

Climate Change – Recent Developments and What is the U.S. Doing About It?

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**DC Council of Engineering and Architectural Societies
Engineers Week Awards Banquet**

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Silver Spring, MD**

Overview

- I. **What Does Science Tell Us About the Problem?**
- II. **What Do Analyses Tell Us About the Solutions?**
- III. **Why Policy Solutions Will Likely Be Difficult**
- IV. **A Path Forward**
- V. **Conclusions**



**I. What Does Science Tell Us
About the Problem?**

The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Solar radiation powers the climate system.



Some solar radiation is reflected by the Earth and the atmosphere.

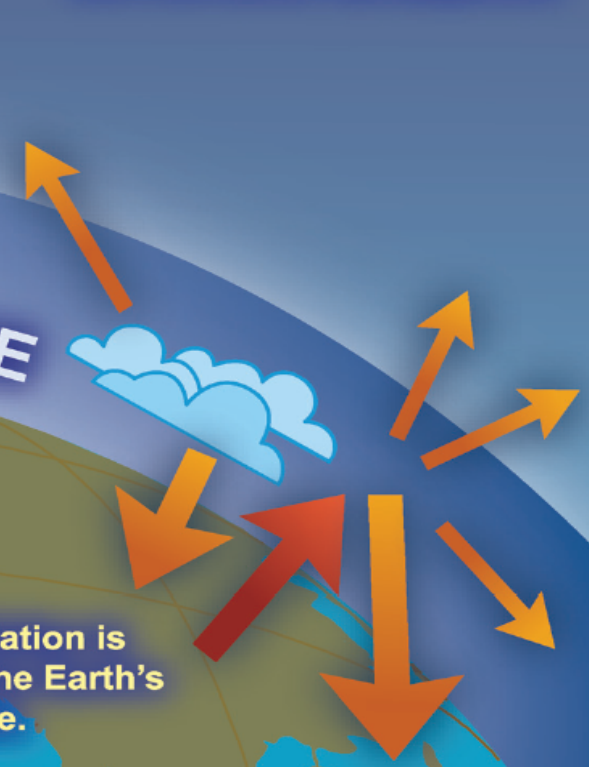


About half the solar radiation is absorbed by the Earth's surface and warms it.

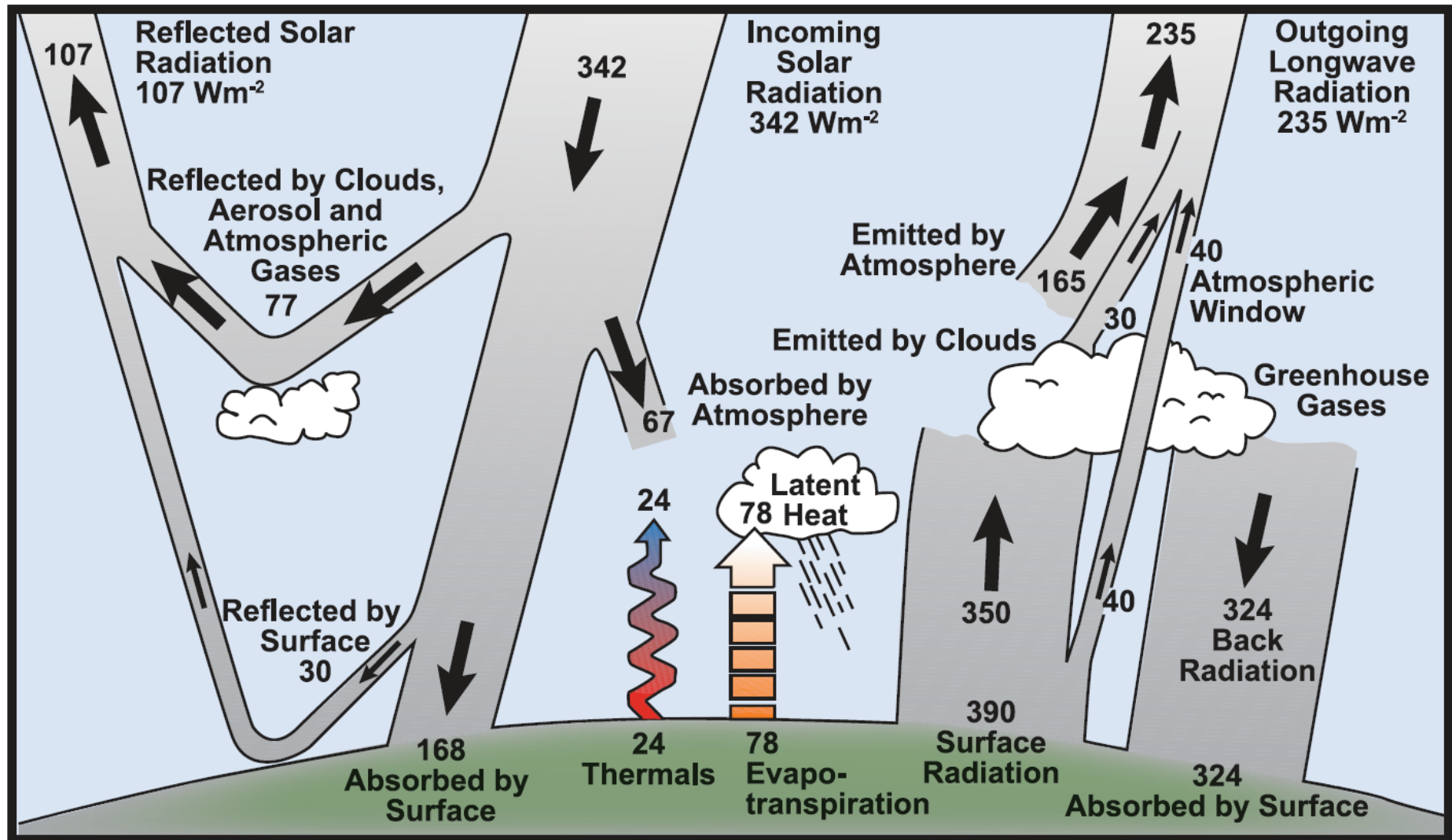
ATMOSPHERE

EARTH

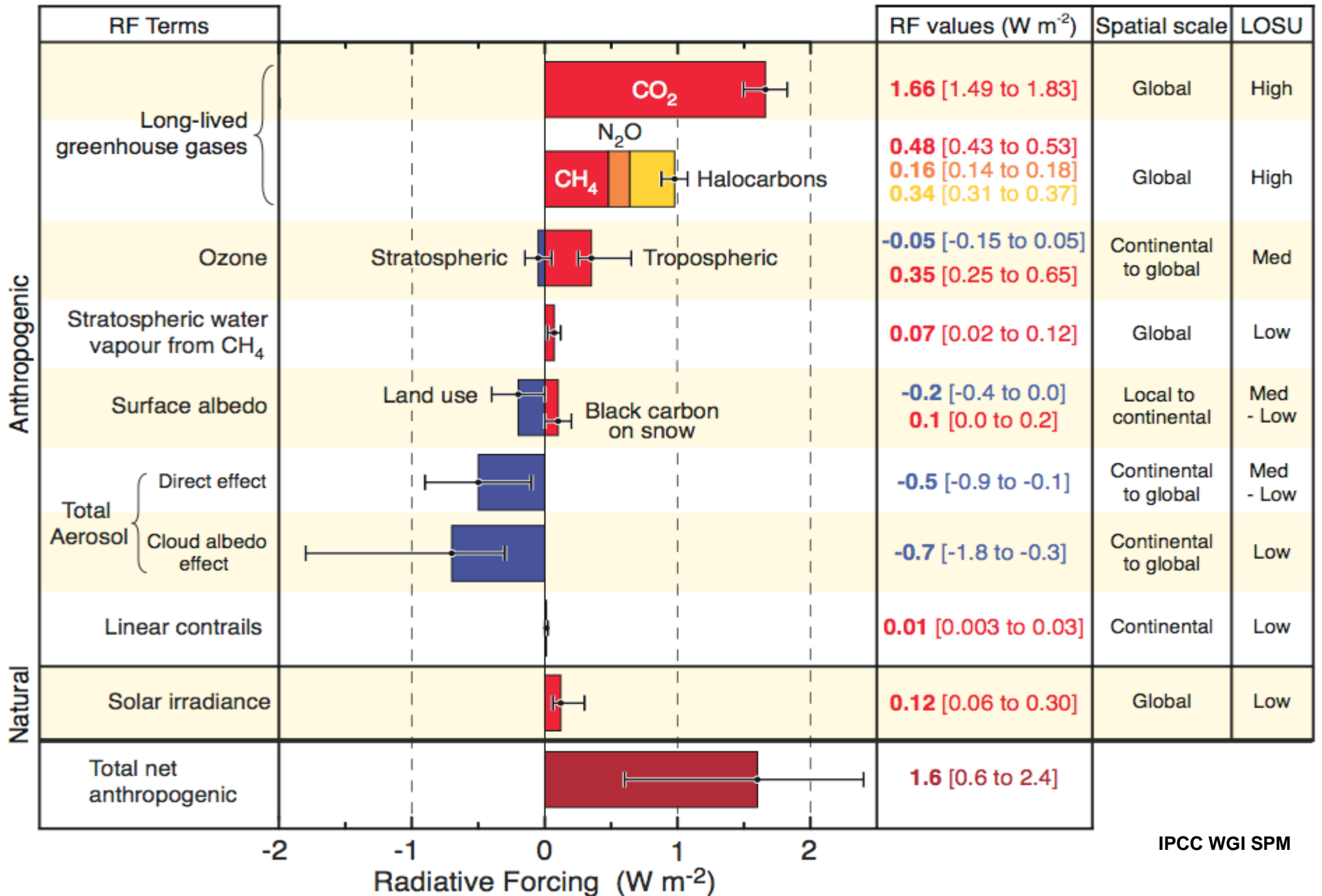
Infrared radiation is emitted from the Earth's surface.



Global Mean Energy Balance – Now in Disequilibrium



Radiative Forcing Components



©IPCC 2007: WG1-AR4

GHG Concentrations and Man-Made Interferences

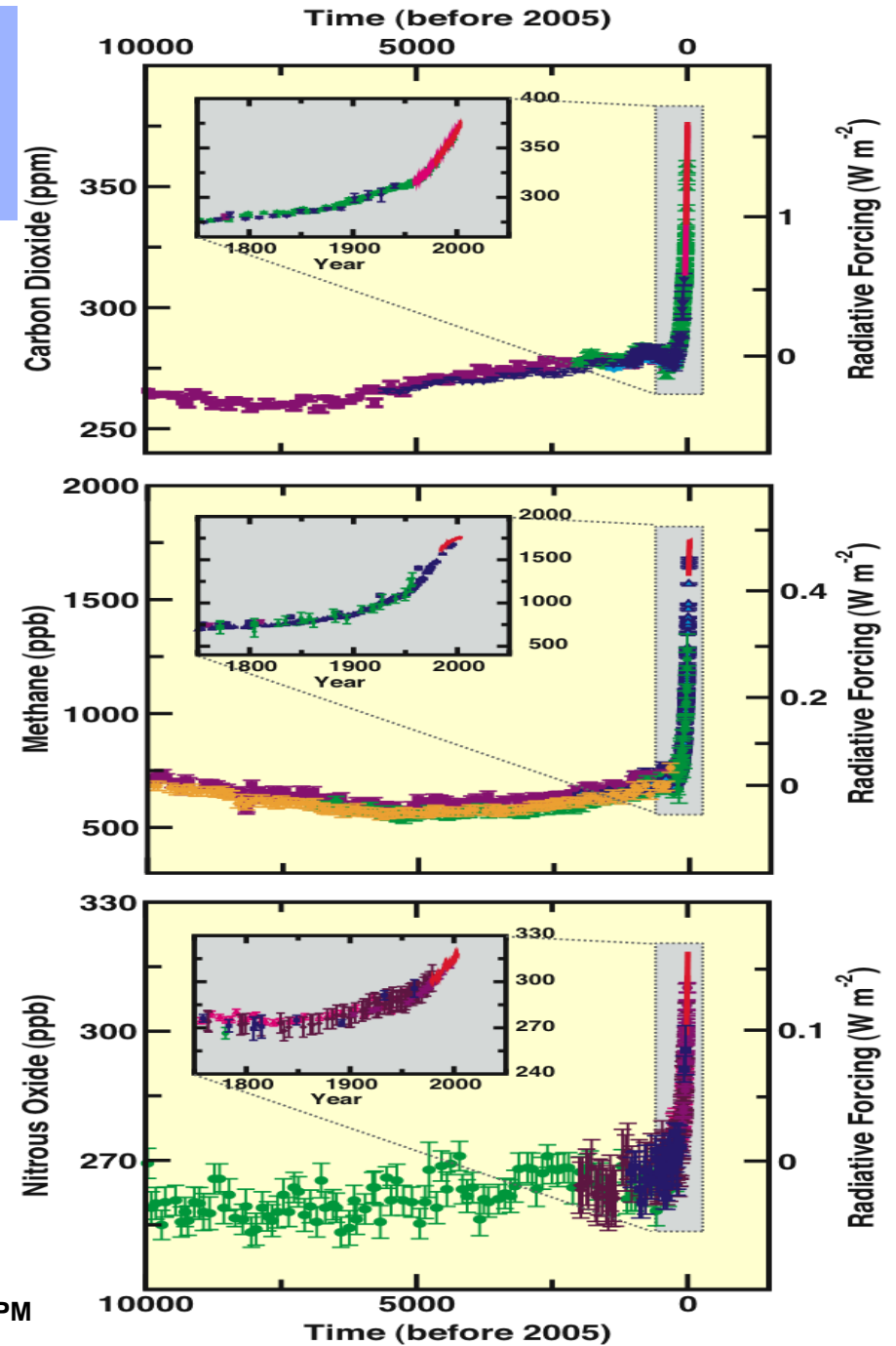
“Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.”

CO₂, CH₄ and N₂O Concentrations

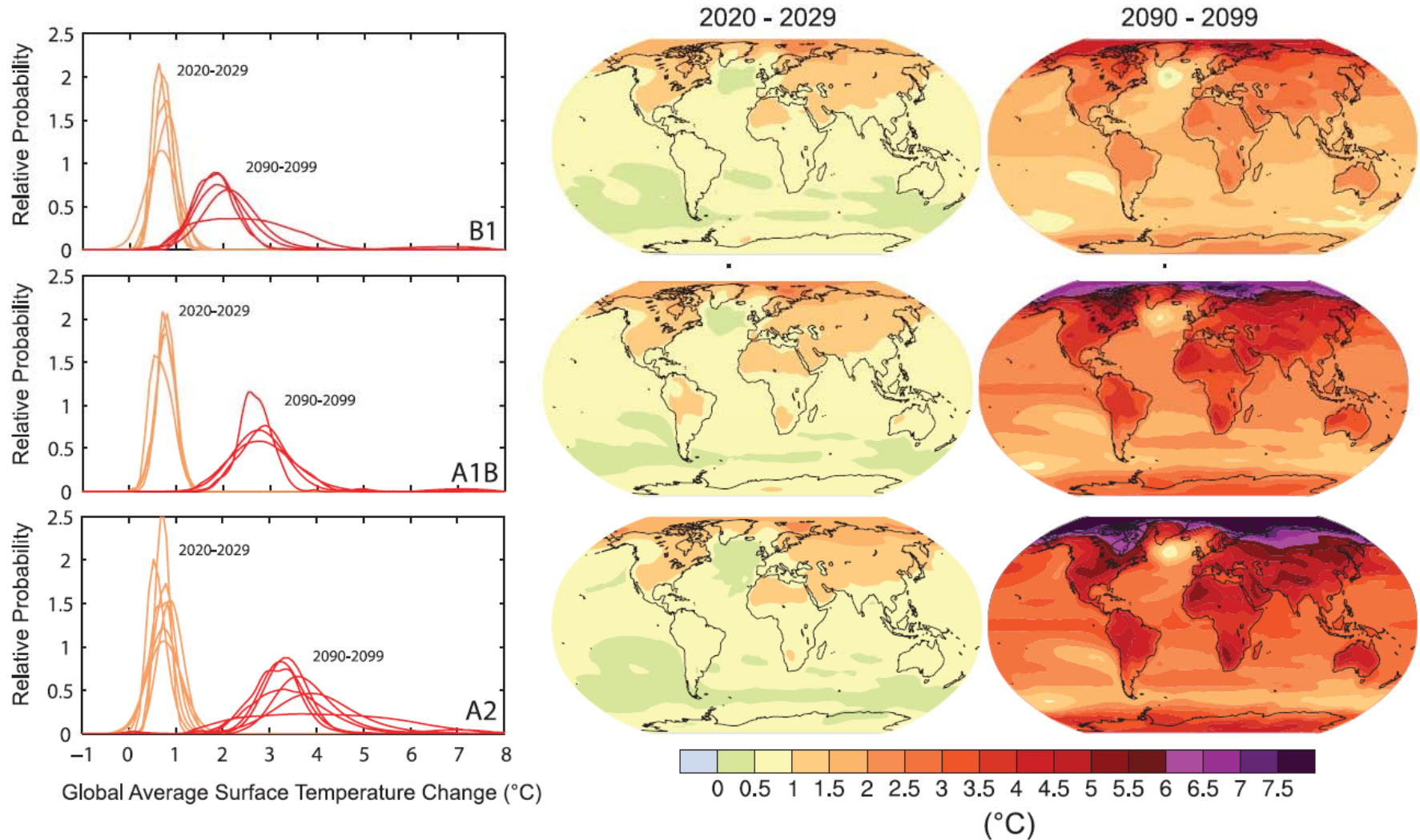
- far exceed pre-industrial values
- increased markedly since 1750

Relatively little variation before the modern industrial era (1750)

IPCC WGI SPM



Projections of Changes in Global Surface Temperatures



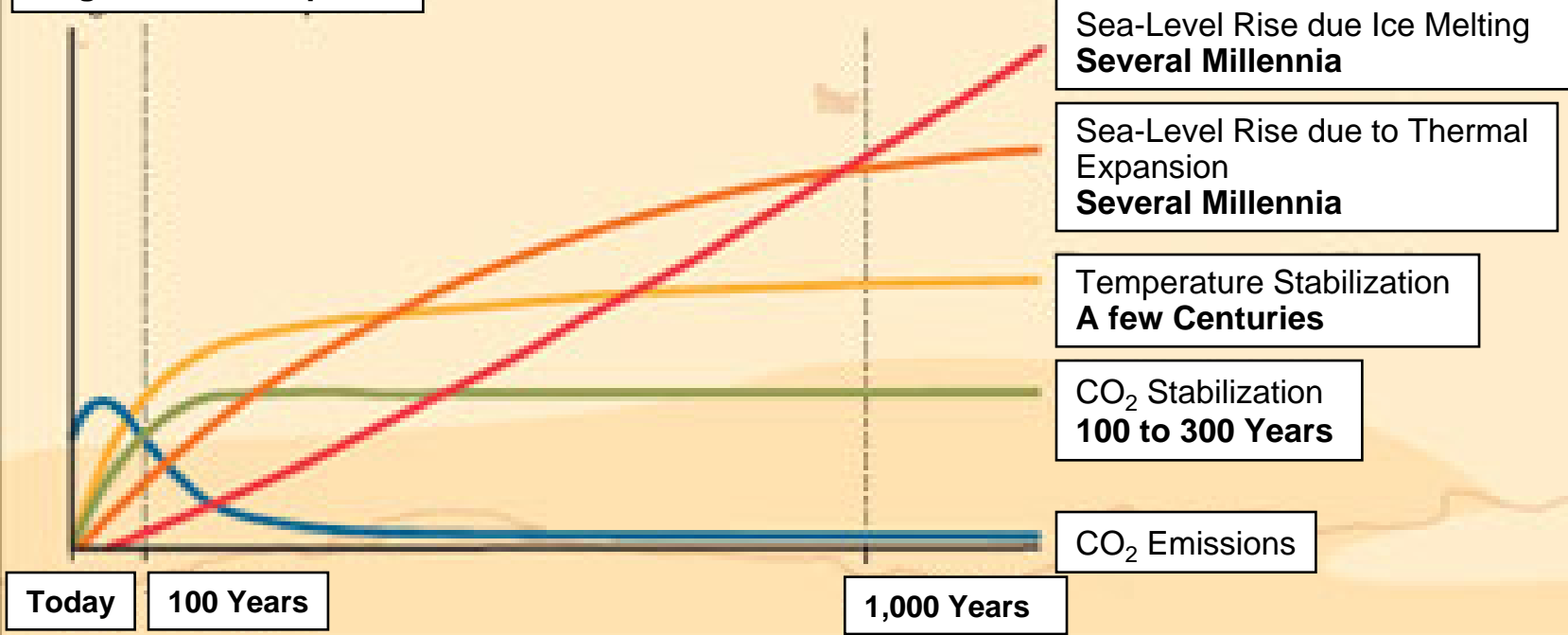
©IPCC 2007: WG1-AR4

Time to Equilibrium

Time to Equilibrium

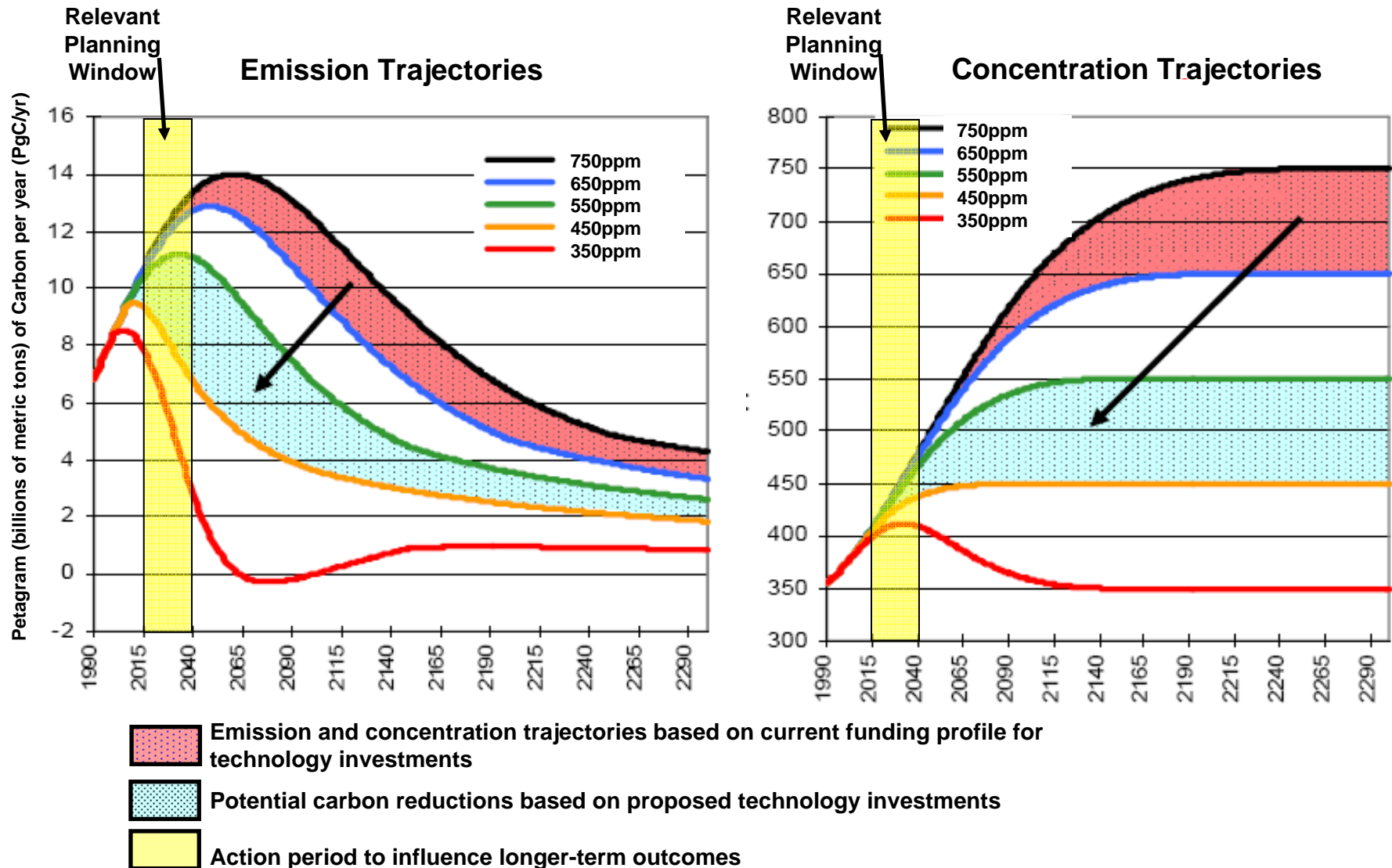
Climate-change experts predict that even when GHG emissions are curtailed, their effects on the environment will continue to be felt for hundreds, if not thousands, of years.

Magnitude of Response

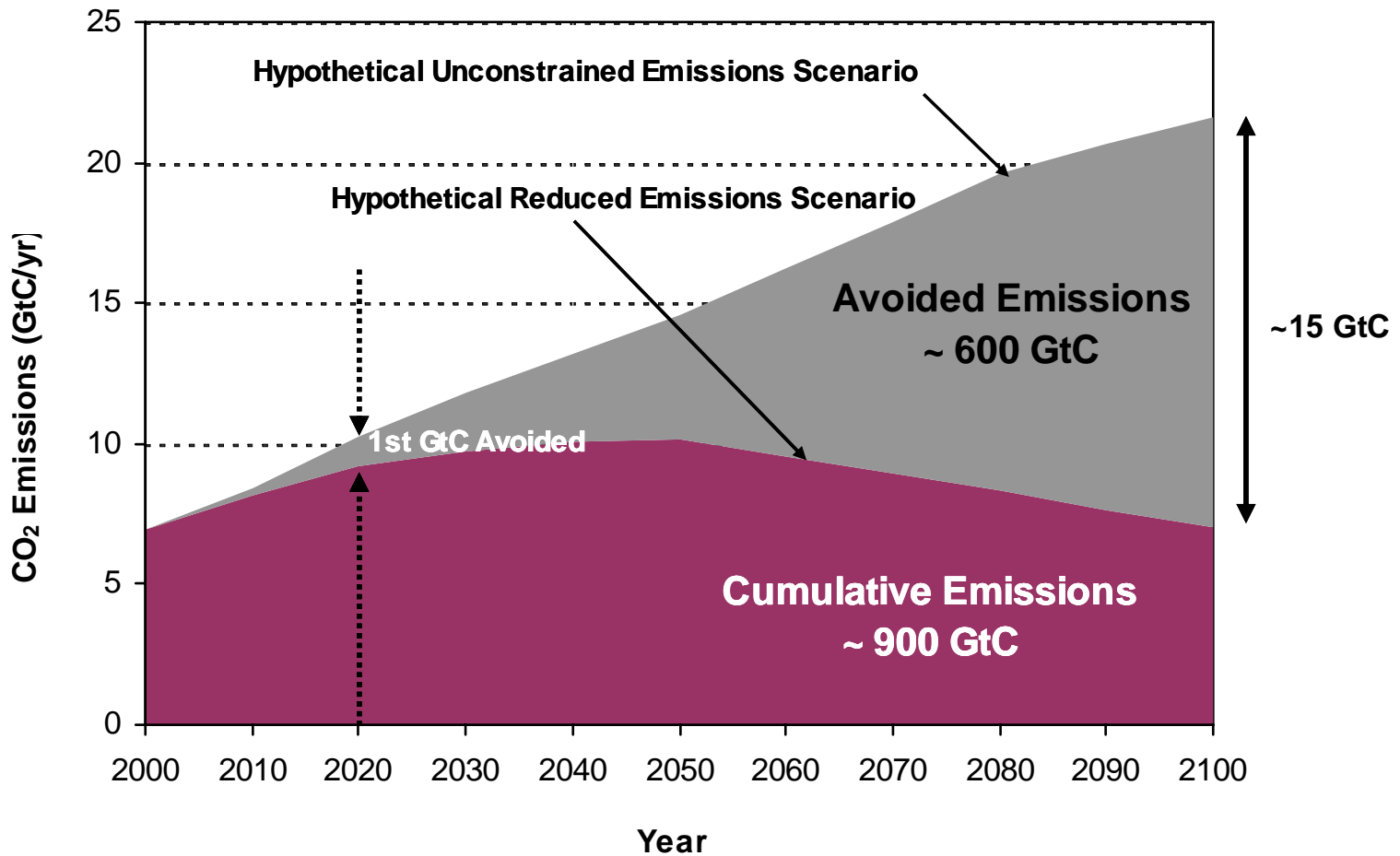


II. What Do the Analyses Tell Us About the Solutions?

Long-Term Goals Require Near-Term Actions



Mid-Range Example of A Reduced GHG Emissions Future



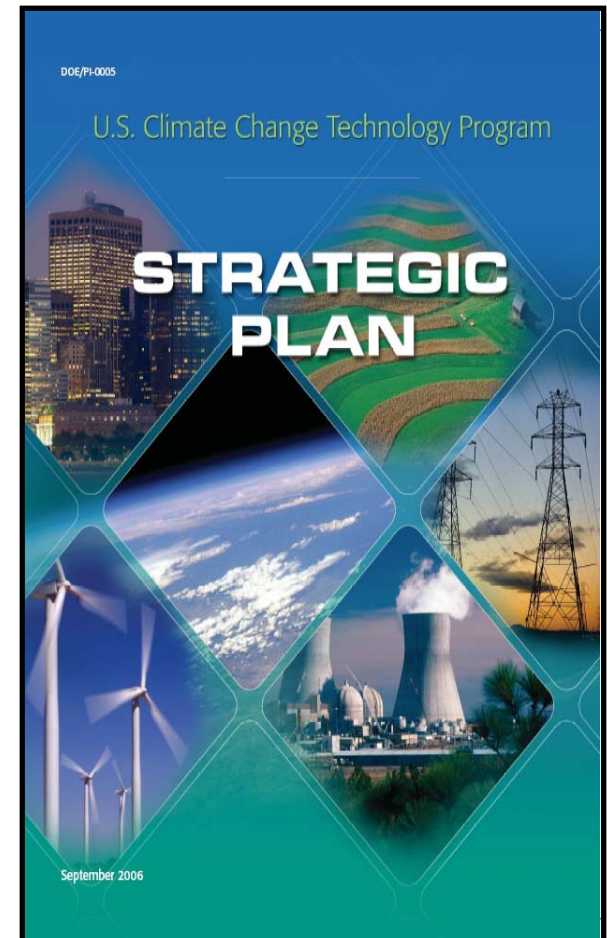
GtC = Giga-Tonnes Carbon
 Giga-Tonne = Billion (10⁹) Metric-Tonnes (1000 Kilograms)

How Big is a Gigaton? Using U.S. Technology,* These Actions Can Cut Emissions by 1 GtC/Year

Today's Technology	Actions that Provide 1 Gigaton / Year of Mitigation
Coal-Fired Power Plants	Build 1,200 "zero-emission" 500-MW coal-fired power plants (in lieu of coal-fired plants without CO ₂ capture and storage) (73% CF)
Geologic Sequestration	Install 3,700 sequestration sites like Norway's Sleipner project (0.27 MtC/year)
Nuclear	Build 500 new nuclear power plants, each 1 GW in size (in lieu of new coal-fired power plants without CO ₂ capture and storage) (90% CF)
Electricity from Landfill Gas Projects	Install 28,000 "typical" landfill gas electricity projects (3 MW projects at non-regulated landfills) that collect landfill methane emissions and use them as fuel for electric generation.
Efficiency	Deploy 1 billion new cars at 40 miles per gallon (mpg), instead of new cars at 20 mpg (assume 12,000 miles per year per car)
Wind Energy	Install 650,000 wind turbines (1.5 MW each, operating at 0.45 capacity factor) in lieu of coal-fired power plants without CO ₂ capture and storage.
Solar Photovoltaics	Install 6 million acres of solar photovoltaics to supplant coal-fired power plants without CO ₂ capture and storage (10% cell DC eff'cy; 1700 kWh/m ² solar radiance; 90% DC-AC conv. eff'cy).
Biomass fuels from plantations	Convert to biomass crop production a barren area about 20 times the total land area of Iowa (about 700 million acres)
CO ₂ Storage in New Forest.	Convert to new forest a barren area about 9 times the total land area of the State of Washington (nearly 400 million acres) (Assumes Douglas Fir on Pacific Coast)

Success Attributed to Strategic Approach, Supported by Portfolio Analysis

- U.S. Climate Change Technology Program
 - ✓ ≈\$22 Billion Invested from FY01 to FY08
 - ✓ ≈\$4.4 Billion Requested for FY09
- CCTP Goals:
 - ❖ Four emissions-related strategic goals:
 - ✓ Reduce emissions from energy end use & infrastructure;
 - ✓ Reduce emissions from energy supply;
 - ✓ capture & sequester CO₂; and
 - ✓ Reduce emissions from non-CO₂ gases.
 - ❖ Two cross-cutting and supporting strategic goals:
 - ✓ Improve capabilities to measure & monitor GHGs; and
 - ✓ Bolster basic science.
- CCTP authorized in *EPAAct2005*.



www.climatetechnology.gov

Roadmap for Climate Change Technology Development

	NEAR-TERM	MID-TERM	LONG-TERM
GOAL #1 Energy End-Use & Infrastructure	<ul style="list-style-type: none"> Hybrid & Plug-In Hybrid Electric Vehicles Engineered Urban Designs High-Performance Integrated Homes High Efficiency Appliances High Efficiency Boilers & Combustion Systems High-Temperature Superconductivity Demonstrations 	<ul style="list-style-type: none"> Fuel Cell Vehicles and H₂ Fuels Low Emission Aircraft Solid-State Lighting Ultra-Efficient HVACR “Smart” Buildings Transformational Technologies for Energy-Intensive Industries Energy Storage for Load Leveling 	<ul style="list-style-type: none"> Widespread Use of Engineered Urban Designs & Regional Planning Energy Managed Communities Integration of Industrial Heat, Power, Process, and Techniques Superconducting Transmission and Equipment
GOAL #2 Energy Supply	<ul style="list-style-type: none"> IGCC Commercialization Stationary H₂ Fuel Cells Cost-Competitive Solar PV Demonstrations of Cellulosic Ethanol Distributed Electric Generation Advanced Fission Reactor and Fuel Cycle Technology 	<ul style="list-style-type: none"> FutureGen Scale-Up H₂ Co-Production from Coal/Biomass Low Wind Speed Turbines Advanced Biorefineries Community-Scale Solar Gen IV Nuclear Plants Fusion Pilot Plant Demonstration 	<ul style="list-style-type: none"> Zero-Emission Fossil Energy H₂ & Electric Economy Widespread Renewable Energy Bio-Inspired Energy & Fuels Widespread Nuclear Power Fusion Power Plants
GOAL #3 Capture, Storage & Sequestration	<ul style="list-style-type: none"> CSLF & CSR Post Combustion Capture Oxy-Fuel Combustion Enhanced Hydrocarbon Recovery Geologic Reservoir Characterization Soils Conservation Dilution of Direct Injected CO₂ 	<ul style="list-style-type: none"> Geologic Storage Proven Safe CO₂ Transport Infrastructure Soils Uptake & Land Use Ocean CO₂ Biological Impacts Addressed 	<ul style="list-style-type: none"> Track Record of Successful CO₂ Storage Experience Large-Scale Sequestration Carbon & CO₂ Based Products & Materials Safe Long-Term Ocean Storage
GOAL #4 Other Gases	<ul style="list-style-type: none"> Methane to Markets Precision Agriculture Advanced Refrigeration Technologies PM Control Technologies for Vehicles 	<ul style="list-style-type: none"> Advanced Landfill Gas Utilization Soil Microbial Processes Substitutes for SF₆ Catalysts That Reduce N₂O to Elemental Nitrogen in Diesel Engines 	<ul style="list-style-type: none"> Integrated Waste Management System with Automated Sorting, Processing & Recycle Zero-Emission Agriculture Solid-State Refrigeration/AC Systems
GOAL #5 Measure & Monitor	<ul style="list-style-type: none"> Low-Cost Sensors and Communications 	<ul style="list-style-type: none"> Large Scale, Secure Data Storage System Direct Measurement to Replace Proxies and Estimators 	<ul style="list-style-type: none"> Fully Operational Integrated MM Systems Architecture (Sensors, Indicators, Data Visualization and Storage, Models)

Timing

CCTP Strategic Goal	Very High Constraint	High Constraint	Medium Constraint	Low Constraint
Goal #1: Reduce Emissions from Energy End Use and Infrastructure	2010 - 2020	2030 - 2040	2030 - 2050	2040 - 2060
Goal #2: Reduce Emissions from Energy Supply	2020 - 2040	2040 - 2060	2050 - 2070	2060 - 2100
Goal #3: Capture and Sequester Carbon Dioxide	2020 - 2050	2040 or Later	2060 or Later	Beyond 2100
Goal #4: Reduce Emissions of Non-CO ₂ GHGs	2020 - 2030	2050 - 2060	2050 - 2060	2070 - 2080

Estimated timing of advanced technology market penetrations, as indicated by the first GtC-eq./year of incremental emissions mitigation, by strategic goal, across a range of hypothesized GHG emissions constraints.

Source: Clarke, L., M. Wise, M. Placet, C. Izaurralde, J. Lurz, S. Kim, S. Smith, and A. Thomson. 2006. Climate Change Mitigation: An Analysis of Advanced Technology Scenarios. Richland, WA: Pacific Northwest National Laboratory.

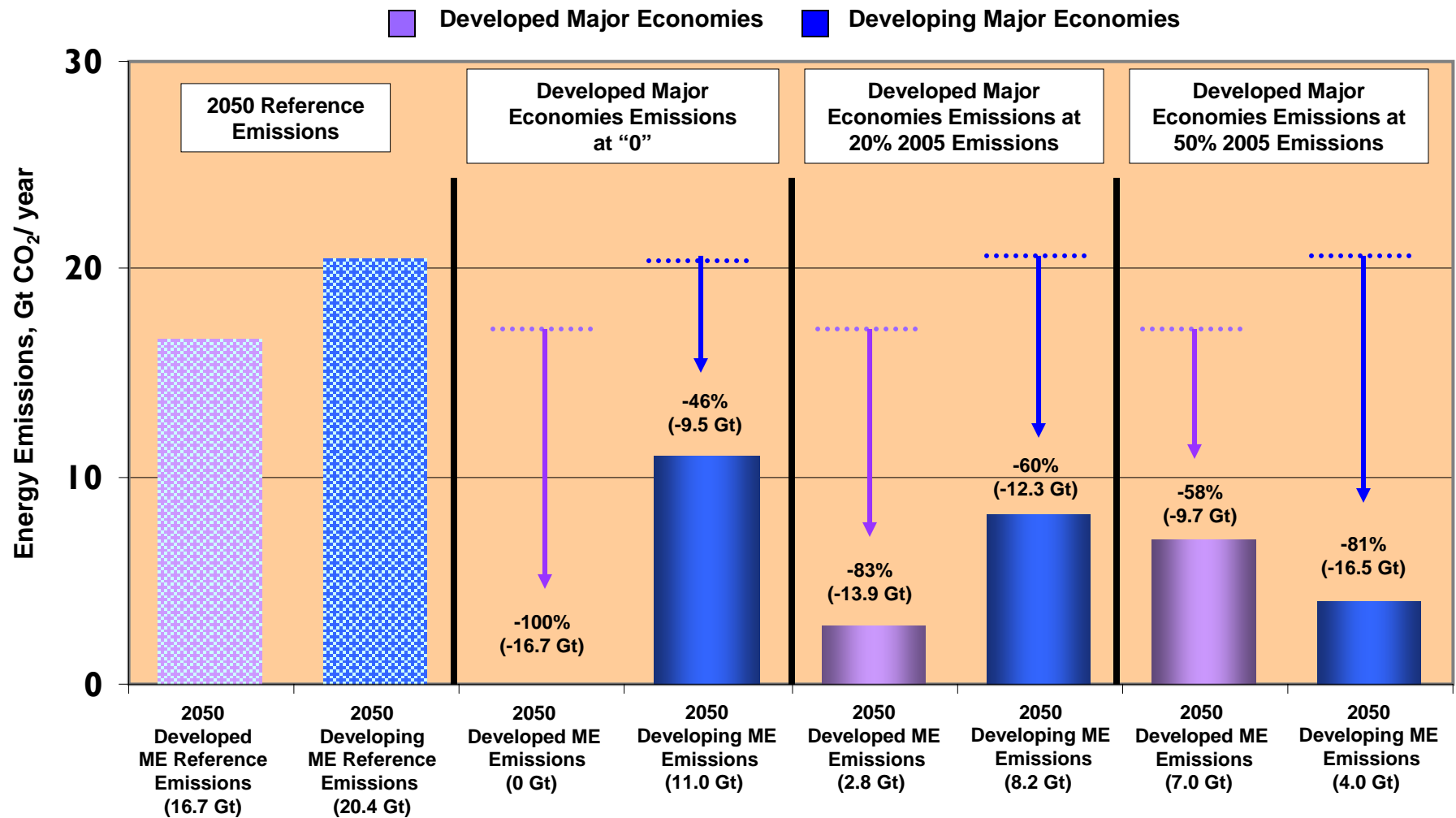
III. Why Policy Solutions Will Likely Be Difficult?

Broad Public Support

Will be Conditioned on Two Key Criteria:

- **Solutions Must Be Environmentally Effective:**
 - Must involve measurable actions by the world's largest producers of GHG emissions that are measurable, reportable, and verifiable.
 - Without substantial participation by developing economies, GHG emissions will continue to rise rapidly over the next 50 years even if the U.S. and other developed economies cut emissions to zero.
- **Solutions Must Be Economically Sustainable:**
 - Actions must uphold the hopes and aspirations of peoples everywhere
 - Support economic growth, energy security and improved quality of life.
 - Lowering the cost of the remedies is the key, and it requires:
 - » Speeding up the development and deployment of technologies that will fundamentally transform the way we produce and consume energy.

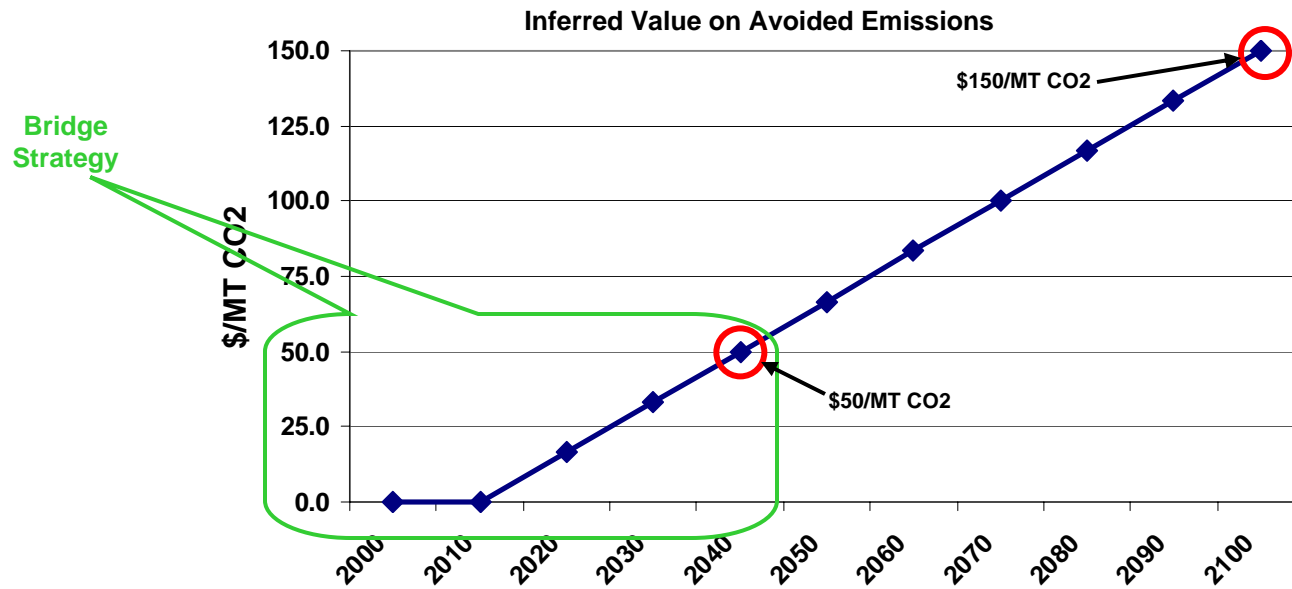
Energy CO₂ Emissions Reductions Needed in 2050 for Major Economies¹ to Achieve a Combined 50% Reduction in Emissions Below 2005² Levels



¹ Equals reduction from the 2050 reference case for that ME group (i.e., Developed or Developing). Developed MEs include: U.S., Europe, Russia, Japan, Canada, South Korea, and Australia. Developing MEs include: China, India, South Africa, Mexico, Brazil, and Indonesia.

² 50% of 2005 total Major Economies energy CO₂ emissions equals 11.0 Gt.

High Costs

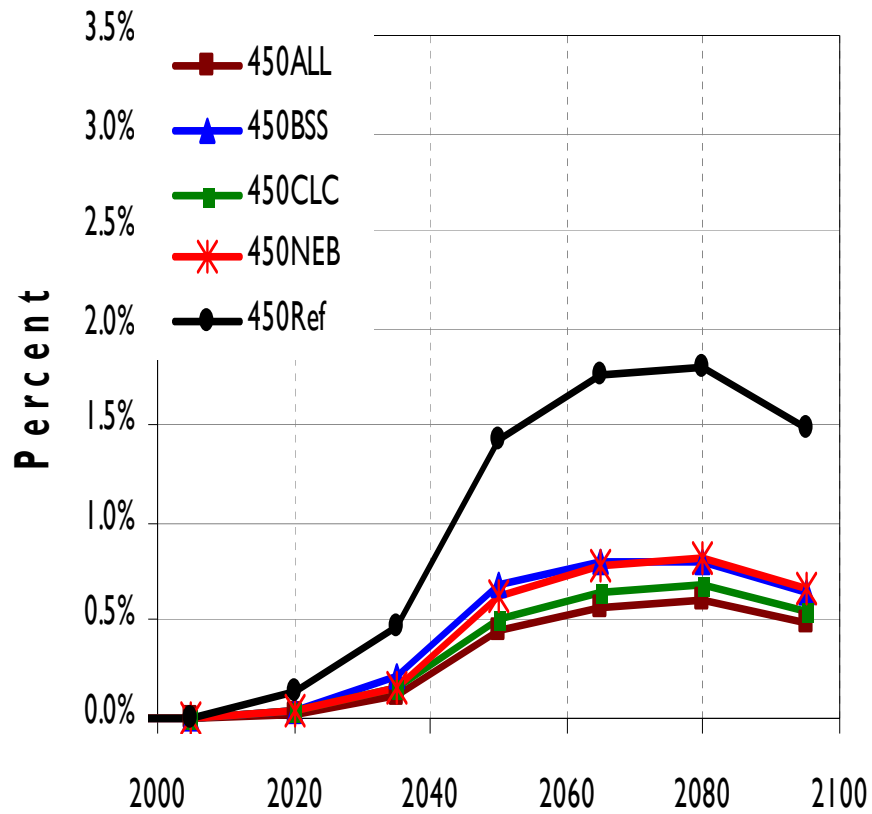


Incremental % Price Increase

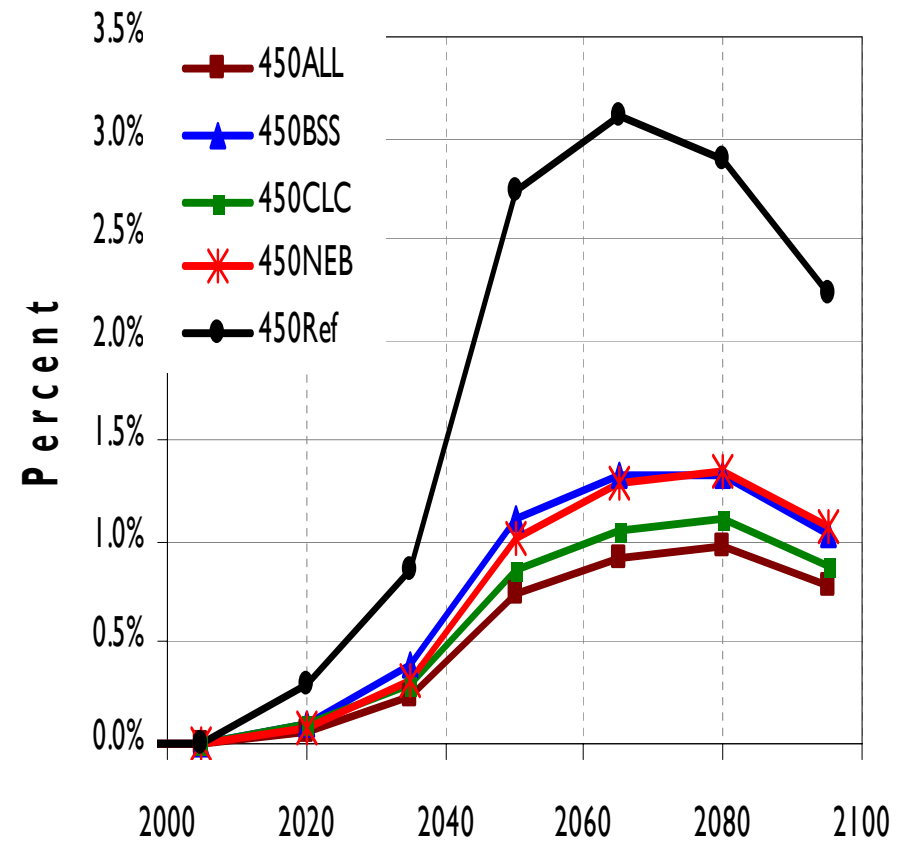
	2004 Price	% Increase at: \$10/ MT-CO2	% Increase at \$50/ MT-CO2
Electricity (kwh)	\$0.076	2.3%	8.2%
Gasoline (Gal)	\$1.90	1.3%	4.6%
Coal (S-Ton)	\$27.30	19%	70%
Natural Gas (mcf)	\$10.74	1.4%	5.1%

GDP Losses in CCTP scenarios

United States

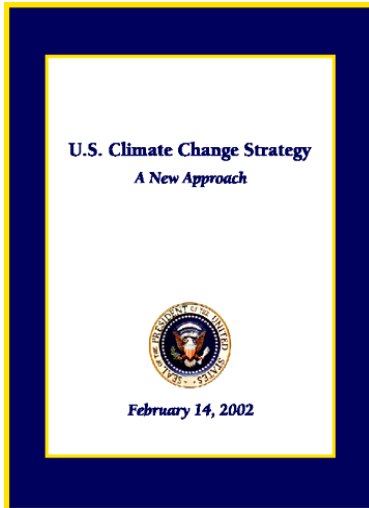


The World



IV. A Path Forward

U.S. Approach



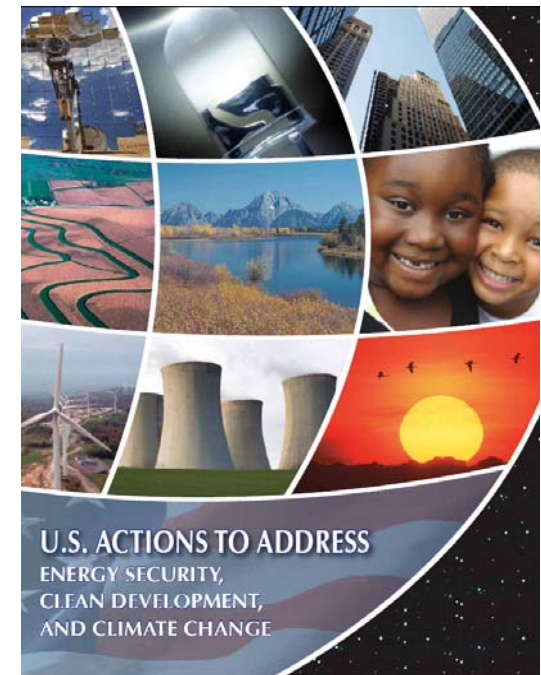
I reaffirm America's commitment to the United Nations Framework Convention and its central goal, to stabilize atmospheric greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate.

President George W. Bush
February 14, 2002

- Harnesses the Power of Markets and Tech. Innovation, Maintains Economic Growth, and Encourages Global Participation.
- Reaffirms U.S. Commitment to the UNFCCC's Ultimate Goal
- Supports the Bali Roadmap (Dec. 2007) to a post-Kyoto Agreement
- Places Climate Change in an Integrated Context of:
 - ❖ Enhancing Energy Security,
 - ❖ Encouraging Economic Growth, and
 - ❖ Reducing Pollution
- Five Basic Elements Are:
 - ❖ Near-term Policies & Measures, incl. Financial Incentives;
 - ❖ Improved Climate Science;
 - ❖ Advanced Technologies, with Lowered Costs;
 - ❖ International S&T Cooperation
 - ❖ Expanded Financing and Trade in Clean Energy Goods & Services

Near-Term Policies and Measures

- **Voluntary Programs**
 - Climate Leaders
 - Climate VISION
 - Energy Star and Natural Gas Star
 - SmartWay Transport Partnership
 - Voluntary GHG Emission Registry “EPACT 1605(b)”
 - Green Power Partnership (EPA)
- **Incentives for Investment**
 - Tax incentives for Conservation, Energy Efficiency, Renewable Energy, & Alternative Fuel Vehicles
 - Incentives for Agricultural GHG Sequestration
 - USAID’s Global Climate Change Program
 - Global Environmental Facility Fund
 - Farm Bill Conservation*
 - Tropical Forest Conservation Act
- **Mandates (EISA 2007)**
- **Executive Orders**
 - Strengthening Federal Government Environmental, Energy, and Transportation Management
- **State Programs**



<http://www.state.gov/g/oes/climate/>

* Biological sequestration (forests), \$1.6B for energy innovation, and \$2B in loans for advanced biofuel plants

Climate VISION Sectors



Alliance of Automobile Manufacturers



Aluminum Association



American Chemistry Council



American Forest & Paper Association



American Iron & Steel Institute



American Petroleum Institute



Association of American Railroads



The Business Roundtable



Industrial Minerals Association - North America



International Magnesium Association



National Lime Association



National Mining Association



Portland Cement Association



Power Partners



Semiconductor Industry Association



Climate Vision Progress Report for 2007

<http://www.climatevision.gov/>

Financial Incentives

Existing Tax Incentives

- **Efficiency & Transportation**
 - Hybrid and Fuel Cell Vehicles (Tax Credit)
 - Clean Fuel Cars, Truck and Refueling Stations
 - Tax Credits for Energy Efficient Building Improvements (Residential and Commercial)
 - Tax Credits for Construction of Energy Efficient Homes
 - Exclusion of Utility Conservation Subsidies
- **Renewable Energy**
 - Renewable Energy Production Credits
 - Residential Solar Energy (Tax Credits)
 - Investment Tax Credits for Solar, Geothermal
 - Hydroelectric, Biomass Elec. (Excl. of Interest on Bonds)
 - Biomass Ethanol (Exemption from Excise Taxes)
- **Low-Carbon Fossil**
 - Coal Bed Methane (Production Credit)
- **Other and Crosscutting**
 - Industry Tax Credits for Landfill Gas and Combined Heat and Power

New Tax Incentives*

- **Efficiency & Transportation**
 - Conservation and Energy Efficiency
 - Tax Credit for Efficient Vehicles
- **Renewable Energy**
 - Extend Renewable Electricity Production Credit (e.g., Home Solar)
 - Renewable Energy Bonds
 - Renewable Content in Gasoline (e.g., Ethanol)
- **Low-Carbon Fossil**
 - Clean Coal Investment Tax Credit
- **Nuclear**
 - Production Credit for Advanced Nuclear,
 - Nuclear Decommissioning,
 - Risk Insurance
- **Other and Crosscutting**
 - Energy Infrastructure (Transmission)
 - Loan Guarantees for Power and Fuels

*EPA05, EISA07, & Omnibus FY08 Appropriation

Recent Mandates

- **Mandatory Renewable Fuel Standard (RFS)**
 - Requires fuel producers to use at least 36 billion gallons of biofuel by 2022.
- **Corporate Average Fuel Economy (CAFE)**
 - Increases the national fuel economy standard to 35 miles per gallon by 2020.
- **Appliance and Lighting Efficiency Standards**
 - Sets energy efficiency standards for light bulbs (phase-out of incandescent lights)
 - Sets standards for residential and commercial appliances (More than 40 appliances).
- **Energy Savings in Buildings and Industry**
 - Increases energy efficiency of residential, commercial, and Federal buildings
 - Increases energy efficiency of industrial equipment and processes
- **State Renewable Portfolio Standards (24 States)**

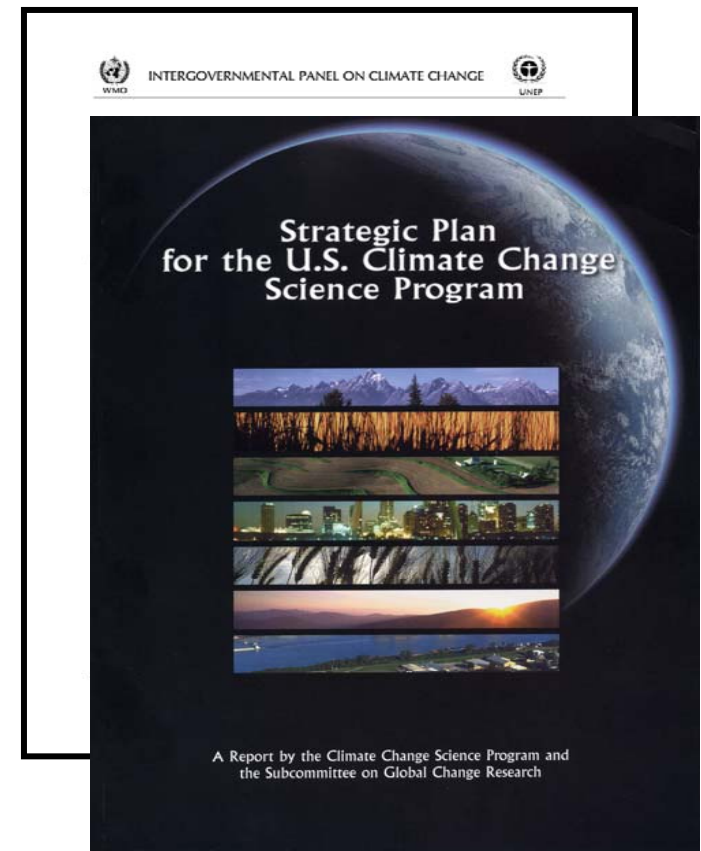
State Programs

States & D.C.	GHG Emissions Targets	Renewable Portfolio Standards	Vehicle GHG Standards	Regional GHG Initiatives	Climate Action Plans	Climate (GHG Reduction) Registries	Public Benefit Funds (Taxes on Energy for R&D, Deployment)	Green Pricing	Biofuels Mandates or Incentives	Energy Efficiency Standards
Alabama					✓			✓		
Alaska				✓		✓			✓	
Arizona	✓	✓	✓	✓	✓	✓	✓	✓		
Arkansas									✓	
California	✓	✓	✓	✓	✓	✓	✓	✓		✓
Colorado		✓		✓	✓	✓		✓	✓	✓
Connecticut	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D.C.		✓								
Delaware		✓		✓	✓		✓		✓	
Florida								✓		
Georgia						✓		✓		
Hawaii		✓		✓	✓	✓	✓	✓	✓	
Idaho				✓		✓		✓	✓	
Illinois		✓			✓	✓	✓	✓	✓	✓
Indiana					✓	✓		✓	✓	
Iowa		✓		✓	✓	✓		✓	✓	
Kansas				✓					✓	
Kentucky					✓			✓	✓	
Louisiana									✓	
Maine	✓	✓	✓	✓	✓	✓	✓		✓	
Maryland		✓		✓	✓				✓	
Massachusetts	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Michigan						✓	✓	✓	✓	
Minnesota		✓		✓	✓	✓	✓	✓	✓	
Mississippi								✓	✓	

States & D.C.	GHG Emissions Targets	Renewable Portfolio Standards	Vehicle GHG Standards	Regional GHG Initiatives	Climate Action Plans	Climate (GHG Reduction) Registries	Public Benefit Funds (Taxes on Energy for R&D, Deployment)	Green Pricing	Biofuels Mandates or Incentives	Energy Efficiency Standards
Missouri					✓	✓		✓	✓	
Montana		✓		✓	✓	✓	✓	✓	✓	
Nebraska				✓				✓		
Nevada		✓		✓			✓			✓
New Hampshire	✓			✓	✓	✓	✓			
New Jersey		✓	✓	✓	✓	✓	✓			✓
New Mexico	✓	✓	✓	✓	✓	✓	✓	✓		
New York	✓	✓	✓	✓	✓	✓	✓		✓	
North Carolina					✓	✓		✓	✓	
North Dakota				✓		✓		✓	✓	
Ohio						✓	✓	✓	✓	
Oklahoma								✓	✓	
Oregon	✓		✓	✓	✓	✓	✓	✓		
Pennsylvania		✓	✓		✓	✓	✓	✓	✓	✓
Rhode Island	✓	✓	✓	✓	✓	✓	✓		✓	
South Carolina						✓		✓		
South Dakota				✓		✓		✓	✓	
Tennessee					✓			✓		
Texas		✓		✓			✓	✓	✓	✓
Utah				✓	✓	✓		✓	✓	
Vermont	✓	✓	✓	✓	✓	✓	✓	✓		✓
Virginia										
Washington		✓	✓	✓	✓	✓		✓	✓	
West Virginia										
Wisconsin		✓		✓	✓	✓	✓	✓	✓	
Wyoming				✓		✓		✓	✓	

Improved Climate Science to Guide and Pace Solutions

- **U.S. Climate Change Science Program**
 - Ambitious Program of Research (\$2 B/Year)
- **Science Has Deepened Understanding:**
 - Reduced Uncertainties
 - Helped Identify & Clarify Risks
 - Added Info With Regional Specificity
 - » Water » Big Ice
 - » Coasts » Sea Level Rise
 - » Food » Ecosystems
 - » Health » Ocean Acidification
- **Growing Awareness of Hard Realities:**
 - Uneven Responses Internationally
 - Conditional Participation by Third World
 - Shadow Price of Avoided Emissions High
 - Pros & Cons of EU Trading System
- **Underscored Need for Ambitious Goals for Technology and Accelerated Development**



Advanced Technologies, with Lower Costs



“Energy security and climate change are two of the great challenges of our time. These challenges share a common solution: technology.”

President George W. Bush
Major Economies Meeting
September 28, 2007

- **Key Technology Elements**
 - **Coal -- De-Carbonize the Grid**
 - » **Nuclear Power**
 - » **Low-Emission Coal Power**
 - » **Renewable Power**
 - **Cars -- Transform Cars/Trucks Toward New Fuels**
 - » **Hybrid & Electric Vehicles**
 - » **Alternative Fuel Vehicles & Bio-Based Fuels**
 - » **Alternatives, including Other Modes**
 - **Efficiency (All Sectors)**
 - **Other GHGs**
 - **Enablers**
 - » **CO₂ Capture and Storage**
 - » **Modernized Grid**
 - » **Energy Storage, Large and Small Scale**
 - » **Strategic and Exploratory Research**
- **Supporting Policies to Promote Deployment**
 - **Financial Incentives**
 - **Fuel Mandates**
 - **Codes, Standards, Labeling**
 - **Transparent System for Measuring Progress**
- **Establish U.S. Climate Change Technology Program**
 - **Strengthen Federal R&D Portfolio**
 - **Prioritize Investments**
- **Expand R&D Cooperation with non-Federal Entities**

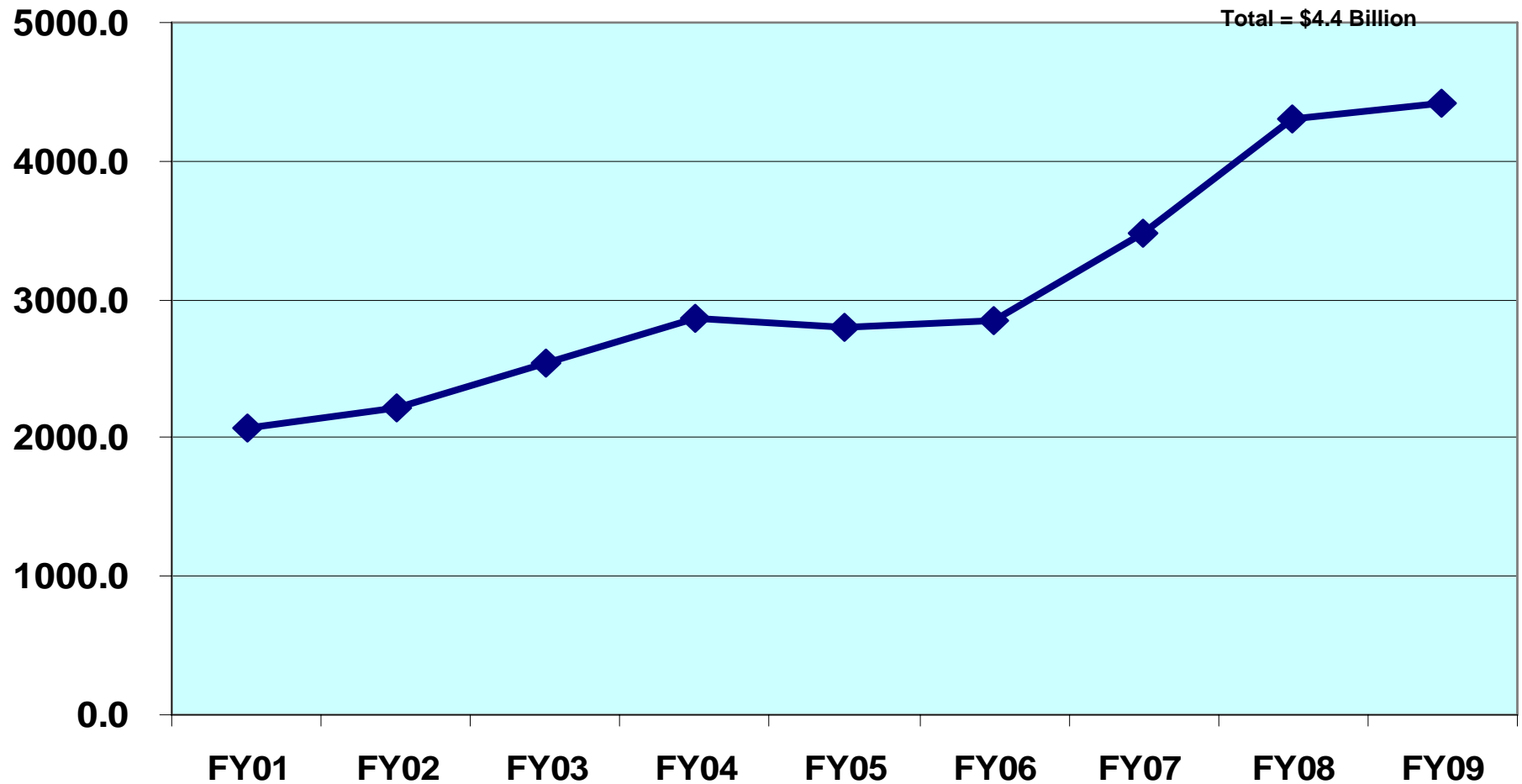
CCTP Goals and Technologies

Goal #	Goal #1	Goal #2	Goal #3	Goal #4	Goal #5
1. Reduce Emissions from Energy End-Use and Infrastructure					
2. Reduce Emissions from Energy Supply			 Enhanced Oil Recovery		
3. Capture and Sequester Carbon Dioxide					
4. Reduce Emission of Non-CO2 Greenhouse Gases					
5. Improve Capabilities to Measure and Monitor GHG Emissions					

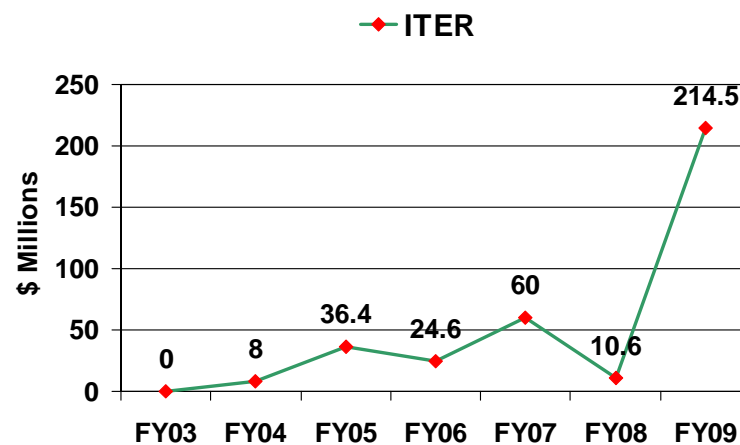
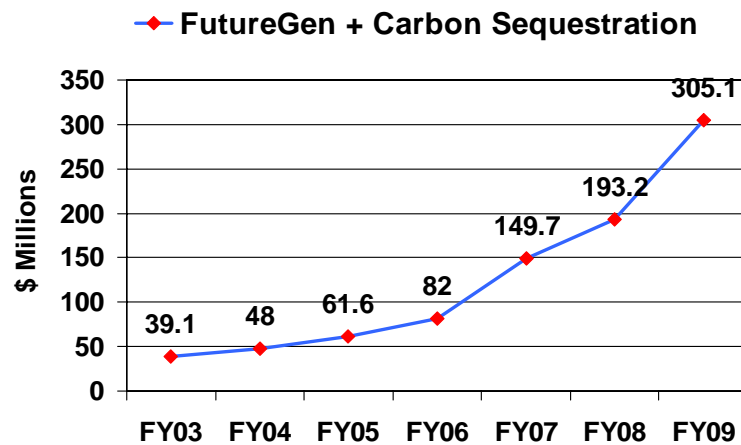
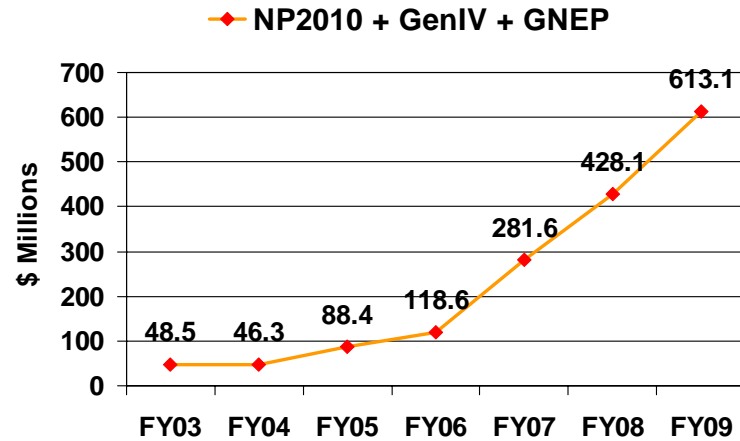
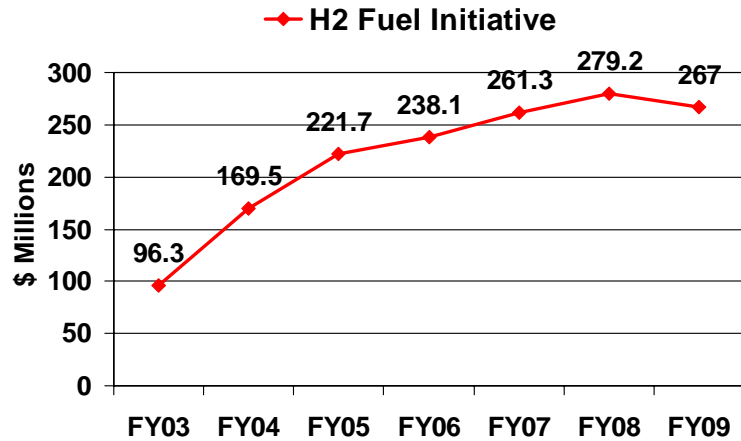
FY 2009 Budget – Good News for CCTP

CCTP Budget History

FY 2009 CCTP
Total = \$4.4 Billion

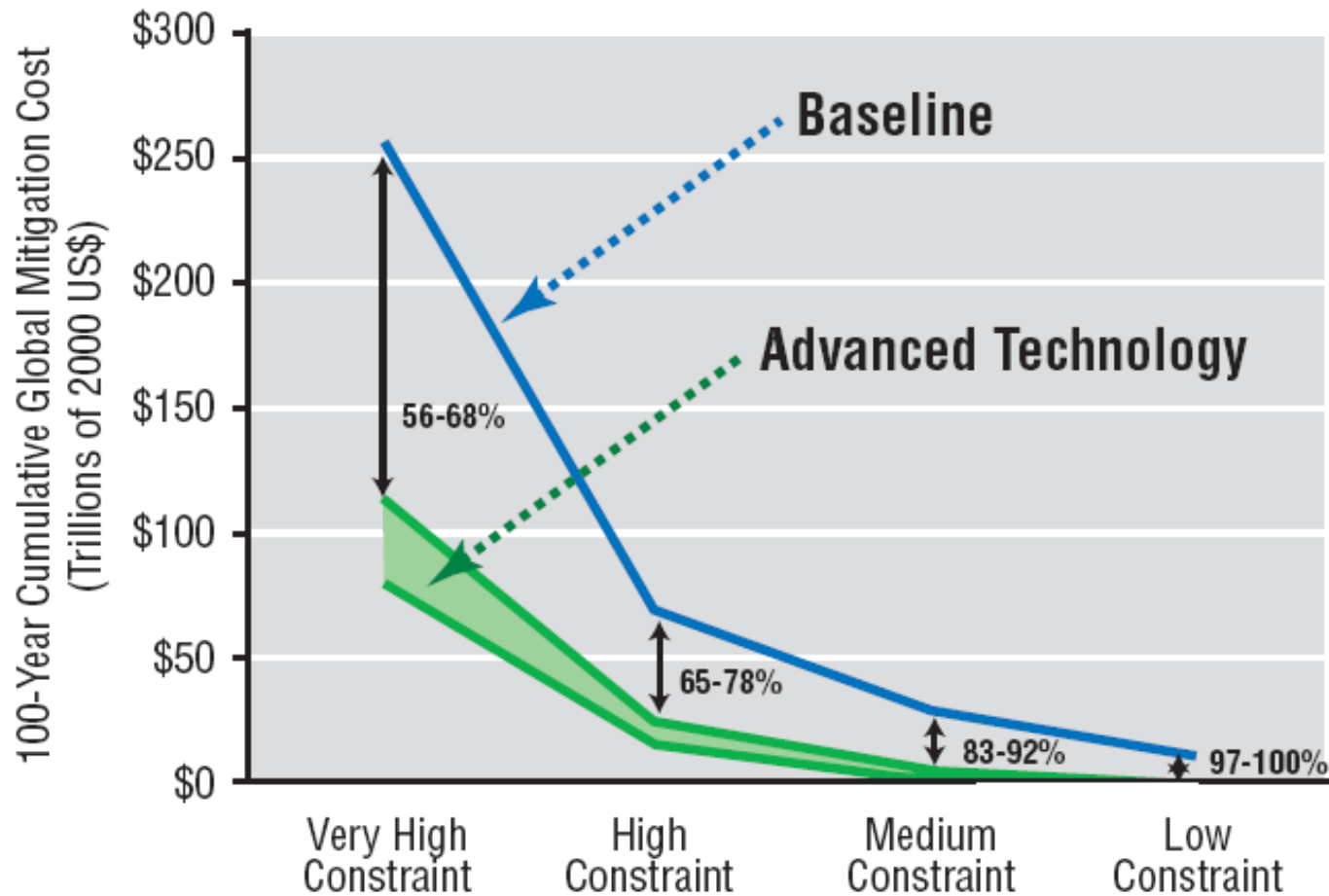


Key Technology Initiatives



Cost – 100-Year Reductions

Comparative Analysis of Estimated Cumulative Costs Over the 21st Century of GHG Mitigation, With and Without Advanced Technology, Across a Range of Hypothesized GHG Emissions Constraints.



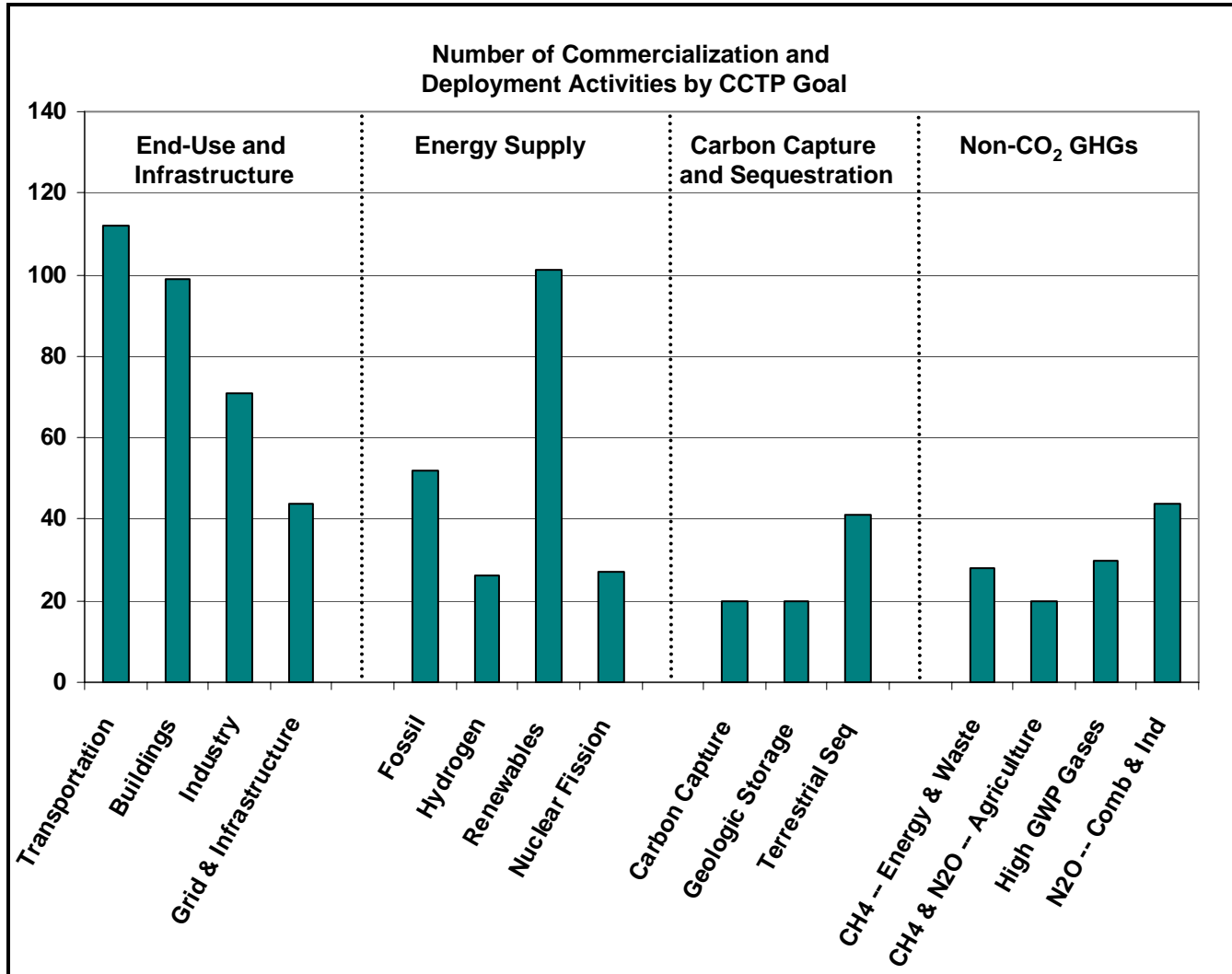
Non-Technical Barriers Call for Supporting Policies to Promote Technology Deployment

Cost Effectiveness	Fiscal Barriers	Regulatory Barriers	Statutory Barriers	Intellectual Property Barriers	Other Barriers
High Costs	Unfavorable Fiscal	Unfavorable Regulations	Unfavorable Statutes	IP Transaction Costs	Incomplete and Imperfect Information
Technical Risks	Fiscal Uncertainty	Regulatory Uncertainty	Statutory Uncertainty	Anti-competitive Patent Practices	Infrastructure limitations
Market Risks	Unfavorable tariffs			Weak International Patent Protection	Industry Structure
External Benefits and Costs				University, Industry, Government Perceptions	Misplaced Incentives
Lack of Specialized Knowledge					Policy Uncertainty

6 Barrier Categories
21 Barriers
~50 Detailed Barriers

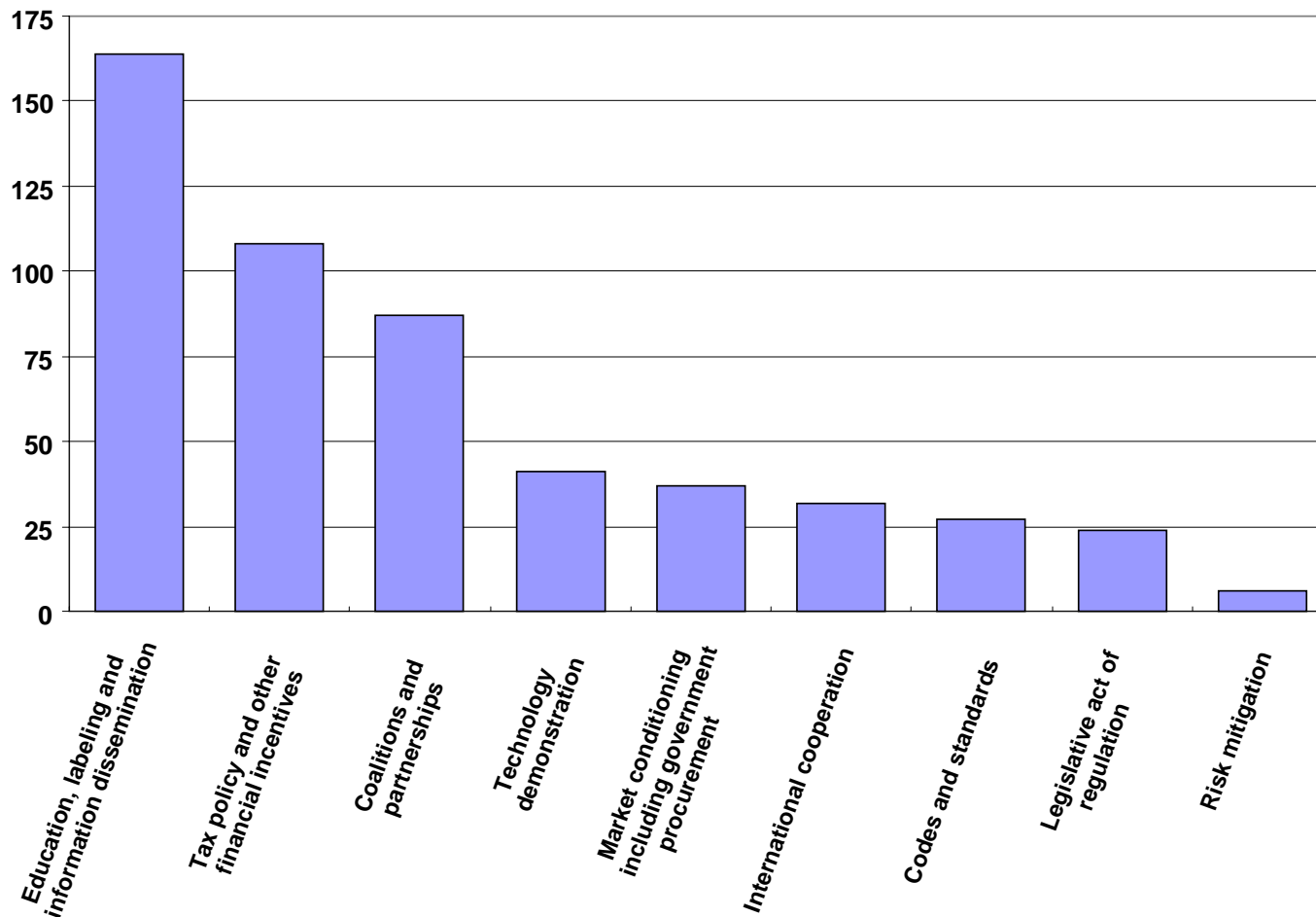
Barriers are organized into six categories consistent with EAct 2005 Title XVI.

More Than 400 Policies & Measures to Address Barriers to Deployment



Commercialization & Deployment Policies & Measures, by Genre

Number of Government Commercialization and Deployment Activities by Type of Policy and Measure



Policy Process Underway to Address Remaining Barriers

Technology Areas	Tax Policy and Financial Incentives*	Legislative Acts and/or Regulation
Coal w/CCS	Loan Guarantees; Tax Incentives	CO2 Storage – Siting & Permitting; Monitoring; Liability
Nuclear Fission	Loan Guarantees; Tax Incentives	Waste and Fuel Management and Storage
Electric Grid and Infrastructure	Investor Incentives	Rate Structures; Transmission Corridors Renewables & Distributed Generation: Net Metering; Access Rights; Standard Interconnection Policies; Energy Storage Capacity
Transportation	Tax Credit; Manufacturing Credit; Consumer Incentives	National Regulatory Policies; Urban Planning; CAFE; Federal Fleet
Hydrogen	Loan Guarantees; Investor Incentives; Insurance	National Regulatory Policies; Safety, Codes & Standards
Bio-Based Fuels	Loan Guarantees; Production Tax Credit	Stable Subsidies; National Regulatory Policies; Biofuels Tariff; Federal Fleet
Wind Power	Loan Guarantees; Production Tax Credit	Stable Subsidies; Federal RPS; Construction Incentive; Minimum Purchase Price
Industry	Loan Guarantees; Efficiency Tax Credits; CHP Tax Credits; Sector Specific Tax Credits	Equipment Standards; Emissions Regulations; Informational Partnerships (e.g.; MEPs)
Buildings	Manufacturer and Consumer Efficiency Tax Credits; Efficient Residential and Commercial Buildings Tax Credit (builders); CHP Tax Credits	Equipment Standards; Building Codes; Gov't Procurement;
Solar Power	Loan Guarantees; Investment & Manufacturing Tax Credit; Residential & Commercial Installation Tax Credit; Extended Production Tax Credit; Clean Renewable Energy Bonds	Federal RPS; Stable Subsidies; Federal Procurement of Solar Power; Ensured Availability of Public Lands (for concentrating solar power installations)
Other Renewables	Exploration Tax Credit; Extended Production Tax Credit: geothermal, ocean energy; Clean Renewable Energy Bonds	Federal RPS; Ensured Availability of Public Lands; Federal Procurement of Geothermal Power

Green: Existing Policies
Red: Policy Options

International Framework For Addressing Climate Change

Global Action Programs

- **Asia-Pacific Partnership (7 Nations)**
 - Accounts for 50% of emissions
 - Nearly 100 actions
- **G-8 Dialogue (13-20 Nations)**
 - More than 40 programs
- **Methane to Markets (20 Nations)**
 - 180+ million tons reduced by 2015
- **Renewable Energy and Efficiency (17 Nations)**
- **12+ Bilateral Agreements on Technology and Lower Emissions**
- **Tropical Forest Conservation**
- **Stopping Illegal Logging**
- **Major Economies Process (17 Nations, Including EU)**

Technology Advancement

- **Carbon Capture and Storage (22 Nations)**
- **Future Gen Coal (5 Nations)**
- **Hydrogen (17 Nations)**
- **Global Nuclear Energy Partnership (19 Nations)**
- **Gen IV Nuclear (10 Nations)**
- **Fusion Energy - ITER (7 Nations)**
- **Global Earth Observation (71 Nations)**
 - Recommended by National Academy of Sciences
- **Clean Energy Technology Fund (US, UK and Japan, World Bank)**

Major Economies Process

- The U.S. is working with other “Major Economies” to establish a new post-2012 framework on GHG emissions.
- Endorsed by UN, G8 & APEC leaders
- New framework by Dec. 2008 will help lead to an international agreement by the end of 2009.
- Six elements:
 1. A **long-term global goal** for GHG reduction, consistent with economic development & energy security objectives;
 2. **National plans** that advance the long-term global goal and that set mid-term goals that are effective and measurable;
 3. Collaborative **technology development and deployment strategies for key sectors**, including lower carbon fossil power generation, transportation, land use, and near zero carbon energy (e.g., efficiency, nuclear, wind, and solar);
 4. Improved entity-level **measurement and accounting** systems;
 5. Support accelerated adoption of clean technologies by **innovative financing and lowering/eliminating tariffs** and non-tariff barriers; and
 6. Robust programs to address **adaptation, forestry, and technology access** for all UN member states.
- Treasury seeking \$2 billion over 3 years for Clean Energy Technology Fund.
- Second meeting held in Hawaii January 30-31.
- Third meeting planned for April in France.



"Energy security and climate change are two of the great challenges of our time. The United States takes these challenges seriously. The world's response will help shape the future of the global economy and the condition of our environment for future generations. The nations in this room have special responsibilities."

President George W. Bush
September 28, 2007

Major Economies Represented		
Australia	Germany	Mexico
Brazil	India	Russia
Canada	Indonesia	South Africa
China	Italy	UK
EU / EC	Japan	United States
France	Korea	UNFCCC*

* Observer

V. Conclusions

Summary -- A Path Forward Involves ...

- A **Visionary Long-Term Approach**, Aimed at the UNFCCC Goal, Based on Innovation, Growth and International Cooperation
- Continued **U.S. Leadership** on Tech. Solutions & Int'l Dialogue
- **Near-Term Actions** – Voluntary, Financial Incentives & Mandates
- Progress in Climate Change **Science** Will:
 - Reduce Uncertainty and Illuminate Risks and Benefits
 - Add Relevance and Specificity to Assist Decision-Makers
- Progress in Climate Change **Technology** Will:
 - Create New, Better, and More Affordable Solutions
 - Facilitate Means for Transformational Change
 - Enable Broadened Consensus on Policy Formulation
- Expand Opportunities for **S&T Cooperation** Among:
 - Business, Industry, States and NGOs
 - Research Institutions and Academia
 - Cooperative Frameworks with S&T Actions Abroad
- Multi-Lateral Collaboration on Goals, **Finance & Trade** on Clean Energy
- Build a **Bridge to Low-Emissions Future** with Broadened Public Support

Links and Contact

- CCTP Strategic Plan: www.climatetechnology.gov
- CCTP Scenarios:
http://www.pnl.gov/main/publications/external/technical_reports/PNNL-16078.pdf
- CCSP Integrated Assessment Modeling Comparison:
<http://www.climate-science.gov/Library/sap/sap2-1/finalreport/default.htm>
- Oak Ridge “Carbon Lock-In” Report incorporating CCTP deployment report barrier typology:
http://www.ornl.gov/sci/eere/PDFs/Carbon_Lock_In_Report.pdf

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