization wedge." It represents the total emissions cut that climate-friendly technologies must achieve in the coming 50 years.



15 Solocow/Pakala Wedge Options



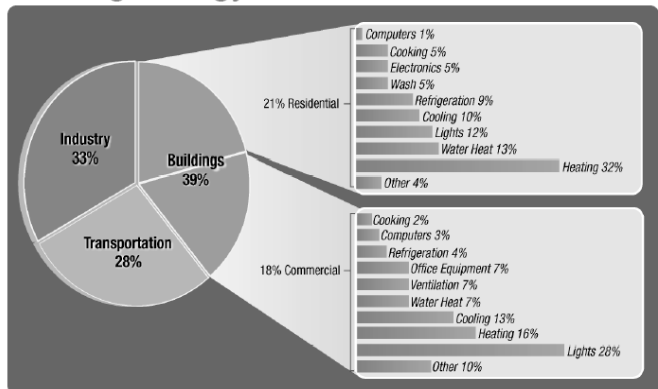
McKinsey, December 2007 U.S. GHG Abatement Mapping Initiative



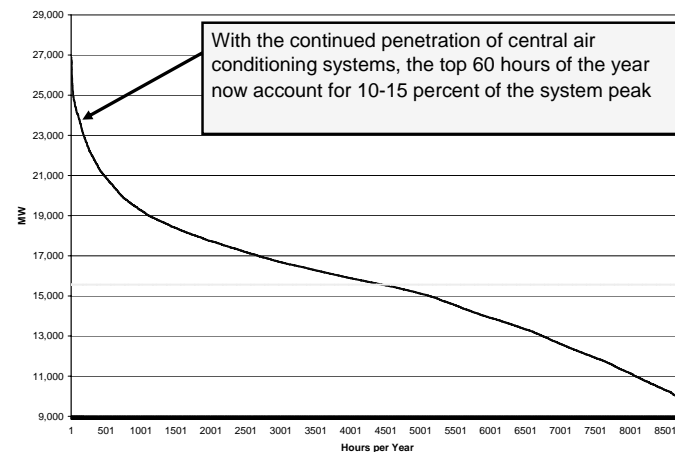
Source: McKinsey analysis
Note: The McKinsey report only examines a scenario through 2030. NRDCC recommends a goal of 80 percent emissions reductions by 2050.

Building Energy Use

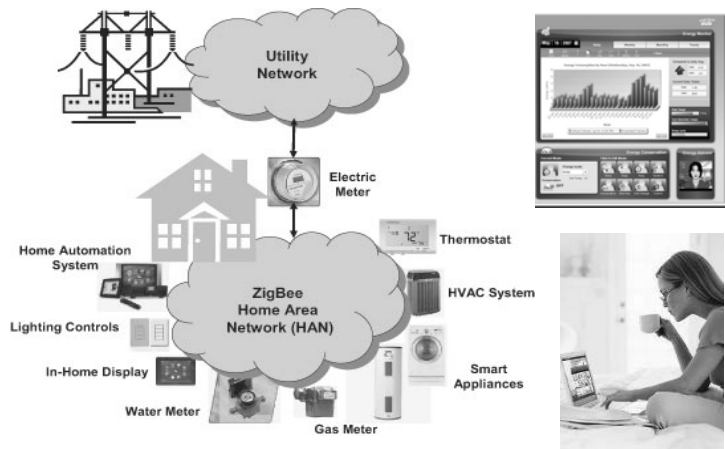
39% total U.S. energy
71% electricity, 54% of natural gas



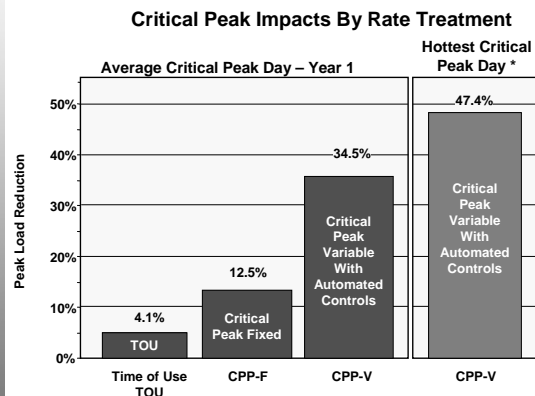
Pricing and/or Demand Response



Customer Side of Smart Grid = Responsive Energy Providing consumers with energy diagnostics, feedback, control



Smart Grid AMI/pricing helps, but consumers respond more with information and/or controls



Source: Statewide Pricing Pilot Summer 2003 Impact Analysis, Charles Rivers Associates, Table I-3, I-4, August 9, 2004.

Cross-campus Responsive energy research

- **Energy Box** - consumer-managed modulation systems.
- **Behavioral systems** to encourage energy efficiency.
- **Intelligent Infrastructure** for Energy Efficiency (I2EE) research on in-building communication methods.
- **Building energy analysis** based on control schema.
- Evaluating **community-level measurement** and modulation systems
- **Innovation Pathways** - for energy efficiency and smart grid.



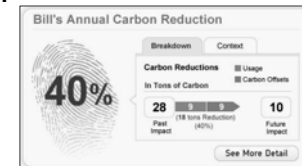
Vision - Applications for the Smart Consumer

- **Utility, thermostat, appliance, Google, etc. make app.**
- **View on home PC, work PC, TV, cell phone (at least until next year).**



Application ideas:

- **Make my AC, water heater, pool pump, refrigerator use pattern smarter.**
- **Find out what anything costs to run.**
- **Choose the best rate for me.**
- **Choose a theme – understand the consequences- do it (ie. More Green)**
- **Sell a DR option.**



NStar-funded Practicum - Enabling Efficiency through Utility/Community Partnerships

Targets of the investigation include:

- **Community goals for consumer participation, and various forms of scorekeeping, such as CFL's and Energystar appliances**
- **Engaging communities in helping discover specific groups that are likely to be underserved or under-participating and creating community-supported interventions to overcome these barriers.**
- **Community focus to increase municipal, school, hospital, churches**
- **Assessment of barriers and options to advanced efficiency buildings created by land use, code and utility approval/connection processes,**

Objective: A broadly applicable standard approach to utilities working with interested communities.

Opportunity

Time for new leaders to develop greater energy efficiency!

...through technologies, policies, planning, building methods, systems, software, business models.

TIME IS SHORT

NEED IS HIGH

OPPORTUNITY IS GREAT

