



Climate Action Planning for U.S. Shipyards

Parikhit (Ricky) Sinha, Ph.D.



O'BRIEN & GERE
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Outline

PART 1: UNDERSTANDING

- Introduction – climate change impacts
- Relevant climate policy trends
- Baseline GHG inventory development
 - General overview
 - Case study for US shipyard

PART 2: TAKING ACTION

- GHG emission forecasting
- Goal-setting: *Long-Term; Interim*
- GHG emission reduction: *Strategies; Projects*
- Communicating with stakeholders

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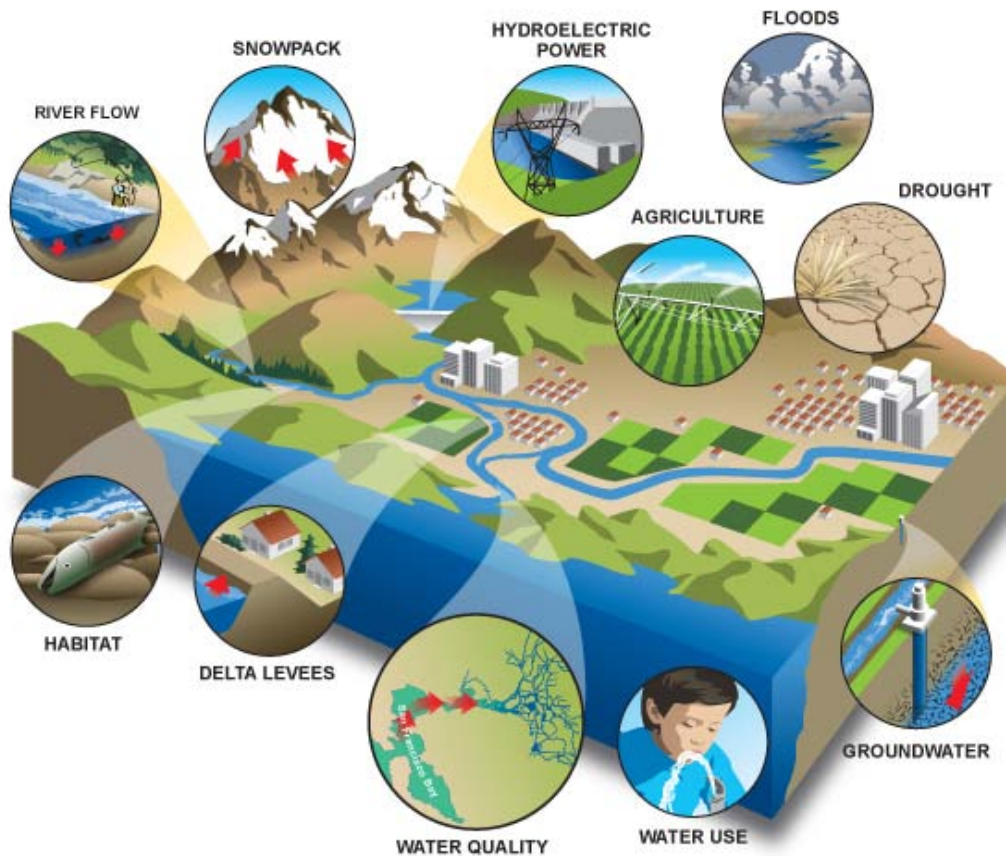
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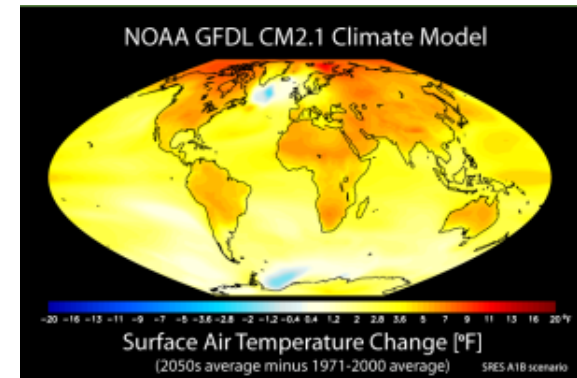
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Climate Change Impacts



Impacts are expected to be:

1. Diverse
2. Critical
3. Global
4. Irreversible?

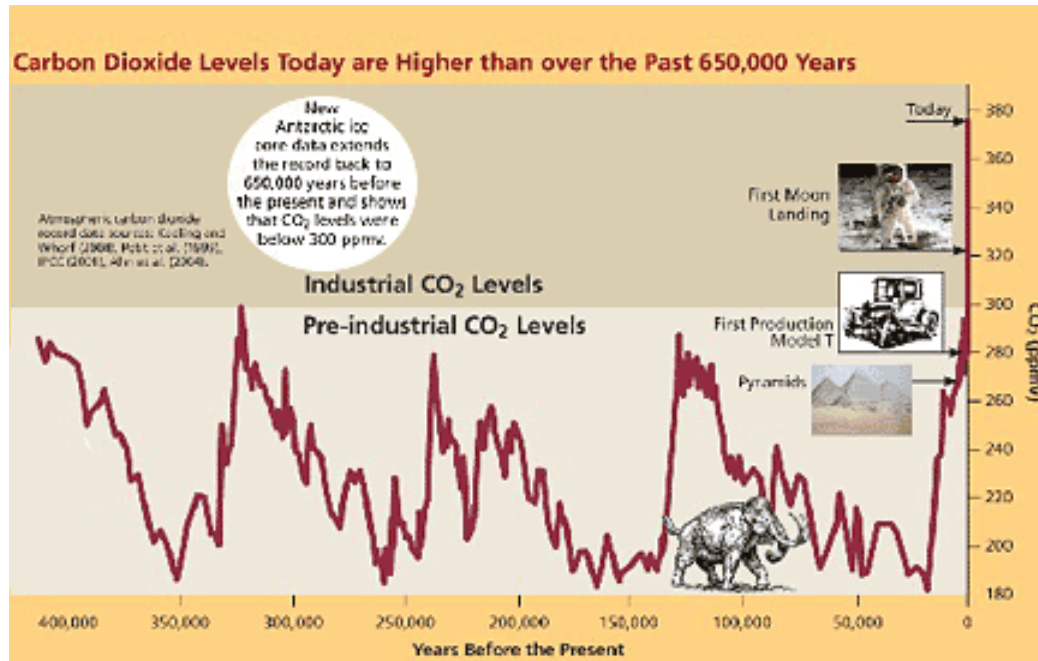


<http://www.water.ca.gov/climatechange/factsheet.cfm>



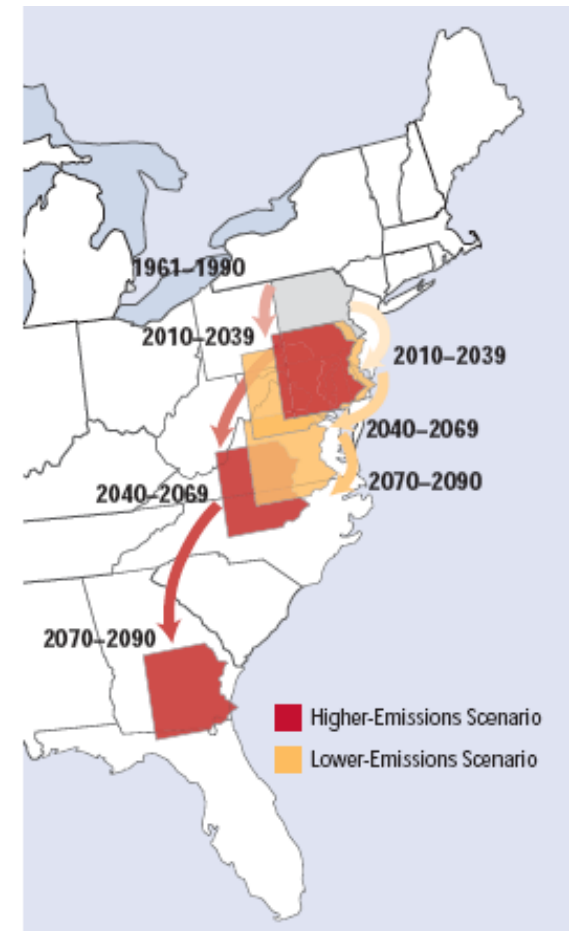
Climate Science - Global & Regional Indicators

CO₂ concentrations exceed natural variability



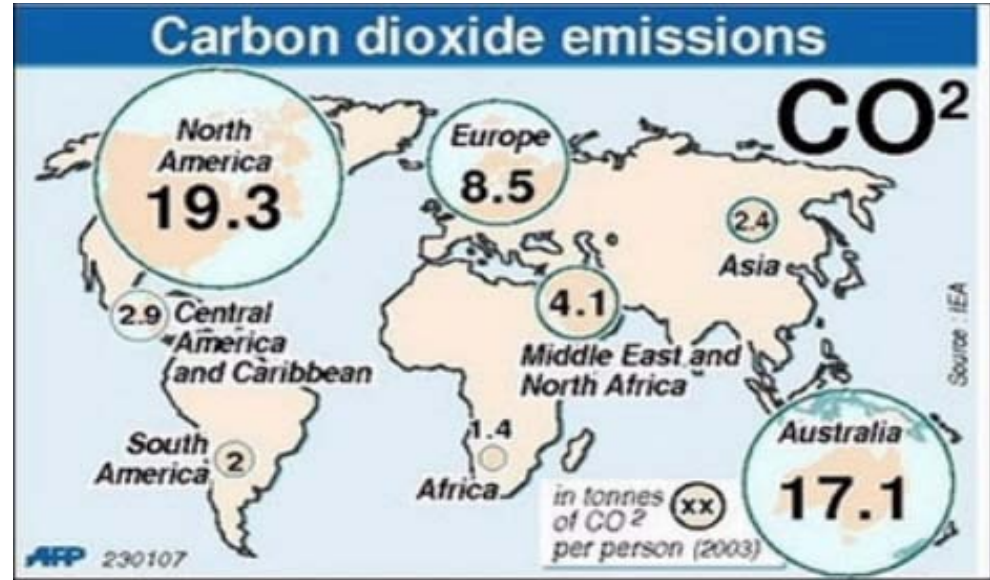
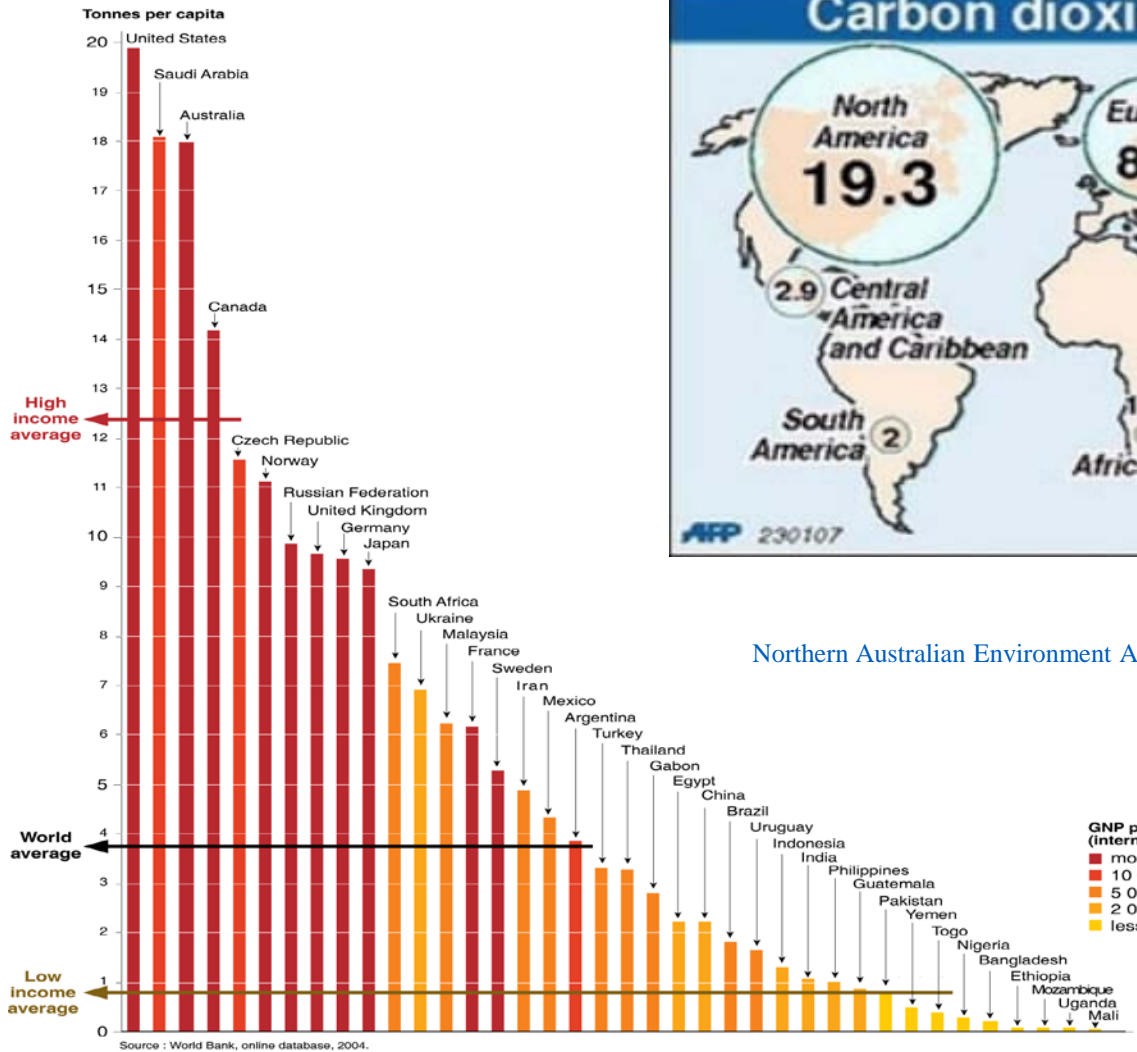
20% decline in summer sea ice extent in past 30 years

Northeast Climate Impacts Report



Per Capita CO₂ Emissions

CO₂ Emissions in 2002



Northern Australian Environment Alliance

GNP per capita, PPP (International \$)

- more than 20 000
- 10 000 to 20 000
- 5 000 to 10 000
- 2 000 to 5 000
- less than 2 000

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GHG Policy: International

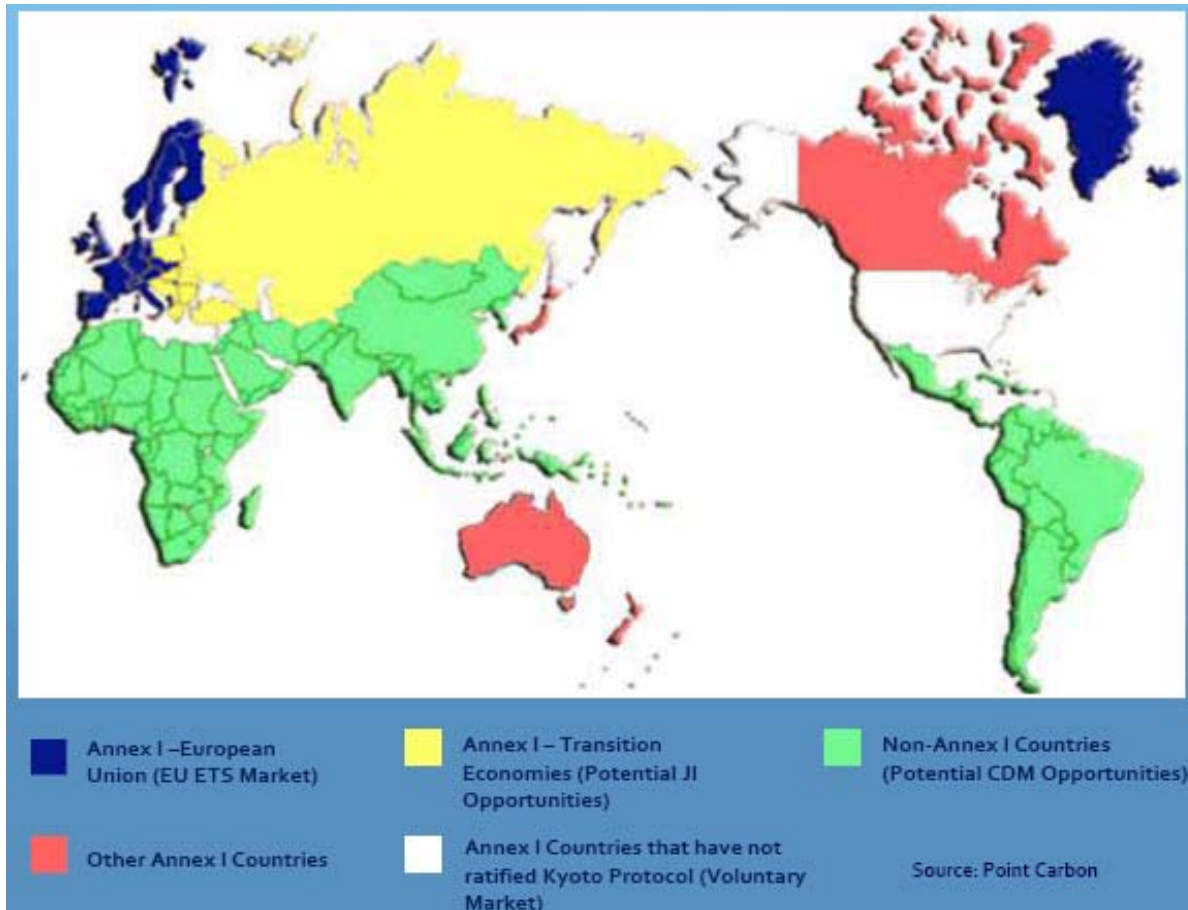
- 2007 - U.N. Intergovernmental Panel on Climate Change (IPCC) releases 4th assessment report concluding:
 - with 90% confidence that the global average net effect of human activities since 1750 has been one of warming
- 2007 U.N. Climate Change conference in Bali
 - 180 countries agree to negotiate new global climate agreement in 2009



- 2007 - U.S. Supreme Court rules that U.S. Environmental Protection Agency has authority to regulate greenhouse gases
- 2007 - IPCC and Al Gore win Nobel Peace Prize
- 2007 - China overtakes United States as largest GHG emitter.
- 2008-2012 Kyoto protocol commitment period
 - Annex B countries must collectively reduce GHG emissions by 5% below 1990 levels

Current Regulatory Drivers: International

- 2008-2012 Kyoto protocol commitment period
 - Annex I countries must collectively reduce GHG emissions by 5% below 1990 levels



Federal Regulatory Driver: New U.S. Administration

President Obama's Climate Change Platform



- Co-sponsor of the 2007 Global Warming Pollution Reduction Act (reduce greenhouse gas emissions in the U.S. by 80% in the year 2050)
- Re-engage with the UN Framework Convention on Climate Change
- Cap-and-trade GHGs, auction 100% of allowances
- Pledged to invest \$150 billion USD over the next decade in renewable energy.
- Green infrastructure/jobs as part of \$789B economic stimulus package of 2009
- Executive Order for federal agencies/programs?

Regulatory/Economic Driver: 2009 U.S. Stimulus

GHG/climate-related components from the American Recovery and Reinvestment Act (U.S. economic stimulus 2009)*:

Amount (\$ billion)	Purpose
11.0	Modernizing U.S. electricity grid & developing “smart grids”
6.0	Providing loan guarantees for wind/solar energy development
6.3	Energy efficiency & conservation grants
5.0	Weatherizing homes
4.5	Making federal buildings more energy efficient
2.5	Energy efficiency & renewable energy research
1.0	Energy efficiency programs: –energy-efficient appliances –alternative-fueled trucks & buses

*<http://www.reuters.com/article/ousiv/idUSTRE51B7FV20090212>

Future Regulatory Driver: U.S. EPA

- 2007 - U.S. Supreme Court rules that U.S. Environmental Protection Agency has authority to regulate greenhouse gases
- CO₂ determined to be an “air pollutant” and thus covered by the Clean Air Act
- Regulation is coming
 - Advance Notice of Proposed Rulemaking

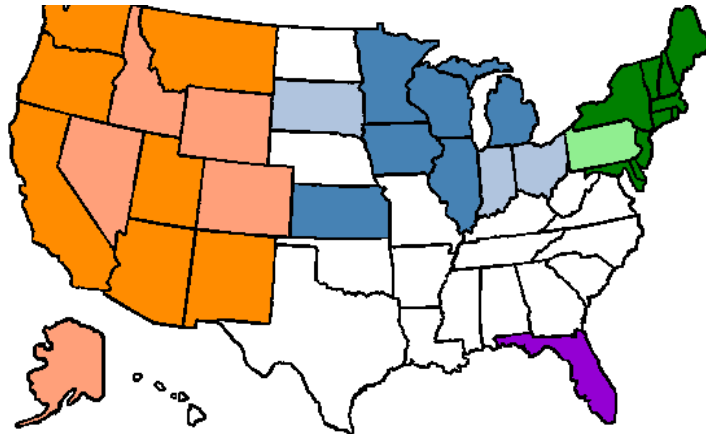


Future Regulatory Driver: U.S. Congress

- Lieberman-Warner Climate Security Act of 2008 (currently in Senate) would:
 - Establish cap-and-trade for greenhouse gases
 - Reduce greenhouse gas emissions in the U.S. by 63% in the year 2050
 - Focus on upstream sources
 - Impact electric utilities, oil & gas, coal users
- Committee on Energy and Commerce preparing climate change legislation
- Rep. Waxman will chair Committee on Energy and Commerce: strong support for environment

Regulatory Drivers: Regional & State

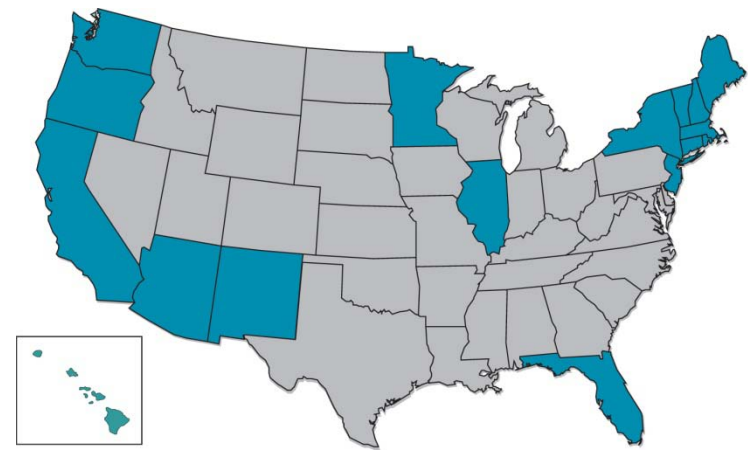
Regions with GHG Emission Programs



- Regional Greenhouse Gas Initiative RGGI
- RGGI Observer
- Midwestern Regional GHG Reduction Accord
- MRGHGRA Observer
- Western Climate Initiative
- Western Climate Initiative Observer
- Individual State Cap-and-Trade Program

- Multi-state Climate Registry
 - Formal North American GHG registry
 - 39 participating U.S. states
- RGGI (Northeast) requires mandatory 10% reduction in power sector GHG emissions by 2018

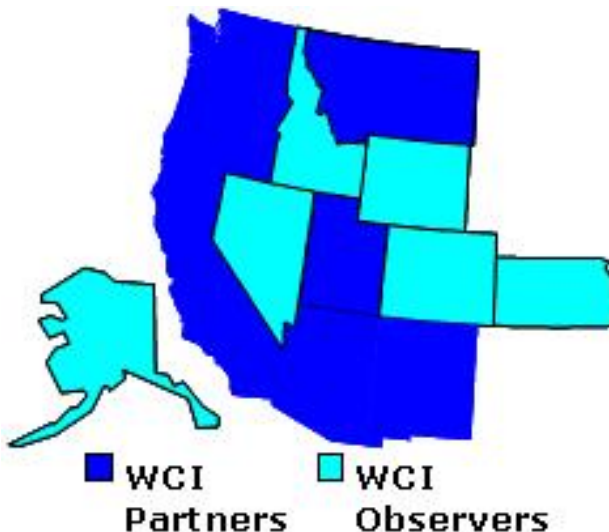
States with GHG Emission Targets



- California's Assembly Bill No. 32 establishes mandatory state-wide limits on greenhouse gases and annual reporting
 - 2000 levels by 2010; 1990 levels by 2020; 80% below 1990 levels by 2050
- New York's State Environmental Quality Review Act (SEQRA) considers GHGs as part of an environmental assessment

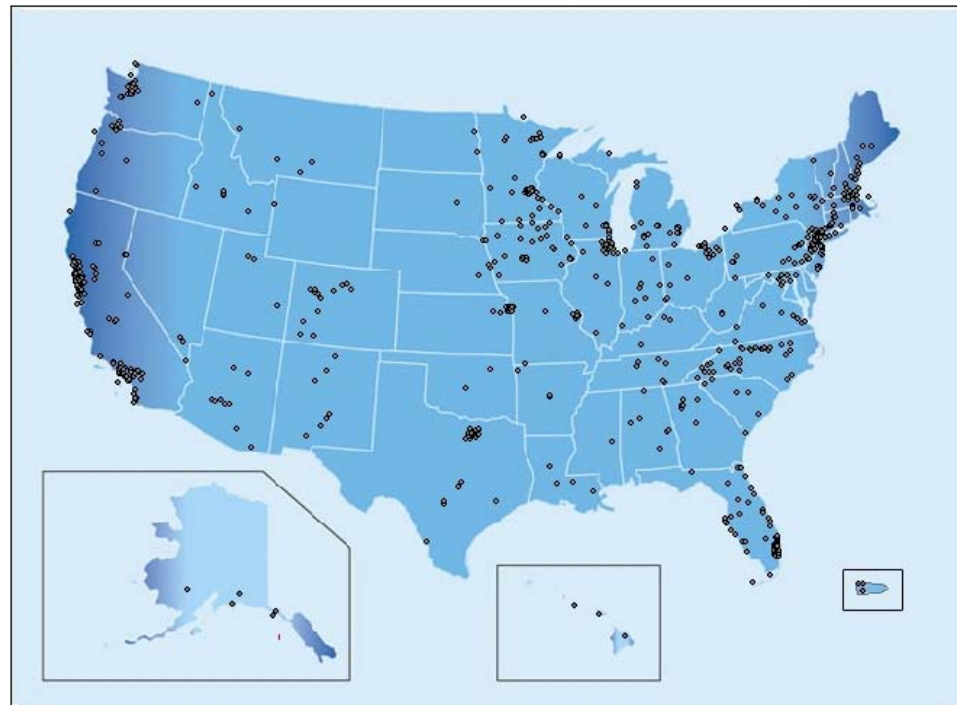
Future Regulatory Driver: Regional Cap & Trade

- Western Climate Initiative: designing GHG multi-sector cap-and-trade system with mandatory reporting
- Midwest Regional GHG Reduction Accord: setting targets and designing cap-and-trade system



Current Regulatory Drivers: Municipal

- 500 U.S. mayors signed a Climate Protection Agreement - reduce greenhouse gases by 7% by 2012 (compared with 1990 levels)
- Need to quantify GHGs and develop reduction strategies to meet Agreement goals



<http://www.usmayors.org/climateprotection/ClimateChange.asp>

Business Community

- United States Climate Action Partnership
 - Major U.S.-based international corporations call for mandatory, economy-wide, market-driven climate regulation in the U.S.
- Greening of the Supply Chain
 - As large retail and food service companies adopt sustainability programs, so do vendors supplying materials and resources to these companies



- Green Marketing
 - Major corporations base entire marketing campaign around sustainability



imagination at work



Investment Community

- Dow Jones Sustainability Index: economic, environmental, and social criteria



- Carbon Disclosure Project: Institutional investors with \$57 Trillion in managed assets ask world's largest companies to disclose their efforts to address climate change

FTSE 350 – Carbon Disclosure Leadership Index for carbon-intensive sectors

Sector	Company	CDLI score	Scope 1*	Scope 2*	Scope 3**	Intensity***
Chemicals & Pharmaceuticals	AstraZeneca	73	442	276	576	24
	GlaxoSmithKline	62	872	1,095	3,832	43
Construction & Building Products	Marshalls	70	20	40	373	76
	Brixton plc	58	–	1	–	–
Manufacturing****	Rolls-Royce	65	237	372	–	41
Oil & Gas	Royal Dutch Shell	68	92,000	13,000	743,180	295
	BG Group	65	9,401	7	83,000	583
	BP	64	63,460	10,670	521,000	261

Higher Education

- American College and University Presidents Climate Commitment (ACUPCC)
 - Establish baseline GHG Inventory within one year
 - Establish Climate Action Plan within two years
 - Take immediate steps to reduce greenhouse gas emissions by choosing from a list of short-term actions
 - Make the action plan, inventory, and progress reports publicly available
 - More than 600 Presidents have pledged to eliminate their campuses' greenhouse gas emissions over time



Carbon Markets

- Voluntary cap-and-trade
 - Chicago Climate Exchange: Members buy and sell GHG allowances to meet emission reduction targets. Voluntary but legally binding.
- Over-the-counter carbon market
 - The VCS Program provides a global standard and program for approval of credible voluntary offsets.



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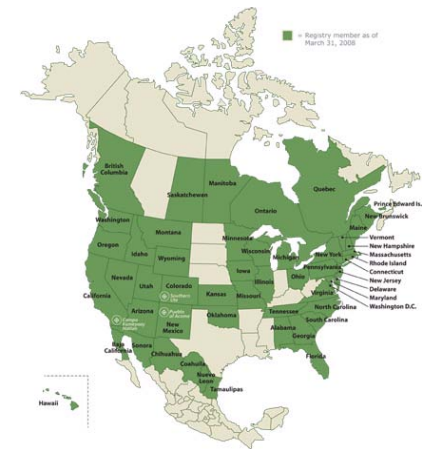
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GHG Accounting Protocols

- International
 - World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD, 2004)
 - ISO 14064, based on WRI/WBCSD
- European Union
 - EU Emission Trading Scheme
- United States
 - California Climate Action Registry, based on WRI/WBCSD
 - USEPA Climate Leaders, based on WRI/WBCSD
 - Climate Registry (adopted by 39 U.S. states, including PA, NJ, NY), based on WRI/WBCSD
- Colleges and Universities
 - Clean Air Cool Planet



Boundaries and Definitions

- Intended audience
 - Climate Registry, USEPA
- Organizational boundary
 - Based on ownership
 - Report emissions from all assets that you own
 - Based on control
 - Report emissions from all assets that you operate
 - Control can include leased assets that you operate but do not own (e.g., leased vehicles and buildings)

Boundaries and Definitions

- Operational boundary
 - Scope 1 direct emissions (within org. boundary)
 - Stationary sources (e.g., boilers, heaters, generators)
 - Mobile sources (e.g., cars, vans, trucks, forklifts)
 - Process sources (e.g., cryogenic CO₂, SF₆, PFC)
 - Fugitive sources (refrigerant leakage)
 - Scope 2 indirect emissions (outside org. boundary)
 - Purchased electricity, steam, heat, chilled water



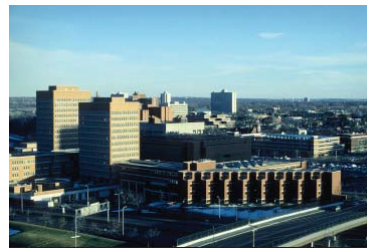
Boundaries and Definitions

- Scope 3 indirect emissions (outside org. boundary; optional)
 - Employee commuting
 - Employee business travel
 - Landfilled waste
 - Supply chain of purchased chemicals
- Report Scope 3 if you have:
 - Reliable data,
 - Significant emissions,
 - Stakeholder interest,
 - Ability to reduce emissions



Boundaries and Definitions

- Baseline Year
 - First year (post-1990) for which complete, verifiable emissions data is available
 - Year against which future emissions are tracked
- De Minimis Threshold
 - Emissions sources that account for a small percentage of entity-wide emissions (3-5%) can be called de minimis and approximated.
 - Fugitive emissions (refrigerant leakage)
- Emission intensity metric
 - Used to normalize emissions to account for institutional growth over time (e.g., gross square footage, full-time equivalent students)



Inventory Program

- Kick-off meeting
 - Intended audience
 - Organizational boundary
 - Operational boundary
 - Baseline year
 - De minimis threshold
 - Emission Intensity metric



Inventory Program

- GHG Activity Questionnaire
 - Distribute to facilities staff
 - Ask which Scope 1, 2, and 3 emission sources are present.
 - For these sources, ask what types of fuels and process greenhouse gases are used to operate these sources.
 - For these fuels and gases, ask whether monthly, quarterly, or annual data is available.

1. Activity Description	Greenhouse gas emission sources	1a. Please list any stationary sources at your campus.
		1b. Please list any mobile sources owned or leased by your campus.
		1c. Please list any process sources at your campus.
		1d. Please list any fugitive sources of refrigerants at your campus.

Inventory Program

- GHG Scorecard
 - Use questionnaire results to create data entry tool for inventory data collection
 - Include fuels, gases, and other metrics needed to calculate Scope 1, 2, and 3 emissions
 - Allow for user input in raw units
 - Automatically convert to units required for GHG accounting

<i>Stationary Sources</i>		
Natural Gas		ccf GJ m3 mcf
Liquid Propane		Gallon Liter
Boiler Fuel - No. 2		Gallon Liter

Inventory Program

- Carbon Footprint - Annual entity-wide emissions of greenhouse gases from activities undertaken by or in support of an organization, expressed in metric tons of carbon dioxide equivalents
- GHG Inventory
 - Calculate Scope 1, 2, and 3 emissions (metric tons CO₂ equivalent) and emissions intensity
 - Kyoto protocol gases: CO₂, CH₄, N₂O, HFC, PFC, SF₆
 - Organization-wide; site-specific
 - Calendar year basis
 - For baseline year and every subsequent year
- Provide benchmark against which future emission reduction projects can be measured.
- Identify which emission sources are significant and which are *de minimis*.

Verification and Uncertainty

- Third party verifier
- Risk based - aims for 95% accuracy in inventory
- Check completeness of emission sources
- Check accuracy of input data (e.g., utility bills, fuel bills, mileage records)
- Check methodology and accuracy of emission calculations
- Estimate uncertainty in entity-wide emissions
- Provide verification opinion



Case Study: Baseline for U.S. Shipyard

Atlantic Marine Shipyard provided 2007 fuel/energy use information for the following segments:

- Electricity consumption (kWh)
- Mobile Diesel (incl. gantry and Clyde cranes)
- Stationary Diesel (incl. boilers)
- Gasoline
- Kerosene

Data were converted into CO₂ units using standard conversion factors and plotted



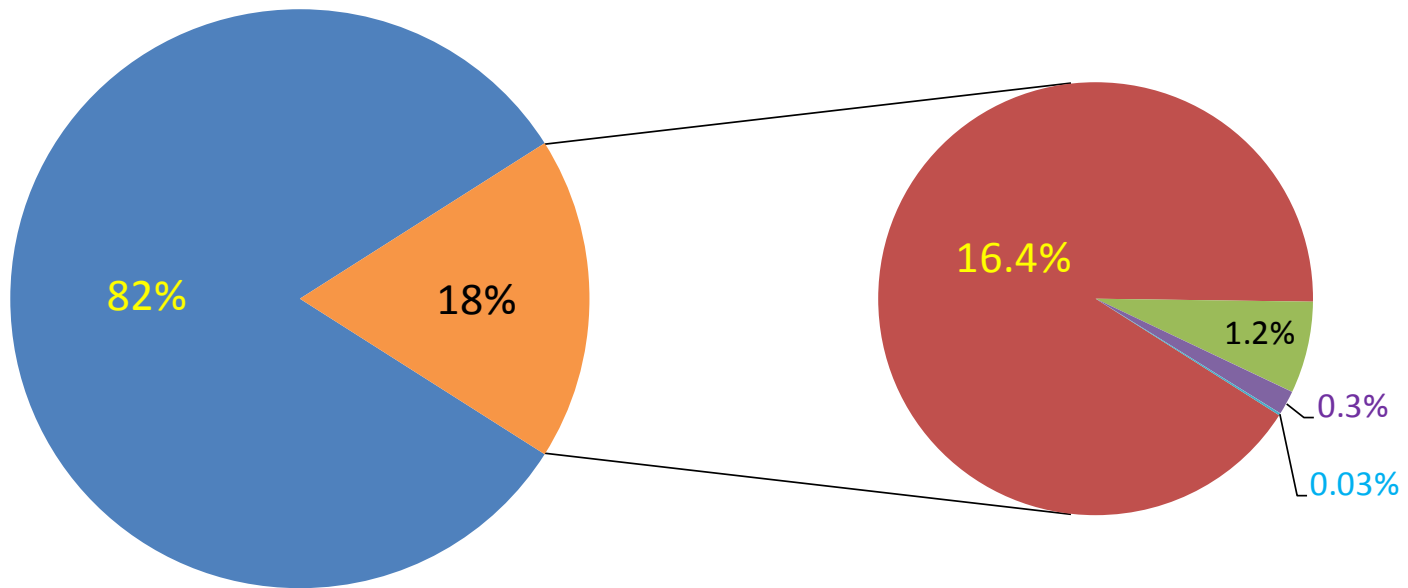
Image: Flickr.com/theanewcombe

Case Study: Baseline for U.S. Shipyard

2007 Emissions Summary - Atlantic Marine Shipyard

Total Emissions:
9915 MTCO₂e

- Indirect Electricity
- Mobile Diesel
- Stationary Diesel
- Mobile Kerosene
- Mobile Gasoline



For reference, a U.S. passenger car emits ~5 MTCO₂E per year.

Summary – Part 1

- GHG Inventory Program Development
 - Kick-off Meeting
 - Decide upon audience, boundaries, definitions
 - GHG Activity Questionnaire
 - GHG Scorecard
 - GHG Inventory
 - GHG Verification
- Further information
 - <http://www.obg.com/GHG>
 - sinhap@obg.com, 215-628-9107 ext. 273



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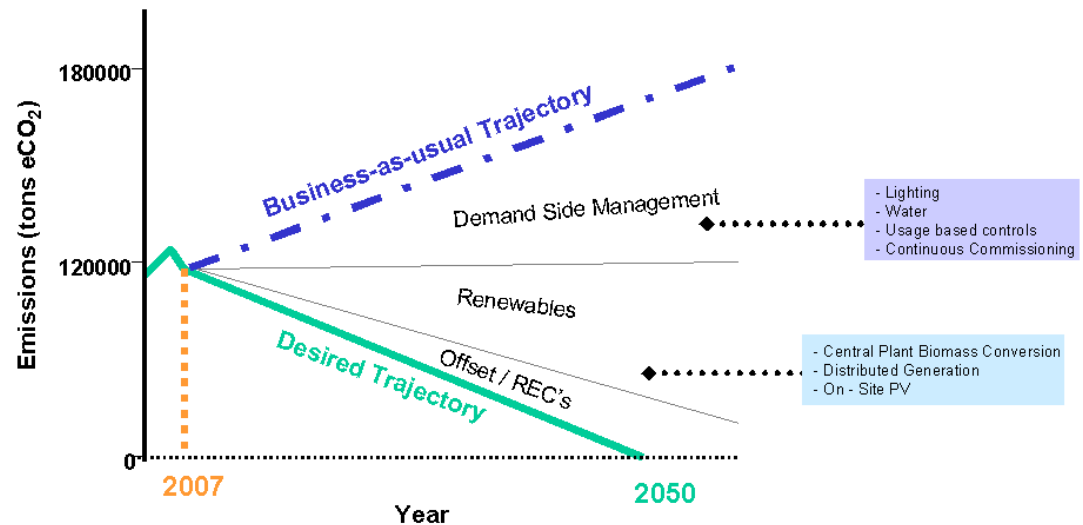
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Climate Action Planning

- Establish baseline
- Set future emission reduction goals
 - Absolute emissions
 - Emission intensity
- Project business as usual emission trajectory
- Project emission trajectory needed to meet emission reduction goals
- Break up difference into smaller wedges
- Each wedge represents an emission reduction project



Based on Pacala and Socolow, *Science* (2004)

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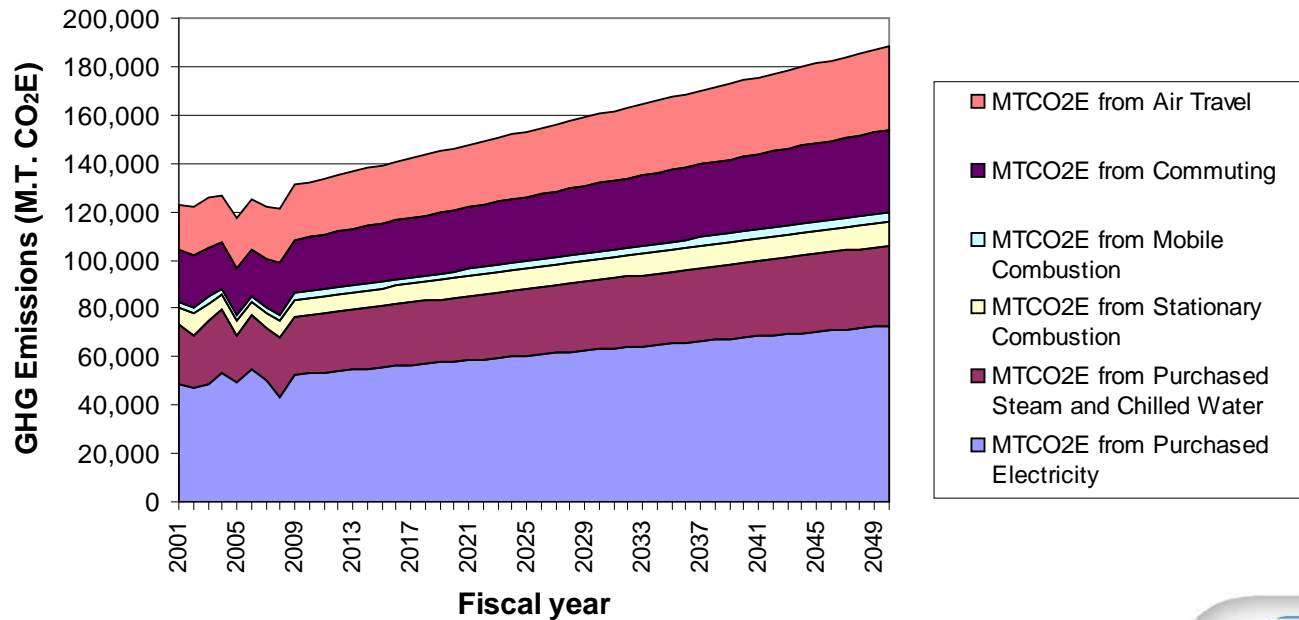
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GHG Emission Forecasting

- Business-as-usual
 - Trend analysis of historical data
 - Integration of institutional growth plan (increase in gross square footage) with baseline emission intensity (metric tons CO₂e per gross square footage)



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Goal Setting

- Set interim goals
 - To facilitate progress towards the long term goal, interim goals may be set to track progress in the near and short term
- Match regulatory goals
- Match scientific goals
 - Climate stabilization by mid to late 21st century
- Match feasibility goals
 - Set goals that are attainable through economically feasible emission reduction projects

Organization	Targeted Emissions Reduction (% below baseline level)	Target Year	Commitment Period*	Corresponding Annual Emissions Reduction (% per year below baseline level)
IPCC	25%	2020	19	1.3%
	80%	2050	49	1.6%
Global Warming Pollution Reduction Act	27%	2030	29	0.9%
	53%	2040	39	1.4%
	80%	2050	49	1.6%

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Carbon Mitigation

<i>Demand Side Management (Technology)</i>	<i>Demand Side Management (Behavior)</i>	<i>Supply Side Management</i>	<i>Offset Projects</i>
Smart Meters	Work-From-Home Programs	Fuel Switching	Forestry / Wetland Sequestration
LEED Certification	Behavioral Protocols for Equipment Idling	Combined Heat and Power	Green Space Conservation Easements
High Mileage Vehicles	Broadening Acceptable Temperature Range	Biofuel - Biodiesel, Ethanol	Geologic Sequestration
Green / Reflective Roofs	Commuter Incentives for Public Transportation	Landfill Gas	Chemical Sequestration
Efficient Lighting		Renewable Power - Solar Project Developer	
Insulation Repair		Purchasing RECs	
Energy Star Appliances			

Emission Reduction Projects

- Identification
 - Infrastructure improvements
 - Demand side
 - Supply side
 - Behavioral change
 - Conservation
 - Recycling/Reuse
 - Offsets
 - Renewable energy certificates
 - Carbon credits
- Relevance to NSRP “Lean” programs:
 - Potential synergies with existing programs?
 - Incorporation into future programs?



Emission Reduction Projects

- Prioritization
 - Economic criteria
 - Return on investment, life cycle cost, simple payback
 - Overall index - Cost per metric ton CO₂ reduced
 - Project portfolio - Bundle projects with high index and large reduction potential with projects with low index and lower reduction potential
 - Make business case to financial officer



Example Metric to Prioritize Opportunities

Data

- Upfront cost for enhanced equipment: \$80,000
- Annual energy savings:
 - Electricity: 96,580 kWh
 - Natural Gas: 4,082 therms

Assumptions

- Project lifetime: 15 years
- Discount rate: 6%
- Energy costs:
 - Electricity: \$0.11/kWh
 - Natural Gas: \$0.90/therm

\$ Calculation

NPV = Upfront cost + energy savings over lifetime of project

NPV = -80,000 + [(96,580 kWh * \$0.11/kWh) * NPV factor + (4082 therms * \$0.90/therm) * NPV factor]

Where NPV factor = $\frac{(1 + 0.06)^{15} - 1}{0.06 * (1 + 0.06)^{15}} = 9.71$

NPV = -\$80,000 + [(10,624 * 9.71) + (3674 * 9.71)] = -80,000 + (103,159 + 35,673) = \$58,832

This project will produce net savings over the lifetime of the project.

MTCO₂e Calculation

We assume emissions factors of 2755 kWh/MTCO₂e and 200 therms/MTCO₂e based on our inventory results.

MTCO₂e = (energy savings/year / emissions factor) * project lifetime in years

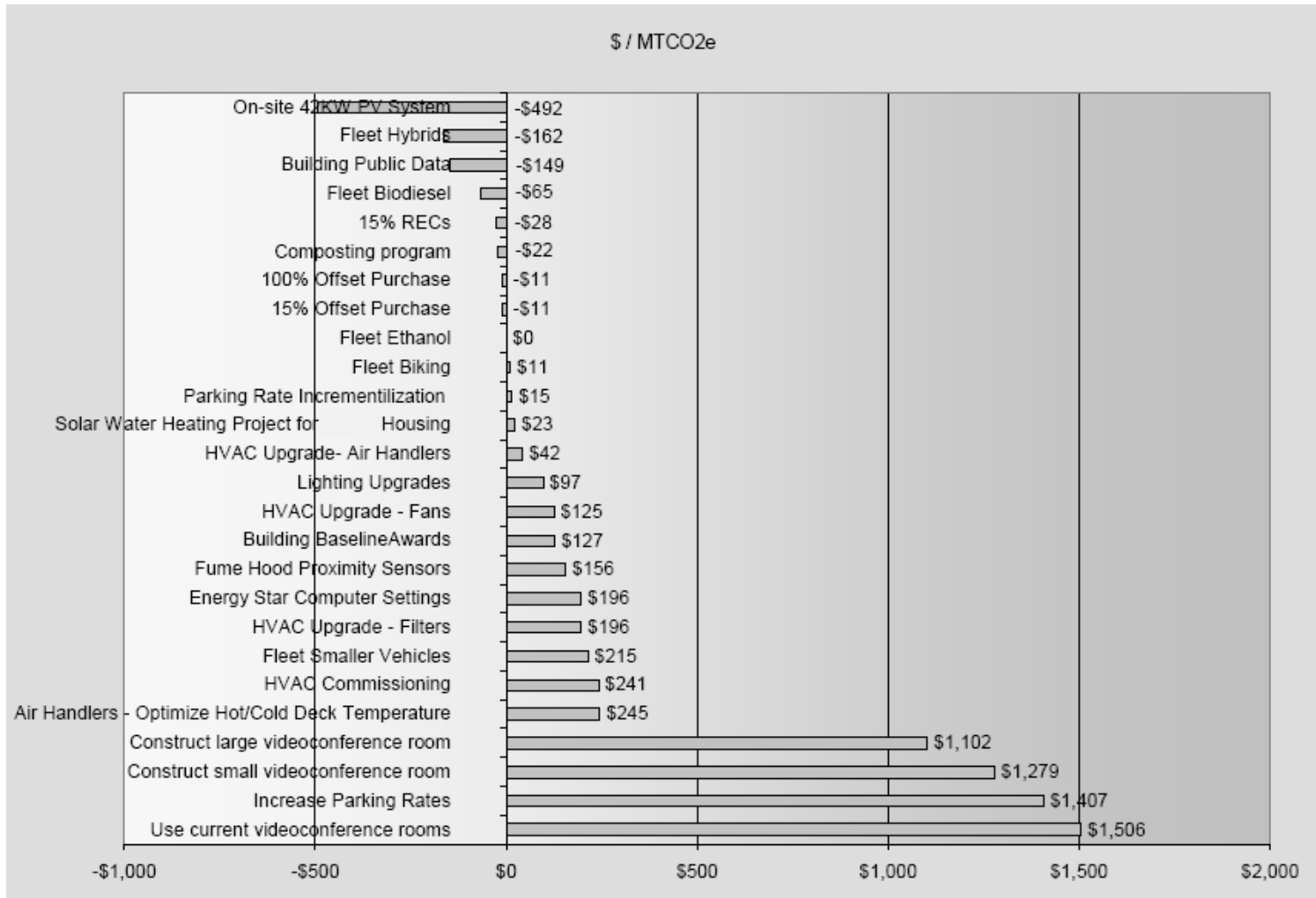
MTCO₂e = (96,580 kWh / 2755 kWh / MTCO₂e + 4082 therms / 200 therms / MT) * 15 years

MTCO₂e = (35 MTCO₂e + 20.4 MTCO₂e) * 15 = 832 MTCO₂e

\$/MTCO₂e Calculation = \$58,832 / 832 MTCO₂e = \$70.71/MTCO₂e

This number indicates the client should recoup a net present value of savings of \$70.7 per MTCO₂e reduced using this mechanism over the lifetime of the project.

Example Opportunity Ranking



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Communication

- Stakeholder presentations
- Annual reports
- Corporate disclosure questionnaires
- Track progress and periodically update plan



Conclusions

- Systematic approach to climate action
 - Baseline inventory
 - Forecasting
 - Goal Setting
 - Develop project portfolio
 - Make business case and communicate to stakeholders

Further information

<http://www.obg.com/GHG>

sinhap@obg.com, 215-628-9107 ext. 273

