

Advanced Membrane Technologies
Stanford University, May 07, 2008



Water-Energy-Carbon Nexus and Your Membrane Plant

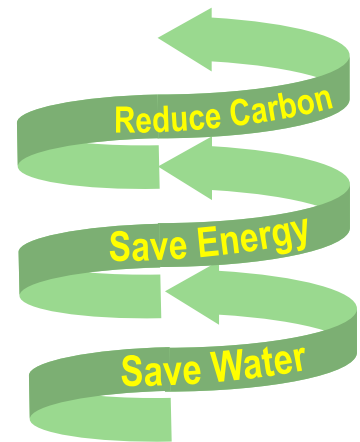
Alan Zelenka
Energy Services Leader
Kennedy/Jenks Consultants



The Water-Energy-Carbon Nexus



- ▶ **Energy is needed to produce potable water**
- ▶ **Energy production creates carbon emissions**
- ▶ **Saving or creating water reduces energy consumption, lowers carbon emissions, and saves money!**



Road Map



- ▶ **Why to do a Climate Action Plan (CAP)**
- ▶ **Greenhouse Gas (GHG) Regulatory Structure**
- ▶ **How to do a CAP**
- ▶ **Case Study: Carlsbad Desalination Plant**
- ▶ **Describe some Benefits and Risks**

Why do a Climate Action Plan?



- ▶ **Regulatory**
 - **AB 32**
 - **RPS**
 - **Siting criterion**
 - **Permit Requirement?**
- ▶ **Political**
 - **Commissioner or Board action**
 - **Internal Sustainability or Green initiative**
 - **Consumer/ratepayer pressures**
- ▶ **High Energy and Operations Costs**

Recent Events in California



- ▶ **Attorney General Jerry Brown lawsuits against Conoco Philips & San Bernardino County – for failure to include a CAP in their environmental analysis**
- ▶ **Carlsbad Desal Plant - SLC & CCC permit conditions, bootstrapped their regulatory authority!**
- ▶ **Is it now the standard in California?**

GHG Regulatory Timeline & Structure



- ▶ **1988 – IPCC (Intergovernmental Panel on Climate Change) was established by the U.N.**
- ▶ **1992 – UNFCCC (U.N. Framework Convention on Climate Change) was created**
- ▶ **1997 - Kyoto Protocol negotiated**
- ▶ **2001 - World Business Council for Sustainable Development and the World Resources Institute created “Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard”**

GHG Regulatory Timeline & Structure



- ▶ **2001 - SB 1771 established California Climate Action Registry (CCAR)**
- ▶ **2003 - CCAR creates "General Reporting Protocol"**
- ▶ **2006 - AB 32 Global Warming Solutions Act**
 - **2000 levels by 2010, 1990 levels by 2020, 80% below 1990 by 2050**
 - **Cap & Trade System (in-progress)**
 - **CARB is lead state agency for enforcement**
 - **CARB uses CCAR as a resource**

What Must Be Done First?



- ▶ **Establish the goal**
 - **Carbon neutral**
 - **Carbon reduction**
- ▶ **What is driving the plan?**
 - **Permit requirement**
 - **Local agreement**
 - **Creation of revenue**



Climate Action Plan Steps

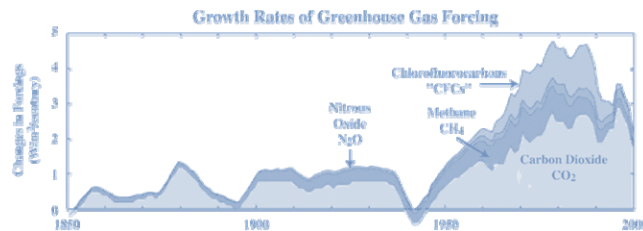


- 1 → **Conduct a greenhouse gas (GHG) inventory**
- 2 → **Identify mitigation options**
- 3 → **Evaluate and analyze options**
- 4 → **Select best option**
- 5 → **Implement and monitor plan**

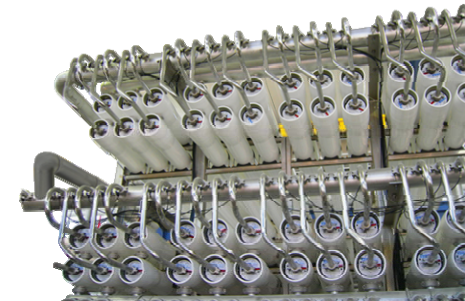




Conduct a GHG Inventory



- ▶ Use recognized reporting protocols & tools from:
- ▶ Determine your geographic & organizational boundaries for emissions
- ▶ Report CO₂ only or all GHGs?
- ▶ Establish your baseline year: 1990, current year, future first year of operations
- ▶ Calculate your direct emissions
- ▶ Calculate your indirect emissions from electricity consumption



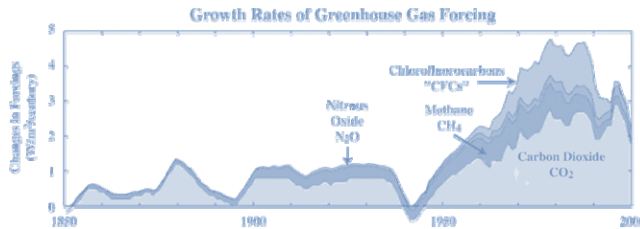
Conduct a GHG Inventory



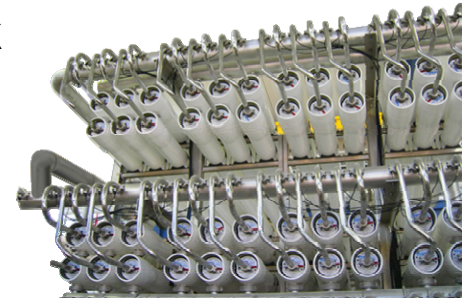
- ▶ **Quantify Direct Emissions**
 - ***Process, Stationary & Mobile Combustion, Imported & Fugitive***
- ▶ **Quantify Indirect Emissions**
 - ***Purchased Electricity Emissions Factor from the local utility***



Conduct a GHG Inventory



- ▶ Use recognized reporting protocols & tools from:
- ▶ Determine your geographic & organizational boundaries for emissions
- ▶ Report CO₂ only or all GHGs?
- ▶ Establish your baseline year: 1990, current year, future first year of operations
- ▶ Calculate your direct emissions
- ▶ Calculate your indirect emissions from electricity consumption
- ▶ Calculate any credits for avoided energy use and net carbon footprint
- ▶ Evaluate your risk
- ▶ Total your annual emissions of CO₂ and/or CO₂e





Identify & Analyze Options



- ▶ **Improve the energy efficiency of the project**
- ▶ **Renewables: on-site or remote location**
- ▶ **Green power direct purchases or from your electric utility**
- ▶ **Carbon reduction projects or Offsets**
- ▶ **Renewable Energy Credits (RECs) or Green Tags**

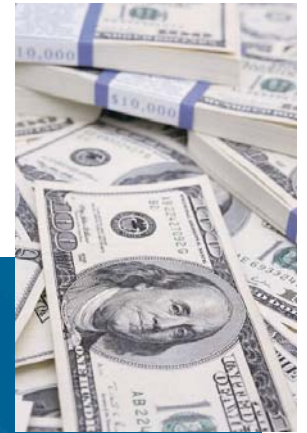




Select the Best Option



- ▶ Lower your energy use first!
- ▶ Assess political and regulatory influences on the selection of options
- ▶ Calculate the capital cost and life-cycle cost of each option
- ▶ Conduct a cost/benefit and “Triple Bottom Line” analysis to determine net benefits of project
- ▶ Evaluate Risks
- ▶ Conduct public and regulatory review as appropriate to secure approval of selected option





Implement the Plan



- ▶ **Use reputable and experienced organizations with experience doing RECs and Offsets and Renewable Projects!**
- ▶ **It is not as easy as it looks!**





Monitor the Plan



- ▶ **Continuously monitor and control the plan**
- ▶ **Annually update your carbon footprint and renew the plan**



Case Study: Carlsbad Desalination Plant



- ▶ **Location: City of Carlsbad, CA**
- ▶ **56 MGD (~\$300 Million Capital Cost)**
- ▶ **First major desal plant in California**
- ▶ **Water purchased by 7 local agencies**

Case Study: Carlsbad Desalination Plant



- ▶ **Displaces imported water from Northern California**
- ▶ **Co-located with electric power plant with existing intake from lagoon**
- ▶ **Volunteered to become Carbon Neutral**
- ▶ **Permitting Controversial (SLC & CCC)**

Carbon Footprint: Two Key Metrics



- ▶ **Energy Use by the Project (MWh)**
 - Initial from engineering estimate
 - Actual from utility billing data
 - May change over time

- ▶ **Emissions Factor for Electricity Used**
 - Emissions Factor is the pounds of CO₂ per MWh of electricity used
 - Will change over time
 - Utility EF or default EF

Project Energy Use



- ▶ **New Desalination Plant will use 31.3 aMW of power**
- ▶ **Poseidon will install a High Efficiency Energy Recovery Device Saving 10%**
- ▶ **Poseidon Will Use 28.1 aMW of SDG&E System Power**
 - **246,156 MWh per year**
 - **aMW x 8760 hrs/yr = MWh**
 - **1000 KWh = 1 MWh**

SWP Facilities



Net Carbon Footprint Calculation



- ▶ **The Carlsbad Project eliminates need for equal amount of SWP water**
- ▶ **As a result, Carlsbad will avoid pumping of water over the Tehachapi's, avoid the energy (21.8 aMW), and avoid the emissions**
- ▶ **After applying this credit, the net energy used to provide desalinated water to the San Diego region is 6.3 aMW**
 - **55,538 MWh per year**

Net Carbon Footprint Calculation



- ▶ **Carlsbad's Gross Carbon Footprint is 61,004 metric tons of CO₂**
 - **Using SDG&E Emissions Factor of 546 tons of CO₂ per MWh for delivered system power**
- ▶ **SWP has no CCAR Report, used the SDG&E emissions factor to calculate SWP's carbon footprint of 47,240 metric tons of CO₂**
- ▶ **The Carlsbad Desalination Plant's Net Carbon Footprint is 13,764 metric tons per year of CO₂**

Net Carbon Footprint Calculation



	aMW	Metric Tons of CO ₂
Typical Plant	31.3	67,950
After ERD	28.1	61,004
SWP Credit	21.8	47,240
Net Footprint	6.3	13,764

If CARB's interim EF of 1,100 tons of CO₂ were used, all the numbers would double.

Comparing Utility Emissions Factors



CCAR Annual Emission Reports			
Utility	Report Year	Report Date	Emission Factor
SDG&E	2005	7-Mar-07	546
SDG&E	2004	16-Mar-06	614
PG&E	2005	1-Dec-06	489
PG&E	2004	12-Oct-06	566
SCE	2005	30-Jan-06	666
SCE	2004	6-Feb-06	679

Carbon Mitigation Options



▶ Direct Emissions Reductions

- Process Changes
- Credits
- Energy Efficiency

▶ Indirect Emissions Mitigation

- Renewables
- Renewable Energy Credits (RECs) or Green Tags
- Carbon Offset Projects

Carlsbad's Climate Action Plan Elements



- ▶ **Commitment is to reduce net carbon emissions to zero through implementing some or all of the following measures:**
 - 1. Efficient Energy Recovery Device**
 - 2. Other Energy Efficiency**
 - 3. LEED-type Process**
 - 4. Possibly Rooftop Solar PV Project**
 - 5. Wetlands Mitigation Project**
 - 6. Carbon Offset Projects or RECs (local projects)**
 - 7. Annually Update & Renew the Plan**

Short-Term Benefits



- ▶ **Regulatory Approval**
- ▶ **Environmental Compliance Strategy**
 - **Site selection (BARD)**
- ▶ **Lower Operating Costs (but increased capital costs)**
- ▶ **PV Project, Wetlands Mitigation, Energy Efficient Design, Local Offset Projects = Good PR!**
- ▶ **Responding to the political pressures & doing the right thing**

Risks & Long-Term Considerations



- ▶ **Which Emissions Factor?**
 - **Utility EF can go up (over time likely to go down)**
- ▶ **Offset and REC price escalation or rule changes**
 - **RECs 1 - 3 years**
 - **Offset 10 years plus**
- ▶ **Regulatory scheme could causes double counting problem**
 - **Who is responsible for the mitigation?**
- ▶ **Plant's energy use could increase**
- ▶ **Plant's direct emissions could increase**