Energy Security and Climate Change: Linkages in the U.S. Policy Arena

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Outline

• Drivers of increased attention to energy security & climate change by U.S. public & policy-makers

• Underlying realities re…
  – energy security
  – climate change

• Links between energy security & climate change in…
  – public & policy-maker (mis)understandings
  – reality
Drivers: oil dependence / security

- high gasoline prices
- rising imports (and dollar outflows) with little prospect for relief
- jitters about reliability of supply, accentuated by Iraq war, Iran, Russia
- hand-wringing about China’s growing oil use & imports
- uneasiness about potential for war, foreign-policy distortions to maintain access to supplies
- concern about oil revenues funding terrorism
- upwelling of concern by some credible analysts over “peak oil”
Drivers: climate change

- drumbeat of new climate science
- people’s everyday experience (and news reports) suggestive of actual climate change
- climate policies embraced by cities (~290) & states (~28)
- changing corporate attitudes & publicity: BP, Shell, GE, Dupont, Duke Energy…
- bipartisan, multi-sectoral consensus in high-profile reports (e.g., National Commission on Energy Policy)
- shifting position of labor & religious communities
- 2005 “sense of the Senate” resolution
- Al Gore’s “An Inconvenient Truth”
- 2006 shift in balance of power in Congress
- 2007 IPCC report
Underlying Realities: Oil
Leading oil consumers

China has passed Japan (but is only than a third of USA). India is nearly equal Russia.
Net imports constitute 60% of U.S. oil supply. Transport accounts for 66% of U.S. oil use, electricity generation for only 2.6%.
U.S. petroleum consumption by sector

Transport dominance of oil use is growing

- Transportation
- Electric Power
- Industrial
- Residential and Commercial

1 Petroleum products supplied is used as an approximation for consumption.
2 Through 1988, electric utilities only; after 1988, includes independent power producers.
The gap is growing
The dangers of oil dependence

import dependence $\rightarrow$ worsening balance of payments

$\rightarrow$ enrichment of oil-exporting regimes that may use the money to export terror & import nuclear weapons

total oil dependence $\rightarrow$ economic vulnerability to price shocks

$\rightarrow$ increased incentive for military preparation, threats, action to maintain access

$\rightarrow$ reduced freedom of action in foreign policy and counter-terrorism

Total oil dependence is the bigger problem
U.S. trade balance 1974-2005, billion nominal $
62% of US imports come from regions of questionable stability / reliability.
Underlying Realities: Climate
The Earth is getting warmer.

2005 was the hottest year on record; the 13 hottest all occurred since 1990, 23 out of the 24 hottest since 1980.

J. Hansen et al., *PNAS* 103: 14288-293 (26 Sept 2006)
We know why. Current computer model with sensitivity $\sim 0.75^\circ$C per W/m$^2$, using best estimates of natural & human influences (A) as input, reproduces almost perfectly the last 125 years of observed temperatures (B).

Other “fingerprints” of GHG influence on climate also match observations.

Changes in climate are already causing harm

Major floods per decade, 1950-2000

There’s a consistent 50-year upward trend in every region except Oceania.
Harm is already occurring (continued)

The trend has been sharply upward everywhere.
Harm is already occurring (continued)
Total power released by tropical cyclones (green) has increased along with sea surface temperatures (blue).

Kerry Emanuel, MIT, 2006
Links between energy security and climate change in perception & reality
Public & policy-maker perceptions

• Energy-security and climate-change problems both have to do with fossil-fuel dependence.

• Both problems require federal government policy responses.

• Expanding nuclear energy would give major leverage against both problems.

• A carbon tax (or cap-and-trade system) would give major leverage against both problems.

• The world may run out of fossil fuels in time to prevent us from wrecking the climate.
Perceptions [and realities]

• Energy-security and climate-change problems both have to do with fossil-fuel dependence. [correct]

• Both problems require federal government policy responses. [correct]

• Expanding nuclear energy would give major leverage against both problems. [not soon]

• A carbon tax (or cap-and-trade system) would give major leverage against both problems. [no]

• The world may run out of fossil fuels in time to prevent us from wrecking the climate. [no]
Realities: nuclear energy

- With current end-use patterns & infrastructure, nuclear energy has little leverage on oil use.
  - Today’s nuclear technology makes only electricity.
  - The USA uses little oil for electricity generation.
  - Substituting nuclear electricity for oil in the transport sector would require large expansion of plug-in hybrids and/or electric public transit.
  - Nuclear-thermal- or nuclear-electric hydrogen for transport is even farther away for a combination of technical, economic, & infrastructure reasons.
U.S. net electricity generation, 2005, billion kWh

total = 4038

Half of US electricity is coming from coal.
Realities: nuclear energy (continued)

• Even the task of reducing electricity-sector CO₂ emissions by expanding nuclear is hard.
  – In 2005, 104 reactors (total 100 GWe) generated 19% of US electricity; 435 reactors (total 370 GWe) generated 15% of world electricity.
  – Getting 1 wedge (avoiding 1 GtC by 2055) requires replacing ~700 GWe of non-CCS coal with nuclear, hence 2X 2005 capacity plus replacing that capacity.
  – 1100 GWe of nuclear in 2055 implies 160 million SWU enrichment work and 20,000 metric tonnes of spent fuel per year; diversion of 0.1% of SWU → 12-50 U bombs; if half recycle Pu, diversion of 0.1% → 20 Pu bombs.
Carbon-price realities

• If price on CO$_2$ emissions is $100/tC$ ($27/t$CO$_2$), effect on economics of coal-electric generation is large but effect on economics of operating an automobile is small.
  – At $100/tC$, cost of electricity from a 36% efficient pulverized-coal power plant goes from $50 to $75 per MWh.
  – But the increase in gasoline price @ $100/tC is only $0.26 per gallon ($0.07/liter).

• Conclusion: a carbon price high enough to affect consumer & manufacturer incentives re autos is not in the cards; autos require separate measures.
Realities: Will running out take care of it?

- Combustion of conventional fossil fuels yields about
  - 15 million tonnes C in CO₂ per EJ of natural gas
  - 20 million tonnes C in CO₂ per EJ of petroleum
  - 25 million tonnes C in CO₂ per EJ of coal
  - 1 tonne of C makes 3.67 tonnes of CO₂

- Remaining ultimately recoverable resources would yield
  - 200+ billion tonnes of C in CO₂ from natural gas
  - 300+ billion tonnes of C in CO₂ from petroleum
  - 4,000 billion tonnes of C in CO₂ from coal

Current C content of the atmosphere (380 ppmv) = 800 billion tonnes C in CO₂ (an increase of ~215 billion tonnes C since 1750). About half of added CO₂ now stays in atmosphere; if this remains so, adding 700 billion more tonnes of C in CO₂ will get us to 2X 1750 concentration.

There is more than enough conventional fossil fuel to double – indeed to quadruple – pre-industrial atmospheric concentration of CO₂.
Oil & climate linkages: my view of reality

• Oil & climate are the 2 biggest energy challenges
  – how to control urban air pollution & oil-dependence risks in the face of rising demand for personal transport
  – how to provide the affordable energy needed to create & sustain prosperity without wrecking global climate

• We need to think about their solutions together
  – The oil problem is a 600-pound gorilla already in the room; climate change is an 800-pound gorilla beating down the door.
  – Trying to appease the 600-pound gorilla in ways that accelerate the 800-pound gorilla’s entry is folly.
  – Tar sands and coal-to-liquids without CCS are follies; efficiency increases & biofuels are win-win solutions.