Options for Carbon Sequestration and Climate Change Mitigation

David Ryan PE
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Butte, Montana September 2007

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Option costs and potential as developed by the Center for Climate Strategies

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Montana Numbers 2007-2020

MMtCO2E = Millions of Metric Tons of Carbon Dioxide Equivalent

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Work in progress - - -

TBD's and NA's etc. Left Out

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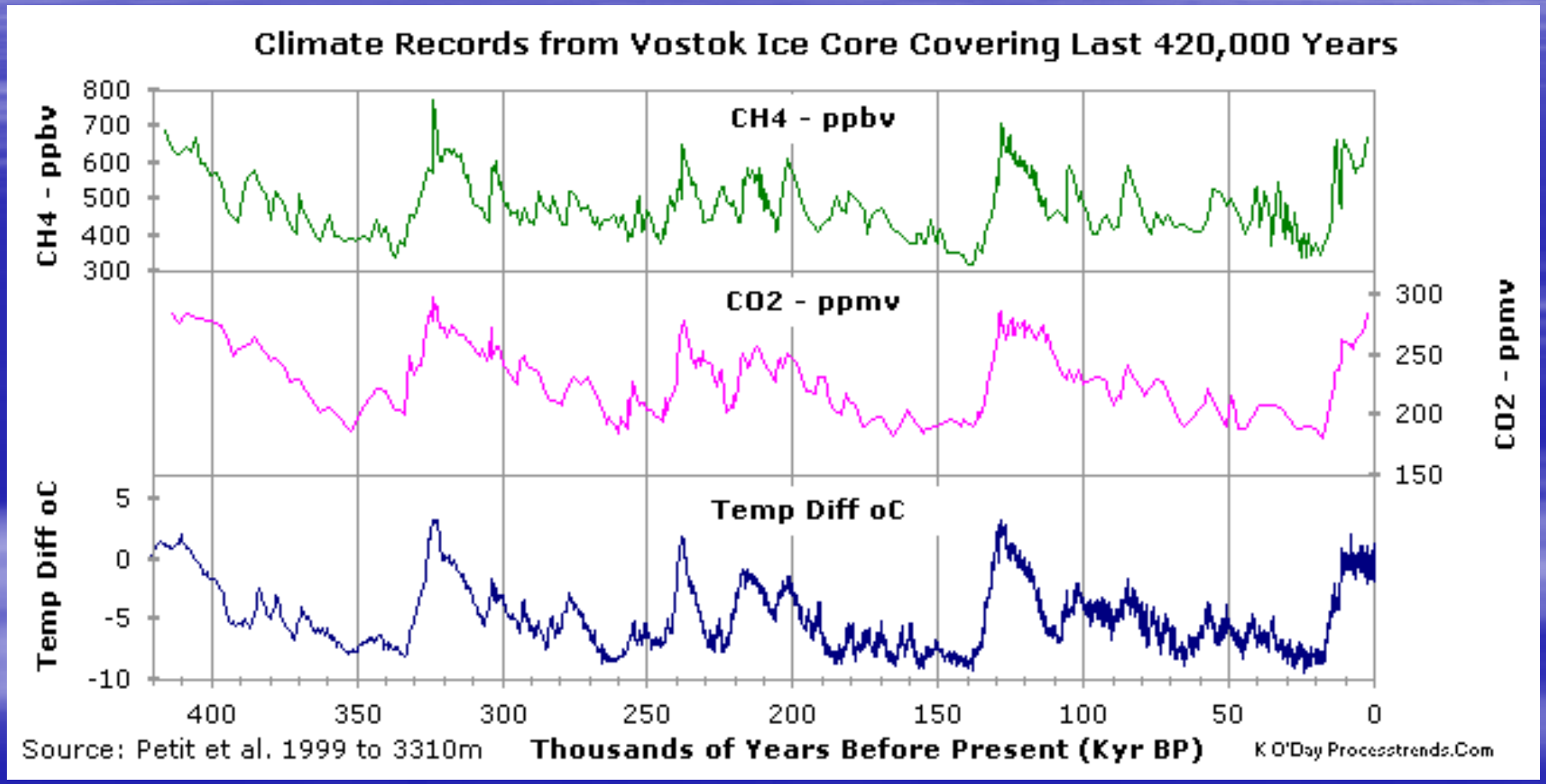
Why We Care



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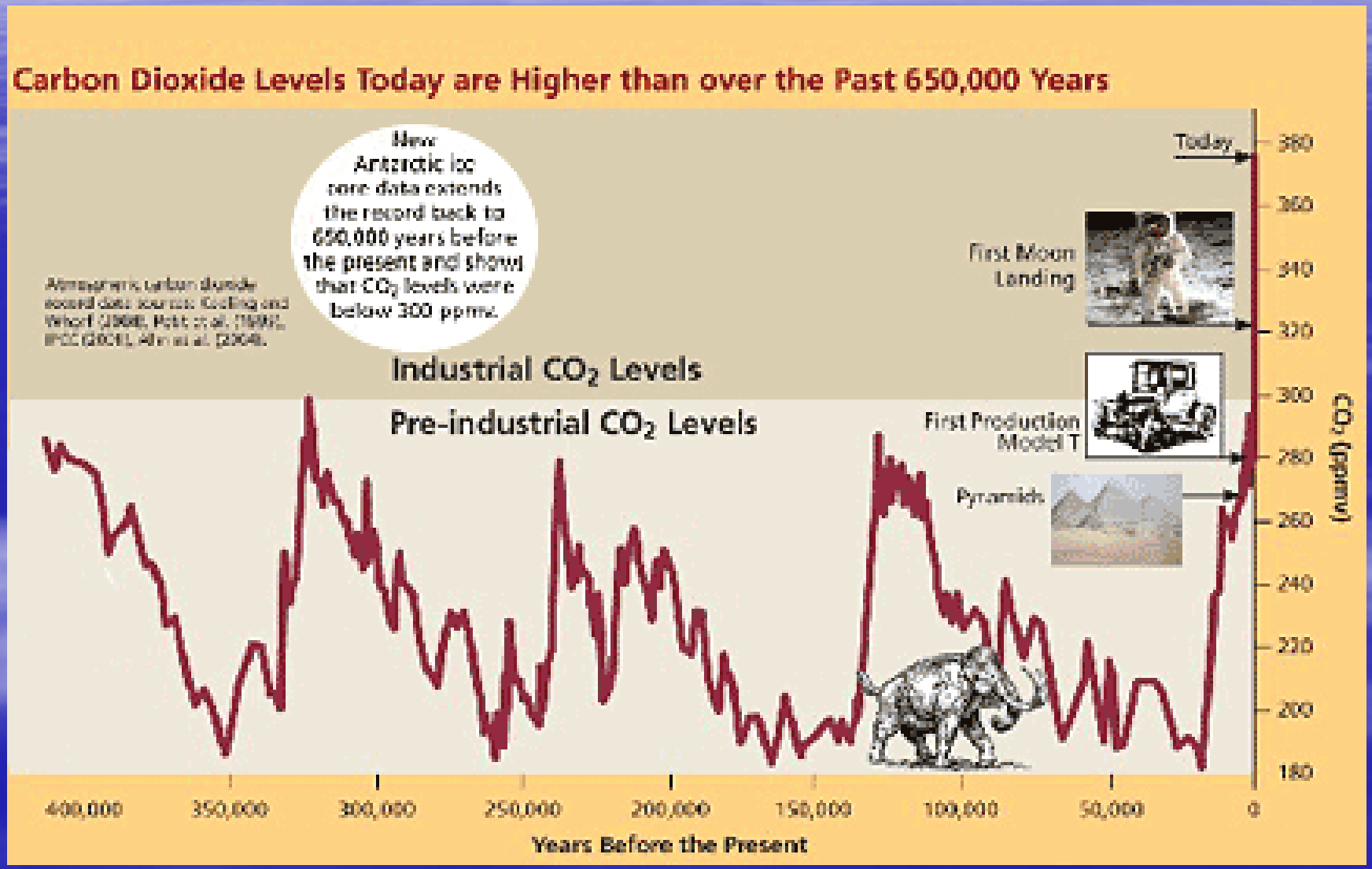

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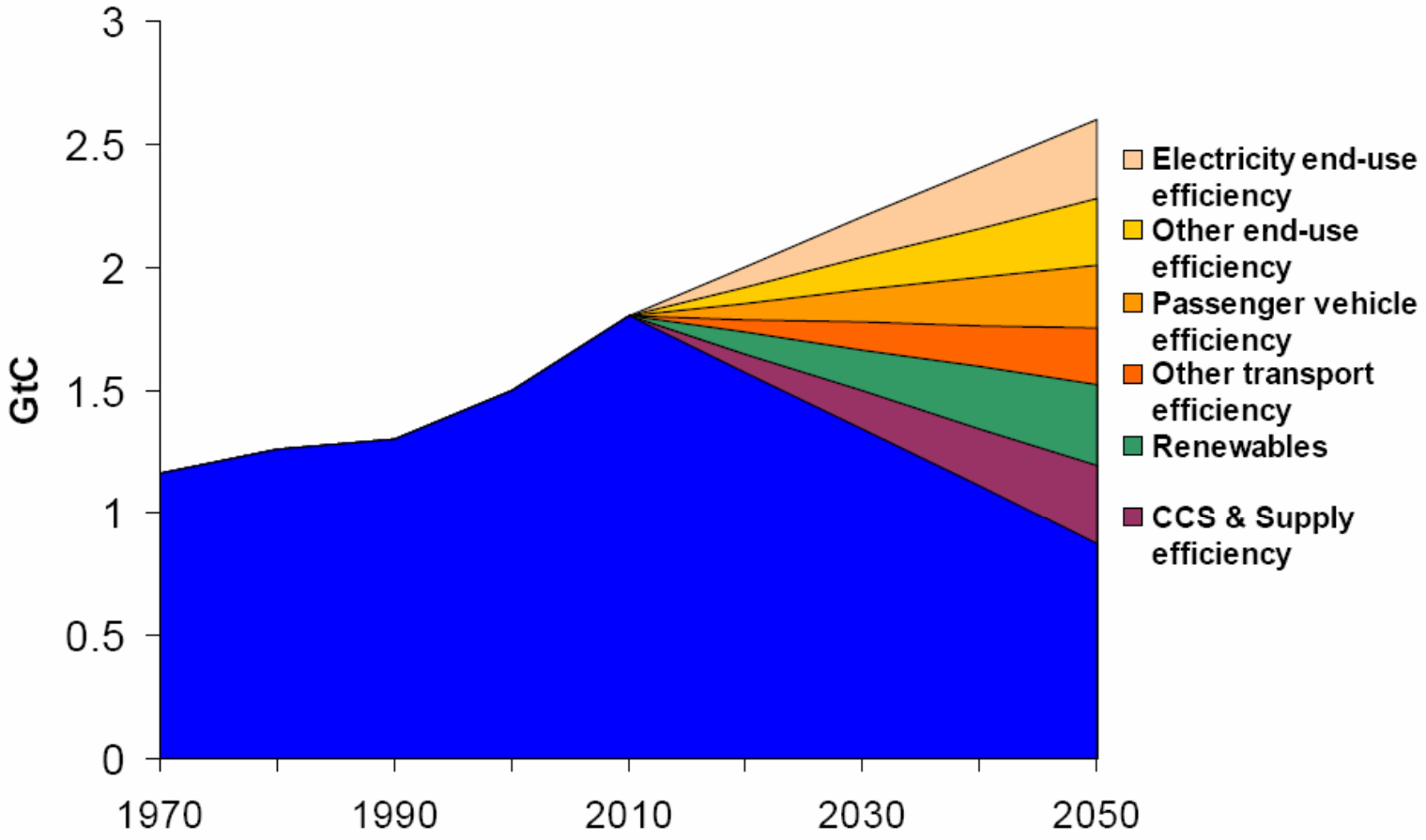
We Need Big Solutions, Fast, and Lots of 'em



- 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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Options in four categories

- Agriculture, Forestry and Waste Management
- Energy Supply
- Residential, Commercial, Institutional, Industrial
- Transportation and Land Use

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Agriculture, Forestry and Waste Management

Measure	Potential MMtCO2E	$/tCO2E
Ag soil carbon management–Conservation/No-Till	3.7	0
Biodiesel Production (Incentives for Feedstocks and Production Plants)	0.9	14
Ethanol Production	2.2	4
Incentives for Enhancing GHG Benefits of Conservation Provisions of Farm Bill Programs	15.0	12
Preserve Open Space and Working Lands – Agriculture	0.12	32
Preserve Open Space and Working Lands – Forests	0.9	3
Expand biomass feedstocks for energy use	1.1	-23
Afforestation/Reforestation Programs – Restocking	3.4	12
Afforestation/Reforestation Programs – Urban Trees	0.04	-3
Improved Management and Restoration of Existing Stands	1.3	119
Programs to Promote Local Food and Fiber	0.12	1
Enhanced Solid Waste Recovery and Recycling	3.3	17

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Energy Supply

Measure	Potential MMtCO2E	$/tCO2e
Efficiency/Conservation	5.4	-15
Renewable Energy	5.5	10
Distributed Renewables	0.8	21
Combined Heat and Power	5	16
Incentives for Advanced Fossil Fuel Generation and Carbon Capture and Storage (CCS), Including Combined Hydrogen and Electricity Production with Carbon Sequestration	24.4	30
Generation Performance Standards or GHG Mitigation Requirements for New (and/or Existing) Generation Facilities, with/without GHG Offsets	4.7	13

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Residential, Commercial, Industrial

Measure	Potential MMtCO2E	$/tCO2e
Demand Side Management Programs	6.6	-21
Market Transformation Programs	1.9	-23
Appliance Efficiency Standards	1.5	-36
Building Energy Codes	1.6	-10
“Beyond Code” Building Design	3.4	-5
Industrial Energy Audits and Recommended Measure Implementation	3.6	-26
Low Income and Rental Housing Energy Efficiency Programs	4.7	-9
State Lead by Example	2.0	-6
Metering Technologies w/Opportunity for Load Management and Choice	0.9	-12

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Transportation and Land Use

Measure	Potential MMtCO2E	$/tCO2e
Light Duty Vehicle Clean Car Program	4.9	-100
Fuel Efficient Replacement Tires	0.14	-90
Growth and Development Measures	0.26	<0
HD Vehicle Emission Standards and Retrofit Incentives	0.16	79
HD Vehicle and Locomotive Idle Reduction	0.13	-44

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Other Benefits

- Agricultural Soil Carbon Management – Conservation/No-Till
  - Sequesters CO2
  - Improves soil quality
  - Reduces soil erosion
  - Saves farmer money by reducing fuel consumption
  - Saves farmer time and labor and reduces wear and tear on equipment
  - Over time, organic matter increases, improving yield

Other Benefits

- Afforestation/Reforestation Programs – Urban Trees
  - Sequesters CO2
  - Reduces building energy use and cooling costs
  - Increases property values
  - Enhances health of urban dwellers by absorbing air pollutants
  - Reduces stormwater run-off and topsoil erosion
  - Enhances community economic stability by attracting businesses and tourists
  - Reduces noise pollution by action as a buffer

Other Benefits

- Energy Efficiency/Conservation Programs
  - Decrease CO2 emissions
  - Consumers save money on energy bills
  - Help low income people with their energy cost
  - Capacity benefits – less need to construct new power plants, transmission lines, distribution systems, and pipelines
  - Create new jobs in energy related services

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Other Benefits

- Metering Technologies w/Opportunity for Load Management and Choice
  - Decrease CO2 emissions
  - Enables utilities to shift loads, improve efficiency
  - Gives consumers more options
  - Reduces operating and maintenance costs for utilities
  - Increased reliability – blackout prevention, disaster recovery, backup power
  - Utility manages wholesale price hedge increasing national energy security

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Other Benefits

- Light Duty Vehicle Clean Car Program, Fuel Efficient Replacement Tires, HD Vehicle and Locomotive Idle Reduction
  - Decrease CO2 emissions
  - Decrease other pollutants
  - Decrease dependency on foreign oil
  - Reduced consumer operational and fuel costs

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Other Benefits

- Distributed Generation/Combined Heat and Power
  - Decrease CO2 emissions
  - Decrease other pollutants
  - Less exposure to terrorism
  - More options for better utility balancing/load following

How to Prioritize Actions

- Prioritize measures based upon cost
- Prioritize measures based upon other benefits

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How to Prioritize Actions

- Prioritize measures based upon cost
  - Transportation measures first (-$100 to -$44/tCO2E)
  - Conservation and efficiency measures next (-$36 to -$5/tCO2E)
  - Agriculture and Forestry measures next (-$23 to $0/tCO2E)
  - Low cost measures (<$10/tCO2E)
    - Local Food and Fiber Programs
    - Open Space and Working Lands - Forests
    - Ethanol production
    - Solid waste recovery and recycling

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How to Prioritize Actions

- Prioritize measures based upon cost
  - Medium cost measures ($10-$20/tCO2E)
    - Renewable Energy (Big stuff like central station wind)
    - Biodiesel production
    - Farm bill programs and afforestation
    - Combined Heat and Power
  - High cost measures ($20/tCO2E and higher)
    - Generation performance standards
    - Distributed renewable generation
    - Carbon capture and storage
    - Preserve open space and working land – agriculture
    - Improved management and restoration of existing forest stands

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Summary

- Let's implement the measures that save both money and carbon quickly
- Some higher cost climate change mitigation measures have other benefits that might move them up in priority
- Let's change policy to encourage measures that save money AND mitigate climate change (No Brainer Measures)

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Questions and Comments

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