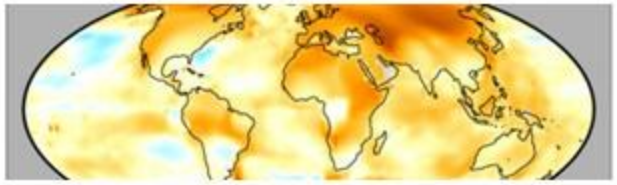


Carbon Disclosure Policy Approaches:
Lessons from the case of Carbon Monitoring for Action (CARMA.org)

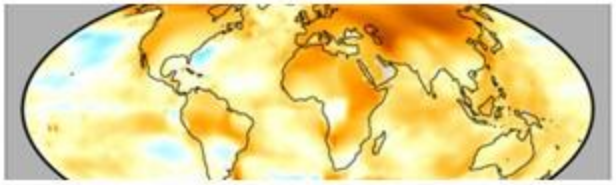
Shakeb Afsah, Performeks LLC, Bethesda, MD, USA

27 June, 2008 / EAERE 2008, Göteborg, Sweden

www.performeks.com

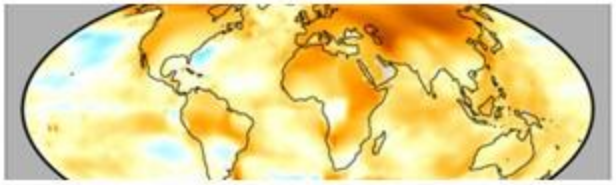
www.climatedataduediligence.org

Presentation Outline



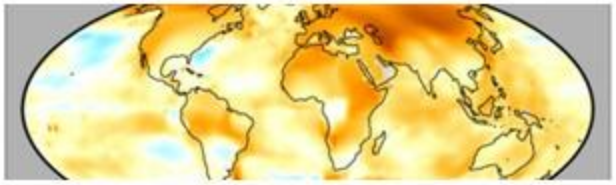
1. Review of Carbon Disclosure Initiatives
2. About Carbon Monitoring for Action (CARMA.org)
3. Origin of this Research – Audit and Verification of CARMA's CO2 Estimates
4. Carbon Disclosure Issues – Use of private data, regression model for CO2 estimates & debatable ranking methodology
5. Policy Lessons for Carbon Disclosure Initiatives

About Carbon Disclosure



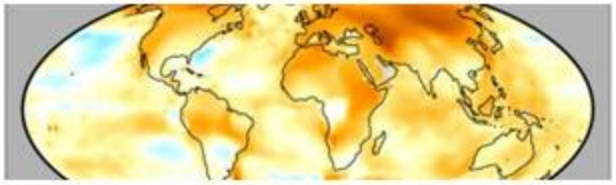
- **Act of disclosing information about CO2 emissions from a site or at a company level or other aggregates so that the public can evaluate comparative performance of emitters.**
- **Basic idea is to motivate emitters to reduce CO2 emissions through informational incentives and/or stakeholder pressure**
- **Origin of disclosure initiatives can be traced to the US Government's Toxic Release Inventory program (1986) or the industrial environmental ratings initiative of the Government of Indonesia (PROPER program 1995).**

About Carbon Disclosure



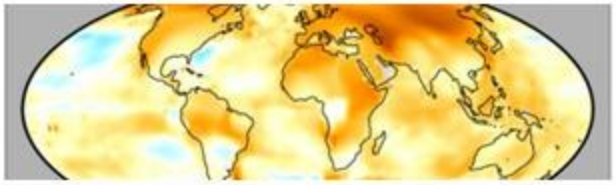
- **Empirical research shows that disclosure of environmental information (raw data or performance rating) leads to performance improvement.**
- **Carbon disclosure builds on this decade long research findings**
- **First published document on carbon disclosure dates back to 1998 ("*Disclosure in the Electricity Marketplace: A Policy Handbook for States*", Center for Clean Air Policy, March 1998)**
- **A recent publication on carbon disclosure is *"How to Reduce Greenhouse Gas Emissions Now,* Policy Brief Note #161-The Brookings Institution", Mary Graham and Elena Fagotto, June 2007.**

A Quick Review of Carbon Disclosure Initiatives



- **This presentation focuses on Direct CO2 Emissions from Stationary Sources**
- **Discussion covers nine disclosure initiatives**
- **Lessons and findings derived from the audit report of a popular climate initiative—Carbon Monitoring for Action (CARMA)—run by a prominent Washington DC think tank, the Center for Global Development (CGD).**

Various Carbon Disclosure Initiatives



Electricity Supplier Disclosure Label—US State level Initiative

4CE

Global Reporting Initiative™

CLIMATE LEADERS
U.S. Environmental Protection Agency

CARBON DISCLOSURE PROJECT

California Climate Action Registry

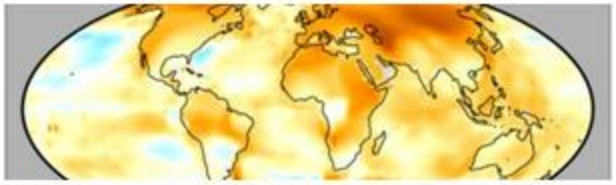
The Climate Registry

WWF

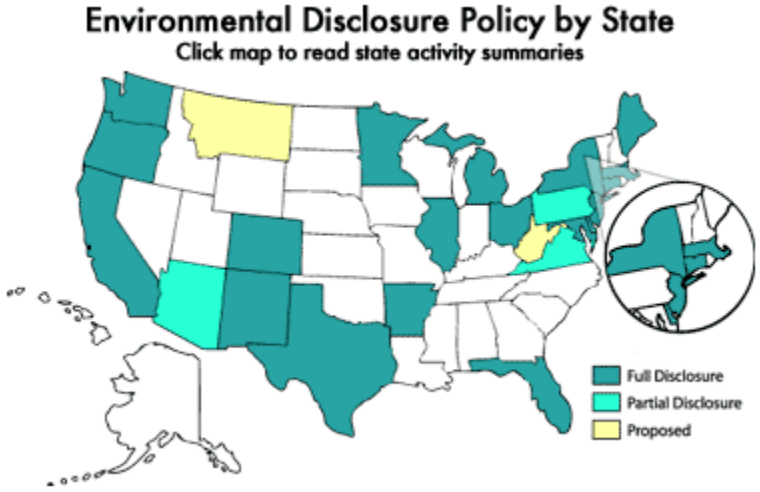
PowerSwitch! CAMPAIGN

CARMA
Carbon Monitoring for Action
carma.org

1. Environmental Disclosure Initiatives for Electricity Suppliers at the State level in US

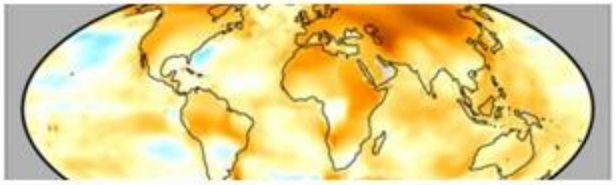


- **Main Goal: Inform consumers about fuel mix and environmental emissions including CO2, SOx and NOx**
- **Start Year: around 2000**
- **Coverage: Currently twenty one states have adopted full disclosure policies**
- **Methodology: IPCC greenhouse gas methodology using fuel consumption, a fuel-specific carbon coefficient, and the fuel-related fraction of carbon oxidized (same as the WRI / WBCSD GHG protocol)**



Source: http://www.eere.energy.gov/greenpower/markets/disclosure.shtml#me

1. Environmental Disclosure Initiatives for Electricity Suppliers—Disclosure Label Format



UNIFORM INFORMATION DISCLOSURE LABEL
for

Standard Offer Service provided by Energy Atlantic, LLC
(Meets or Exceeds Maine's 30% Renewable Requirement)

Residential & Small Commercial Class
August 2001

Generation Price:
Average price per kWh at different levels of use. Prices do not include regulated charges for customer service and delivery:

Ave. Use per Month	250 kWh	500 kWh	1000 kWh	2000 kWh	10,000 kWh	20,000 kWh	40,000 kWh
Ave. Price per kWh	4.089 ¢	4.089 ¢	4.089 ¢	4.089 ¢	4.089 ¢	4.089 ¢	4.089 ¢

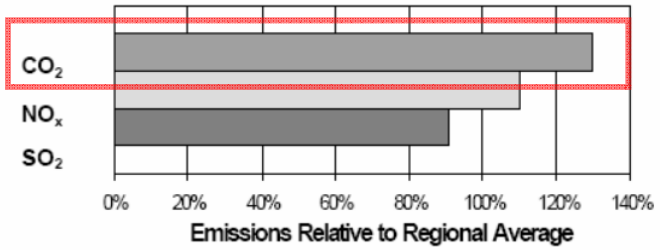
Power Sources:

Demand for this electricity product was assigned generation from the following sources:

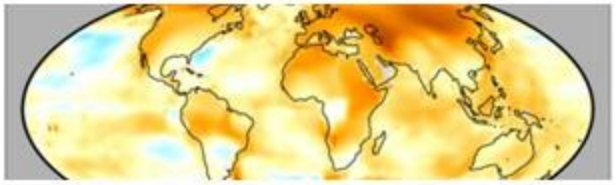
Biomass	14 %
Coal	13 %
Hydro	9 %
Nuclear	15 %
Natural Gas	13 %
Solar	0 %
Oil	26 %
Other Renewables	7 %
Wind	0 %
Municipal Trash	3 %

Air Emissions:

Carbon dioxide (CO_2), nitrogen oxide (NO_x), and sulphur dioxide (SO_2) emission rates from these sources, relative to the regional average:



2. Consumer Choice and Carbon Consciousness for Electricity (4CE)



4CE

An EU initiative, started in 2002 aims to label electricity suppliers so that consumers can make informed choices in the liberalized market.

ELECTRICITY LABEL

Product: Product name
Supplier: Supplier´s name
Phone: 0800 - xxxx xxxx
Website: www.supplier-website.com

Monthly electricity cost

For an annual consumption of	1.600 kWh e.g. single-household	2.500 kWh e.g. two-person-household	4.000 kWh e.g. four-person-household
your monthly electricity bill is (Prices as of: 01.01.02)	23,20 €	33,30 €	50,30 €

final prices incl. VAT

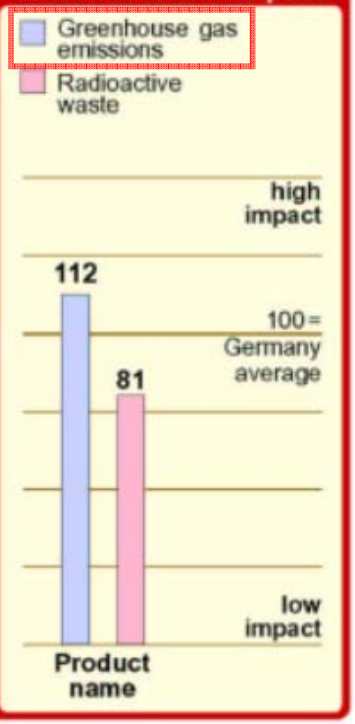
Minimum contract period: 3 months

Fuel mix

Your electricity is generated from the following fuel sources (percent):

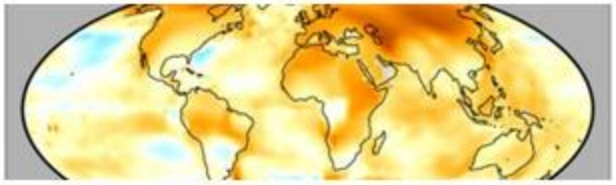
	Product name (2002)	for comparison: Germany average (2001)
Coal	61,0%	51,1%
Nuclear	25,0%	31,0%
Natural gas	4,5%	7,0%
Renewable energy	8,5%	7,5%
of which		
Hydroelectric	4,5%	3,5%
Wind	3,2%	3,2%
Biomass	0,8%	0,8%
Solar	<0,1%	<0,1%
Other renewable	<0,1%	<0,1%
Other energy sources	1,0%	3,4%

Environmental impact



Source: Öko-Institut 2002

3. Climate Leaders—USEPA



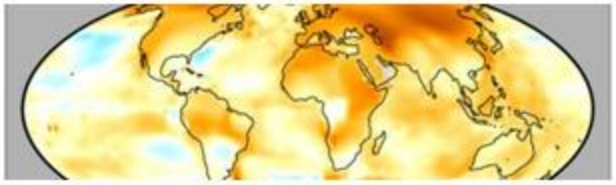
CLIMATE LEADERS
U.S. Environmental Protection Agency

Coverage: Since 2002, participation has increased to 191 Corporations covering various sectors including steel, pulp & paper and others.

Methodology: Based on WRI / WBCSD GHG Protocol; Companies are required to document emissions of the six major GHGs (CO2, CH4, N2O, HFCs, PFCs, and SF6) on a company-wide basis

Source: http://www.epa.gov/stateply/index.html

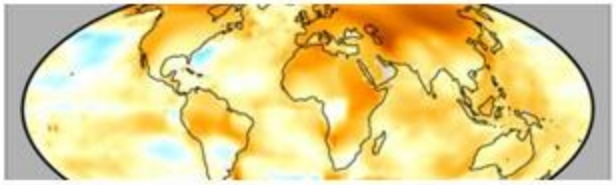
4. Corporate Environmental Reporting using Global Reporting Initiative (GRI) Framework



Voluntary disclosure of CO2 emissions data using the GRI protocol

- **Methodology: Based on WRI / WBCSD GHG Protocol**
- **Coverage: Several thousand companies world wide report CO2 emissions data**
- **Key Challenge: Difficult to do comparative analysis because of dispersed data**

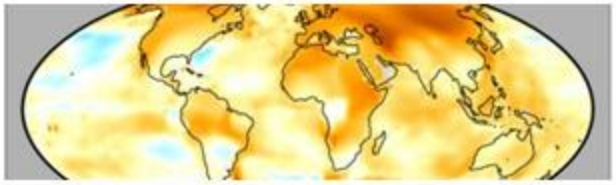
5. Carbon Disclosure Project-UK based



- **Methodology: WRI / WBCSD GHG Protocol**
- **Coverage: 3,000 corporations by 2008**
- **Key Features: As described on CDP's website,**
  - **Over 8 years CDP has become the gold standard for carbon disclosure methodology and process.**
  - **The CDP website is the largest repository of corporate greenhouse gas emissions data in the world.**
  - **CDP leverages its data and process by making its information requests and responses from corporations publicly available, helping catalyze the activities of policymakers, consultants, accountants and marketers.**

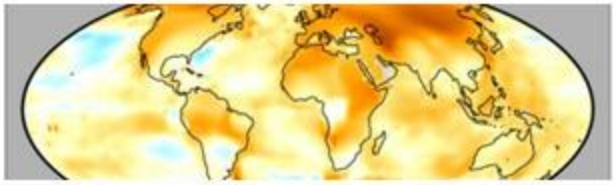
Source: http://www.cdproject.net/index.asp

6. California Climate Action Registry



- **<u>Implemented by</u>: A private non-profit group**
- **<u>Origin</u>: The California Climate Action Registry was formed in 2001 when a group of CEOs, who were investing in energy efficiency projects that reduced their organizations' greenhouse gas emissions, requested the state create a place to accurately report their greenhouse gas emissions history.**
- **<u>Coverage</u>: Only California based business entities; so far 344 members who pay annual subscription fee ranging from $600-$10,000 depending on the size of the private entity**
- **<u>Methodology</u>: Based on WRI / WBCSD GHG Protocol**

7. The Climate Registry



The Climate Registry

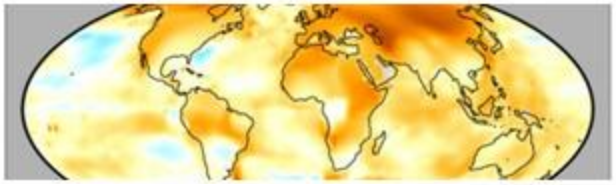
Create a common standard for measuring and tracking greenhouse gas emissions.

Standardize best practices in greenhouse gas emissions reporting. **The WRI/WBCSD GHG Protocol Corporate Standard** has already established internationally-recognized standards for greenhouse gas accounting at the entity-level.

Promote full and public disclosure of greenhouse gas emissions. The Registry will ensure that greenhouse gas emissions data is made available to the public through annual reports posted on the Registry's website.

Programs covers 39 US States, 7 Canadian Provinces, 6 Mexican States, 3 Native Tribes and the District of Columbia

8. Dirty Thirty-EU25 Power Plants



WWF PowerSwitch! CAMPAIGN

WWF International
Groβe Präsidentenstr. 10
10178 Berlin
Germany

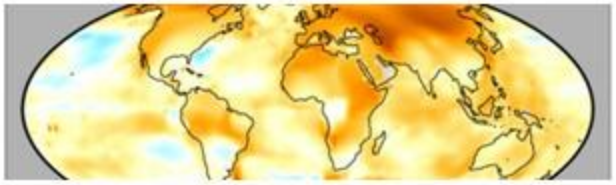
Tel.: +49-30-308742-0
Direkt: -21
Fax: +49-30-308742-50
teriete@wwf.de
www.panda.org

Dirty Thirty – Europe's worst climate polluting power stations

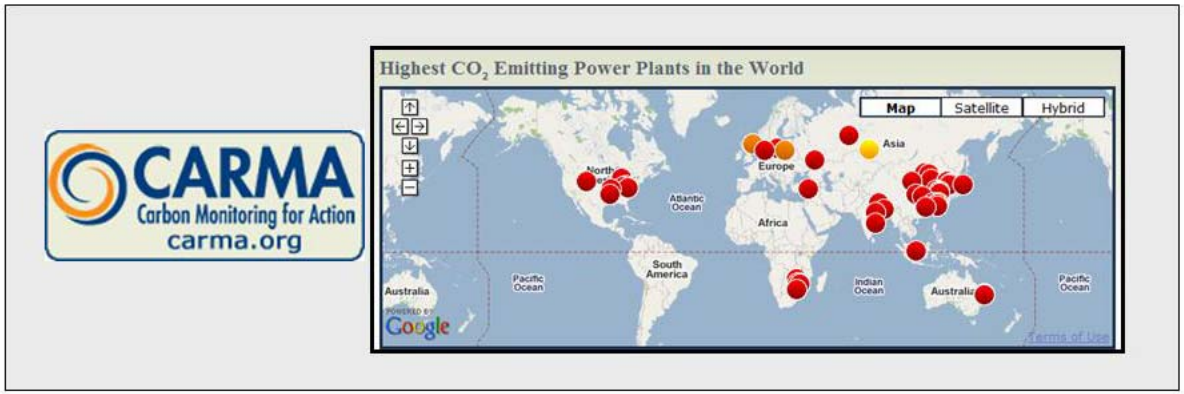
Rank	Name	Country	Fuel	Commissioning Date	Parent Company	Relative Emissions[1]
1	Agios Dimitrios	Greece	Lignite	1984-1986, 1997	DEH	1.350
2	Frimmersdorf	Germany	Lignite	1957-1970	RWE	1.270
3	Aboño	Spain	Hard coal	1974 & 1985	Hidrocantábrico	1.270
4	Kardia	Greece	Lignite	1975, 1980-1981	DEH	1.250
5	Jänschwalde	Germany	Lignite	1976-1989	Vattenfall	1.200
6	Weisweiler	Germany	Lignite	1955-1975	RWE	1.180
7	Neurath	Germany	Lignite	1972-1976	RWE	1.150

- **Methodology: Based on EU Directive for monitoring and verification**
- **Coverage: Top thirty power plants**
- **Key Feature: Ranks based on carbon intensity (gms / kwh)**
- **Source:http://assets.panda.org/downloads/european_dirty_thirty_may_2007.pdf**

8. Carbon Monitoring for Action-CARMA.org

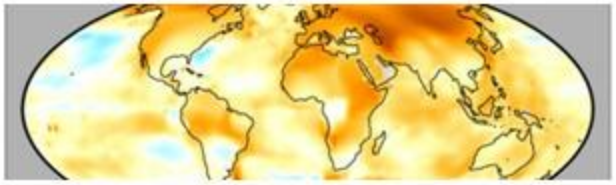


- **A ranking system for power plants based on the annual estimates of total CO2 emissions.**



- **CO2 emissions of individual power plants are calculated using regression equations developed by CARMA**
- **CARMA was launched on 14 Nov, 2007 and it disclosed the relative ranks of 50,000 power plants.**
- **CARMA also ranked countries, and the US States, counties and congressional districts**

CARMA's Methodology



- **The CO2 emissions of 22,417 plants are estimates** based on a regression analysis of 2,469 CO2-emitting facilities in the US.
- **The power production for 47,302 plants are estimates** derived from the actual data of 3,869 power plants in the US and 202 in India. The estimation process consists of the following 5-steps:

  1. Estimate capacity factors using a regression analysis based on US facilities

  2. Multiply estimated capacity factors by World Electric Power Plant Database (WEPP) /Platts reported operational plant capacities

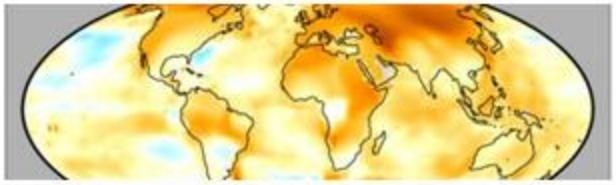
  3. Combine estimated and reported power to obtain total power production by energy source for each country

  4. For each energy source, divide the total by the corresponding total from the US Energy Information Agency to obtain an adjustment factor

  5. For each country and energy source, multiply each estimated power output by the relevant adjustment factor (if the power output isn't publicly-reported)

- A plant's **power production** in megawatt-hours (MWh) is the product of its capacity factor (% of potential capacity actually used), its capacity (MW), and its potential operating hours per year (usually 24 * 365 = 8,760). **Emissions intensity** for each plant is calculated by dividing CO2 emissions by power production.

CARMA's Methodology: Detailed Description



Center for Global Development

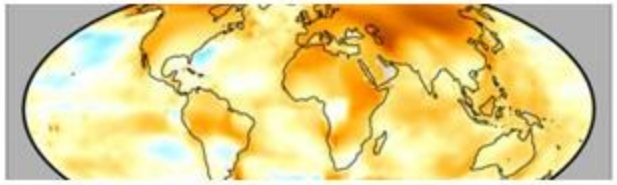
Working Paper Number 145
May 2008

Calculating CARMA: Global Estimation of CO2 Emissions from the Power Sector

By David Wheeler and Kevin Ummel

Download from: http://cgdev.org/content/publications/detail/16101

CO2 Estimation Methodology Comparison



Methodology: Based on WRI / WBCSD GHG Protocol & EU Directive

CLIMATE LEADERS
U.S. Environmental Protection Agency

4CE

Global Reporting Initiative

Electricity Supplier Disclosure Label—US State level Initiative

CARBON DISCLOSURE PROJECT

California Climate Action Registry

The Climate Registry

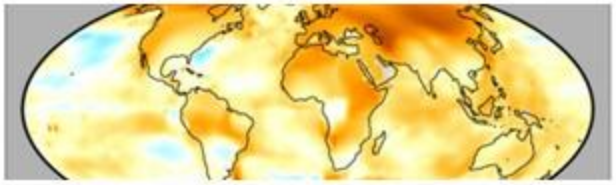
WWF

PowerSwitch! CAMPAIGN

Methodology: Based on regression estimates

CARMA
Carbon Monitoring for Action
carma.org

CARMA attracted considerable public attention



The New York Times

AP Associated Press

Greenwire

AFP .COM

BBC

The Washington Post

REUTERS

CNN

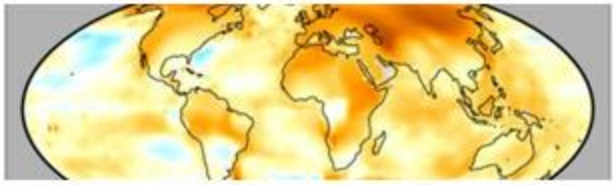
Bloomberg

Environment News Service
international Daily Newswire Since 1990 We Cover the Earth for You

CARMA received 358 media citations between 14-20 Nov, 2008.

Source: The Center for Global Development, Washington DC based think tank that runs CARMA

Data quality concerns about CARMA surfaced immediately



INTERNATIONAL
Herald Tribune | Asia - Pacific

iht.com Business Culture Sports Opinion

AMERICAS EUROPE ASIA/PACIFIC AFRICA/MIDDLE EAST | TECH/MEDIA STYLE HEALTH

TRAVEL PROPERTIES BLOGS DISCUSSIONS SPECIAL REPORTS AUDIONEWS

Hong Kong company says database got it wrong on CO2 emissions

The Associated Press Published: November 16, 2007

E-Mail Article
Listen to Article
Printer-Friendly
3-Column Format
Translate
Share Article
Text Size

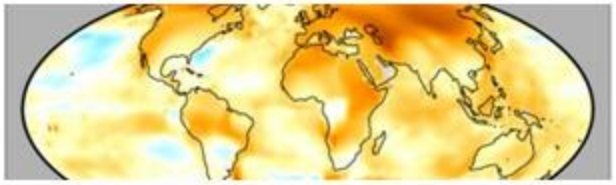
HONG KONG: U.S. researchers who listed a Hong Kong power plant as Asia's third worst polluter have agreed to retract the claim after it was found they used inaccurate data, the operator of the plant and the researchers said Friday.

The newly launched Carbon Monitoring for Action database said the coal-fired Castle Peak power plant spewed out 35.8 million tons of heat-trapping carbon dioxide a year, making it the third biggest emitter of the greenhouse gas in Asia.

But China Light and Power, the company that operates the plant, said the data was wrong, citing its own independently audited reports that put carbon dioxide emissions at 13.3 million metric tons (14.7 million U.S. tons) for 2006, well under half the amount cited in the database.

Researchers at the Washington-based Center for Global Development, which directed the global database of carbon emissions, had agreed to amend the data, CLP spokesman Carl Kitchen said.

Others raised concerns about CARMA too



A spokeswoman for NSW Energy Minister Ian Macdonald said: "The US study has utilised a number of assumptions, some of which are highly questionable.

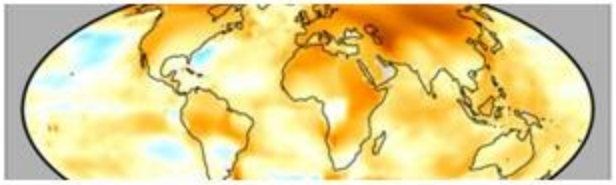
"For example, the quoted tonnes are inaccurate because they are based on capacity only and ignore actual generation, fuel type and efficiency.

"Simply using the size of a power plant is not appropriate for comparing rates of emissions.

"The study also appears to have assumed how the power stations operate, rather than researching the actual operation data."

Source: AFP / 15 November, 2007 / Reporter: **Ilya Gridneff**
Website: http://www.news.com.au/heraldsun/story/0,21985,22764722-5005961,00.html

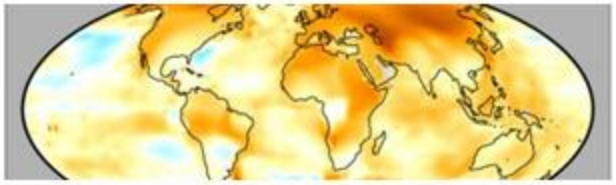
Verification of CARMA became important



Basic Methodology for Verification:

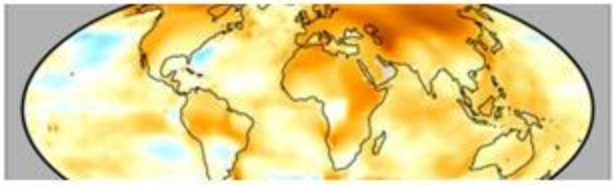
- **Compare CARMA's estimates with the USEPA's data on CO2 emissions, carbon intensity and energy output.**
- **Use USEPA's power plant level data from the Clean Air Markets Division (CAMD) online database for emissions trading program.**
- **Check if the ranks and CO2, carbon intensity and energy output numbers match**
- **Find patterns in the differences between CARMA and USEPA's data**
- **Make policy recommendations**

Comparison of top-12 emitters: Accuracy level -- 4 / 12 correct (33%)



CARMA's Dirty Dozen-2007	USEPA Top 12 Emitters-2007
1. The Scherer plant in Juliet, GA	1. Scherer plant, GA
2. The Miller plant in Quinton, AL	2. James H Miller Jr, AL
3. The Bowen plant in Cartersville, GA	3. Bowen plant, GA
4. The Gibson plant in Owensville, IN	4. Gibson plant, IN
5. The W.A. Parish plant in Thompsons, TX	5. Martin Lake plant, TX
6. The Navajo plant in Page, AZ	6. W A Parish plant, TX
7. The Martin Lake plant in Tatum, TX	7. Monroe plant, MI ★
8. The Cumberland plant in Cumberland City, TN ★	8. Navajo Generating Station, AZ
9. The Gavin plant in Cheshire, OH	9. Colstrip plant, MT ★
10. The Sherburne County plant in Becker, MN ★	10. Gen J M Gavin plant, OH
11. The Bruce Mansfield plant in Shippingport, PA ★	11. Labadie plant, MO ★
12. The Rockport plant in Rockport, IN ★	12. Monticello plant, TX ★

Rank accuracy declines rapidly in the next dozen: Accuracy level -- 1 / 12 correct (8%)



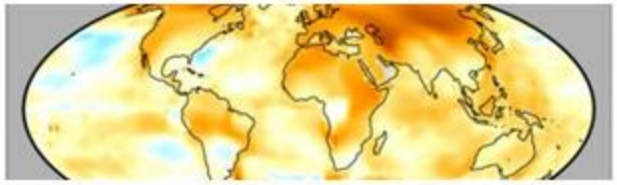
CARMA's List

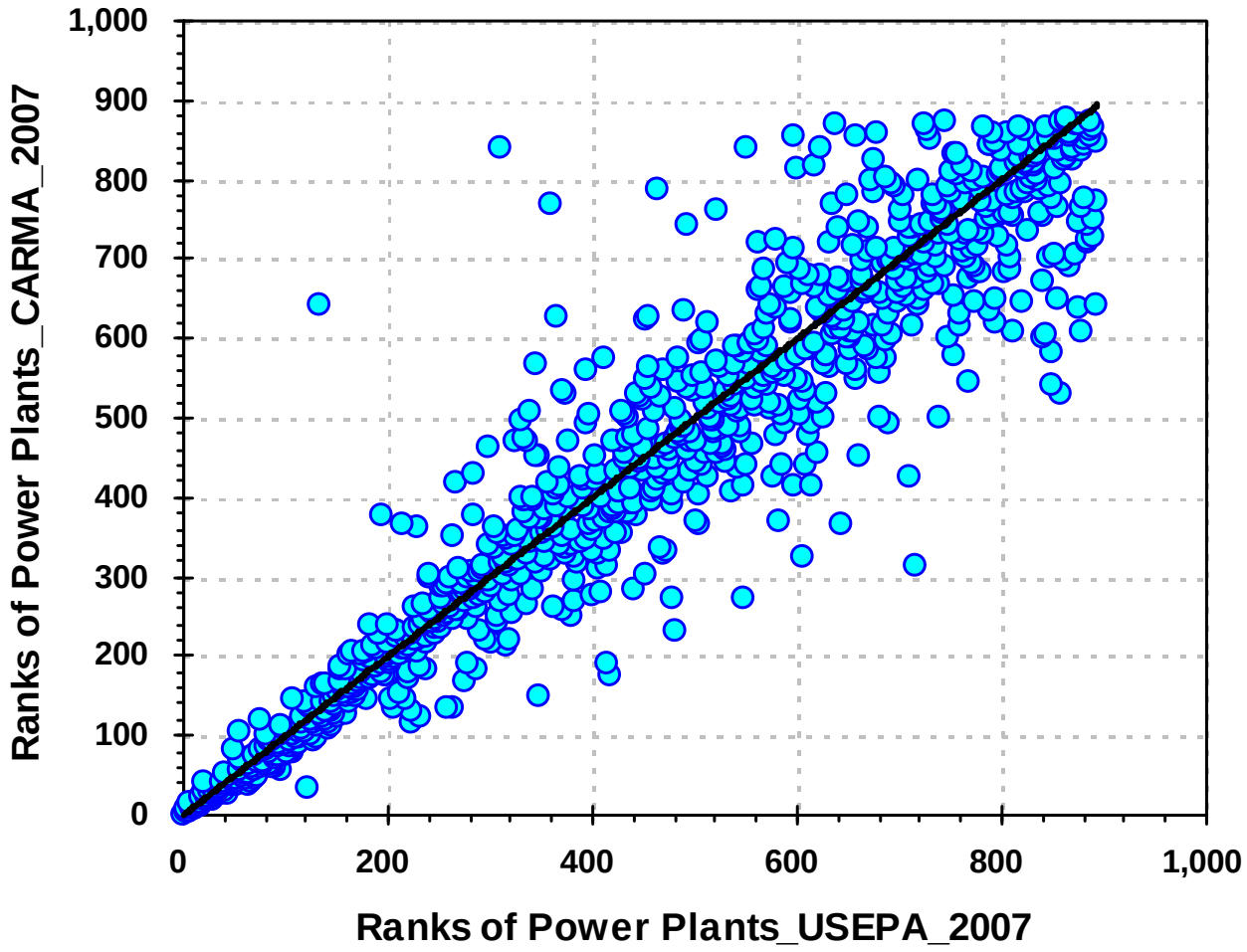
	State	County	CARMA_Name
CARMA's Top Dozen	Georgia	Monroe	SCHERER
	Alabama	Walker	MILLER
	Georgia	Bartow	BOWEN
	Indiana	Gibson	GIBSON
	Texas	Fort Bend	WA PARISH
	Arizona	Coconino	NAVAJO
	Texas	Rusk	MARTIN LAKE
	Tennessee	Stewart	CUMBERLAND (TN)
	Ohio	Gallia	GAVIN
	Minnesota	Sherburne	SHERBURNE COUNTY
	Pennsylvania	Beaver	BRUCE MANSFIELD
	Indiana	Spencer	ROCKPORT (IN)
CARMA's 2nd Dozen	Wyoming	Sweetwater	JIM BRIDGER
	Missouri	Franklin	LABADIE
	Kansas	Pottawatomie	JEFFREY
	Texas	Titus	MONTICELLO (TX)
	Utah	Millard	INTERMOUNTAIN
	Michigan	Monroe	MONROE (MI)
	West Virginia	Kanawha	JOHN E AMOS
	Florida	Citrus	CRYSTAL RIVER 4&5
	North Carolina	Person	ROXBORO ★
	South Carolina	Berkeley	CROSS ★
	New Mexico	San Juan	FOUR CORNERS
	Kentucky	Muhlenberg	PARADISE ★

USEPA's List

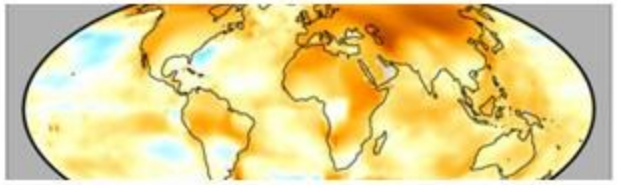
EPA_Name	State	EPA_County
Scherer	GEORGIA	Monroe
James H Miller Jr	ALABAMA	Jefferson
Bowen	GEORGIA	Bartow
Gibson	INDIANA	Gibson
Martin Lake	TEXAS	Rusk
W A Parish	TEXAS	Fort Bend
Monroe	MICHIGAN	Monroe
Navajo Generating Station	ARIZONA	Coconino
Colstrip ★	MONTANA	Rosebud
Gen J M Gavin	OHIO	Gallia
Labadie	MISSOURI	Franklin
Monticello	TEXAS	Titus
Sherburne County	MINNESOTA	Sherburne
Cumberland	TENNESSEE	Stewart
John E Amos	WEST VIRGINIA	Putnam
Bruce Mansfield	PENNSYLVANIA	Beaver
Jeffrey Energy Center	KANSAS	Pottawatomie
Jim Bridger	WYOMING	Sweetwater
Crystal River	FLORIDA	Citrus
Intermountain	UTAH	Millard
W H Sammis ★	OHIO	Jefferson
Rockport	INDIANA	Spencer
Four Corners Steam ElecSt	NEW MEXICO	San Juan
Laramie River ★	WYOMING	Platte

Rank difference worsens for smaller power plants





Rank of US States differ too

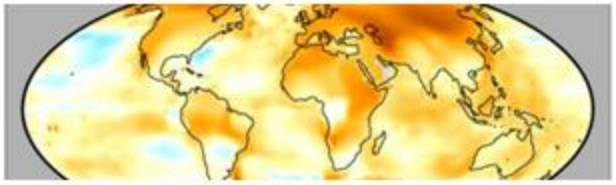


CARMA's State Aggregates for CO2 Differ from USEPA's Results

Rank	States	Annual CO2 Emissions (tons)				Rank Comparison		
		USEPA-2007	CARMA-2007	Diff. %		USEPA	CARMA	
1.	TEXAS	261,798,527	289,729,984	-10.67%	??	1	1	
2.	OHIO	138,567,583	133,183,312	3.89%		2	5	??
3.	FLORIDA	134,583,091	156,889,198	-16.57%	??	3	2	
4.	INDIANA	132,388,691	137,319,341	-3.74%		4	3	
5.	PENNSYLVANIA	123,583,664	135,559,129	-9.69%		5	4	
6.	ILLINOIS	109,014,988	113,276,473	-3.91%		6	6	
7.	KENTUCKY	101,784,838	98,280,596	3.44%		7	7	
8.	GEORGIA	100,759,051	91,514,885	9.17%		8	8	
9.	ALABAMA	94,803,674	90,686,002	4.34%		9	10	
10.	WEST VIRGINIA	90,888,457	88,614,338	2.48%		10	11	
11.	MISSOURI	80,383,505	82,525,517	-2.66%		11	12	
12.	MICHIGAN	78,841,977	91,466,505	-16.01%	??	12	9	??
13.	NORTH CAROLINA	77,650,779	77,642,409	0.01%		13	14	
14.	ARIZONA	66,426,202	64,534,089	2.85%		14	16	
15.	TENNESSEE	63,711,756	63,397,876	0.49%		15	17	
16.	OKLAHOMA	51,548,849	57,088,840	-10.75%	??	16	19	??
17.	WISCONSIN	50,175,431	54,831,774	-9.28%		17	20	??
18.	WYOMING	49,954,054	45,799,988	8.32%		18	24	??
19.	NEW YORK	49,572,620	69,585,841	-40.37%	??	19	15	??
20.	LOUISIANA	47,548,400	61,044,651	-28.38%	??	20	18	
21.	COLORADO	46,961,973	47,143,630	-0.39%		21	23	
22.	SOUTH CAROLINA	46,472,992	52,469,777	-12.90%	??	22	21	
23.	IOWA	43,925,814	38,762,831	11.75%	??	23	28	??
24.	KANSAS	42,987,499	43,570,537	-1.36%		24	25	
25.	CALIFORNIA	42,883,382	79,184,048	-84.60%	??	25	13	??
26.	UTAH	42,177,274	41,899,804	0.66%		26	27	
27.	MINNESOTA	39,927,878	43,440,885	-8.80%		27	26	
28.	VIRGINIA	37,999,833	49,739,380	-30.89%	??	28	22	??
29.	NORTH DAKOTA	34,879,303	37,855,820	-8.58%		29	29	
30.	ARKANSAS	32,721,245	35,380,256	-8.13%		30	30	

CARMA ranks California at 13, but USEPA sets it at 25. Similarly Michigan ranks at 9 by CARMA but 13 by USEPA. Which ranking is right?

Ranks of US counties differ also



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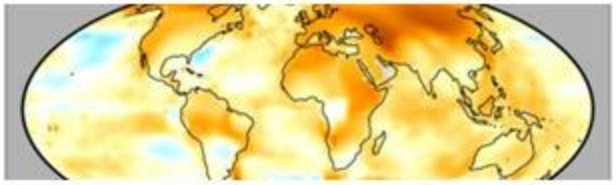
Comparison of County Level CO2 Emissions by Power Plants-2007

	Source: USEPA 2007			Source: CARMA 2007		
Rank	County	State	CO2 (tons)	County	State	CO2 (tons)
1	Titus	TEXAS	30,098,598	Walker	Alabama	28,857,516
2	Monroe	GEORGIA	27,259,555	San Juan	New Mexico	28,475,352
3	San Juan	NEW MEXICO	27,219,562	Harris	Texas	27,981,992
4	Jefferson	OHIO	26,275,972	Gallia	Ohio	26,026,299
5	Gallia	OHIO	25,998,806	Monroe	Georgia	25,302,608
6	Indiana	PENNSYLVANIA	25,701,906	Indiana	Pennsylvania	24,546,125
7	Jefferson	ALABAMA	23,708,510	Jefferson	Ohio	24,222,748
8	Rusk	TEXAS	23,553,669	Kern	California	22,154,254
9	Monroe	MICHIGAN	23,508,562	Berkeley	South Carolina	21,827,904
10	Bartow	GEORGIA	23,243,818	Rusk	Texas	21,342,328
11	Gibson	INDIANA	22,409,315	Fort Bend	Texas	21,322,516
12	Fort Bend	TEXAS	22,161,715	Citrus	Florida	21,158,830

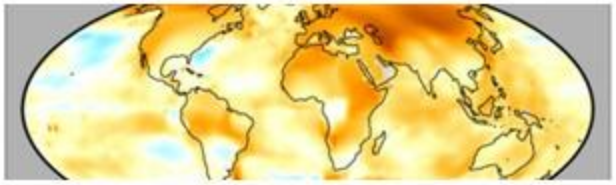
Ranking power plants on the basis of their size produces more accurate results than CARMA

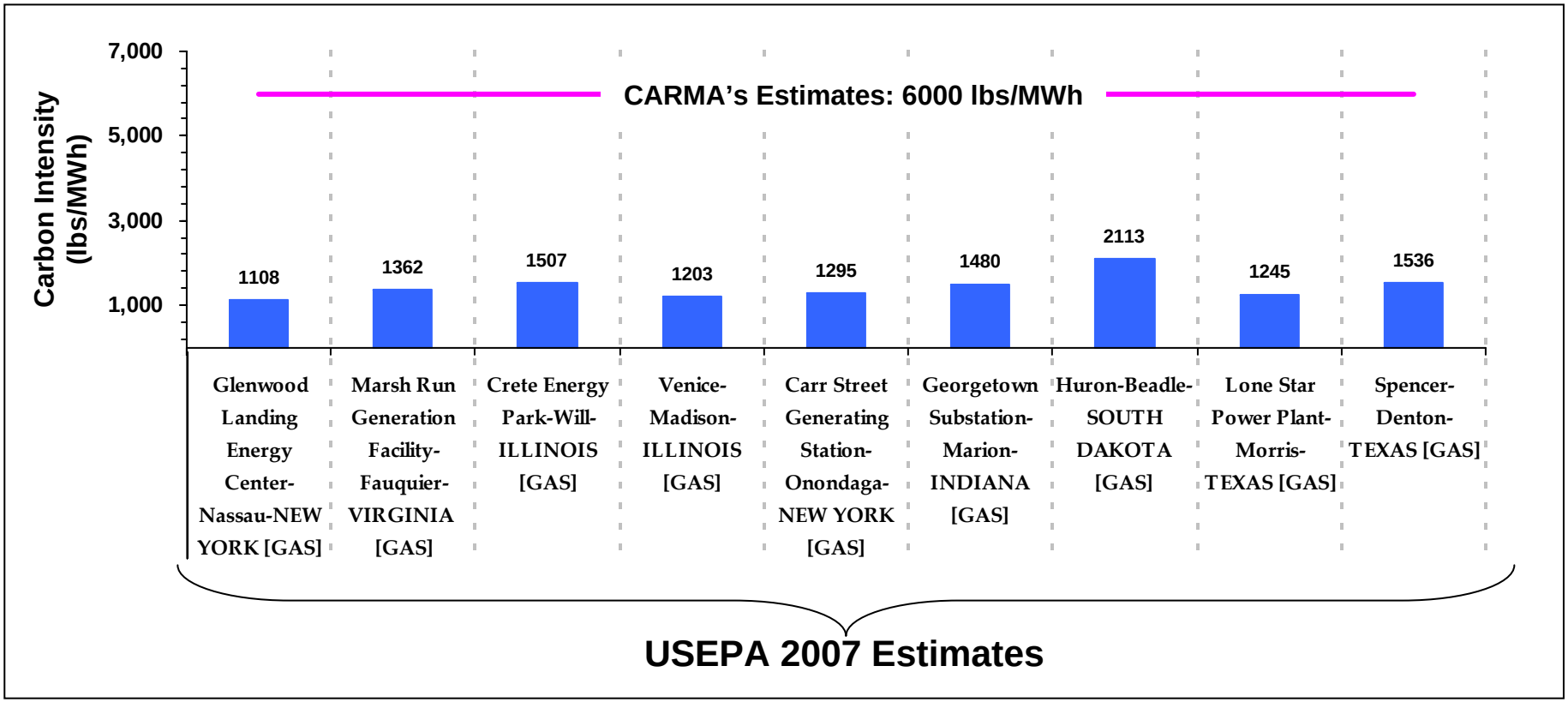


Weak Predictive Ability of CARMA's Model

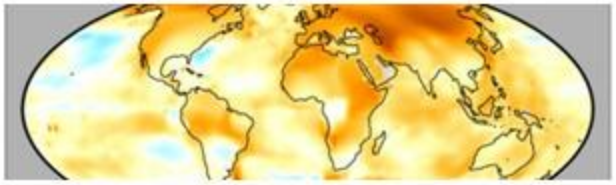
Indicators	Based on CARMA's model	Based on simple ranking of annual energy output	Remarks
Number of power plants with identical rank in USEPA's CO2 estimates	15 of 894 (1.7%)	22 of 894 (2.5%)	This shows that the CO2-emissions ranking of power plants, based solely on their energy output, is nearly 1.5 times more accurate than CARMA's estimation model
Number of power plants within ± 5 ranks, compared to USEPA's CO2 estimates	103 of 894 (11.5%)	189 of 894 (21%)	
Number of power plants within ± 10 ranks, compared to USEPA's CO2 estimates	206 of 894 (23%)	299 of 894 (33%)	
Number of power plants within ± 15 ranks, compared to USEPA's CO2 estimates	273 of 894 (30.5%)	408 of 894 (46%)	

Illogical Results—Gas based power plants show carbon intensity of 6000 lbs/MWh (2722 kg/MWh)



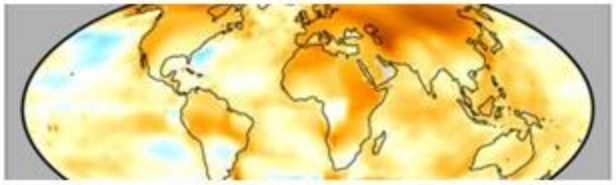


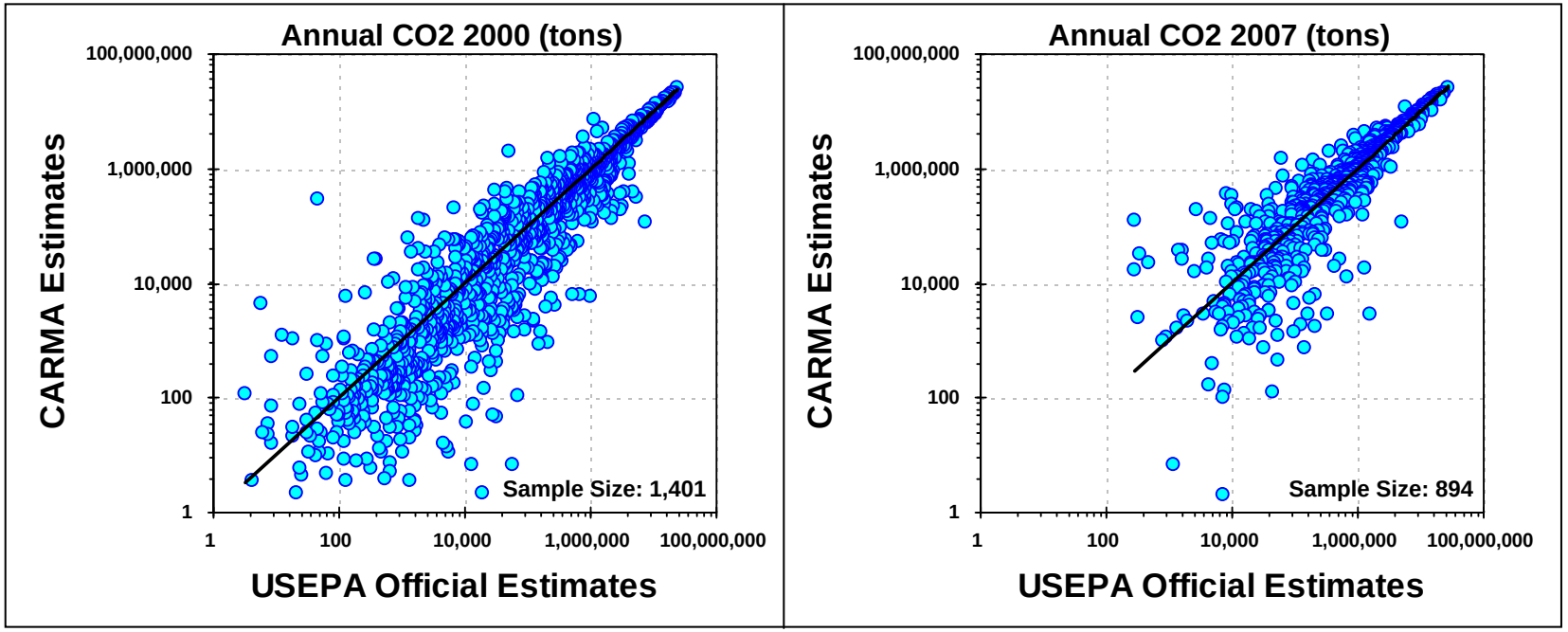
Other Unexplainable results in CARMA



- **Baseload coal fired plants had carbon intensity of 815 lbs/MWh (370 kg/MWh)—such values, which are lower than gas based power plants raise questions about CARMA's accuracy**
- **CARMA's estimates of energy output exceeded generation capacity of power plants**

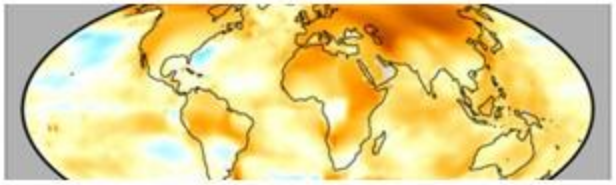
There appeared to be a pattern to the differences between CARMA and USEPA's numbers

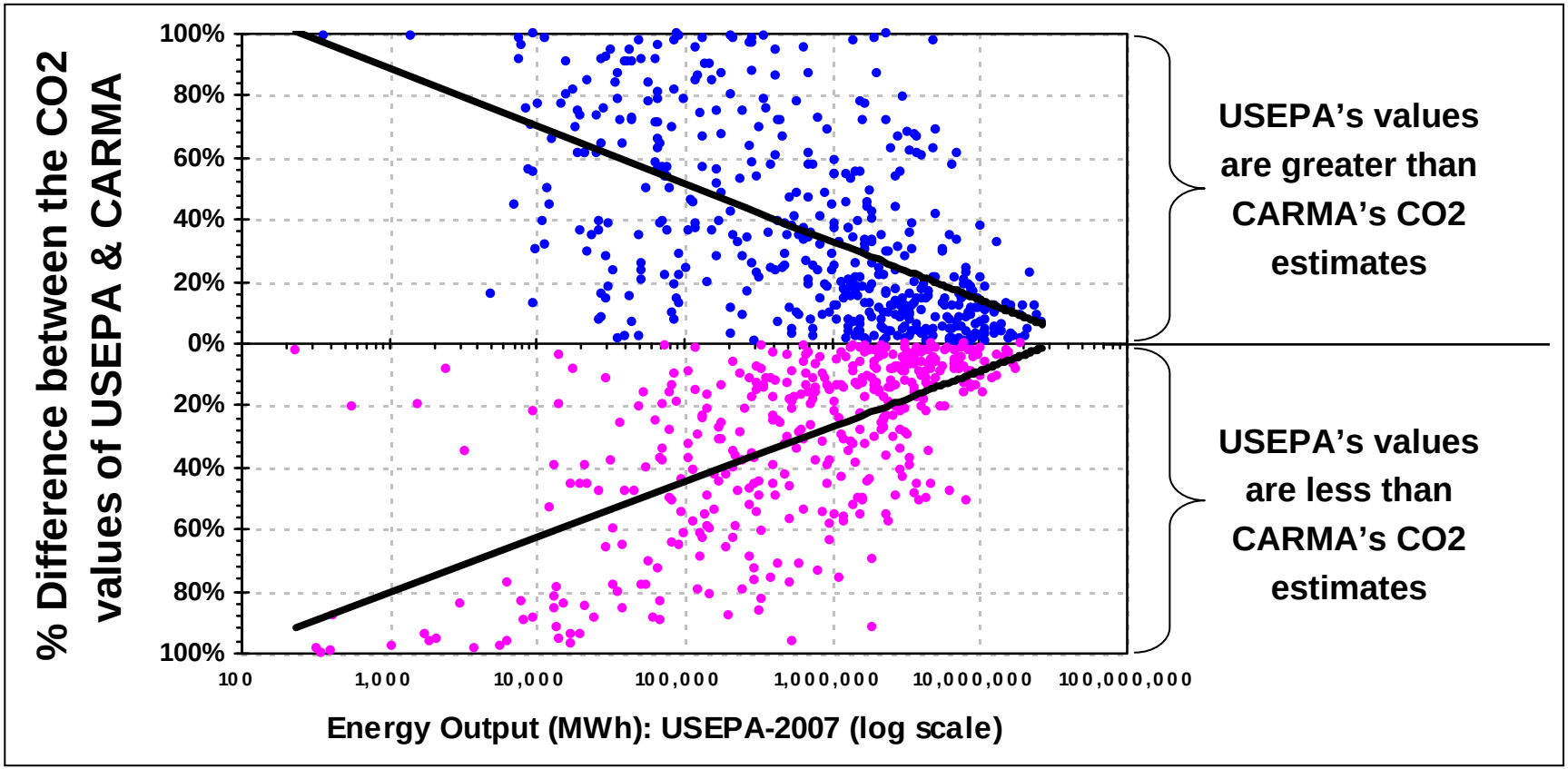




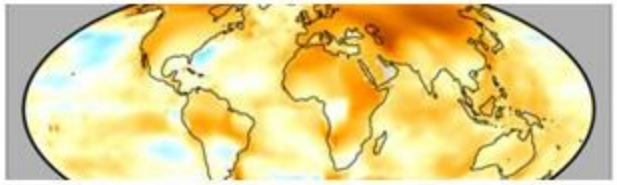
Both axes in log scale

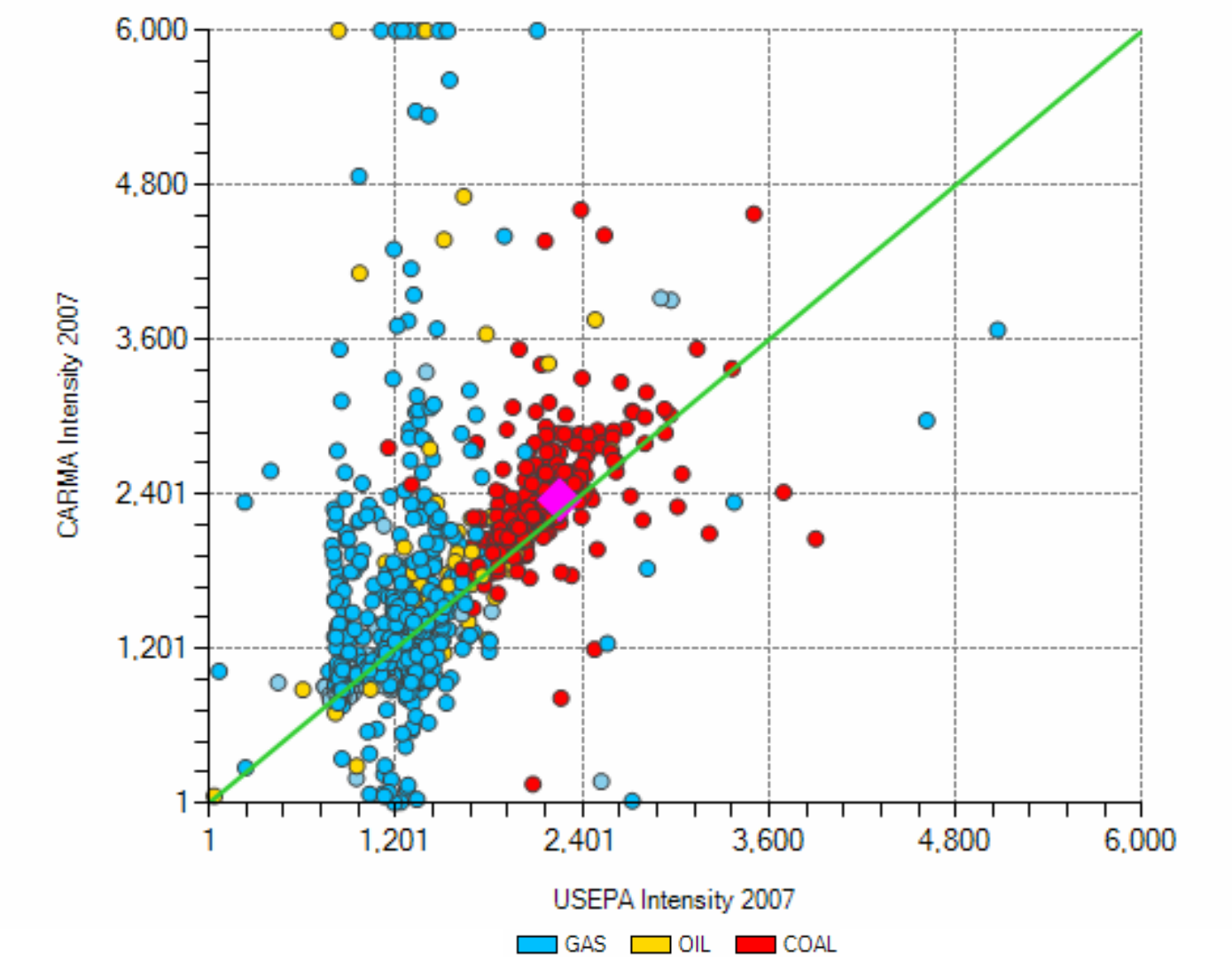
CARMA's errors are related to the size of power plants



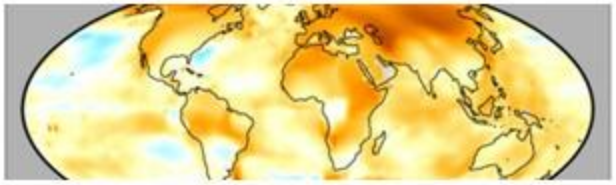


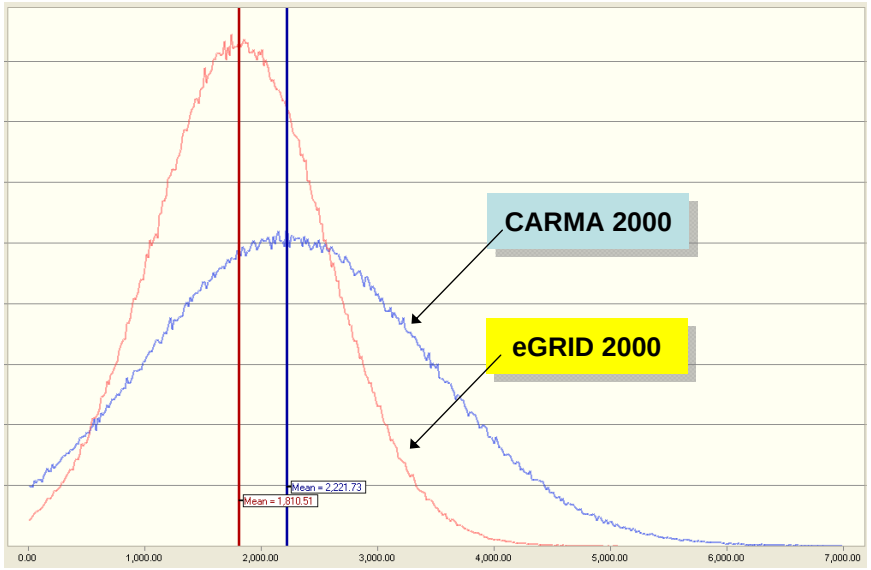
Poor Correlation Between CARMA and USEPA Carbon Intensity

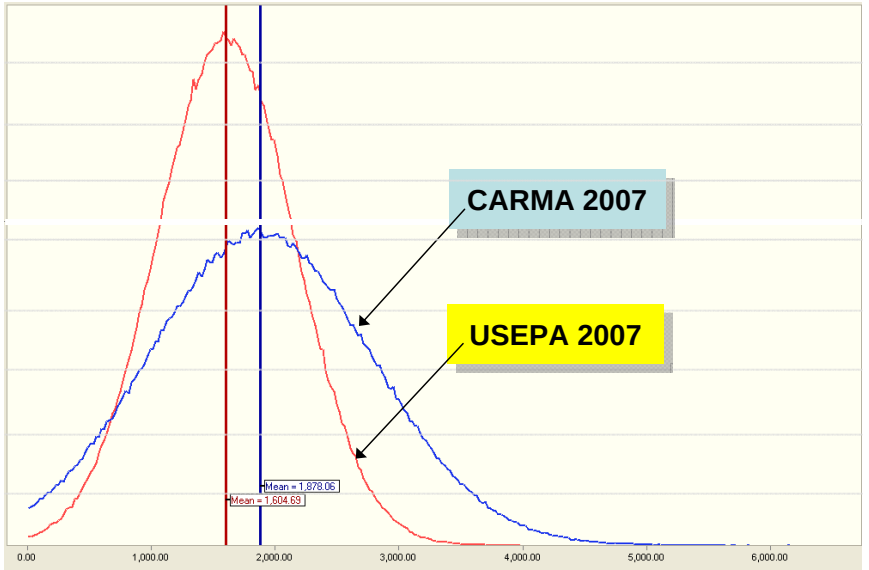




CARMA's estimates of carbon intensity is biased upwards







CARMA's estimate is on average higher than USEPA's average by around 23% in 2000, and 17% in 2007.

Carbon intensity is differences are higher for natural gas plants

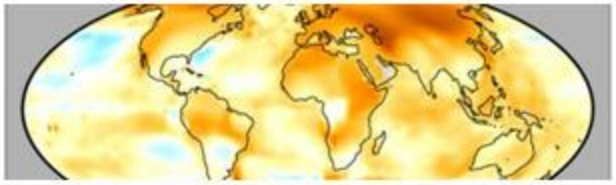
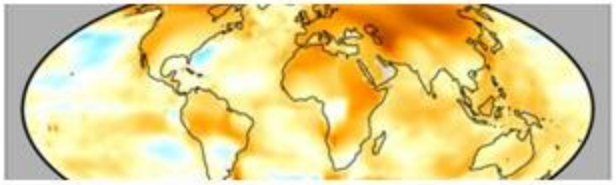
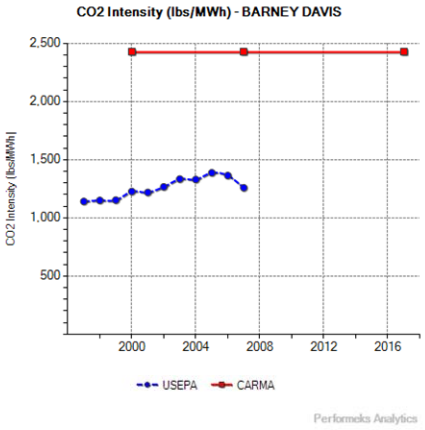
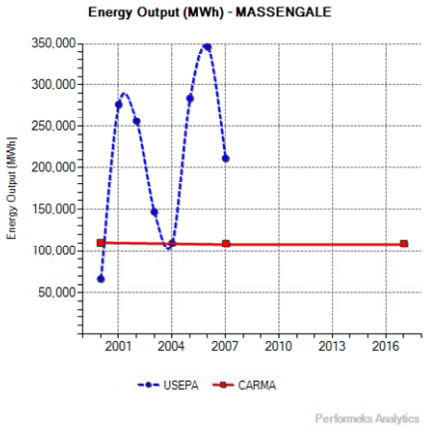


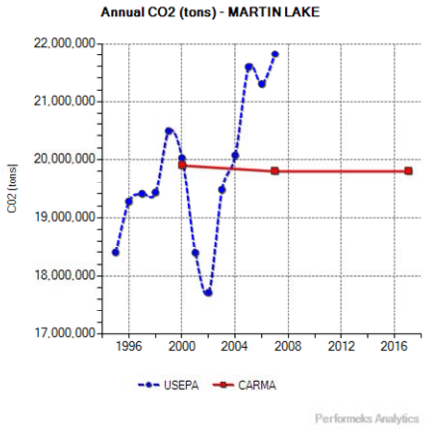
Table 2: Peer Group Comparison					
2007 Data (CAMD-USEPA and CARMA)					
Fuel Category	Peer Group-Capacity	Sample Size	USEPA Avg. Intensity	CARMA Avg. Intensity	% Difference
COAL	<100 MW	21	2,593	2,822	-9%
COAL	100-500 MW	103	2,210	2,500	-13%
COAL	500-1000 MW	85	2,070	2,272	-10%
COAL	> 1000 MW	122	2,015	2,101	-4%
GAS	<100 MW	64	1,327	1,592	-20%
GAS	100-500 MW	194	1,370	1,681	-23%
GAS	500-1000 MW	149	1,173	1,542	-31%
GAS	> 1000 MW	56	1,171	1,510	-29%
2000 Data (eGRID-USEPA and CARMA)					
Fuel Category	Peer Group-Capacity	Sample Size	USEPA Avg. Intensity	CARMA Avg. Intensity	% Difference
COAL	<100 MW	89	2,326	3,730	-60%
COAL	100-500 MW	132	2,346	2,657	-13%
COAL	500-1000 MW	86	2,245	2,349	-5%
COAL	> 1000 MW	109	2,190	2,080	5%
GAS	<100 MW	360	1,389	2,059	-48%
GAS	100-500 MW	200	1,373	1,694	-23%
GAS	500-1000 MW	66	1,279	1,473	-15%
GAS	> 1000 MW	27	1,256	1,510	-20%

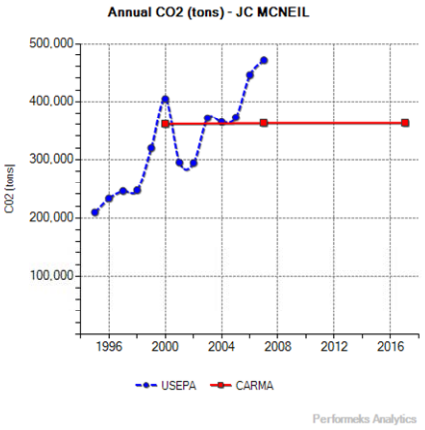
Next decade predictions by CARMA appear to be unreliable

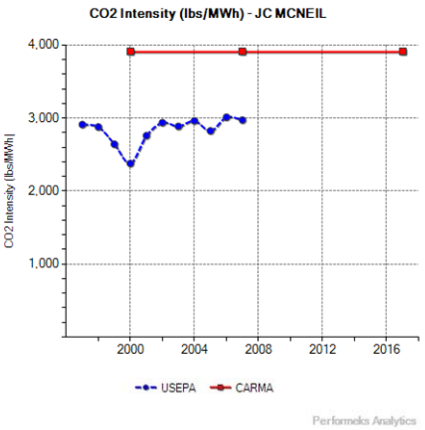


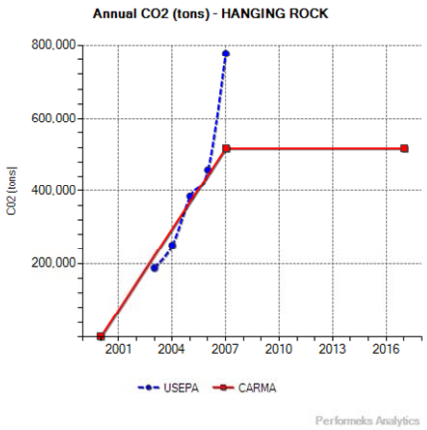


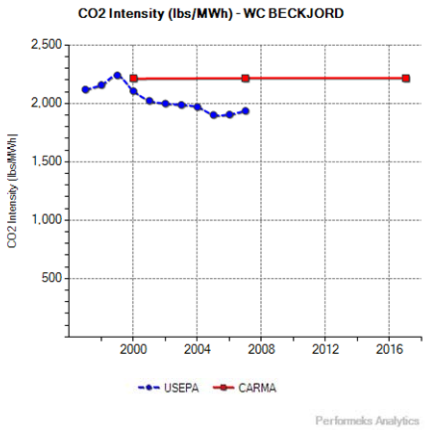


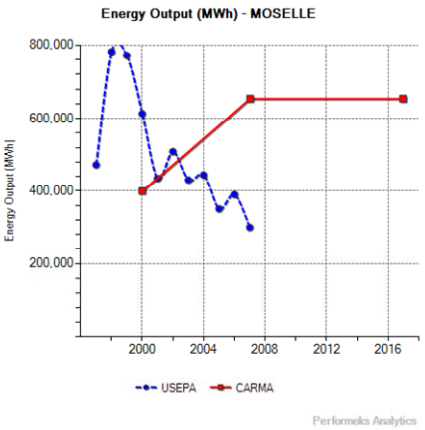












USEPA CARMA

Summary of Differences Between USEPA and CARMA

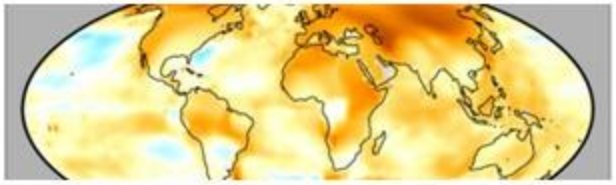
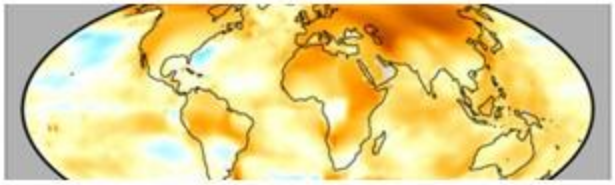
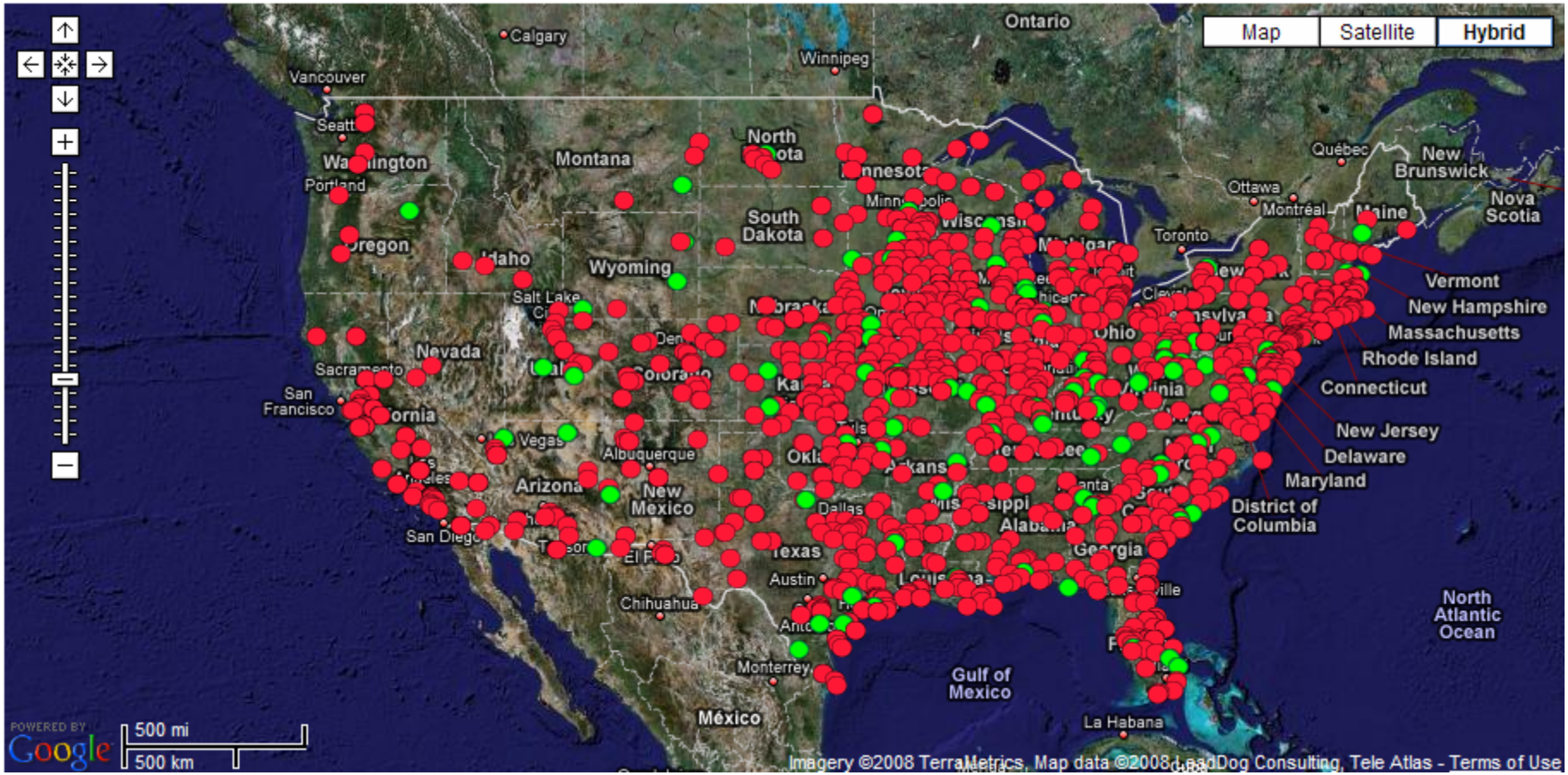


Table A: Percent of Power Plants in CARMA That Differ from USEPA's Official Values by More Than ±5%		
Indicators estimated by CARMA	**Year 2000**	**Year 2007**
Annual CO2 emissions (tons/year)	91%	86%
Carbon intensity (lbs/MWh)	78.5%	78.5%
Energy output (MWh)	94%	90%

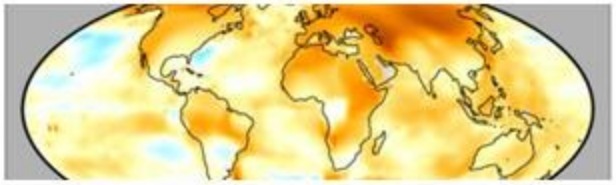
RED Dots Show US Power Plants with Inaccurate CO2 Estimates by CARMA

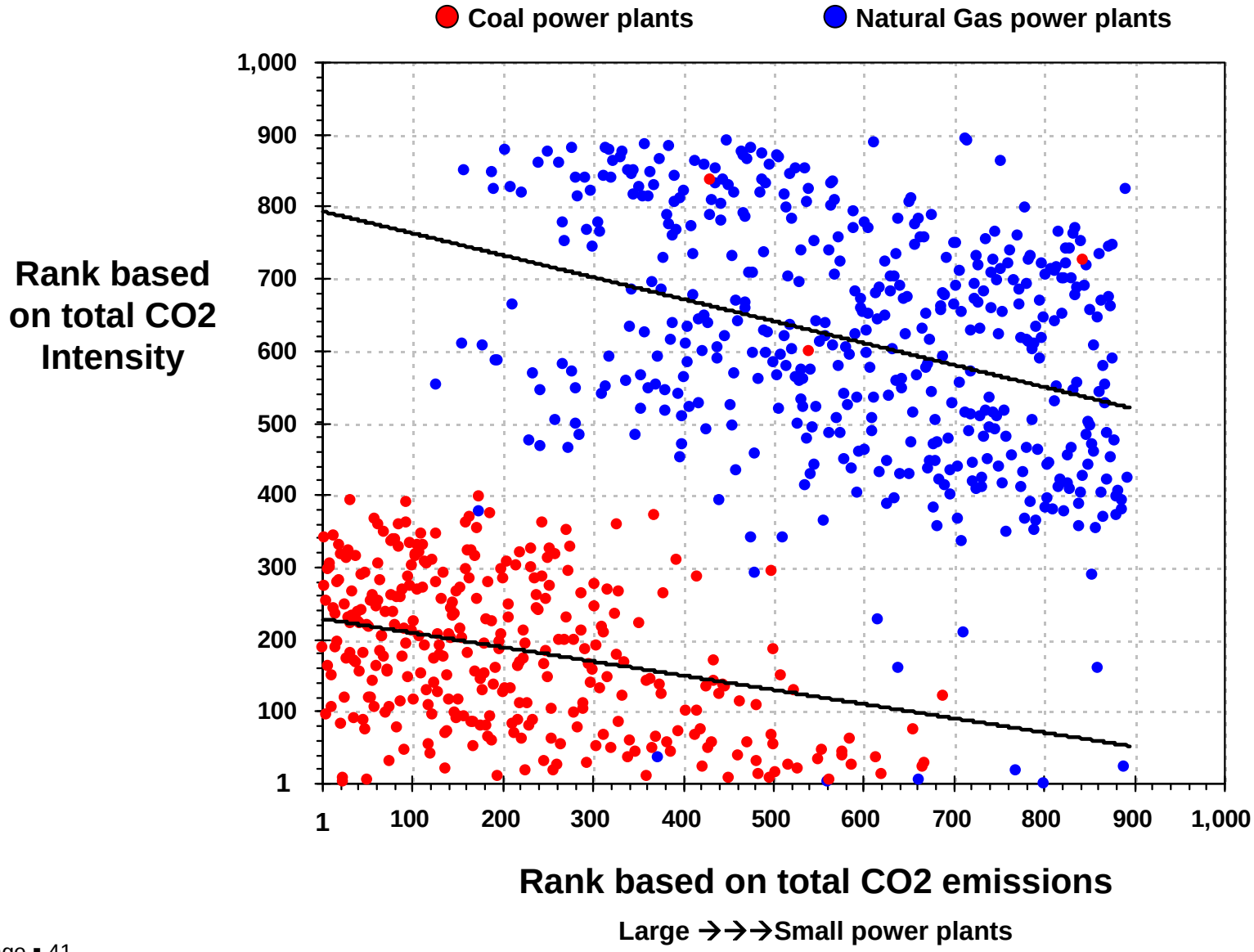




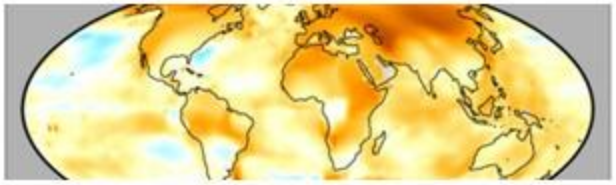
More than 50% of CARMA's CO2 numbers are outside ±25% margin of error when compared to the USEPA official data

Ranking Methodology Issues



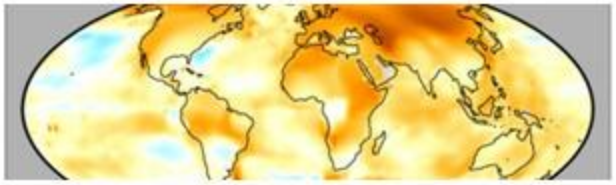


Potential Sources of Errors in CARMA



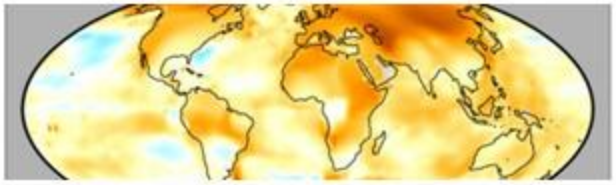
- **CARMA's Model—Power plant's actual output depends only on each power plant's characteristics—not correct**
- **CARMA model ignores the effect of supply stack—composition of power plants in a region**
- **Untested private data vendor (**World Electric Power Plant Database (WEPP) / Platts**)**

Key Lessons for Disclosure: CO2 estimation is not easy



- **Estimating CO2 using regressions is a dodgy business**
  - In fact empirical findings show that environmental estimates in general may have accuracy issues
  - For example, data quality concerns exist even for the Toxic Release Inventory program in the US
    - Source: "**Assessing the accuracy of self-reported data: an evaluation of the toxics release inventory**", de Marchi and Hamilton, Journal of Risk and Uncertainty, Volume 32, Number 1 / January, 2006

Key Lessons for Disclosure: Actual Measurement vs Estimates



- **Regulatory experience shows that data accuracy requires rigorous monitoring and verification. There is basically no substitute for on-site monitoring and verification using established protocols.**
- **So carbon disclosure programs should utilize—to the best possible extent—actual on-site monitored data**
- **Any new methodology must be subjected to detailed stakeholders review and discussions**
- **Regression estimates should not be used for making precise rankings.**

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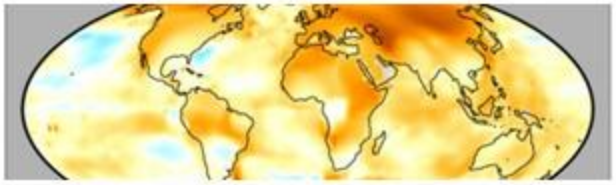

Climate Data Due Diligence

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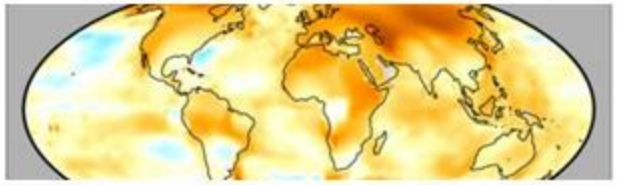
Welcome To Climate Data Due Diligence

The Climate Data Due Diligence Project is an initiative launched by Performeks to look at various studies throughout the world regarding the environment and to write a public peer review of studies outlining their strengths and weaknesses. At the Climate Data Due Diligence Project we intend to release reports on a regular basis, on new and interesting projects to further broaden the discussion on various topics related to the environment.

Performeks is an independent company that focuses on performance analysis in a variety of areas ranging from the environment to the health sector. We encourage public disclosure and the free flow of ideas. Performeks' driving principle is that good data analysis leads to good public policy decisions.

Thank You



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