Bioenergy & Climate: the long, medium, and short of it

Nathanael Greene

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Natural Resources Defense Council

Lifting our eyes to the horizon

- Long-term environmental imperatives are the global environmental imperatives:
  - Sustainable food production
  - Climate change
  - Water
  - Sustainable energy production
  - Biodiversity
- There’s a big difference between:
  - solutions that “fit” bioenergy into a sustainable future and
  - solutions where bioenergy is synergistic to a sustainable future

Walking in the right direction

- In the medium term, bioenergy needs to develop in a way that is clearly a partial solution and isn't making other problems worse
  - Example clearly: low carbon and not driving increase in water use from ag and energy
- As industry matures, must not be predicated on consuming a unsustainable resource (e.g. terrestrial carbon)
- The challenge of scale cannot be underestimated
  - What happens when the demands of a 100 million gallon plant scale to 1 billion gallons, 10 billion, 100 billion?
  - Once a technology is economically competitive, what will stop its growth? The natural resource supply?

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Which way the first step?

- In the short-term, we need to launch the industry on the green and narrow
- Tension between:
  - Financial and engineering challenges of “just getting the first one built”
  - Environmental and sociopolitical imperative of getting off on the right foot/proving the potential to do it right
- Big volume, long-term commitments of US and Europe have not helped with this tension
  - Short-term policy uncertainty hinders market
  - Long-term policy creates a winner-takes dynamic
    - Either business models are in or out
    - Environmental impacts must be evaluated on worst-case basis

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Today's corn and soy biofuels are not good enough

		Percent Reduction Lifecycle GHG Emisisons								
		2022			2017			2012		
	Time Horizon	30	30	30	30	30	30	30	30	30
	Discount Rate	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Range	Low	Mean	High	Low	Mean	High	Low	Mean	High
Dry Mill NG	Base Plant (dry DDGS)	-28%	-17%	-3%	-9%	10%	33%	9%	33%	63%
Dry Mill NG	w/ CHP (dry DDGS)	-31%	-20%	-6%	-13%	7%	30%	5%	30%	59%
Dry Mill NG	w/ CHP and Fractionation (dry DDGS)	-33%	-22%	-7%	-14%	5%	28%	4%	28%	57%
Dry Mill NG	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-37%	-25%	-11%	-18%	1%	24%	-1%	24%	53%
Dry Mill NG	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-41%	-30%	-15%	-23%	-4%	19%	-6%	19%	48%
Dry Mill NG	Base Plant (wet DGS)	-39%	-27%	-13%	-21%	-2%	22%	-3%	21%	50%
Dry Mill NG	w/ CHP (wet DGS)	-42%	-30%	-16%	-24%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill NG	w/ CHP and Fractionation (wet DGS)	-41%	-29%	-15%	-23%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill NG	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-44%	-33%	-19%	-27%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill NG	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-47%	-36%	-22%	-30%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	Base Plant (dry DDGS)	1%	12%	26%	22%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP (dry DDGS)	-1%	10%	24%	19%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP and Fractionation (dry DDGS)	-9%	3%	17%	12%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-16%	-5%	9%	3%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-25%	-14%	0%	-6%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	Base Plant (wet DGS)	-21%	-10%	4%	-2%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP (wet DGS)	-23%	-12%	2%	-4%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP and Fractionation (wet DGS)	-25%	-13%	1%	-6%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-32%	-21%	-7%	-14%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dry Mill Coal	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-38%	-26%	-12%	-20%	-1%	23%	-2%	22%	51%
Dry Mill Biomass	Base Plant (dry DDGS)	-51%	-40%	-26%	-34%	-15%	8%	-18%	6%	36%
Dry Mill Biomass	w/ CHP (dry DDGS)	-59%	-47%	-33%	-42%	-23%	0%	-26%	-2%	27%
Dry Mill Biomass	w/ CHP and Fractionation (dry DDGS)	-57%	-45%	-31%	-40%	-21%	2%	-24%	0%	30%
Dry Mill Biomass	w/ CHP, Fractionation and Membrane Seperation (dry DDGS)	-56%	-45%	-31%	-40%	-20%	3%	-23%	1%	30%
Dry Mill Biomass	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-57%	-45%	-31%	-40%	-21%	3%	-24%	0%	30%
Dry Mill Biomass	Base Plant (wet DGS)	-52%	-41%	-27%	-35%	-16%	7%	-19%	6%	35%
Dry Mill Biomass	w/ CHP (wet DGS)	-59%	-48%	-34%	-43%	-24%	0%	-27%	-3%	27%
Dry Mill Biomass	w/ CHP and Fractionation (wet DGS)	-57%	-46%	-32%	-41%	-21%	2%	-24%	0%	29%
Dry Mill Biomass	w/ CHP, Fractionation and Membrane Seperation (wet DGS)	-57%	-45%	-31%	-40%	-21%	2%	-24%	0%	30%
Dry Mill Biomass	w/ CHP, Fractionation, Membrane Seperation, and Raw Starc	-57%	-46%	-32%	-40%	-21%	2%	-24%	0%	29%
Wet Mill	with NG	-19%	-7%	7%	-3%	17%	40%	13%	37%	67%
Wet Mill	with coal	8%	19%	33%	24%	43%	66%	40%	64%	93%
Wet Mill	with biomass	-59%	-48%	-33%	-43%	-24%	0%	-27%	-3%	27%

Doesn't meet the 20% RFSII requirement

2022

Today

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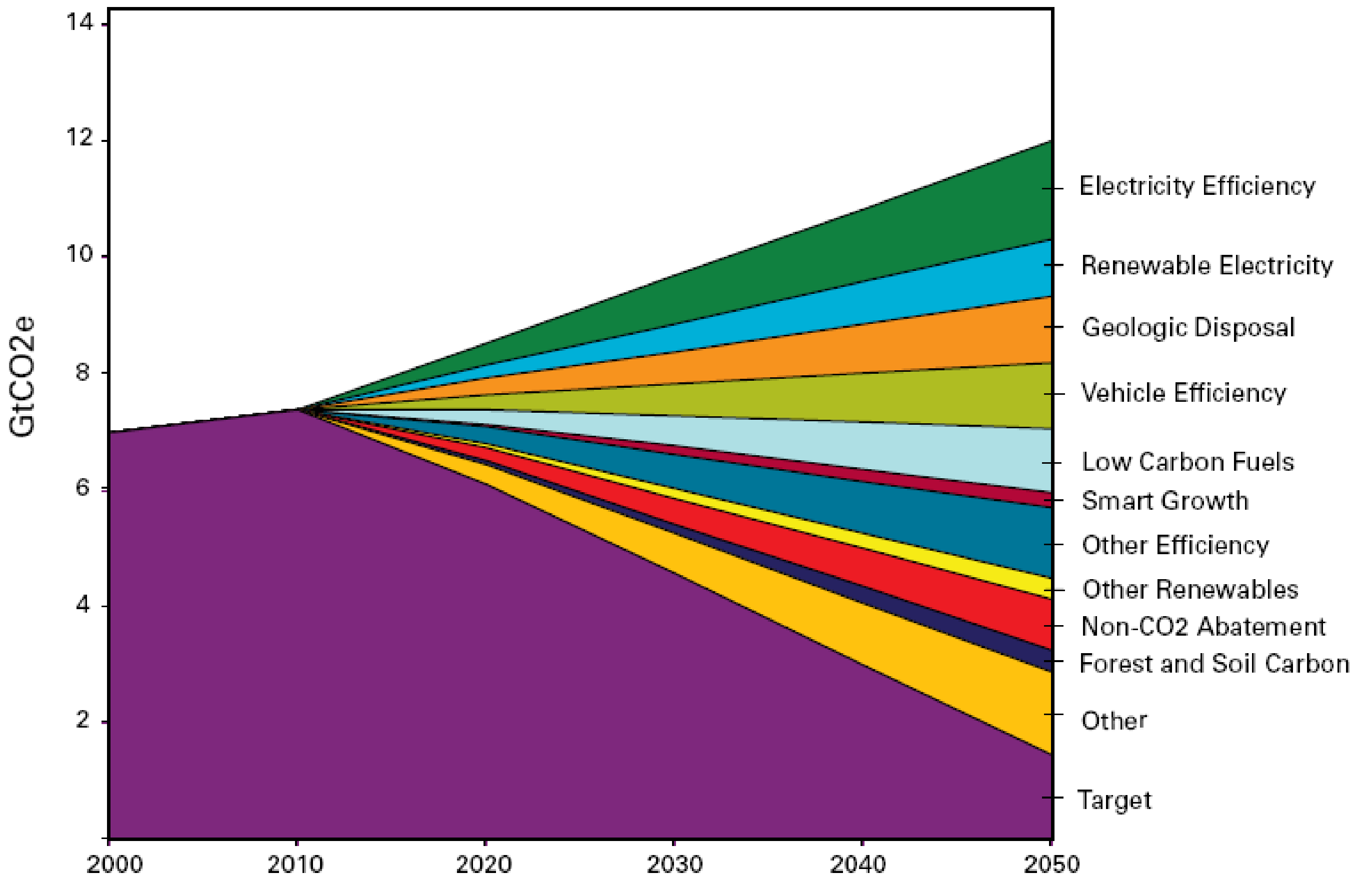
We Need Big Solutions, Fast, and Lots of ‘em



- US must contribute a 60-80% reduction in GHG emissions
- Renewables can provide about 1/5 of these reductions
- Biofuels can provide about half of the renewables wedge

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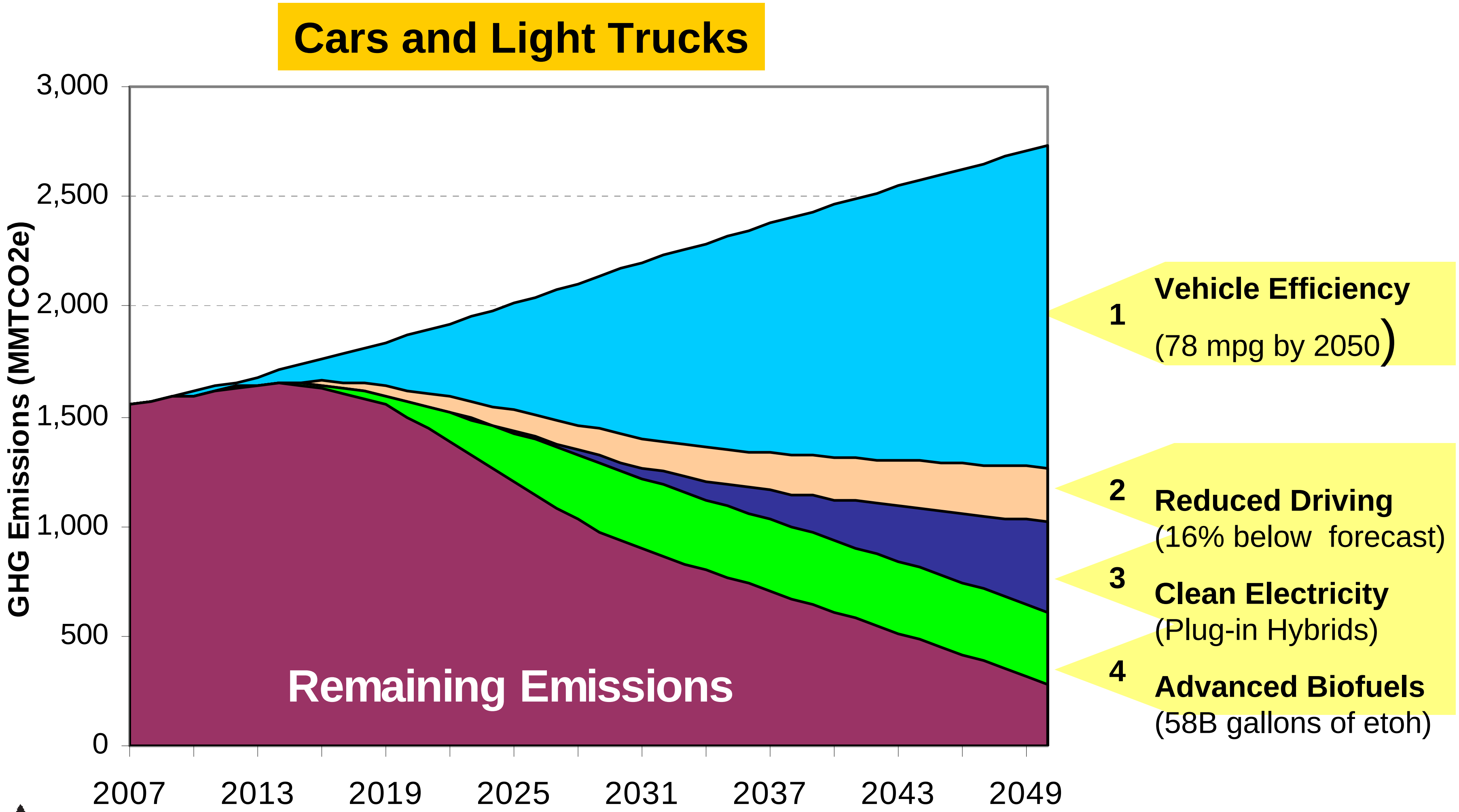
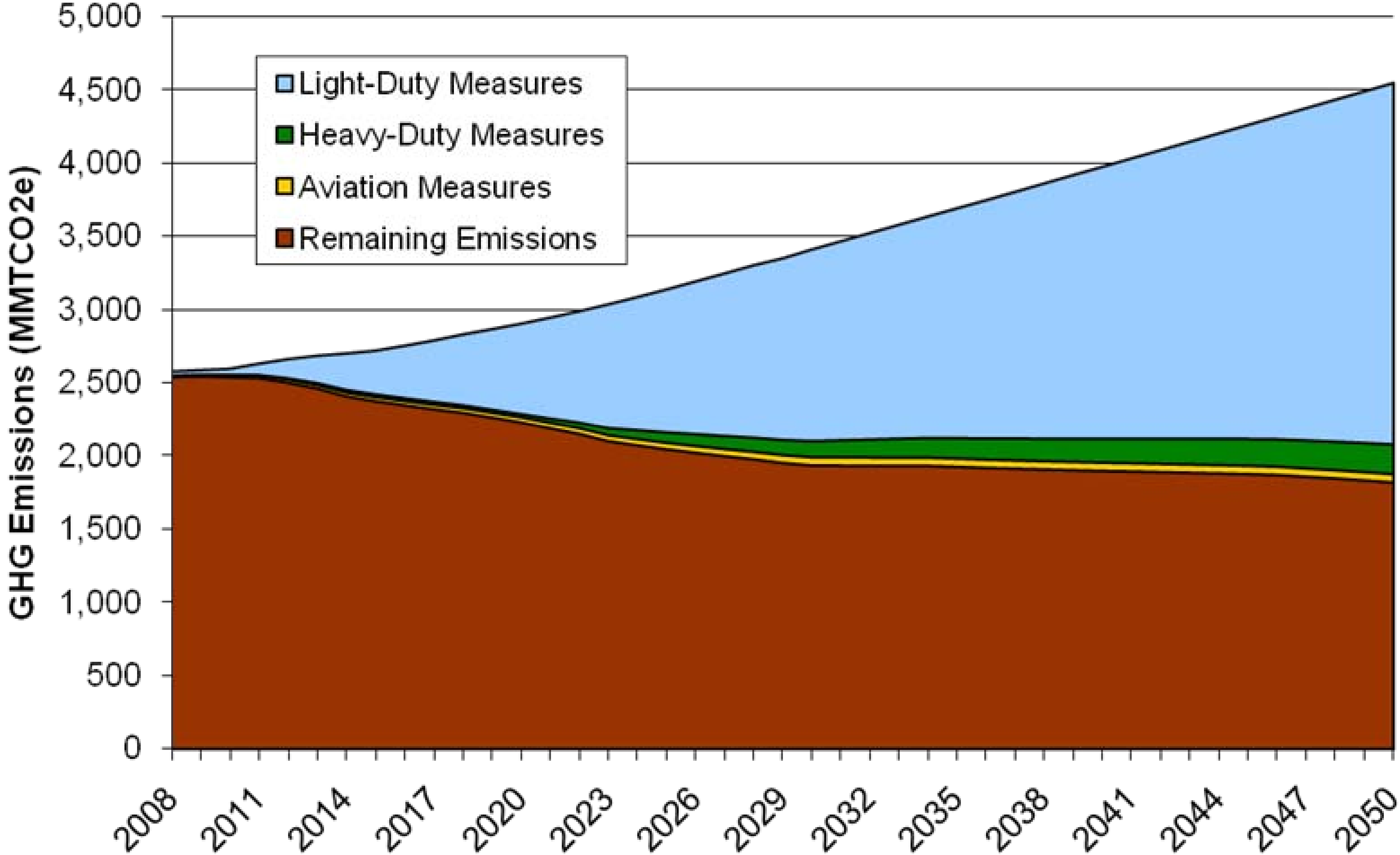
2050 80% Climate Stabilization Target:
Four Key Strategies



Source: NRDC analysis

Looking at all of transportation makes biofuels more urgent



How much low carbon bioenergy can we have?

- Really, how much low-carbon biomass can we produce?
- Have to understand combined demand for biopower, bioheat, and biofuels
- In US, over 2005 baseline, we expect increase of between 101-285 billion kWh and 30 billion gallons of bioenergy by 2020
  - 2.5-3.1 EJ of bioenergy/year in 2020
  - Equal to as much as 28 billion ft3 green wood or nearly 2x average annual harvest over past 2 decades

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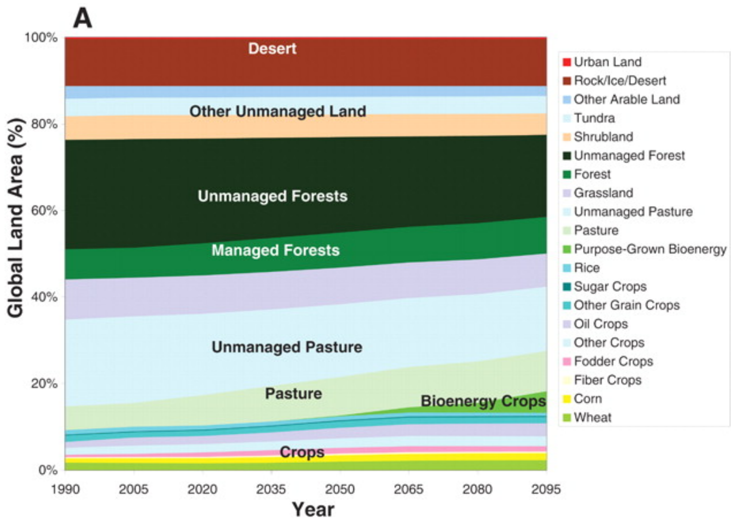
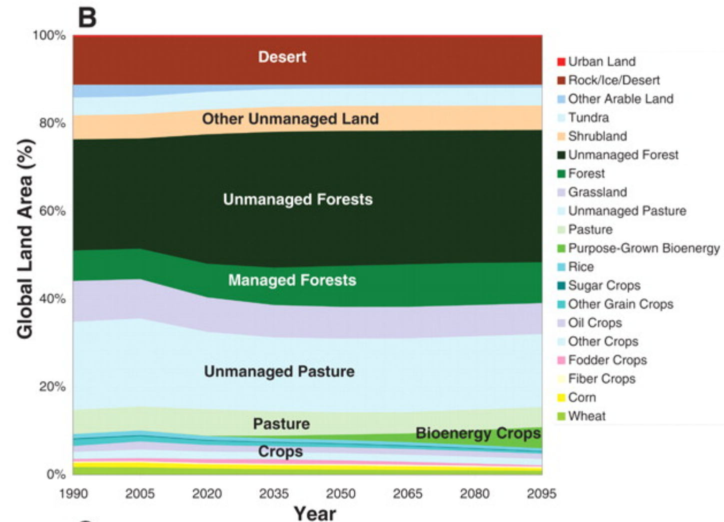
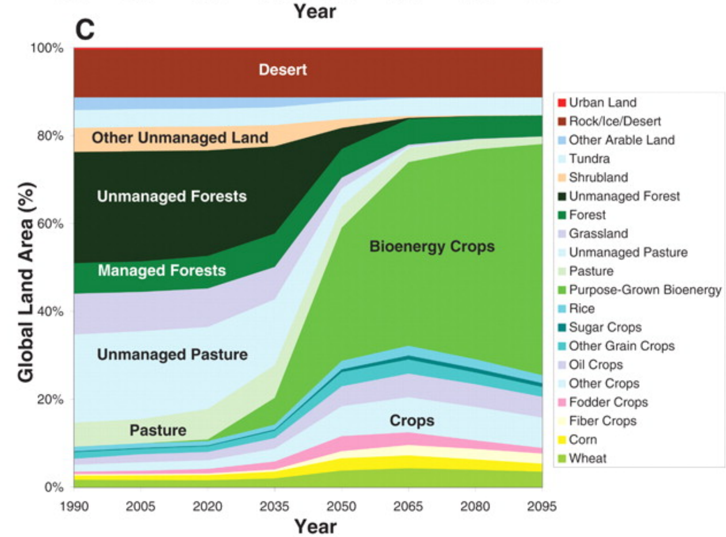
Wise et al., *Science* 2009







Global land-use scenarios:

A)Reference case

B)Universal Carbon Tax for 450ppm including terrestrial carbon

C)Fossil Fuel and Industrial Carbon Tax for 450 ppm excluding terrestrial carbon

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Source: http://www.sciencemag.org/cgi/content/full/324/5931/1183

Cap driven “leakage” is already happening

- European demand for biomass is creating growth in wood pellet industry in US
  - No accounting for carbon
  - Is Europe assuming all biomass is carbon neutral?
- US is poised to make this mistake
  - Notion of offsets and RED prove that not all land-management is carbon neutral
- RED is critical to slow rate of deforestation from non-biofuels related pressures
  - Would need to increase to offset bioenergy LUC
  - Like baling more while we poke more holes in the boat or paying for both sides of the war

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How do we develop low carbon bioenergy?

- First best solution: effectively put terrestrial carbon under international cap
  - Polluter pays!
- Second best:
  A. Mandate feedstocks and practices so that market is limited to “safe” choices
     - Europe – sort of
     - USA for RES thru renewable biomass (weak but essential)
  B. Measure performance and let market decide
     - CA and USA thru ILUC calculation
- Absent regulation, 2020 incremental US bioenergy will lead to between 60-350 million metric tons CO_2 from LUC (1-6% of 2005 baseline)

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How much uncertainty is too much?

- Remember the policy context:
  - Mandates
  - CA performance standard
- Could biofuels grown on crop land actually reduce pressure on forests and grass lands?
  - In the context of mandates, could ILUC push us in the wrong direction?
  - No. ILUC might be smaller than the models show, but can't be negative.
- What is the risk of acting in the face of uncertainty?
  - Too much GHG reductions
  - Perception that we can't make current rules work

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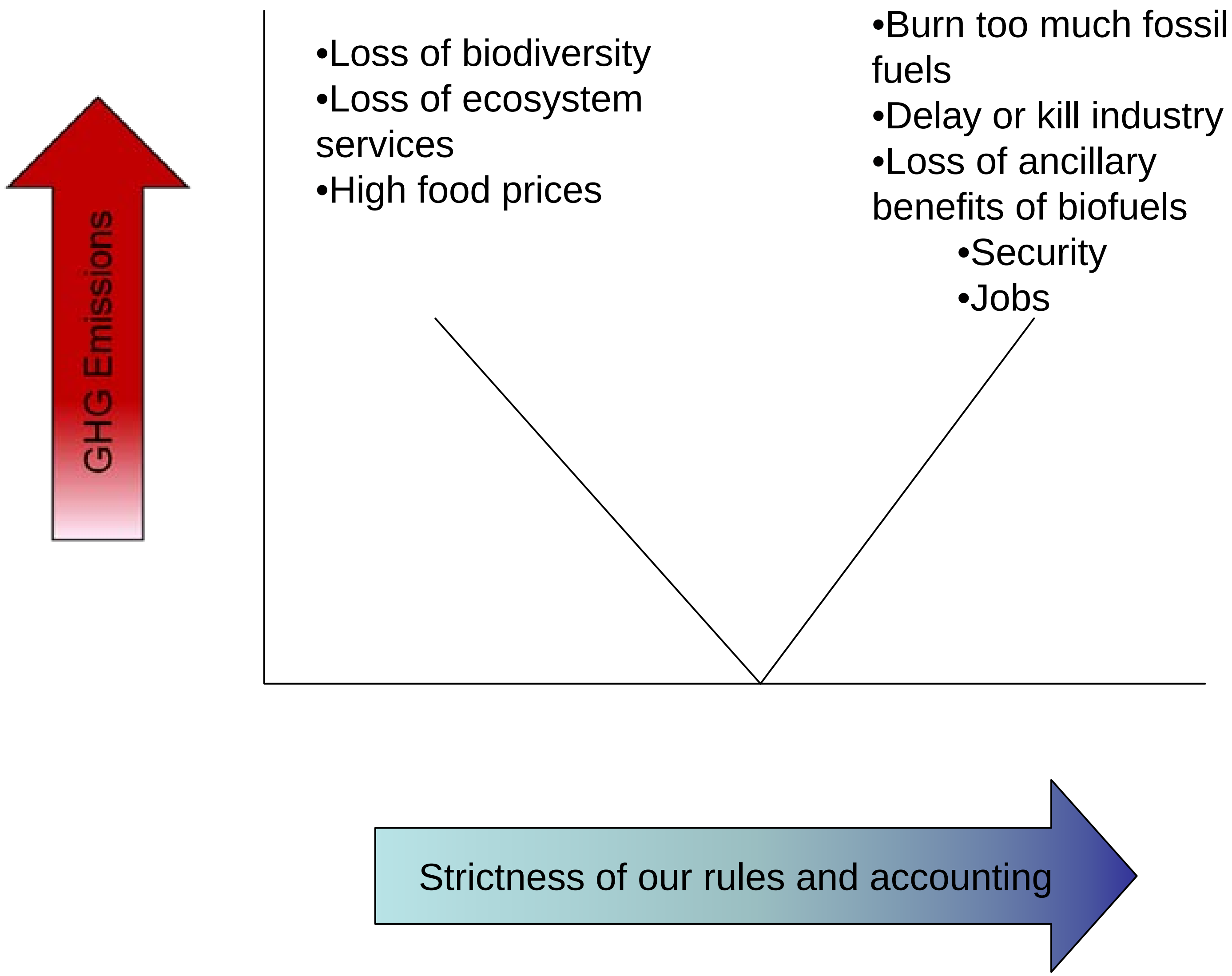
Getting it wrong has a cost



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If we’re going to use, let’s do it right

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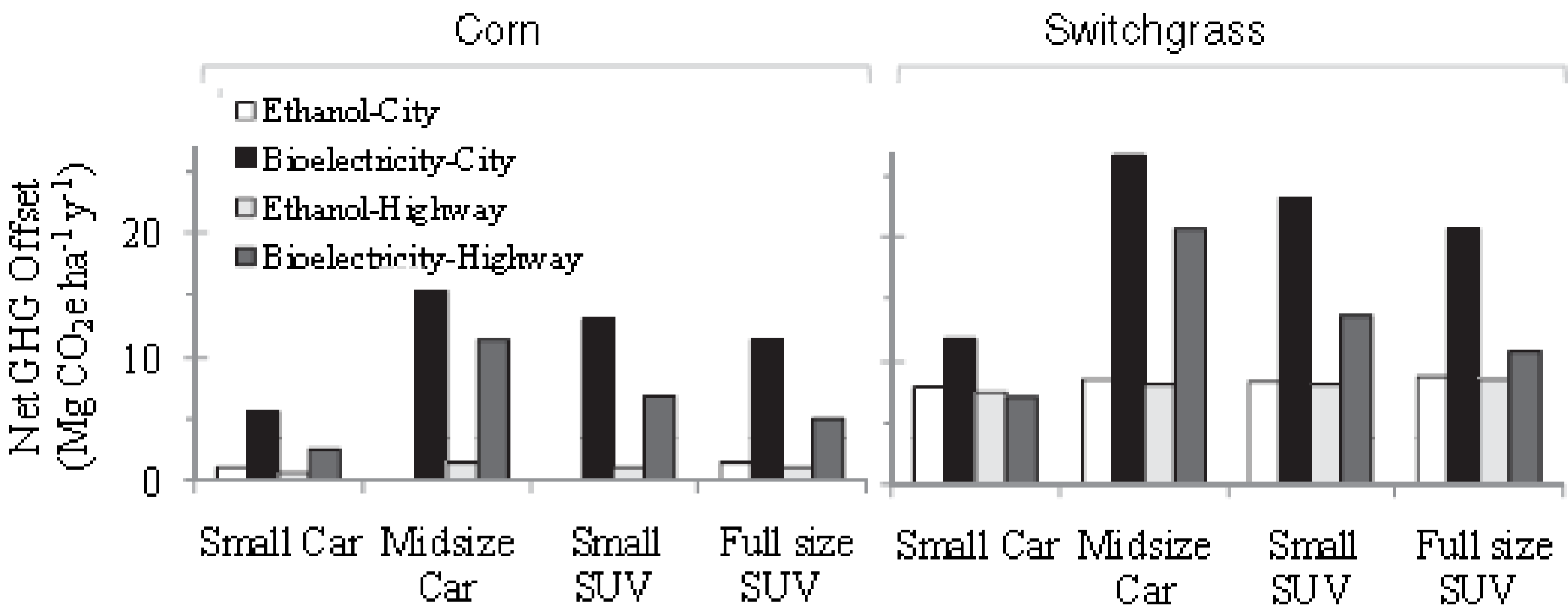
What is the best use of biomass?



Source: Campbell et al, “Greater Transportation Energy and GHG Offsets from Bioelectricity Than Ethanol,” *Science Express*, May 7, 2009. http://www.sciencexpress.org/7May 2009/Page1/10.1126/science.1168885

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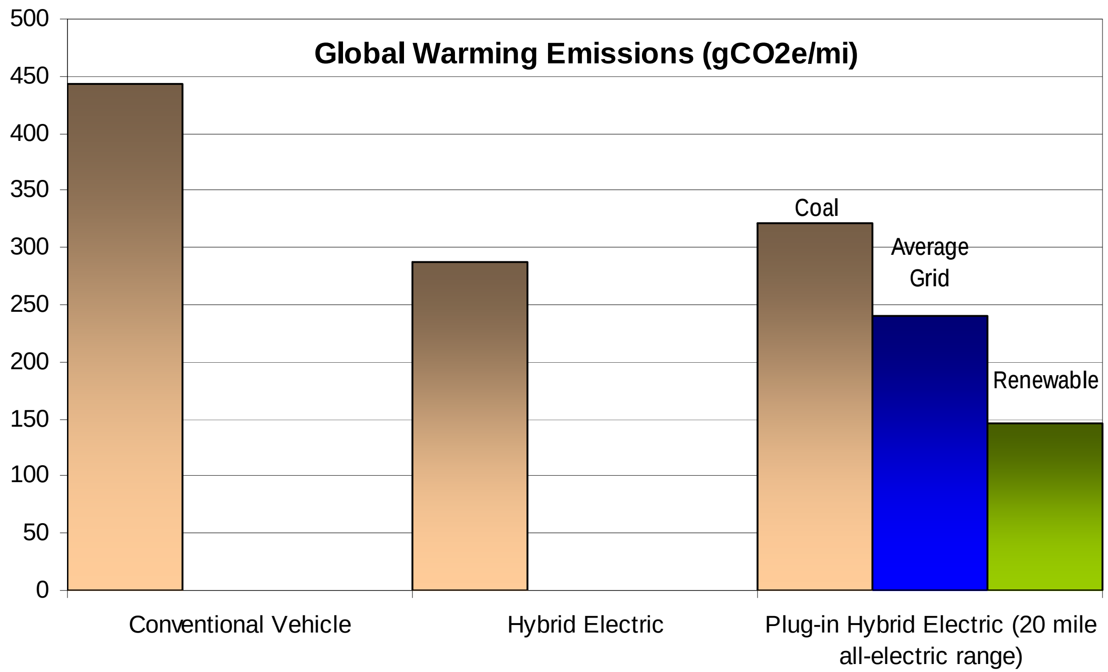
We need renewable electricity & plug-in hybrids

- Electricity is a much more efficient source of energy for transportation
- Efficiency means that even average grid power can reduce GHG emissions
- There are:
  - Technical challenges (batteries)
  - Economic challenges (renewables and cost of plug-in hybrids)
  - Behavioral challenges (plugging in vs. filling up)



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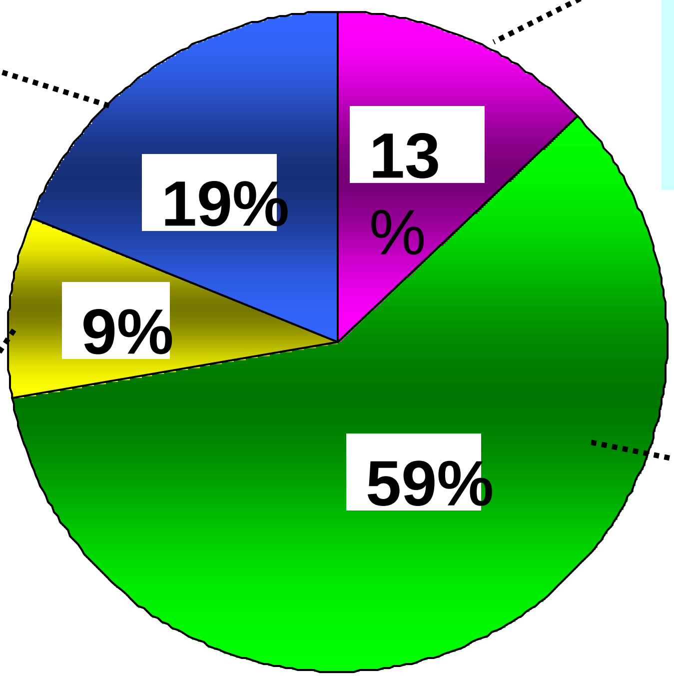
2050 80% Climate Stabilization Target:
Cumulative Emission Benefits by Strategy

Cumulative Emission Benefits by 2050
Cars and Light Trucks

Total Reduction of 53.6 Gigatonnes of CO2e by 2050

4. Advanced Biofuels
- 58B gal by 2050 of etoh by 2050
- Average GHG reduction of 75% compared to gasoline

2. Reduced Driving
- 16% lower miles driven by 2050
- Smart growth, road pricing, and transit



3. Clean Electricity
- 45% of all miles driven are on electricity from low carbon grid

1. Vehicle Efficiency
- 67% reduction in CO2e/mile or about 78 mpg

Source: NRDC analysis

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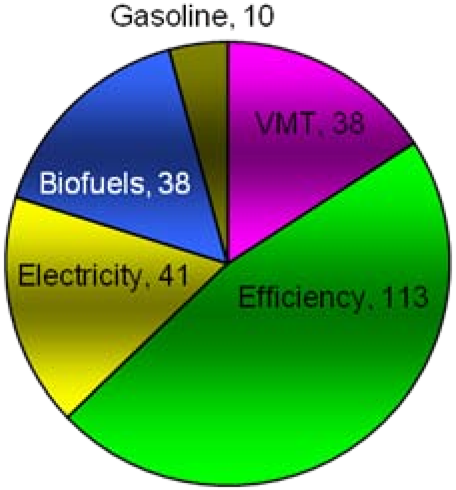
Another way to look at it: We Can Virtually Eliminate Our Demand for Gasoline by 2050

Displacing 240 Billion Gallons of Gasoline Demand in 2050
(gallons of gasoline equivalents)



- To get sufficient GHG reductions from the transportation sector, biofuels will have to play a much larger role than they do today
  - 3x LDV efficiency, 16% VMT reduction, all plug-in flex-fuel hybrids driving first 46% of miles on electricity
  - Still need 60 billion gallons (etoh equiv) of biofuels with 80% reduction in GHG per gallon

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