



COLLEGE OF
Management

Center for Sustainable Enterprise and Regional Competitiveness

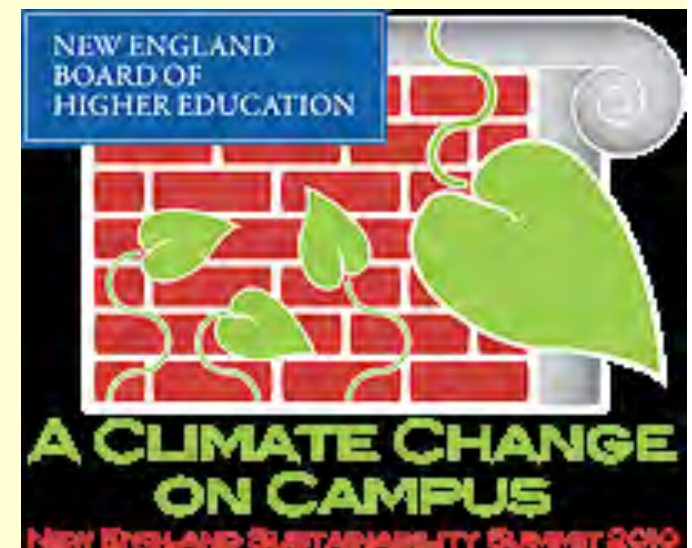
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Business of Climate Change: Education for the Low-Carbon Economy

**New England
Sustainability Summit
Worcester, April 23, 2010**



There's NO Business like CO₂ Business

Investment to reach 450 ppm, 2^o goal estimated at **\$500 billion/year** worldwide, 80-90% from private sources

Global carbon market: \$136 bn 2009, 8.2 bn tonnes CO₂e

\$80 bn of US stimulus package for clean tech

Clean tech 12.5% of US VC funding \$8.2 bn. 2007-9

Global investment in clean energy \$145 bn, 2009

A123 Systems Raised \$378 million Sep. 2009

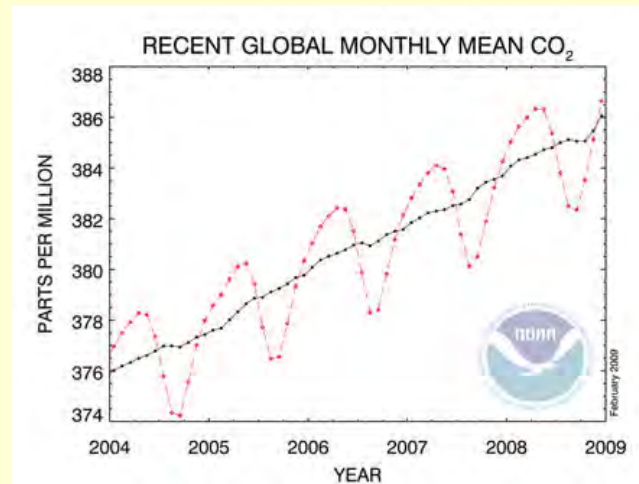


Climate Change remains strategic driver *Despite Brokenhagen, Climategate*



COP15
COPENHAGEN
UN CLIMATE CHANGE CONFERENCE 2009

- 2000's hottest decade on record (NOAA, WMO)
- regulatory action on RPS, efficiency, autos
- business support for clear, predictable regs, carbon markets
- business vested interests – clean energy sector, carbon mgt.
- states, regions competing for jobs, clean tech investment





CLIMATE SUMMIT

WHAT IF IT'S
A BIG HOAX AND
WE CREATE A BETTER
WORLD FOR NOTHING?

- ENERGY INDEPENDENCE
- PRESERVE RAINFORESTS
- SUSTAINABILITY
- GREEN JOBS
- LIVABLE CITIES
- RENEWABLES
- CLEAN WATER, AIR
- HEALTHY CHILDREN
- ETC. ETC.



Climate Change as Economic Threat

- CO2 limits threaten oil, coal, auto industries, other energy intense sectors (aluminum, cement chemicals, malls)
- New technologies threaten corporate assets, capabilities
- Ideological challenge: “they think we are having too much fun, they want us all to live in beehives” (Auto industry exec.)
- political threat: rise of international environmental bureaucracy, NGO pressure



Climate Change: The Single Most Important Strategic Issue Facing Business in 21st Century

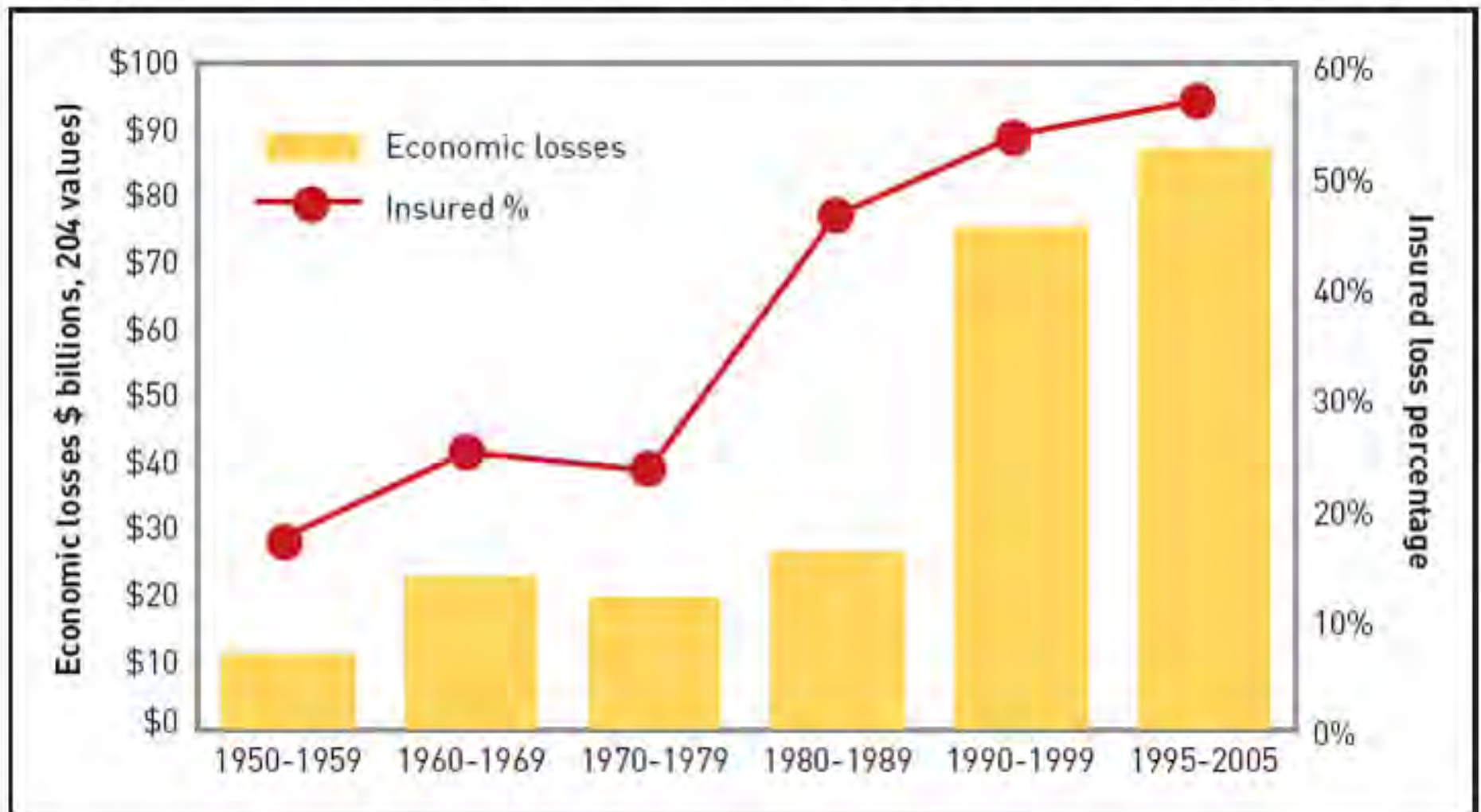
1. Direct cost impact: cost of fuels and power, allowances
2. Indirect Costs: product and process changes, IT systems and personnel.
5. Carbon mgt and cost control: fuel switching, efficiency, process improvements, logistics
7. Corporate Branding and Product Differentiation: at corporate, facility, product levels
9. Demand impacts: e.g. fuels, lighting; cleantech; software, services
11. Strategic impacts: competitive positioning, innovation, competences
12. Carbon trading

Physical Risks

- Insurance industry – flooding, hurricanes
- Real estate and tourism
- Agriculture – drought, floods
- Transportation – road/rail washout, river/port disruption
- Large Scale Engineering Mitigation Projects:

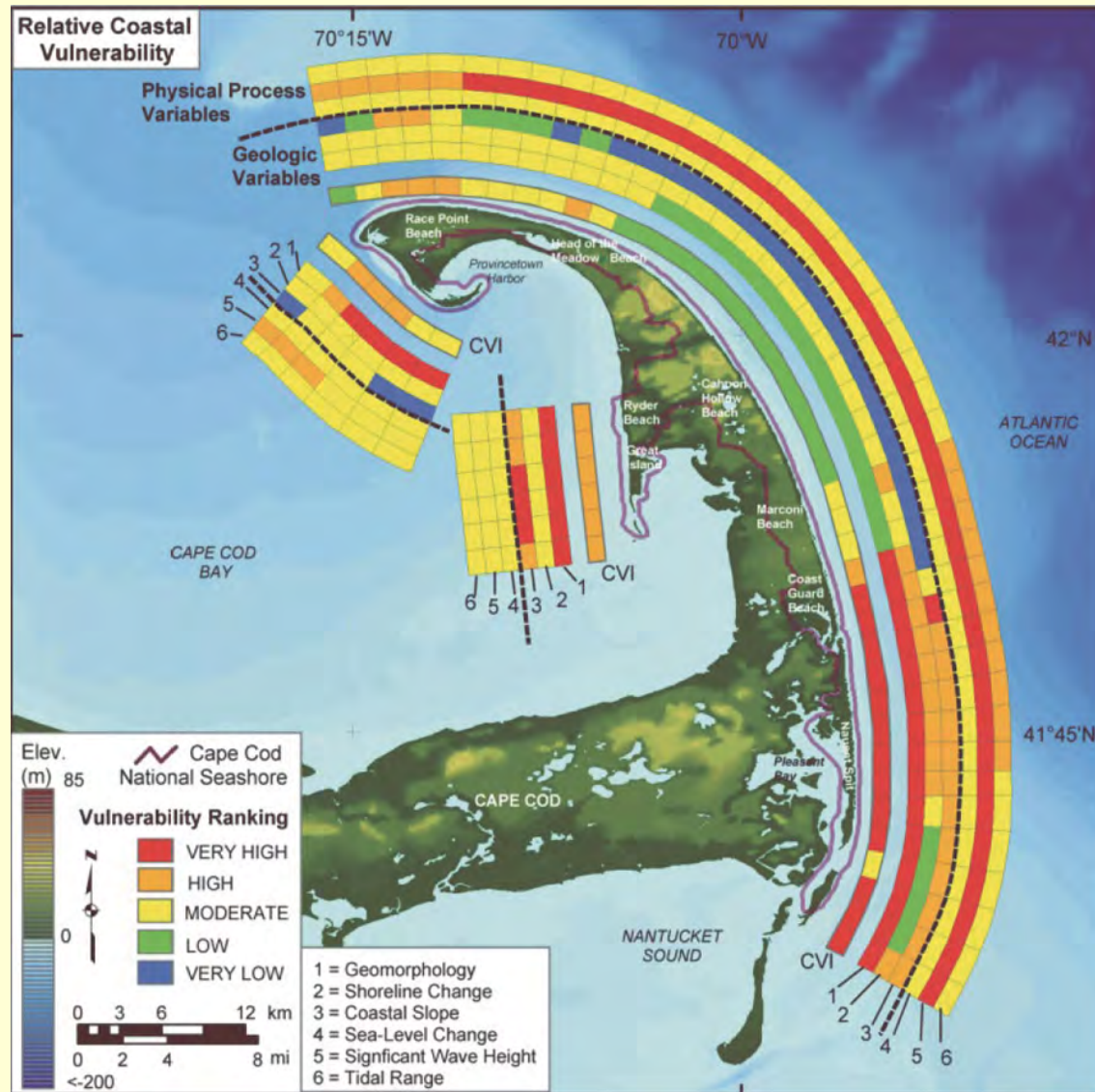


Rising U.S. economic and insured losses from tropical storms and hurricanes



Source: American Re (2005)

Risk of Sea Level Rise to Cape Cod



Source: Vulnerability Assessment of Cape Cod National Seashore to Sea-Level Rise, USGS Report 02-233

Global Clean-Energy Projected Growth 2009-2019 (\$US Billions)



Source: Clean Edge, 2010

ARRA Funding Provides \$80 billion for CleanTech

\$11 bn for “smart grid”

\$6 bn to subsidize loans for renewables, efficiency

\$6.3 bn in state efficiency and clean-energy grants

\$5 bn to weatherize modest-income homes

\$4.5 bn for federal buildings energy efficiency

\$2 bn for advanced batteries

\$8.4 bn for mass transit

\$9.3 bn for high-speed rail

\$20 billion in tax incentives and credits



Green Jobs

770,000 in the US in 2007 - CleanEdge
9.1% annual growth



Top 5 Sectors for Clean-Tech Job Activity (U.S.)

Rank	Sectors
1	Solar
2	Biofuels & Biomaterials
3	Conservation & Efficiency
4	Smart Grid
5	Wind Power

Source: Clean Edge, Inc., 2009

14,400 Mass. Jobs

43% Energy Efficiency

28% Renewable

Energy

28% Consulting &

Support

1% University

Research

Northeast US Strategically Positioned to Benefit

Clean-tech business clusters:

Firms, Universities, Skills, Policies, Industry Assocs.,
NGOs, Venture Capital, Related Services



NorthEast has higher:

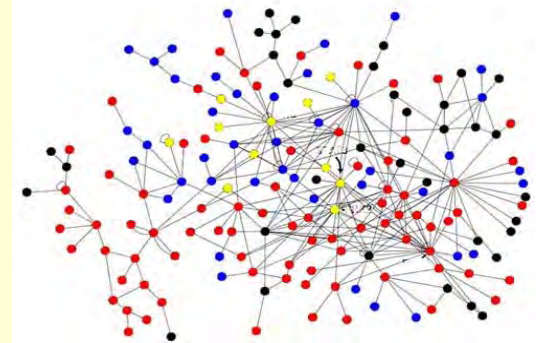
R&D per head in 10-State RGGI Region

Fed University Funding for Science and Engineering

SBIR Phase 1 Awards

Clean Energy business cluster concentration

Labor force skills



Top Clean-Tech Job Sectors

Energy

Renewable Energy (e.g., Solar, Wind)
Energy Storage
Energy Conservation and Efficiency
Smart Grid Devices and Networks
Electric Transmission and Grid Infrastructure
Biomass and Sustainable Biofuels

Transportation

Hybrid-Electric Vehicles
All-Electric Vehicles
Electric Rail
Hydrogen Fuel Cells for Transport
Advanced Transportation Infrastructure
Advanced Batteries for Vehicles

Water

Energy-Efficient Desalination
UV Filtration
Reverse Osmosis Filtration
Membranes
Automated Metering and Controls
Water Recovery and Capture

Materials

Biomimicry
Bio-Based Materials
Reuse and Recycling
Green Building Materials
Cradle-to-Cradle Systems
Green Chemistry

Clean-Tech Job Activity – Top 15 U.S. Metro Areas

Rank	Metro Area
1	San Francisco-Oakland-San Jose, CA
2	Los Angeles-Riverside-Orange County, CA
3	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA
4	Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH
5	Washington-Baltimore, D.C.-MD-VA-WV
6	Denver-Boulder-Greeley, CO
7	Seattle-Tacoma-Bremerton, WA
8	Portland-Salem, OR
9	Chicago-Gary-Kenosha, IL-IN-WI
10	Sacramento-Yolo County, CA
11	San Diego, CA
12	Austin-San Marcos, TX
13	Phoenix, AZ
14	Detroit-Ann Arbor, MI
15	Houston-Galveston-Brazoria, TX

Top 10 Clean-Tech Employers (Publicly Traded Pure Plays)

Rank	Company	Headquarters	Sector/Activity	Employees
1	Vestas Wind Systems	Randers, Denmark	Wind	21,100
2	LDK Solar	Xinyu, China	Solar	14,100
3	Nalco	Naperville, IL	Water	11,700
4	Suntech Power	Wuxi, China	Solar	9,000
5	Itron	Liberty Lake, WA	Smart Grid	8,700
6	China BAK Battery	Shenzhen, China	Energy Storage	8,200
7	Baldor Electric	Fort Smith, AR	Electric Motors	7,800
8	Gamesa	Vitoria, Spain	Wind	7,200
9	Kingspan Group	Kingscourt, Ireland	Green Building	5,500
10	SunPower	San Jose, CA	Solar	5,400

Energy Efficiency

McKinsey 2009 Study of US:

Potential for \$1.2 tn gross energy savings through 2020

Upfront investment of \$520 bn needed

End-use demand reduced by 23% in 2020, 9 Quads.

Reduced GHG emissions of 1.1 GtCO₂e/year

By sector: end-use efficiency potential

Residential: 35%

Industrial: 40%

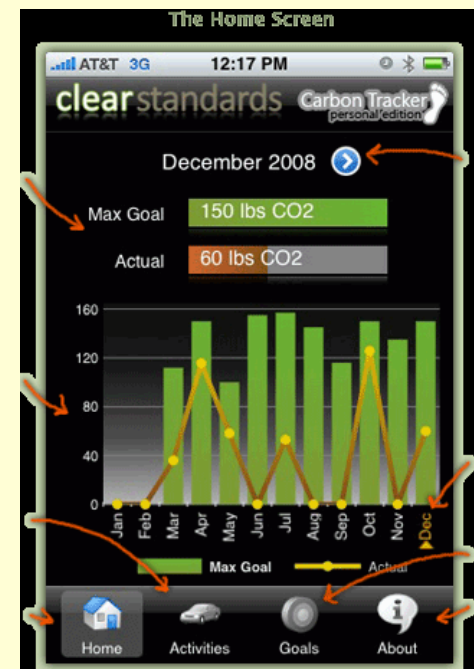
Commercial: 25%



Measuring and managing carbon is big business

- ESCO market to grow \$5.6bn 2009 → \$20bn 2020
- Enterprise Carbon Mgt software: Logica, EnerNOC, SAP etc.
- accounting, consulting, legal firms
- carbon trading

Carbon Software: \$400m 2009
40% annual growth



Carbon Risk and Trading

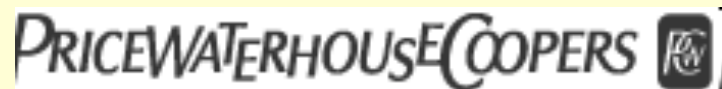
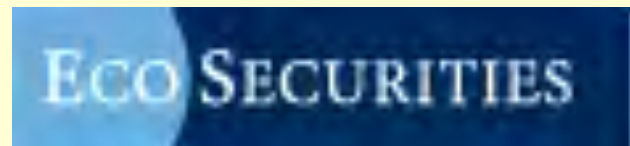
Evaluating carbon risk in financial analysis

Carbon accounting/pricing for trading, derivatives, offsets

Loan portfolio risk for banks

Market for green mutual funds, ETFs

Venture capital risk/returns





“Our mission is to foster a transition to a clean, sustainable, and prosperous economy”

The Center will be an internationally recognized center of expertise and an important regional resource for students, business and policymakers.

The Center will engage in collaborations to advance research, education, and innovative solutions for business sustainability and regional competitiveness

Activities

Education

Courses, programs, exec ed.



Forum for Business-Government-Academic Interaction

translating research into action

Research

Corporate strategies, carbon trading, governance

Generate Resources

From programs, foundations, business, philanthropists

Education

To prepare students and returning professionals for transition to clean economy.

Programs: (grant from Mass. Clean Energy Center)

MBA specialization in Clean Energy/Enviro. Mgt.

Interdisciplinary certificate – policy, economics, science

PhD tracks – Management, Public Policy, or Global Studies

Undergrad minor/certificate Clean Energy

Exec. Ed., workshops.

Internships, MBA Projects

Global Network of Business Schools

- In partnership with Aspen Institute

Research

Corporate strategies

Carbon markets

Carbon measurement, disclosure and management

Energy Efficiency at community level

Climate governance

Regional development and employment

Global clean energy value chains

Collaborations:

University of Canterbury, New Zealand - Carbon Neutrality

Oxford U., Smith School; U. Sydney, Australia – Strategies

U. of Amsterdam – CDP; Carbon Governance

Durham U./Leverhulme Project – Climate Governance

Clark U. – Global Reporting Initiative

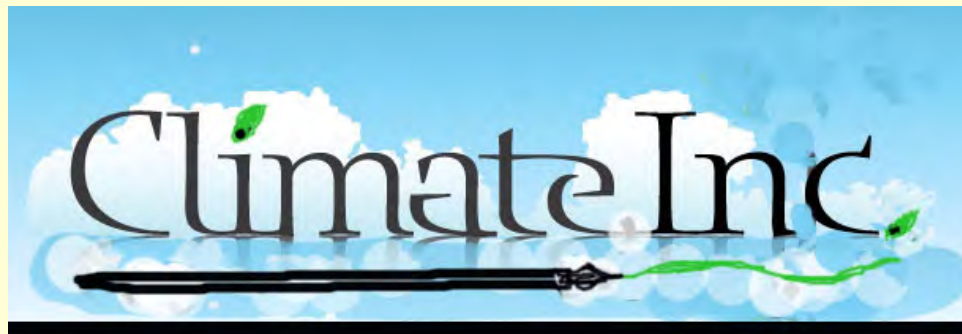
Business-Government-Academic Interaction

Carbon Strategies for Financial Sector May 2009

Green Education for the Next Generation May 2010

Carbon Negative seminars

- Building links to business community
- internships, student placement + recruitment
- Build credibility with state, policymakers
- Value of UMass/SERC as facilitator, convener, connector



www.climateinc.org

*The business
of stopping
climate change*

Can we trust the “magic of the marketplace” to fix climate change?

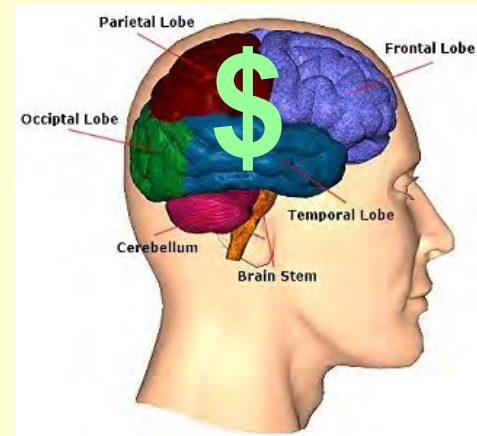
1. Fixing climate is not all “win-win”
2. Market and non-market failures are rampant
3. Markets are politically, socially embedded
4. Politics keep carbon prices too low



Corporate Climate Strategies – Socially and Politically Embedded

Business action depends on ***expectations*** regarding:

- Carbon, energy prices
- Regulation
- Consumer response
- Technological developments
- Competitor moves
- Climate defined as 'crisis'
- Public pressure



The Political Economy of Climate Change

The Grand Carbon Compromise?

Carbon Coalition: business, gov't, NGOs

- reliance on “win-win”, low carbon prices
- central role of carbon trading, flexible measures
- protects core business interests
- USCAP: stabilize emissions in first 10 years
- policymakers driven by ‘competitiveness’
- NGO reliance on carbon disclosure

From *Hopenhagen* to *Brokenhagen*?

- End of road for globally coordinated mandatory controls?
- Countries have conflicting interests
- Huge problems of collective action
- Rise of tea-party cultural politics
- Recession limits resources, diverts attention
- Devil is in the policy details – inter-sectoral fights
- End of US Cap & Trade?
- Defections from USCAP – BP, Caterpillar

