

# Implementing the Behavioral Wedge

Affecting Individual and Corporate Behavior Panel

Implementing Climate Change Policy: Looking Forward to the Hard Part

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# The Behavioral Wedge

□ Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce U.S. Carbon Emissions, Proc. Nat'l Acad. Sci. (2009) available at behavioralwedge.msu.edu and Vanderbilt Climate Change Research Network Website at <http://law.vanderbilt.edu/academics/academic-programs/environmental-law/climate-change-network/index.aspx>

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# The Role of the Behavioral Wedge

- Viable Gap-Filler: The Fast Wedge
- Near-term and Long-term Reductions
- Low Cost and Intrusiveness
- Energy and Carbon Reductions
- Magnitude
  - US = ~ 17% below 2005 Levels by 2020  
is ~280 MtC/year if no emissions  
growth or 406 MtC/year if EIA  
projected emissions growth
  - RAER-10 = 123 MtC if static or 132 MtC if  
growth (44% or 33% of US total)

# Stabilization Wedges

- Pacala & Socolow (2004)
- Stabilization wedge = 1 GtC in 50 years; 25 GtC over 50 year period
  - 7 wedges needed to stabilize emissions
  - US = ~ 20% or 200 MtC/yr per wedge in 50 years; 1.4 GtC/yr in 50 years
  - 7 US wedges in 10 years = 210 MtC/yr
  - RAER-10 = 123 MtC or ~3 wedges (44% of US year 10 contribution)

# Behavioral Wedge Methodology:

## Calculating RAER

- PER: potential emissions reduction if 100% adoption (accounting for existing penetration)
- Plasticity: the proportion of non-adoptors that could be induced to take action
- Reasonably Achievable Emissions Reduction:
  - $RAER = PER \times Plasticity$
  - Corrected for double-counting
  - Not corrected for potential “take-back”
- RAER Estimate
  - 10-year RAER: 20% of household emissions (7.4% of US total)
  - 5-year RAER: 13% of household emissions (5.2% of US total)

# Effective Interventions

- ❑ Single interventions often ineffective
- ❑ Effective interventions
  - ❑ Strong Social Marketing: mass media appeals plus participatory, community-based approaches
  - ❑ Multiple Targets: individuals, communities, businesses
  - ❑ Synergistic Effects: can arise from combinations of mass media appeals, information, financial incentives, informal social incentives, reduction of transaction costs

# Actions

- 17 types and 33 specific actions
- 5 categories
  - W Actions: home *weatherization*, etc.
  - E Actions: more efficient vehicles and non-heating and cooling *equipment*
  - M Actions: equipment *maintenance*
  - A Actions: equipment *adjustments*
  - D Actions: *daily* use behavior

# Individual Behavior: The Opportunity

Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce U.S. Carbon Emissions, 106 PROC. NAT'L ACAD. SCI. 18452 (2009)(Dietz et al)

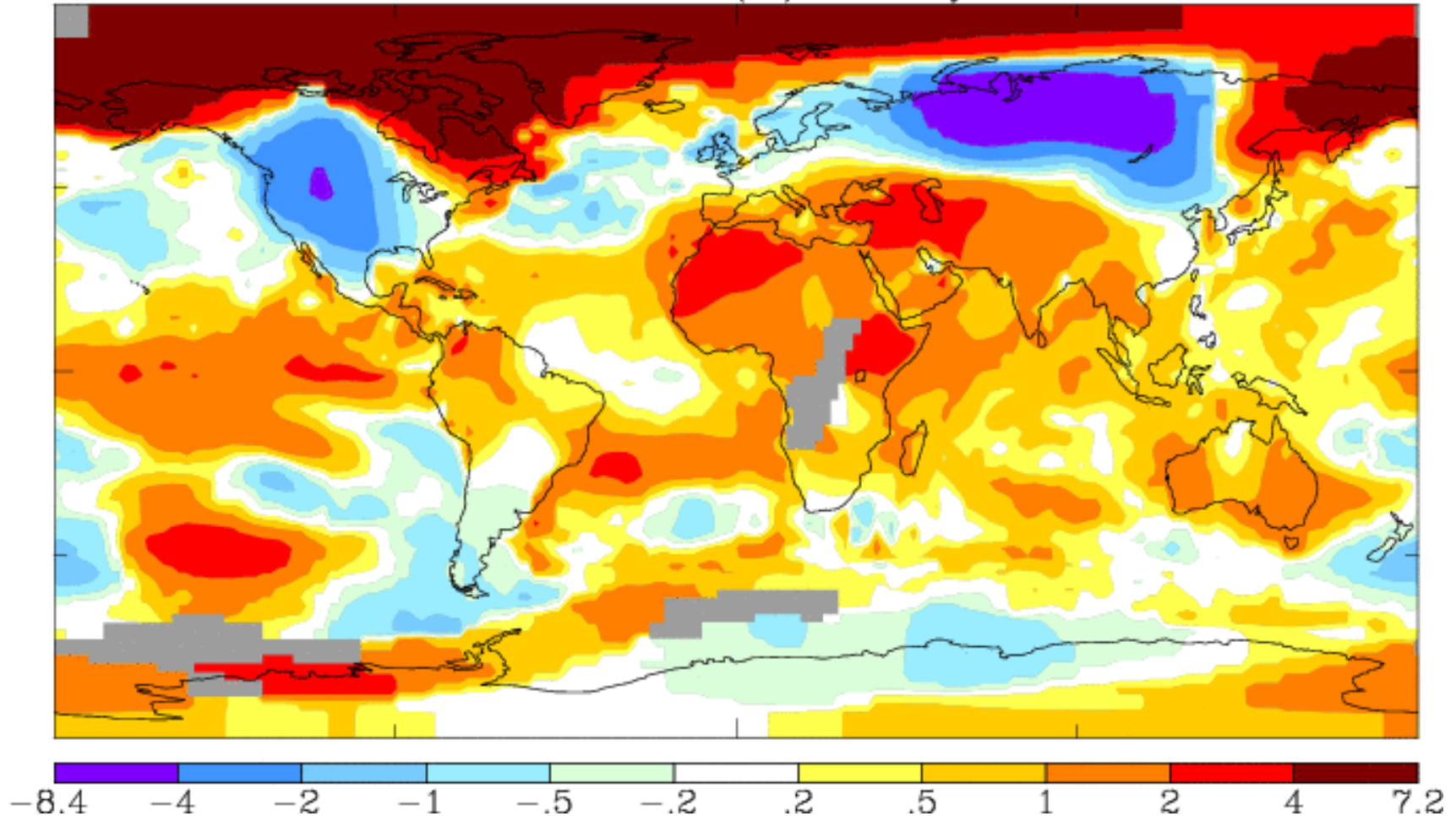
Behavior Change	Category	Potential Emissions Reduction (MTC)	Behavioral Plasticity	RAER (MTC)	RAER (%I/H)
Weatherization	W	25.2	90%	21.2	3.39%
HVAC Equipment	W	12.2	80%	10.7	1.72%
Low-flow showerheads	E	1.4	80%	1.1	0.18%
Efficient water heater	E	6.7	80%	5.4	0.86%
Appliances	E	14.7	80%	11.7	1.87%
LRR tires	E	7.4	80%	6.5	1.05%
Fuel-efficient vehicle	E	56.3	50%	31.4	5.02%
Change HVAC air filters	M	8.7	30%	3.7	0.59%
Tune up AC	M	3.0	30%	1.4	0.22%
Routine Auto Maintenance	M	8.6	30%	4.1	0.66%
Laundry temperature	A	0.5	35%	0.2	0.04%
Water heater temperature	A	2.9	35%	1.0	0.17%
Standby electricity	D	9.2	35%	3.2	0.52%
Thermostat setbacks	D	10.1	35%	4.5	0.71%
Line drying	D	6.0	35%	2.2	0.35%
Driving behavior	D	24.1	25%	7.7	1.23%
Carpooling & Trip-chaining	D	36.1	15%	6.4	1.02%
Totals		233		123	20%

# Barriers: Priority and Urgency about Climate

December 2009

L-OTI(°C) Anomaly vs 1951-1980

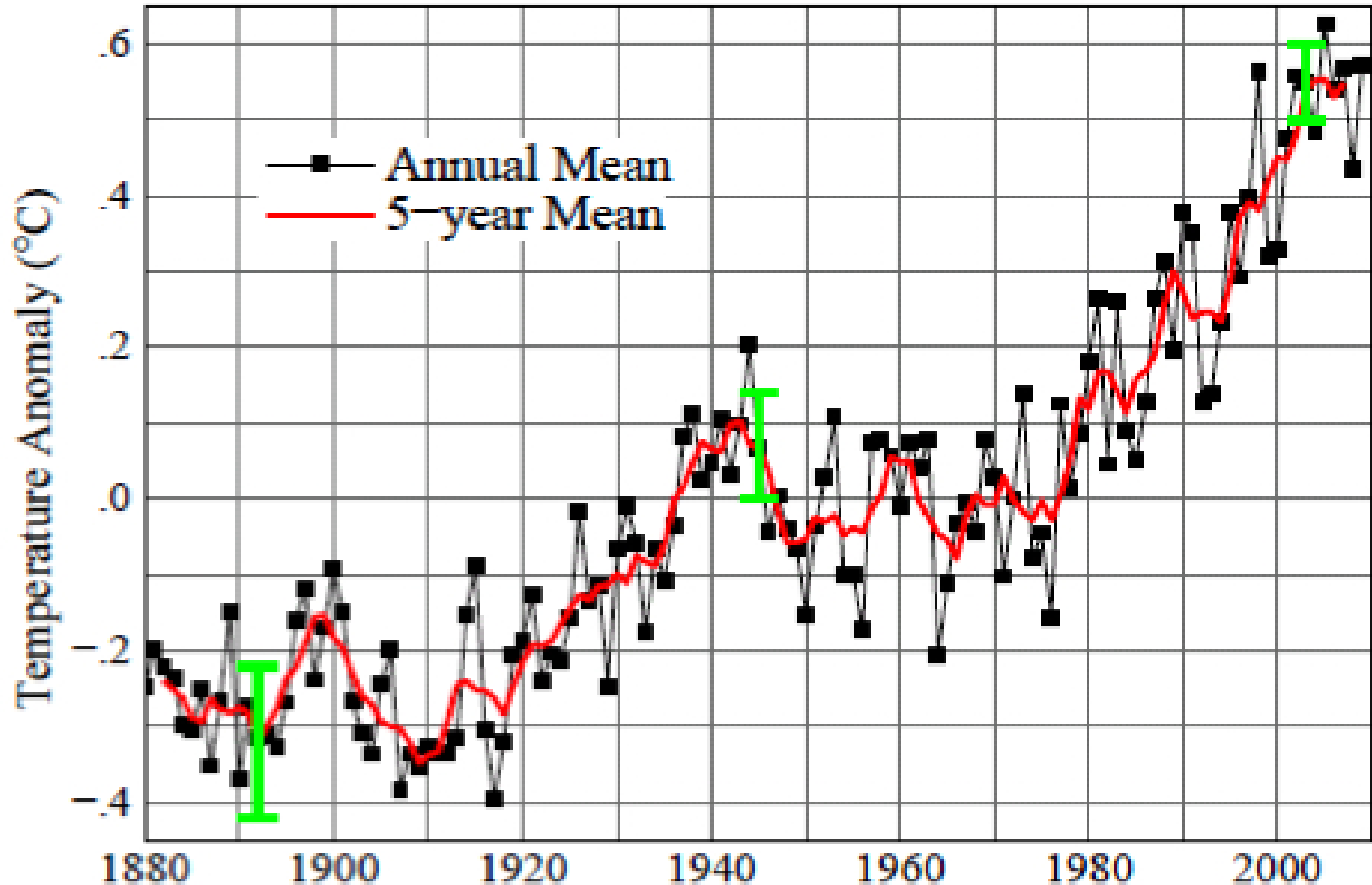
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NASA, Goddard Institute for Space Studies, December 2009 Global Surface Temperature Analysis, available at [http://data.giss.nasa.gov/cgi-bin/gistemp/do\\_nmap.py?year\\_last=2009&month\\_last=12&sat=4&sst=1&type=anoms&mean\\_gen=12&year1=2009&year2=2009&base1=1951&base2=1980&radius=1200&pol=req](http://data.giss.nasa.gov/cgi-bin/gistemp/do_nmap.py?year_last=2009&month_last=12&sat=4&sst=1&type=anoms&mean_gen=12&year1=2009&year2=2009&base1=1951&base2=1980&radius=1200&pol=req)

# Barriers: Priority and Urgency about Climate

(a) Global Land–Ocean Temperature Index



Hansen, Ruedy, Sato, and Lo, "If It's That Warm, How Come It's So Damned Cold?", *Real Climate*, January 17, 2010, available at [http://www.realclimate.org/images/Hansen09\\_fig1.jpg](http://www.realclimate.org/images/Hansen09_fig1.jpg)

# Behavioral Wedge Barriers

- ❑ Policy, Not Legal Problems
- ❑ Taking Individual Behavior Seriously
  - ❑ Source Framing
  - ❑ Crowding Out
  - ❑ The Consumption Assumption: Demand v. Supply
  - ❑ The 1% Problem
- ❑ Implementing Consumer-Level Technology Solutions
  - ❑ The Principal-Agent Problem
  - ❑ The Political Economy Problem
  - ❑ Scaling and Federalism
  - ❑ Mixed Goals: the Weatherization Example
  - ❑ Agency Expertise
  - ❑ Avoiding Price, Technology and Regulatory Hegemony

# Behavioral Wedge Barrier:

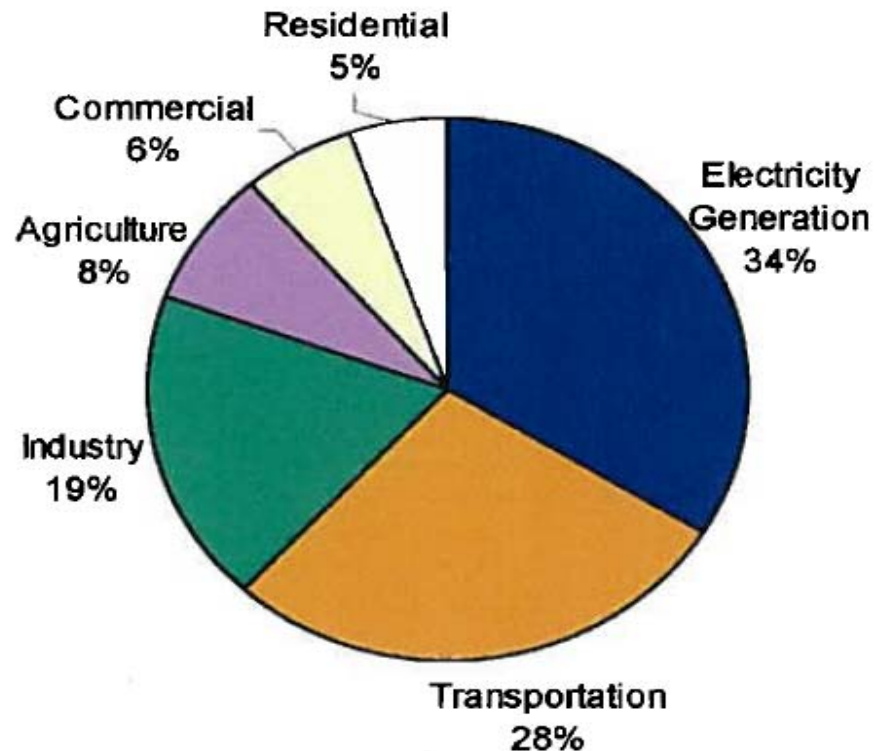
## Source Framing

### Direct U.S. Greenhouse Gas Emissions by Economic Sector (2005)

Sector/Source	2005 Emissions (MMTCO <sub>2</sub> eq)
Electricity Generation	2,429.8
Transportation	2,008.9
Industry	1,352.8
Agriculture	595.4
Commercial	431.4
Residential	380.7
<b>Total*</b>	<b>7,199.0</b>

\*excludes US Territories and emission sinks

MMTCO<sub>2</sub>eq = Million Metric Tons Carbon Dioxide Equivalents

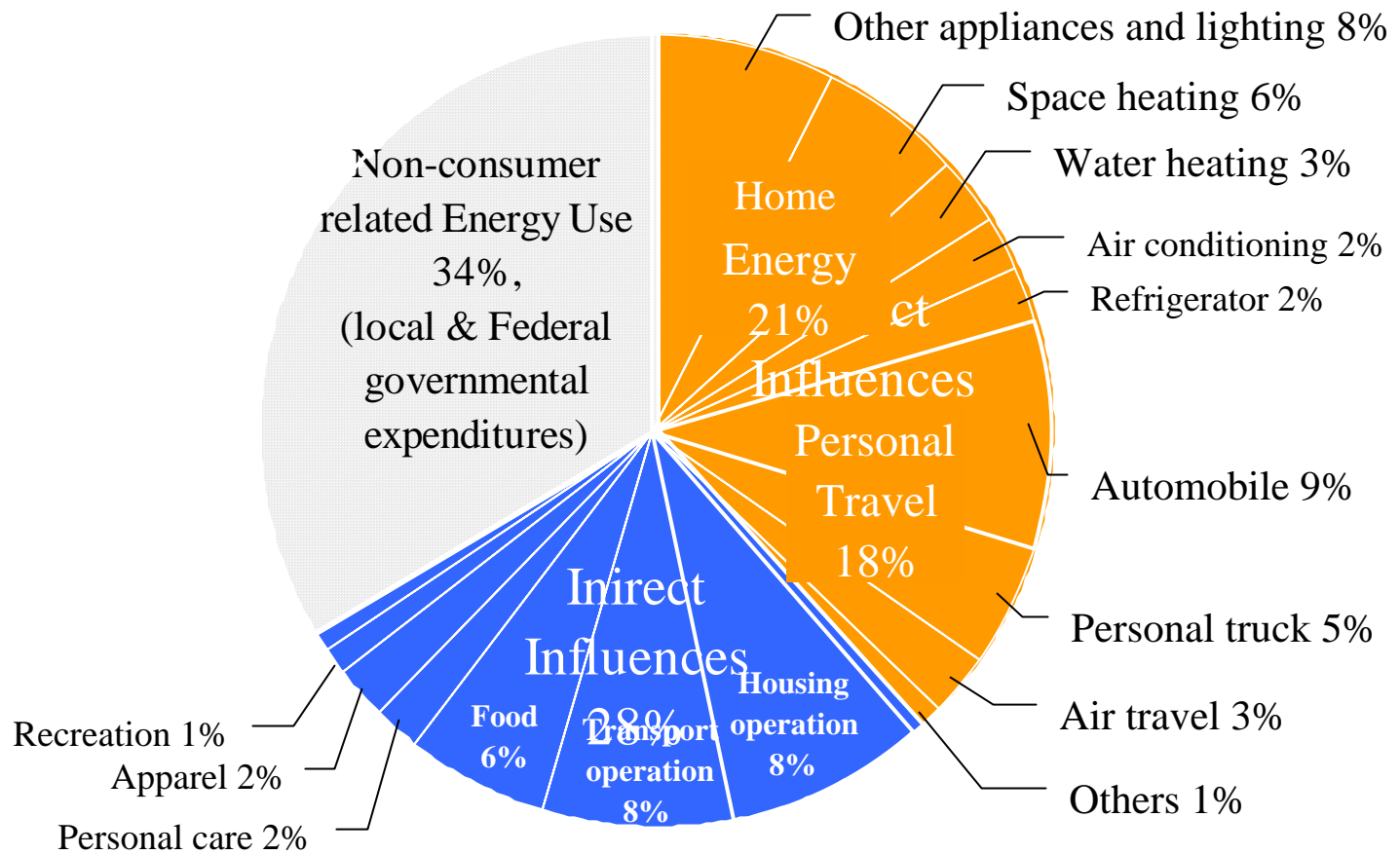


Source: US Environmental Protection Agency, *The US Inventory of Greenhouse Gas Emissions and Sinks (2005)*, April 2007

Source: House Committee on Energy and Commerce, <http://bit.ly/6Xqyon>

# Behavioral Wedge Barrier: 2001 U.S. Energy Use Profile

Source: Shui Bin, Joint Global Change Research Institute (2008)



# Behavioral Wedge Barrier: Crowding Out

- E.g., “To Really Save the Planet, Stop Going Green”
  - Washington Post 12/6/09
  - Assumption: taking small household steps will crowd out support for broad law and policy changes
  
- Kotchen & Moore (2008)
  - Traverse City, MI green electricity (offset) program
  - Participation in program did not increase household electricity use

# Behavioral Wedge Barrier: Demand v. Supply

- Demand Projections in Local, State and Federal Proceedings
- Justice Rehnquist, *Vermont Yankee Nuclear Power Corp. v. NRDC* (1979):

A request to an agency to evaluate electricity demand reduction through energy conservation in the late 1960s/early 1970s was “an exploration of uncharted territory” and “peripheral” to a decision on the adequacy of an Environmental Impact Statement.

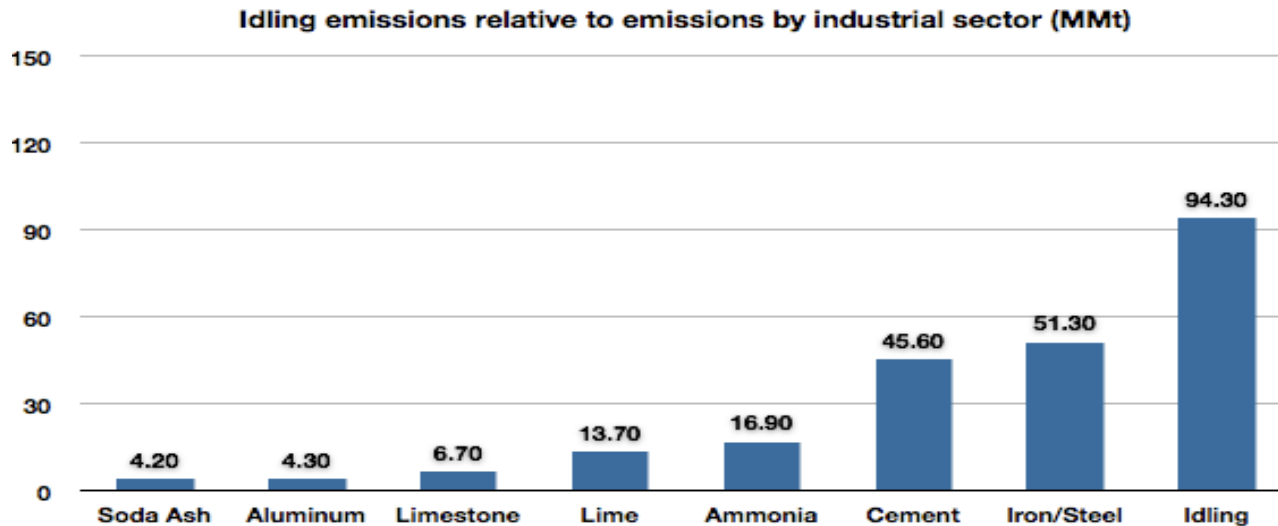
# Behavioral Wedge Barrier

## The 1% Problem

### Motor Vehicle Idling (1.6%)

Table 1. Summary of CO2 emissions and fuel consumption associated with idling behavior

	<u>Minutes/day</u>	<u>CO2 Emissions</u>		<u>Fuel Consumption</u>	
		<u>Annual per person emissions (pounds)</u>	<u>Annual US emissions (MMt)</u>	<u>Annual per person consumption (gallons)</u>	<u>Annual US consumption (billion gallons)</u>
Warming	4.0	266.4	24.3	11.4	2.3
Waiting	3.6	242.8	22.1	10.4	2.1
Traffic	7.8	526.1	47.9	22.6	4.5
<b>Total</b>	<b>15.3</b>	<b>1035.3</b>	<b>94.3</b>	<b>44.4</b>	<b>8.9</b>



# Additional Behavioral Wedge Barriers

- Barriers to Implementing the Behavioral Wedge
  - The Principal-Agent Problem
  - The Political Economy Problem
  - Scaling and Federalism
  - Mixed Goals: the Weatherization Example
  - Agency Expertise
  - Avoiding Price, Technology and Regulatory Hegemony

# Examples of Behavioral Wedge Strategies

## Motor Vehicle Idling: Feedback and ISGs

Source: Carrico et al (2009)

### Motivations/Beliefs:

- It is better to idle for \_\_\_ in order to:
  - Save gas: *4.7 minutes*
  - Prevent pollution: *3.6 minutes*
  - Prevent vehicle wear: *5.7 minutes*
- Over 80% of respondents held inaccurate/outdated beliefs about idling.

Table 2. Projected savings in CO<sub>2</sub> and fuel use associated with a reduction in unnecessary idling

	% of idlers in population	CO <sub>2</sub> Emissions		Fuel Consumption	
		Annual per person emissions (lbs)	Annual US emissions (MMt)	Annual per person consumption (gallons)	Annual US consumption (billion gallons)
Warming	68%	354.1	22.0	15.2	2.1
Waiting	46%	492.4	20.7	21.1	2.0
<b>Total</b>		<b>846.5</b>	<b>42.7</b>	<b>36.3</b>	<b>4.1</b>

# Examples of Behavioral Wedge Strategies

## Feedback Plus Fuel Efficiency

### Effect of Speed on Fuel Consumption

- Fuel consumption generally increases at above 55-60 mph due to increased aerodynamic drag.
- Every 5 mph over 55 is ~ \$.20 per gallon increase in gas prices.
- Drag increases with the square of velocity (law of physics, not just a good idea).

