




# Carbon Footprint Study

## Getting Ahead of the Curve

*Christopher Ivanov*

Power System Engineering, Inc.  
Web Site: [www.powersystem.org](http://www.powersystem.org)  
E-Mail: [ivanovc@powersystem.org](mailto:ivanovc@powersystem.org)

Power System Engineering, Inc. 

## Topics for Discussion

- What is a Carbon Footprint?
- Increased Focus on Carbon Regulation
- How will this Change Current Prices?
- What would a Carbon Footprint Study (CFS) Look Like?
- Staff and Consultant Roles in a CFS?
- Timeline and Costs for a CFS

© 2008 Power System Engineering, Inc. 2

## What is a Carbon Footprint?

- A carbon footprint is a:  
"measure of the impact human activities have on the environment in terms of the amount of green house gases produced, measured in units of carbon dioxide".
- It is meant to help individuals and organizations conceptualize their personal or organizational impact on global warming.

## Increasing Governmental Focus on Carbon

- The Governors Task Force on Global Warming Wisconsin has indentified 40 EURO or \$60 per ton as a possible cost to reach carbon goals that are being considered for the electric utility sector.
- Both presidential candidates mention reducing carbon dependence as a major goal for their administration.
- The Kansas Department of Health and Environment (KDHE) denied permits for a coal plant because of CO<sub>2</sub> emissions.

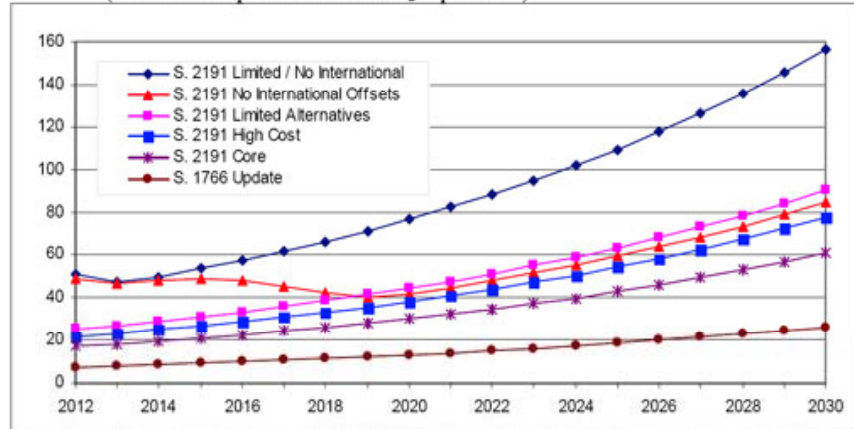
## Federal Legislation

- Lieberman-Warner Climate Security Act of 2007
  - Establishes core of federal program to reduce US GHG emissions from 2008-2050 by enough to avert catastrophic global warming without harming US economy
- Aggressive Targets
  - By 2012 – 4% below 2005
  - By 2020 – 19% below 2005
  - By 2050 – 71% below 2005
- Controls Costs by Cap and Trade System a la SO2
- Allowance Auction Revenues Go to:
  - Deploying Advanced Technology to Reduce Emissions
  - Job Creation
  - Insulating Low/Middle Income US Citizens From Increased Energy Costs
  - Mitigating International Conflicts Due to Global Warming Effects
- Did not pass this year but has set stage for legislation in 2009

## DOE/EIA 2020 Impact Estimates of S2191

• U.S. GDP	-\$43 Billion	-0.3%
• U.S. Consumption	-\$47 Billion	-0.4%
• Industrial Shipments	-\$100 Billion	-1.4%
• Allowance Revenue Generated	\$113 Billion	

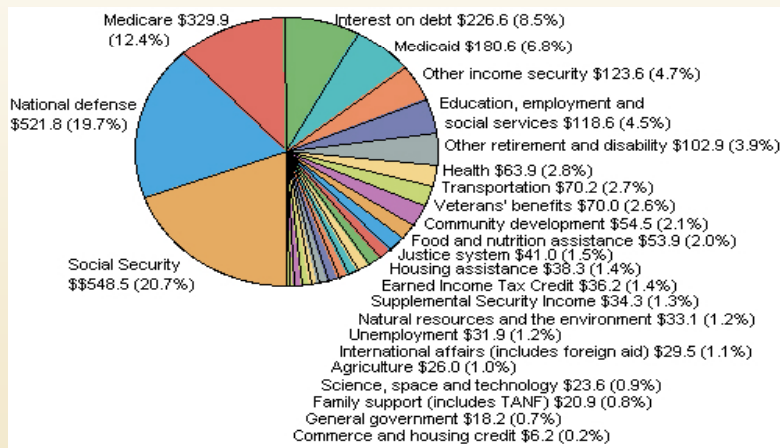
**Figure 5: Allowance Prices in the S. 2191 Cases and the S. 1766 Update Case**  
(2006 dollars per metric ton CO<sub>2</sub>-equivalent)



Source: National Energy Modeling System runs S2191.D031708A, S2191HC.D031708A, S2191BIV.D031608A, S2191NOINT.D032508A, S2191BIVNOLD033108A, and S1766\_08.D031508A.

Core Estimate is \$60/MT by 2030.

## \$113 Billion in Perspective 2007 US Government Budget



## How Can This Affect my Utility?

- Increase in base load power costs
- Increased difficulty in siting new base load plants
- Increase the cost of the current generation mix
- Could the utility make money by producing carbon reductions at below the market price?

## Key Electric Sector Linkages

Cons MWh	X	1/(1-DL%)	EQ	Purch MWh	X	1/(1-TL%)	EQ	GEN MWh	X	HR/3412	EQ	MWh Fuel	X	Carb Fact	EQ	MT CO2	Fuel
Examples	1.00	7.0%	1.075	1.075	3.0%	1.031	1.109	9,000	2.638	2.92	0.32	0.94	0.36	1.05	1.17	Coal	
								10,500								Coal	
	1.00	1.075	1.075	1.031	1.109	1.109	3.077	3.41	0.20	0.68	Gas CT						
	1.00	1.075	1.075	1.031	1.109	1.109	3.077	3.41	0.28	0.96	Oil CT						
							7,200										
	1.00	1.075	1.075	1.031	1.109	1.109	2.110	2.34	0.20	0.47	Gas CC						

### *Illustrative Marginal Impacts on Electric Bills*

Residential Monthly Consumption = 1.0 MWh @ \$30/MT CO2

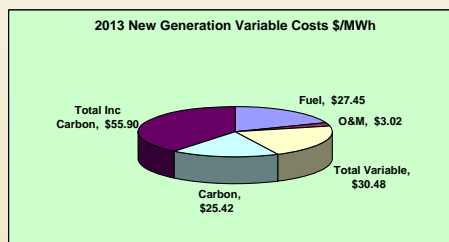
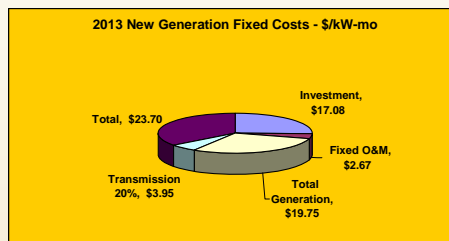
Then, Monthly Bill Increase:

On Coal ~ \$30

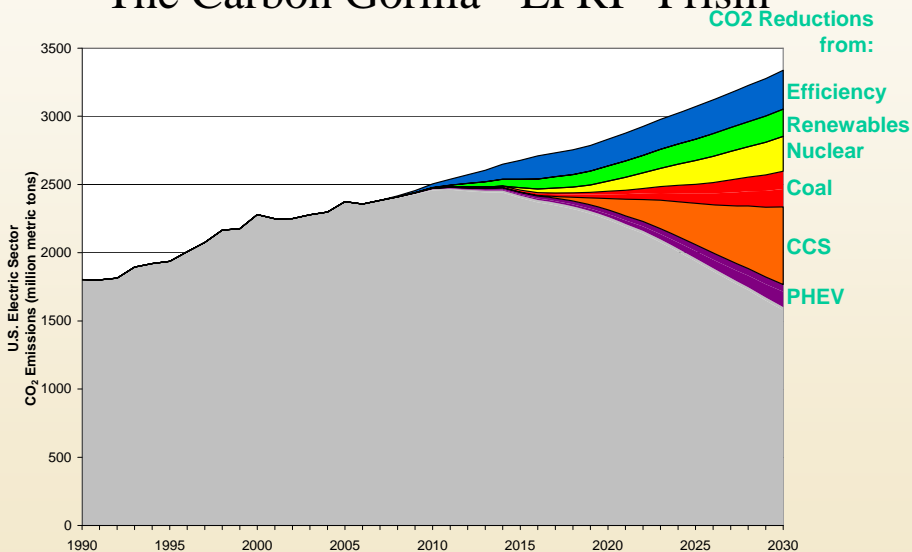
On Gas CC ~ \$15

## What Does a kWh Cost – New Generation in 2013

- Illustration based on
  - 50% coal capacity
  - 20% gas CC capacity
  - 30% gas CT capacity
- Fuel Prices Per MMBTU
  - Coal - \$1.25
  - Gas - \$8.00
- Carbon Tax or Price
  - \$30/MT of CO2
  - Nearly doubles variable generation costs
- Arbitrary Transmission
  - 20% of Generation

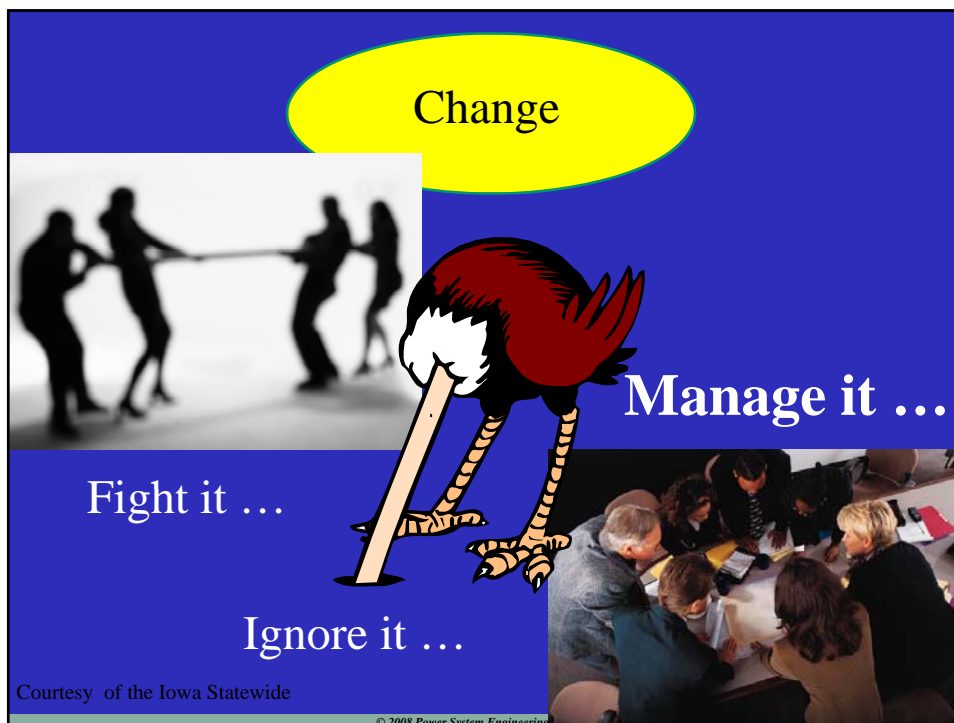


## The Carbon Gorilla - EPRI “Prism”



## Carbon – Problem or Opportunity?

- Utilities (and others) that produce CO2 reductions at costs below the market price will make money
- Who can benefit?
  - Renewable energy developers
  - Energy efficiency (supply and demand side)
  - Nuclear industry
  - Sequestration industry
  - Hybrid industry
  - Landfill Gas Capture
- GRE now says EE is our first fuel



## Getting Ahead of the Curve

- Assessing your Current Situation
- Prudent Planning for all Future Situations
- Being Proactive, not Reactive
- Developing Tools to help you set up Strategies for Managing or Reducing CO<sub>2</sub>

## What Does My Utility's Carbon Footprint Look Like?

- How does your operation generate GHG?
- What is the largest source of CO<sub>2</sub> in your utility?
- Where can you reduce your emissions at the lowest cost?
- What is the possible value of reduced carbon emissions?
  - 10% of MGE customers pay \$6.00/month for green power
  - Alliant now provides SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>, Mercury report to homeowners based on previous 12 month usage
  - Alliant - 2.2 pounds of CO<sub>2</sub> per kWh of consumption
  - At \$30/MT, each kWh would cost Alliant 3.0 cents/kWh just for carbon

## What Part of the Utility's Emission Sources Would be Included in the Study?

- Building Operation and Maintenance
  - Headquarters
  - Maintenance Facilities
  - Electric Consumption
  - Gas or Other Fossil Fuel Consumption
- Vehicle Operation
  - Employee Commuting
  - Vehicle Fleet
- Employee Business Travel
  - Ground
  - Air
- Inbound and Outbound Shipments
  - U.S. Mail
  - FedEx, UPS, etc
  - Equipment by Truck
  - Equipment by Rail

## Creating a Carbon Footprint

### Collecting the data

- Develop an internal employee survey that will feed carbon footprint model covering:
  - Employee commuting distances and mode of transport
  - Fleet vehicles – miles/year by vehicle type
  - Business travel survey – miles by mode
- Create an internal data request covering:
  - Energy use by building by fuel
  - Inbound and outbound mail summary
  - Inbound and outbound shipments
  - Tons of waste sent to a landfill
- Solicit data from the utility's power supplier
  - Transmission loss percentages
  - Generation by fuel
  - Fuel Consumption for each fuel type

## Creating a Carbon Footprint

- Compile the databases and establish the calculation methods and templates
- Create an internal carbon calculator
- Develop the Carbon Footprint for 2007 and report
- Identify sources that could not be quantified from available data
- Establish data collection methods for expanded future analyses and ongoing carbon reporting

## Key Carbon Emission Factors

- Electric consumption at buildings
  - Coal on the margin - 1.0 MT CO<sub>2</sub> /MWh
  - Oil on the margin - 0.8 MT CO<sub>2</sub>/MWh
  - Gas on the margin – 0.55 MT CO<sub>2</sub>/MWh
- Employee commuting:

Commuting Example			
Emps	dpd	Empdays	
35	240	8,400	
Empdays	Avg Comm	Total Miles	
8,400	10	84,000	
MPY	MPG	Gallons	
84,000	20	4,200	
gallons	lbs CO <sub>2</sub> /gal	MT CO <sub>2</sub>	
4,200	19.56	37.3	

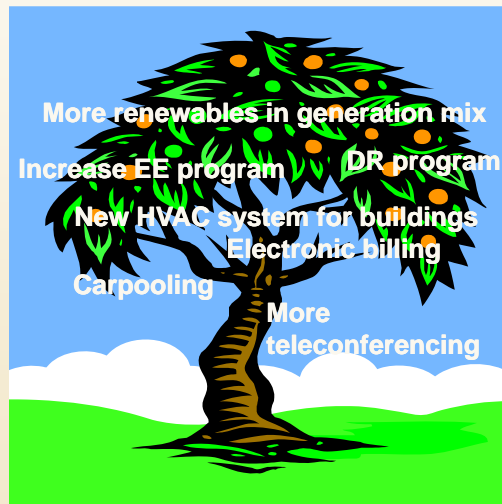
## Key Emission Factors

- Other Employee Travel
  - Plane 0.63 lbs CO<sub>2</sub>/passenger mile
  - Train 0.12 lbs CO<sub>2</sub>/passenger mile
  
- On-Site Fuel Use
  - Gas 11.708 lbs CO<sub>2</sub>/Therm
  - Propane 12.669 lbs CO<sub>2</sub>/Gallon
  - Distillate 22.384 lbs CO<sub>2</sub>/Gallon
  - Bituminous Coal 4,931 lbs CO<sub>2</sub>/short ton
  - Anthracite 3,852 lbs CO<sub>2</sub>/short ton

## Other Factors Considered

- Shipments
  - Truck Freight
  - Train Freight
  - Marine Freight
  
- Waste Emissions
  - Yard Waste
  - Newsprint
  - Cardboard
  - Food
  - Office Paper
  - Non-Decomposable

## Addressing “Low Hanging” Fruit



## How Can You Use A Carbon Footprint Study?

- Generate Employee Interest In Reduction
- PR For Your Customer Base
- Baseline For Improvement – “What is Measured Tends to Improve”
- As Baseline For Possible Future Carbon Sales
- As a Measure of Your Exposure to Future Carbon Prices

Thank You:

Power System Engineering, Inc.  
Name: Chris Ivanov  
Title: Economic Analyst  
Direct: (608) 268-3516  
Email: ivanovc@powersystem.org

Power System Engineering, Inc.  
Name Duane Kexel  
Title VP of Economics and Market Research  
Direct: (608) 268-3522  
Email: kexeld@powersystem.org

**Website: [www.powersystem.org](http://www.powersystem.org)**