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CLIMATE LEADERS
U.S. Environmental Protection Agency

National Action Plan for Energy Efficiency

EPA GREEN POWER PARTNERSHIP

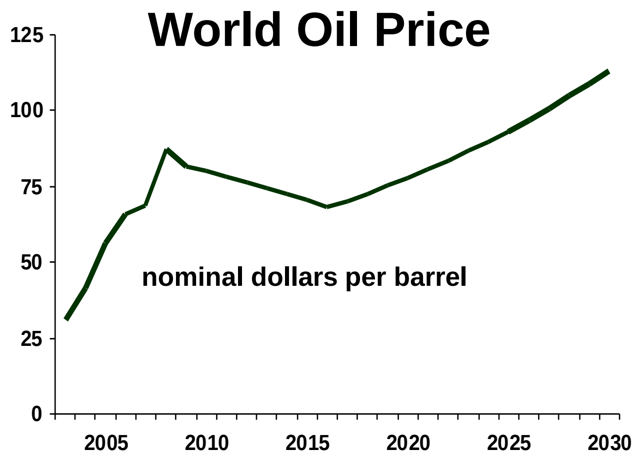
State and Local Climate and Energy Program

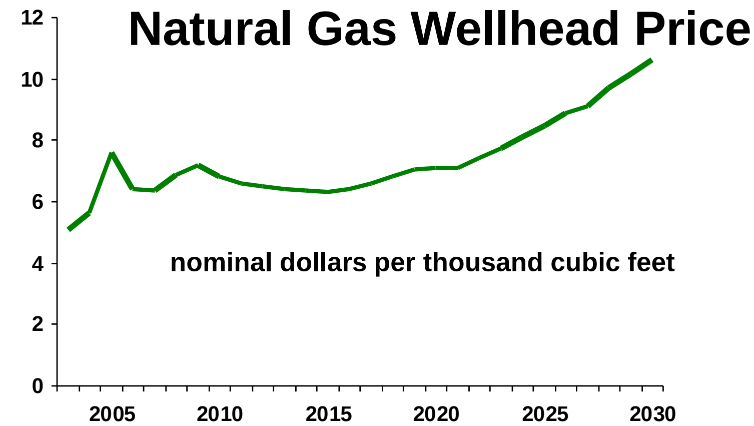
EPA CHP COMBINED HEAT AND POWER PARTNERSHIP

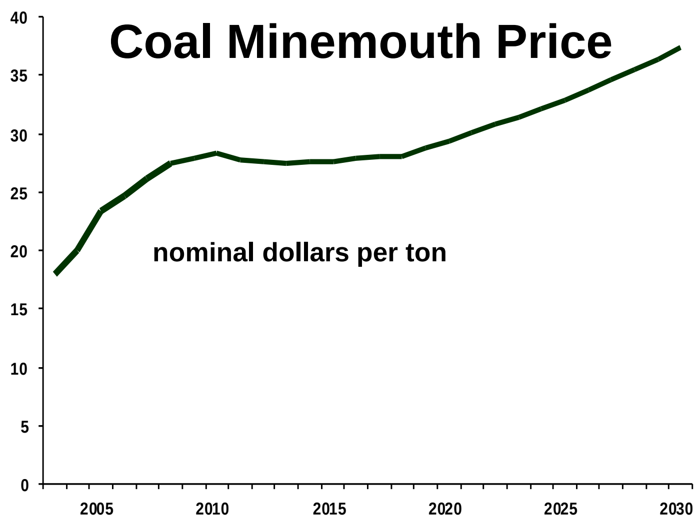
ENERGY STAR

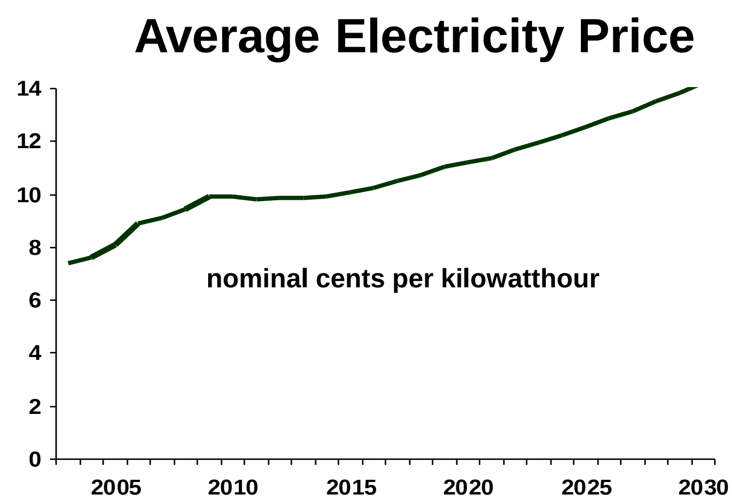
Producing Reliable Energy & Preserving the Environment

Annual Energy Outlook 2008 Price Forecasts



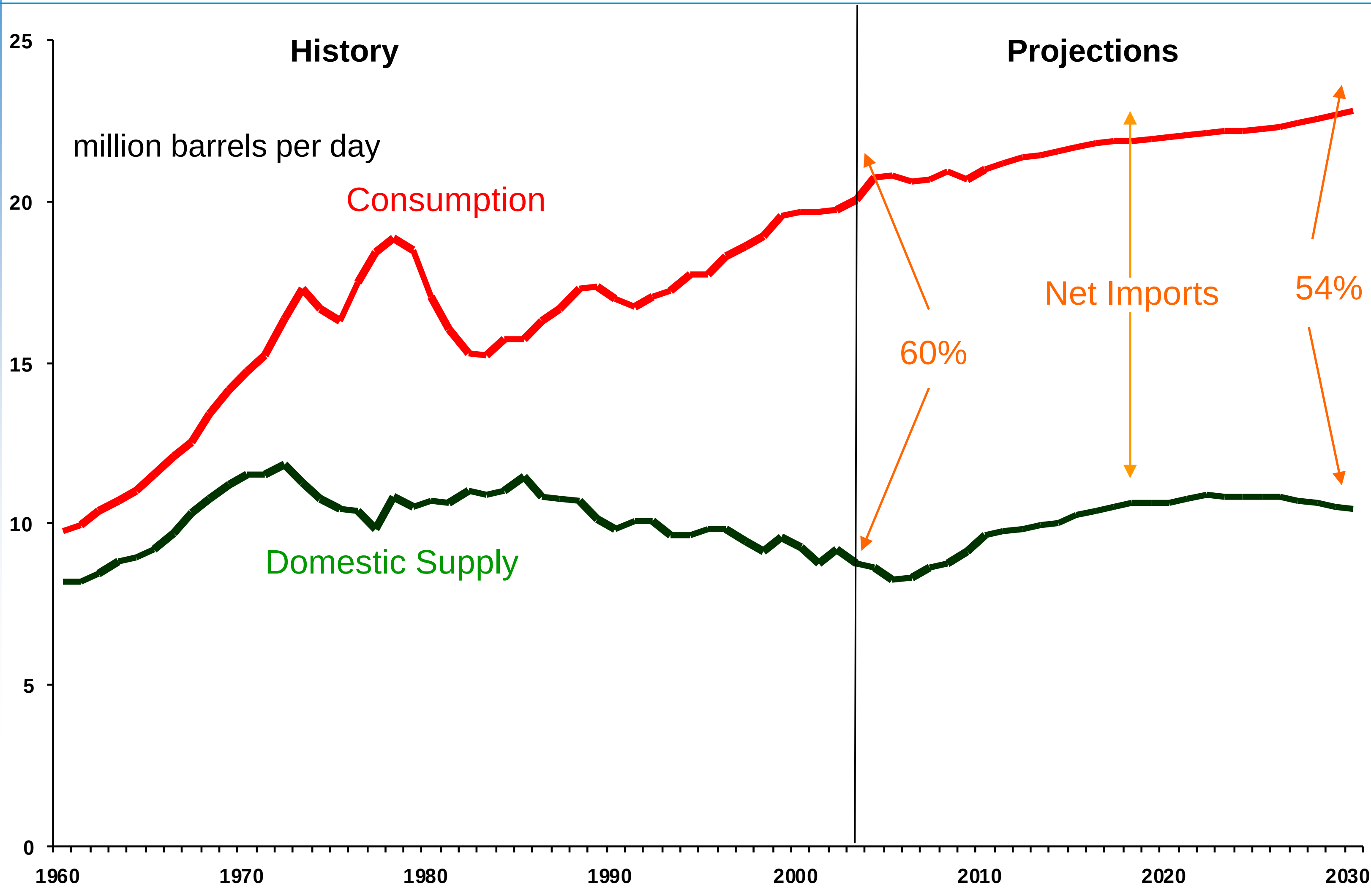






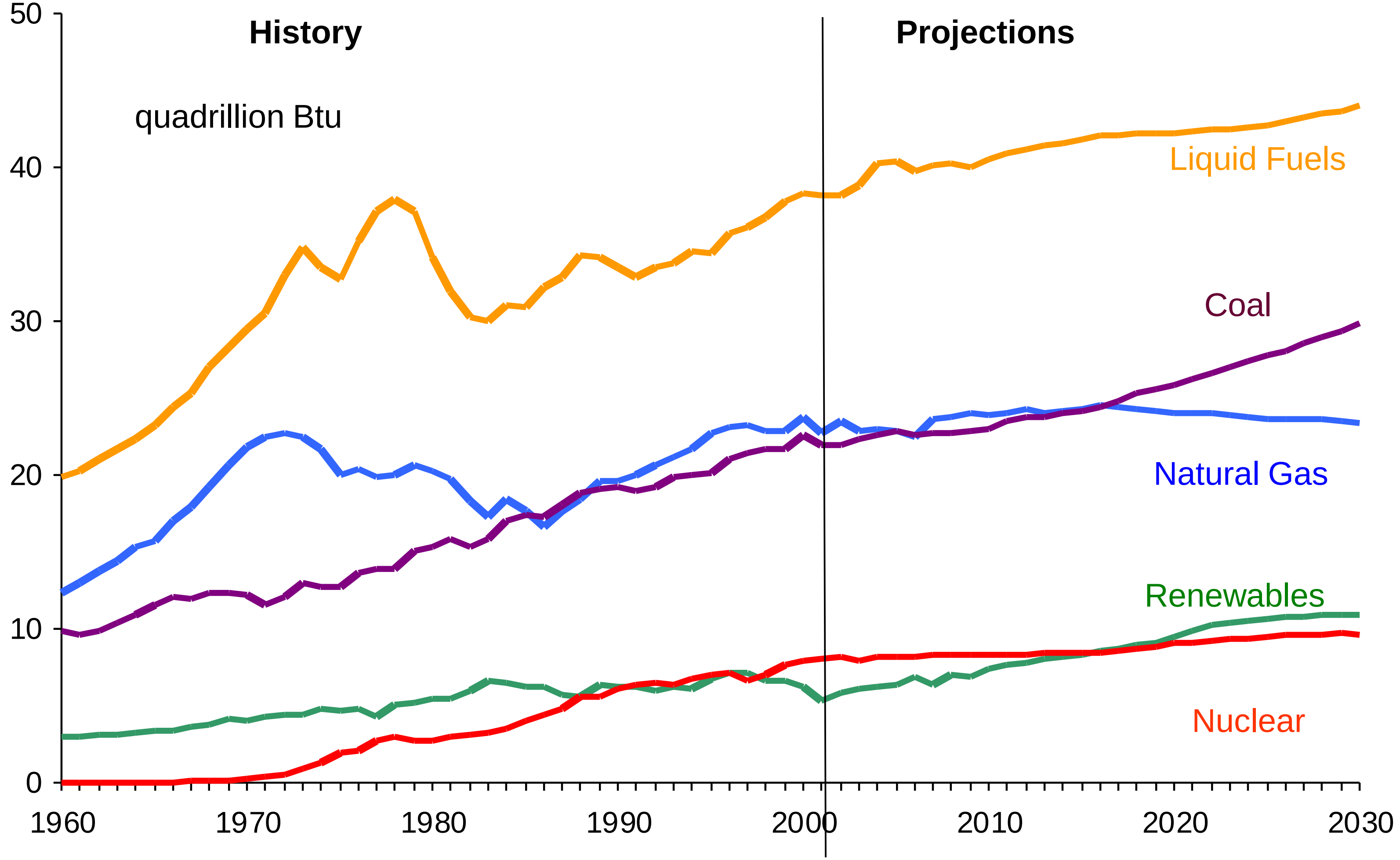
IEA Annual Energy Outlook 2008

US Dependence on Imported Liquid Fuels



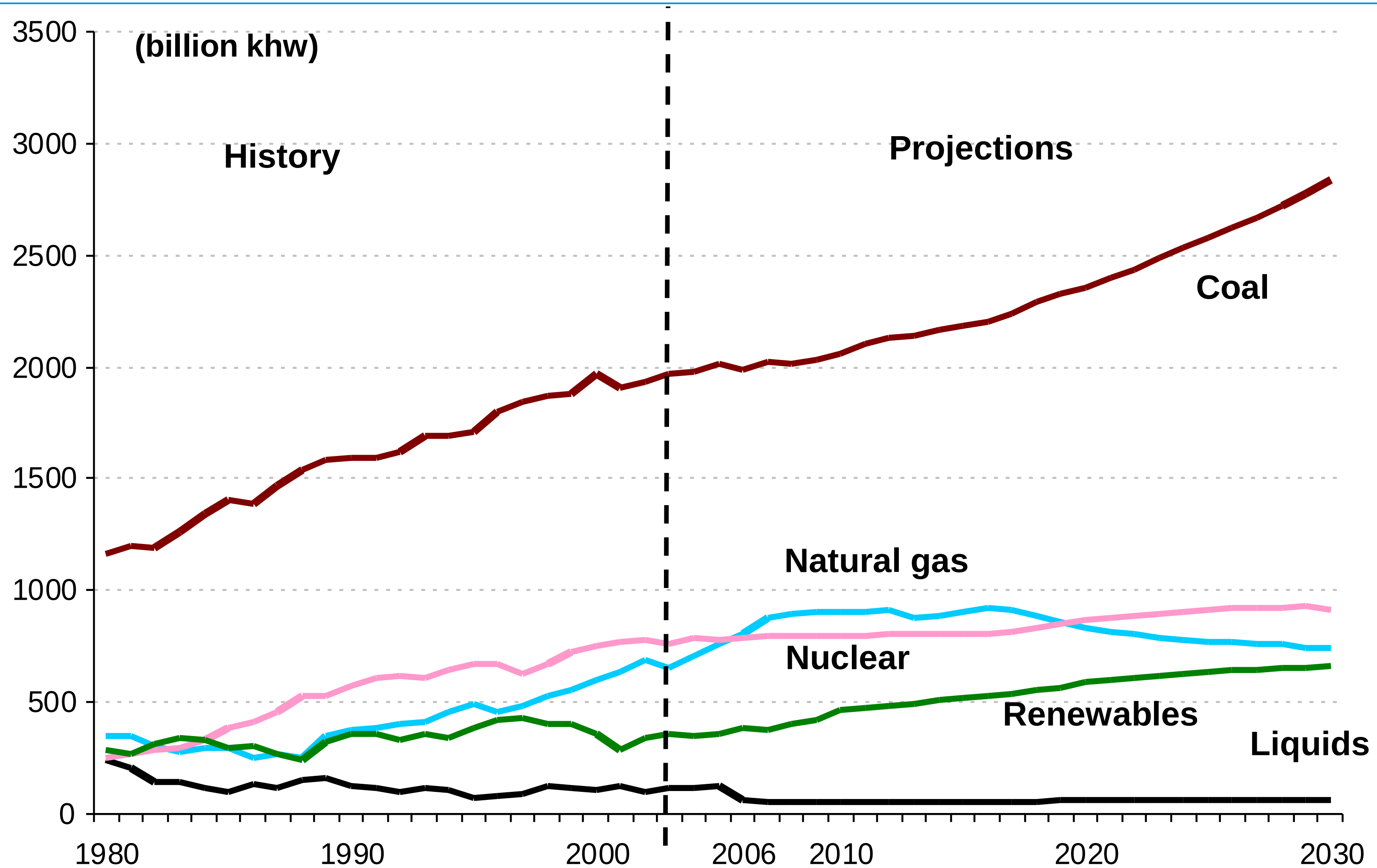
IEA Annual Energy Outlook 2008

Energy Consumption by Fuel Type



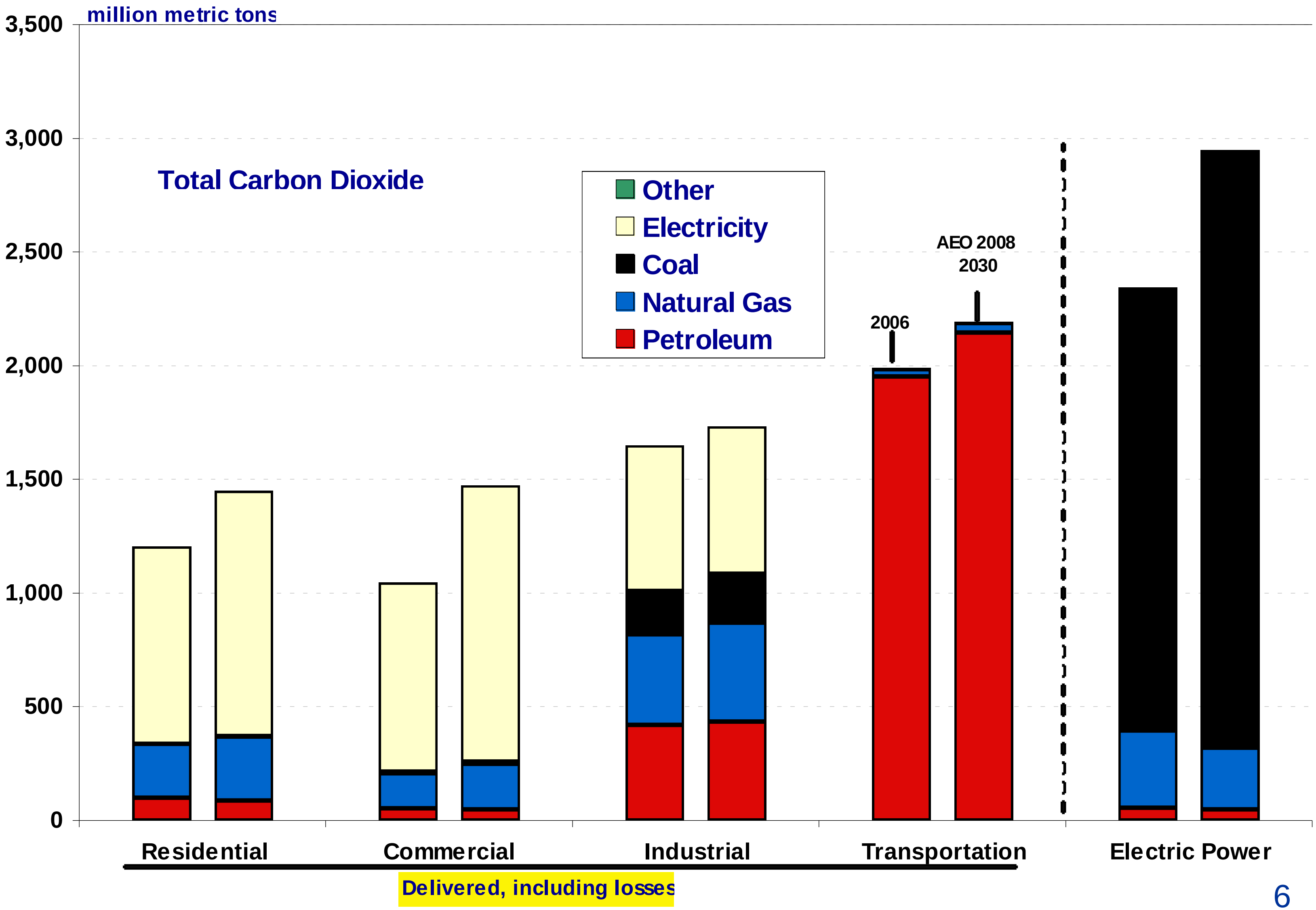
IEA Annual Energy Outlook 2008

Electricity Generation by Fuel 1980-2030



IEA Annual Energy Outlook 2008

Current & Future CO_2 Emissions



Expected Impacts by Sector from Climate Change

- **Health**
  - Likely to affect the health status of millions of people, particularly those with low adaptive capacity
  - Increased deaths, disease & injury from heat waves, floods, storms, fires & droughts;
  - Increased frequency of cardio-respiratory diseases from higher concentrations of ground level ozone related to climate change
- **Food production**
  - Crop productivity projected to increase slightly at mid to high latitudes for local mean temperature increases of up to 1-3°C depending on the crop, & then decrease beyond that in some regions.
  - At lower latitudes, crop productivity is projected to decrease for even small local temperature increases (1-2°C), which would increase risk of hunger.
- **Ecosystems**
  - The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances
- **Water**
  - By mid-century, annual average river runoff & water availability projected to increase by 10-40% at high latitudes & in some wet tropical areas, & decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas.

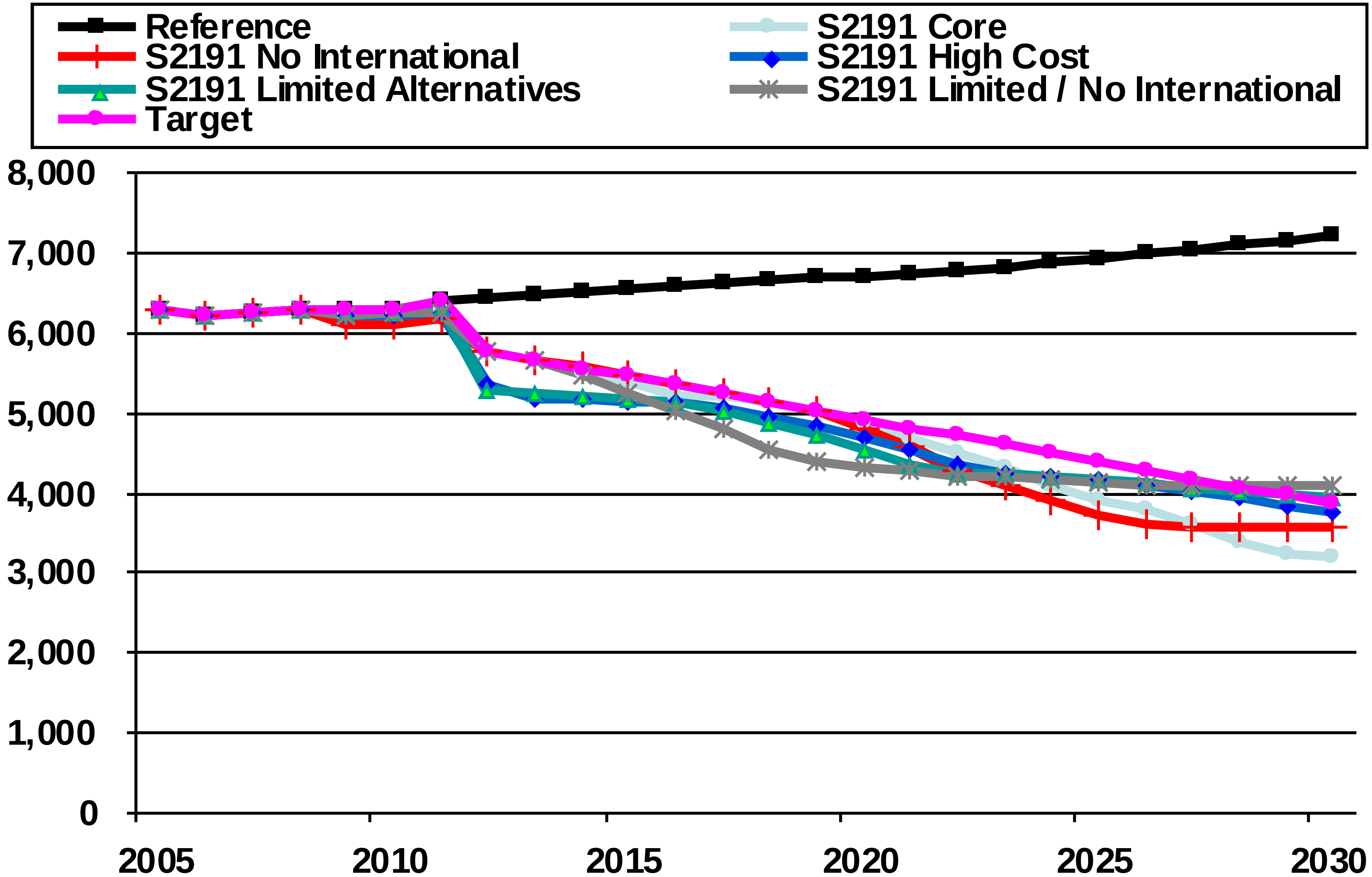
***Source*: IPCC (2007) Summary for Policymakers of Working Group II.**

Climate Change Seen as Threat to U.S. Security

- The **Pentagon and the State Department** have studied issues arising from dependence on foreign sources of energy for years but are only now considering the effects of global warming in their long-term planning documents. The Pentagon will include a climate section in the Quadrennial Defense Review, due in February; the State Department will address the issue in its new Quadrennial Diplomacy and Development Review.

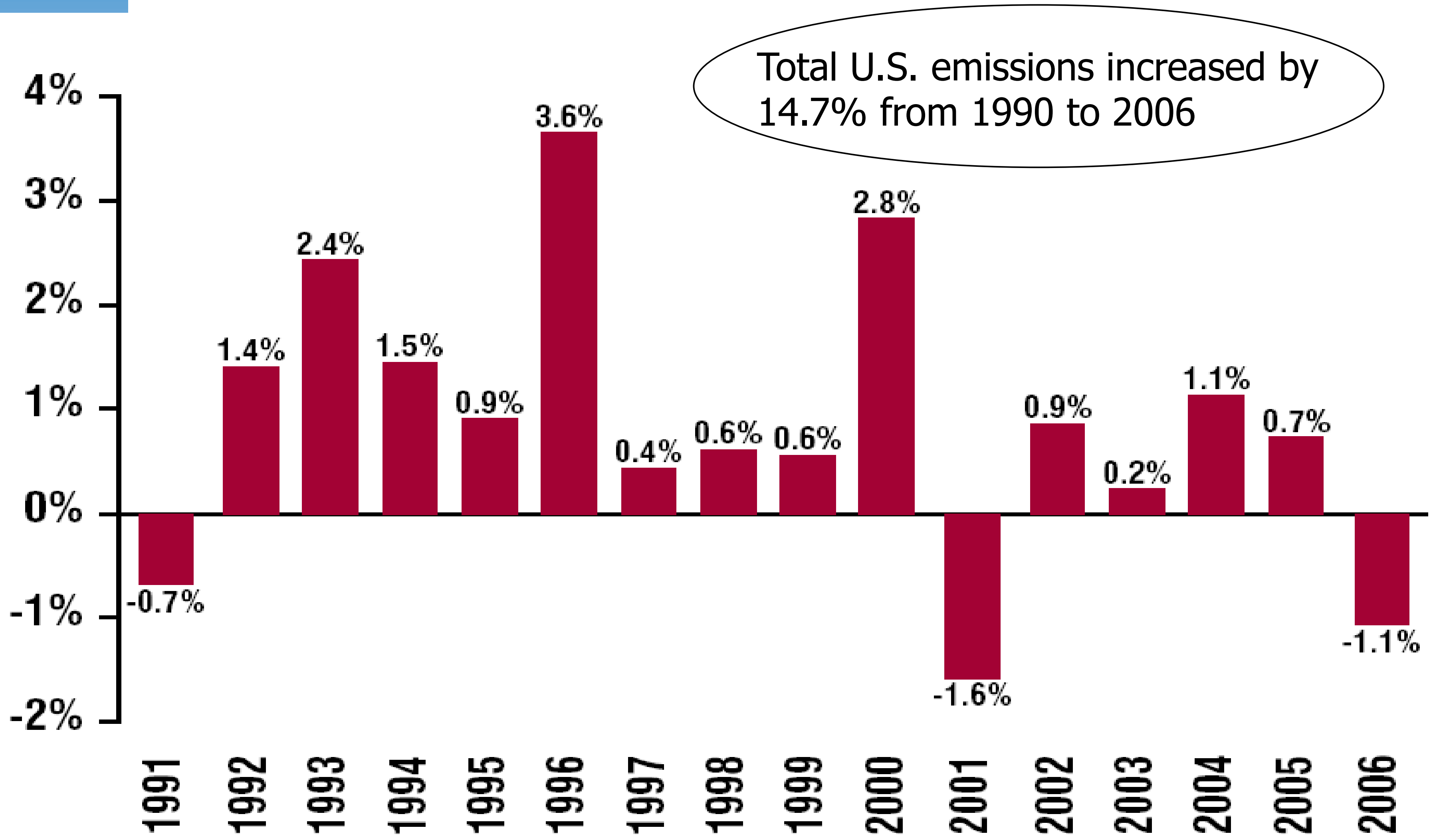
Greenhouse Gas Emissions

(million metric ton carbon dioxide equivalent)

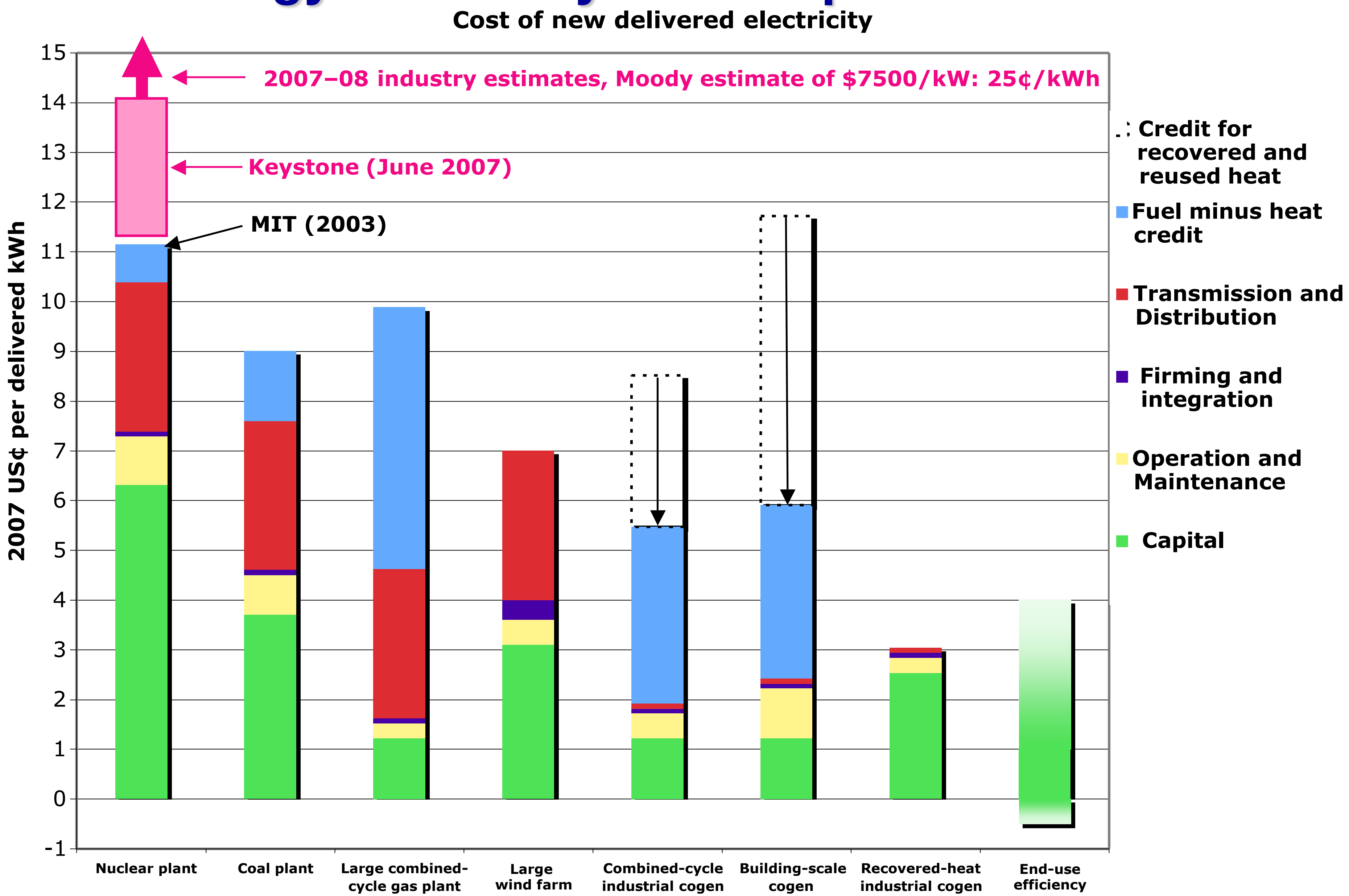


Covered entities are expected to slightly over comply through 2030 to prepare for compliance beyond 2030.

Cumulative change in U.S. GHG Emissions Since 1990



Energy Efficiency: A Cheaper Resource



Federal Climate Change Policy Update

- American Clean Energy & Security Act of 2009
  - "Waxman-Markey" – H.R. 2454 Passed in June
  - Discussion of general building efficiency requirements but no specific requirements around datacenters
  - Goal: to have legislation in time for the UN Climate Change Conference in Copenhagen
- More attention expected to be paid to buildings, the need for disclosure of energy consumption information and the associated GHG emissions.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Regional Climate Change Efforts

- **Western Climate Initiative** - Relevant to LARGE NW users of electricity
  - Goal: Reduce GHG pollutants to 15% of 2005 levels by 2020
  - January 1, 2012: Phase 1 covers emissions from electricity, including imported electricity, industrial combustion at large sources, and industrial process emissions.
  - 2015: Phase 2 expands the program to include transportation fuels and residential, commercial and industrial fuels not otherwise covered
- Regional efforts may play a role depending on the outcome national climate change legislation,.

www.westernclimateinitiative.org

Regional GHG Programs cont.

- **Regional Greenhouse Gas Initiative (RGGI)'s CO_2 Budget Trading Program:**
  - 10 states in NE US (CT, DE, ME, MD, MA, NH, NJ, NY, RI, & VT)
  - Caps CO_2 emissions from electric power plants, starting in 2010. Goal: 10% reduction by 2018
  - **Status:** 2009 is first year of compliance; four allowance auctions held so far, raising millions for energy efficiency and renewable energy projects
- **Midwest GHG Reduction Accord**
  - 6 states (IA, IL KS, MI, MN, WI) + one province (Manitoba)
  - April 2009 - Finalized recommendations for Midwest program design elements for back-stop regional GHG trading program if no national trading system; similar design to WCI's.
  - **Status:** Currently focusing on providing recommendations to Congress for national cap and trade program.

State & Municipal Policy Update

- Trend towards energy codes that mandate reporting of building energy use
- **Washington State**: **SB 5854**, passed Spring 2009
  - January 1, 2010 - Qualifying utilities must maintain and make available to building owners records of the energy consumption data of all nonresidential buildings they serve
  - Starting in 2011-2012, Non-public, non-residential building performance data must be uploaded to **ENERGY STAR Portfolio Manager**; implementation differs depending on the size of the building
- Data centers are not exempt from these requirements

Wash state: http://bcap-energy.org/node/371

DC: http://www.energy codes.gov/news/items/111708_dc_report.stm

Mandatory GHG Mandatory Reporting Rule

- **Objective – ** To provide accurate data that will inform and support development of national climate policy
  - Final rule approved by White House Sep. 22
- **Six greenhouse gases covered:** carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF6), and other fluorinated gases including nitrogen trifluoride (NF3) and hydrofluorinated ethers (HFE).
- **Approximately 85% of US total** GHG emissions covered by this rule (about 10,000 reporters)

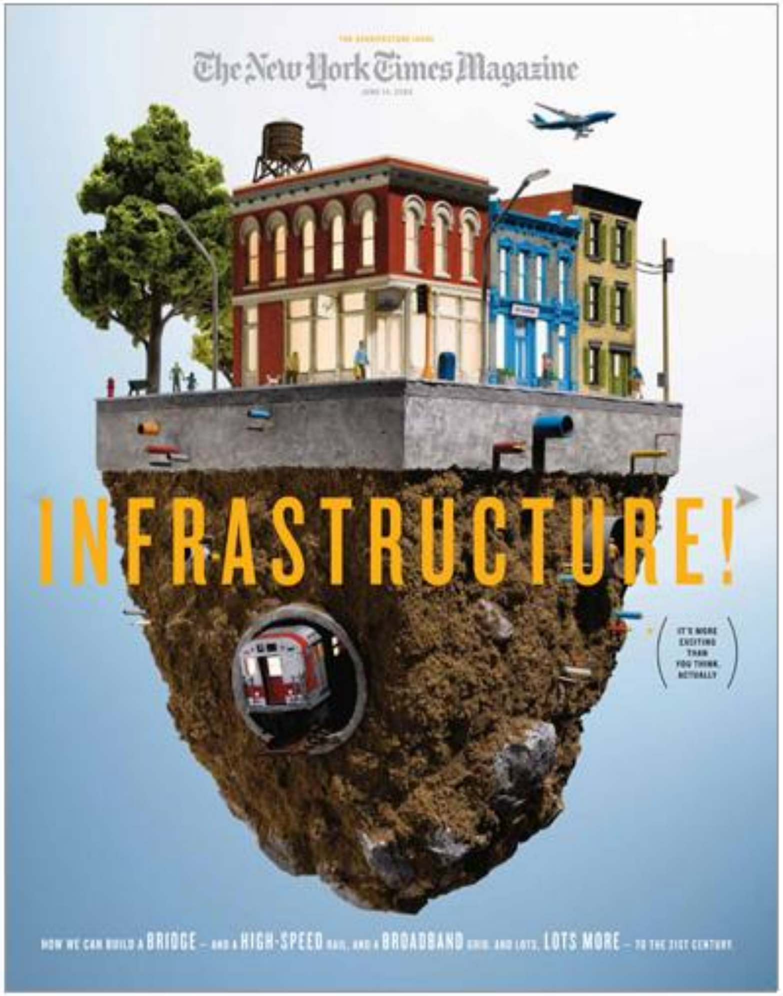
GHG Source Category Coverage

Applies to 29 specific categories of covered sources

- **Both upstream & downstream** suppliers of fossil fuels, producers of aluminum, cement, iron and steel, glass, and various chemicals (both direct emitters and consumers of fuels & chemicals)
  - **Upstream sources** covered includes producers, importers and exporters of petroleum products, natural gas, and industrial GHGs. They will report based on GHG content of fuels or gases they supply to the market.
- **Covers fuel, vehicle, and engine manufacturers and suppliers** but light duty engines exempt because of separate rule making.
  - Starts with CO_2 in model year 2011 and other GHGs in subsequent model years. Individual car and truck owners and fleet owners excluded
  - Added NOx requirement for aircraft engine manufacturers from proposed rule, but postponed CH_4

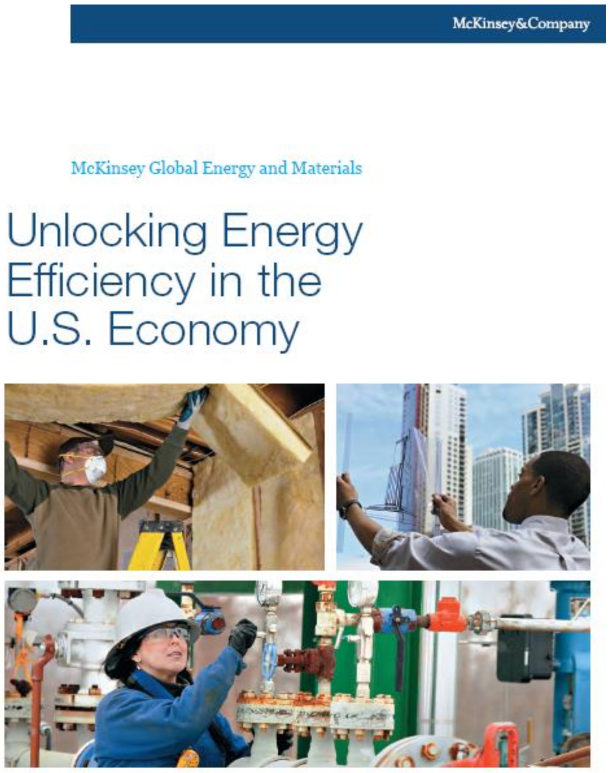
“Data Center Overload”

The NY Times Magazine - June 14, 2009



New McKinsey Consulting Report

- *Unlocking Energy Efficiency in the U.S. Economy*
  - Notes EPA's projection of data center energy use growth by 9.6%/year through 2020
  - As many as 30% of servers consuming electricity operating at less than 3% daily utilization
- Message – efficiency a significant energy resource – abating as much as 1.1 gigatons of CO_2 by 2020 - but accessible only if a national policy can be crafted to unlock it



www.mckinsey.com/**USenergyefficiency**

Why Data Centers?

Annual source energy use of a 2MW data center is equal to energy consumed by 4,600 typical U.S. cars in one year

=

2MW data center

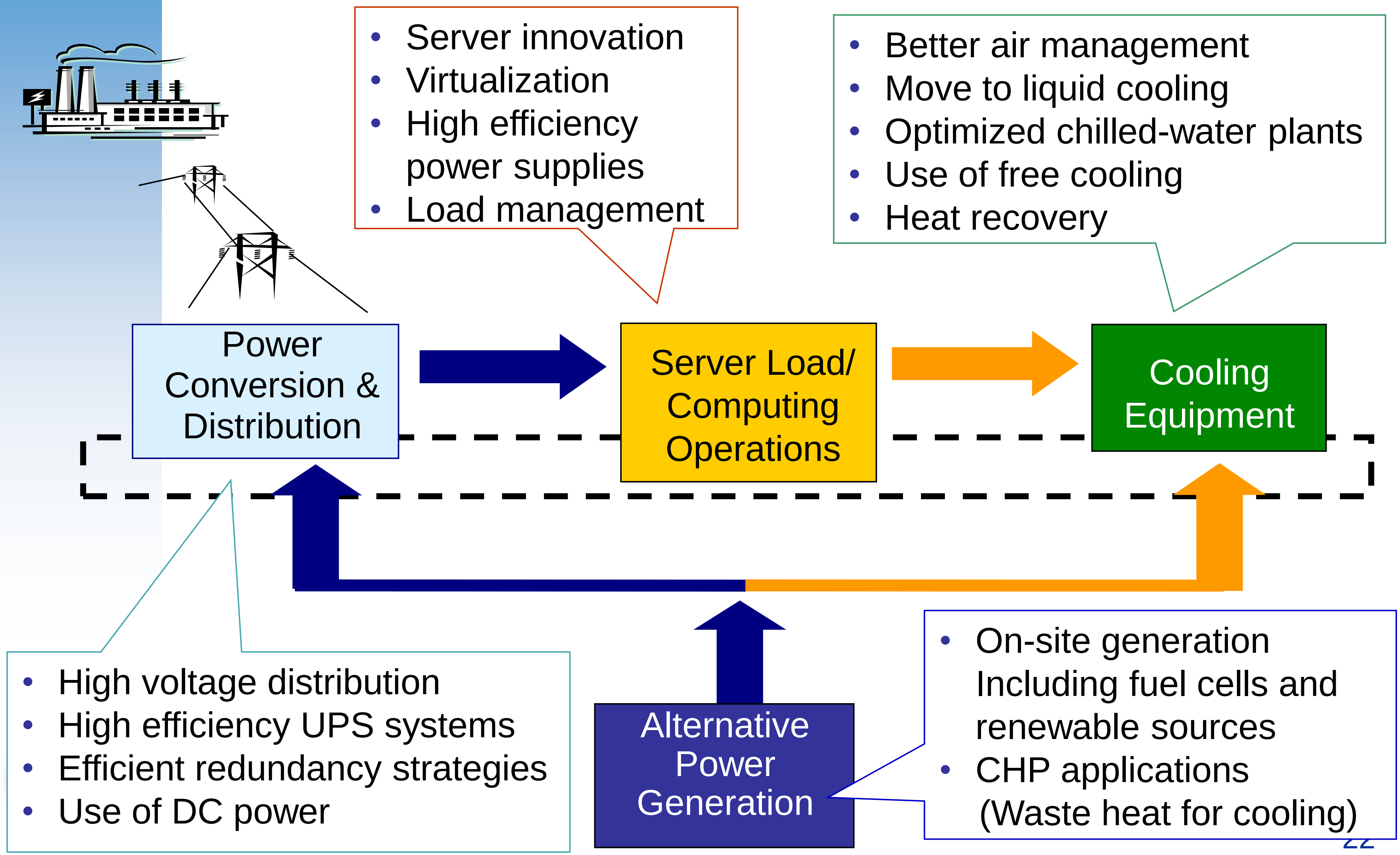
4,600 typical U.S. cars

Growing Interest by Utilities

U.S.News & WORLD REPORT
usnews.com
Tuesday, March 24, 2009

"By 2012, Virginia-based Dominion Power estimates that fully 10 percent of all the electricity it sends to northern Virginia will be gobbled up by [the region's] data centers."

Energy Efficiency Opportunities

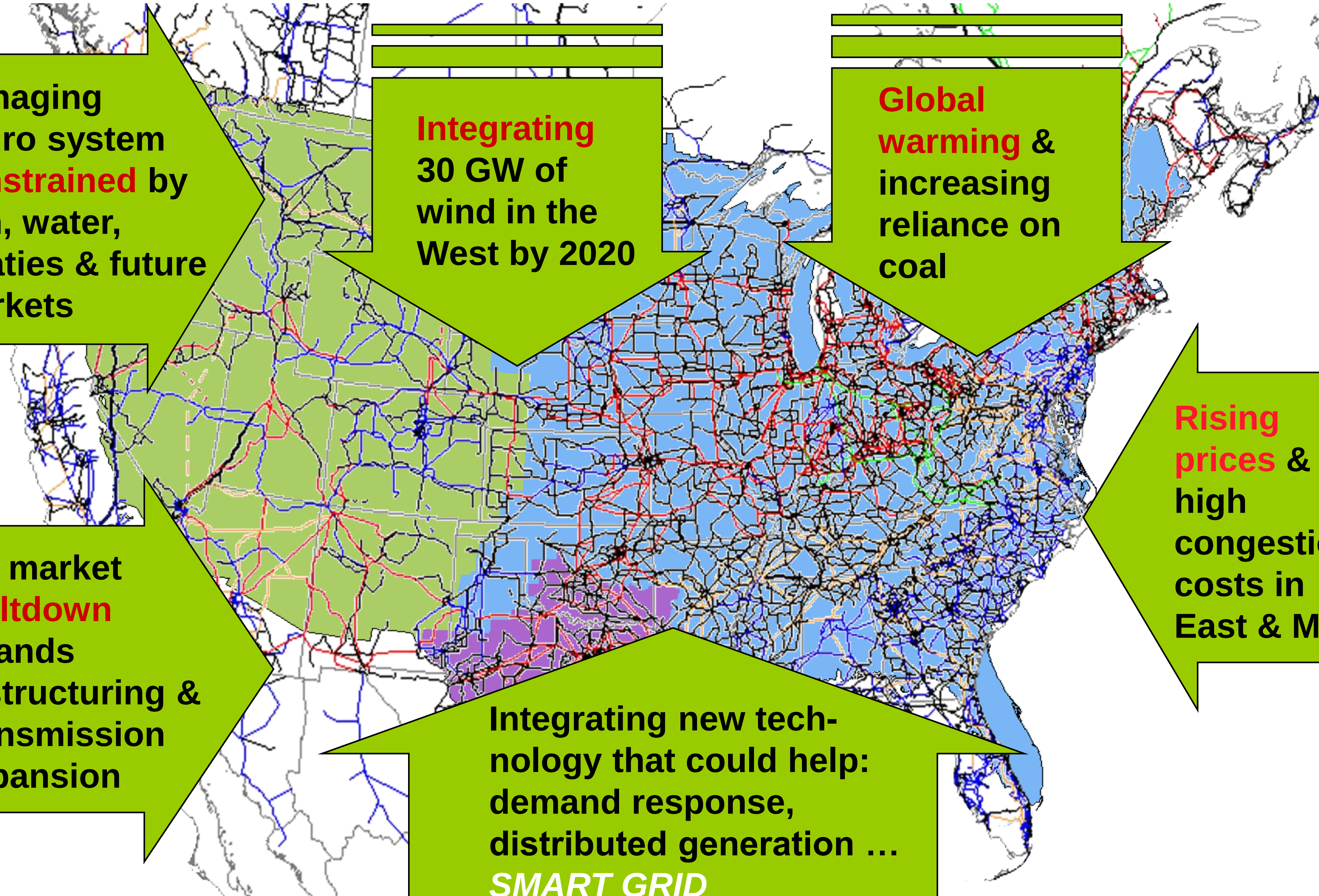


Participating Datacenters

ENERGY STAR Rating for Data Center Facility

- Built on existing ENERGY STAR platform (1-100 scale)
- Score of 75 or higher qualifies for ENERGY STAR designation
- Applies to both stand-alone data centers & those in an office or other building
- Assess performance at the building level to explain <u>how</u> a building performs -- not <u>why</u> it performs a certain way
- Point users to additional unbiased resources to help pursue a tailored strategic energy management plan based on business goals and available resources
- Expect early 2010 announcement

We are facing large transmission and generation investments in an uncertain economic environment



Managing hydro system constrained by fish, water, treaties & future markets

Integrating 30 GW of wind in the West by 2020

Global warming & increasing reliance on coal

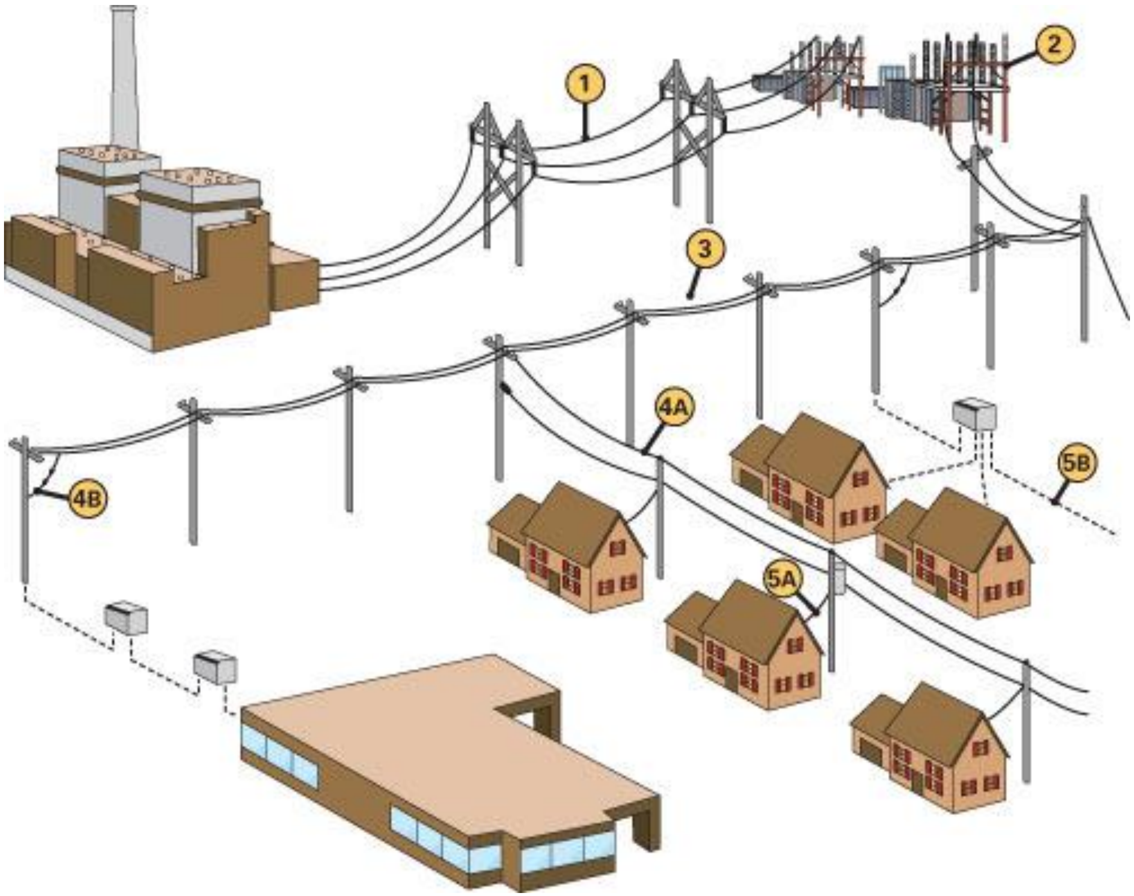
Rising prices & high congestion costs in East & MW

CA market meltdown strands restructuring & transmission expansion

Integrating new technology that could help: demand response, distributed generation … *SMART GRID*

Today's "old" electric grid

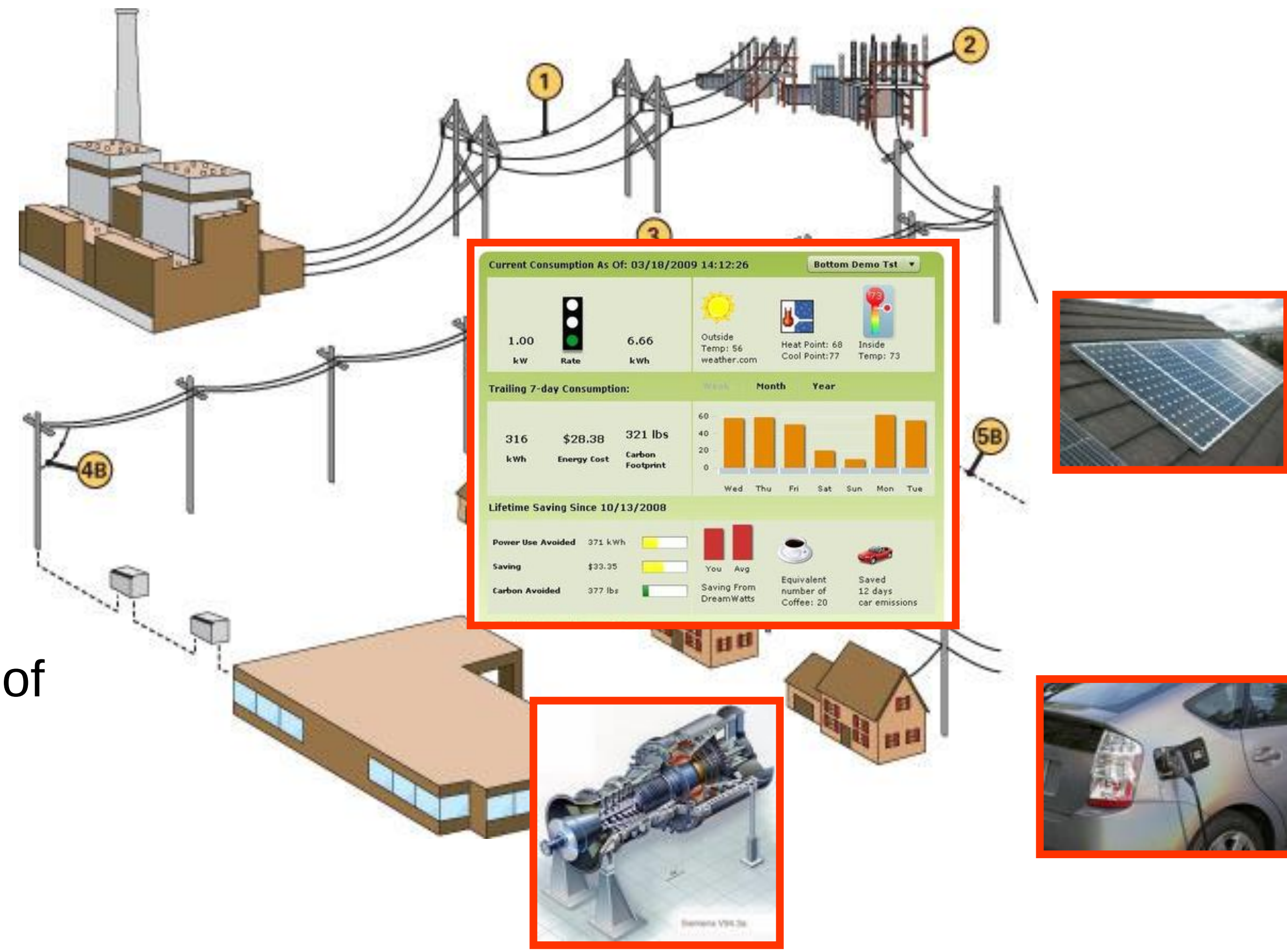
- Central station power plants
- Low load factor
- Consumers don't see real TOU price of energy
- Low RE & DG integration



Source: DTE Energy (http://my.dteenergy.com/products/electricity/images/electricFlow.jpg)

Tomorrow's next generation electric grid

- More DG, RE, storage
- Information to customers
- Electrification of transportation sector



Source: DTE Energy (http://my.dteenergy.com/products/electricity/images/electricFlow.jpg)

What Defines the Smart Grid?

- Many definitions exist but all involve information technology (IT)

  (1) Power system that has an intelligent communications infrastructure enabling the timely, secure and adaptable information flow needed to provide the right information to the right entity (e.g. end-use devices, T&D system controls, customers, etc.) at the right time to take the right action
  – *Electric Power Research Institute*

  (2) Increased use of digital information & controls to improve reliability, security, efficiency of the grid; increased use of distributed generation & renewable energy, demand response, energy efficiency, use of smart technologies & appliances (like meters, distribution automation), storage, information to consumers, development of interoperability standards for device to grid communication, lowering of barriers to adopting smart grid
  – *2007 Energy Independence and Security Act*

- Plethora of technologies that "qualify" - Chinese vs. fixed menu
- Smart Grid technologies and practices already exist BUT not at scale

Smart Grid Federal, State & Utility Activities

Federal

- Energy Independence and Security Act 2007 Title XIII
- American Recovery and Reinvestment Act: ~$4.5 Billion
- National Institutes of Standards (NIST): interoperability

State/ Utility

- Many utilities invested $ billions
  - Advanced Metering Infrastructure
  - Less attention in transmission & distribution
  - Buildings focus has been in residential sector
- Some pilots and deployments moving beyond AMI
  - **E.g., Xcel Energy Smart Grid City project, Boulder**

Smart Grid and Clean Energy: Technologies

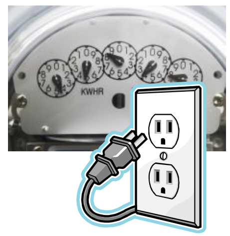
ELECTRICITY GRID —— CONNECTIONS —— CUSTOMERS

ELECTRICITY GRID

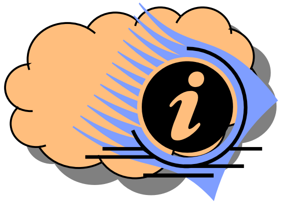
- Transmission monitoring (e.g., dynamic line ratings, phasor measurement units)
- Conservation voltage control
- Energy storage
- Grid-integrated wind forecasting
- Distribution automation
- Flexible alternating current transmission systems

- Plant optimization software
- Monitoring of feed water performance

CONNECTIONS



- Advanced meter infrastructure, including advanced net meters
- Energy data management

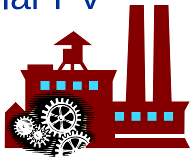


Communications Backbone

- Broadband
- Wireless
- Spectrum

CUSTOMERS

- Home area networks & home energy monitors
- Communicating programmable thermostats
- Grid-connected appliances
- Grid-connected solar PV



- Grid-connected controls and equipment

- Advanced building diagnostics (using whole building energy use)
- Grid-connected building controls and equipment

- Grid-connected electric vehicles, including “smart” charging systems

Smart Grid and Clean Energy: Potential GHG reduction pathways

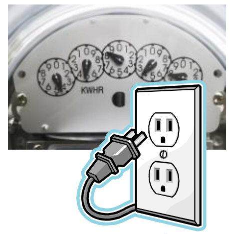
ELECTRICITY GRID —— CONNECTIONS —— CUSTOMERS

ELECTRICITY GRID

- Energy savings from reduced losses
- Increased renewables
- Reduced footprint from better land use, materials use from optimizing existing grid infrastructure

- Reduce fuel use in generators
- Improve water management

CONNECTIONS



- Greater certainty on energy efficiency, clean demand response, and clean distributed generation resource impacts
- Increase use of zero emission options to support grid services

- Integrated electricity, water, and natural gas networks for improved environmental performance

CUSTOMERS

- Energy savings from behavior change, enabled by energy information

- Energy savings from post-diagnostics action

All customer classes:

- Greater certainty of energy/bill savings from energy efficiency (practices, technologies etc) and behavior changes
- Bill savings from demand response may be used to fund efficiency and on-site clean energy

- Revenue from grid to clean energy/CHP

- Potential lower emissions than traditional or alternative transportation fuels

Why Efficiency is the 'First Fuel'

- **No** clean energy strategy will work without substantially moderating demand growth
- Rising demand is straining all conventional energy markets -- whether fossil fuel or renewable energy resources
- Bringing new supply capacity on line is increasingly tough -- clean or dirty. . . .
- Efficiency is essential to making carbon solutions both achievable and affordable
- Efficiency buys us cost-effectiveness, and buys us time to deploy clean supply options

Will Our Future be Limited by the Choices We've made?

- Energy and water sources are not inexhaustible
- Energy use continues to rise at home and abroad
- The grid needs continual expansion, increased capacity and new energy sources
- Could this lead to a future where quality of life is diminished?
- Growing trend at all levels of government to require "disclosure" of energy use & associated emissions from buildings and industry
- Benchmark your facility to document your baseline