Request # 0290

CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

http://www.csuci.edu/ira/index.htm

Application
Instructionally Related Activities Funds Request
2008-2009 Academic Year
DEADLINE: Fall and Academic Year 3/14/08
Spring 10/15/08

Applications must first be sent to the appropriate program chair. Chairs will the recommend and route them to the Dean's Office for review and authorization. The Dean's Office will then forward them to the IRA Committee for consideration.

Activity Title: **Fall 2009 Science Symposium: Climate Change in the 21st Century**

Project Sponsor/Staff (Name/Phone):
Biology Program: Dr. Ching-Hua Wang (437-8870)
Chemistry: Dr. Simone Aloisio (437-8999)

Activity/Event Date(s): Fall 2009

Date Funding Needed By: 9/30/2009
**Please Note that for Fall Requests the earliest that you will be notified of funding availability will be early June 2008 and for Spring Requests early January 2009.

Please check if any of the following apply to your IRA:

- □ Equipment Purchase
- □ Event
- □ IT Requirements
- □ International Travel
- □ Space/OPC Requirements
- □ Infrastructure/Remodel
- □ Other _____
- □ Field Trip
- □ Participant data collection for public dissemination, i.e. interviews/surveys that result is a journal/poster session/newsletter
- □ Risk Management Consultation
- □ Late Submission (Passed Deadlines: **Fall 3/14, Spring 10/15)**

Previously Funded: X YES □NO Yes, Request # _Fall 2008 (234)_____

Does your proposal require IRB (Institutional Review Board) approval: □Yes X No

Assessment submitted for previously Funded Activity: X YES □NO

Academic Program or Center Name and Budget Code: 720

Date of Submission: 2/26/2009

Amount Requested:
(Should match item 2. E. on page 4) $7070

Estimated Number of Students Participating: 100

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Conditions and Considerations

Equipment Purchase-If requesting large equipment, Project Sponsor must show proof of correspondence with OPC Administration. In addition, all other purchases must follow Procurement Guidelines

Events-Attach copy of Events and Facilities Use Request Form (Public Folders-Events & Facilities folder) Consider time frame for set-up and take down.

Participant Data Collection for Public Dissemination-If Project Sponsor proposes to conduct research with human participants then it may be subject to IRB (Institutional Review Board for the Protection of Human Subjects) review. It is the Project Sponsor's responsibility to inquire with the IRB **prior** to IRA application submission to determine if the project is exempt from IRB review so that funding is not delayed. Please indicate on the cover page if your project is exempt from IRB review.

Field Trip-If approved, Identified Risks of Participation and Release Agreement must be submitted for each student to the Program Office (Public Folders-HR Forms).

IT Requirements-Requires proof of correspondence and approval from IT Administration

International Travel-Requires International Travel application be submitted to Center for International Affairs.

Risk Management Consultation-Requires proof of correspondence with Risk Management.

Space/OPC Requirements, Infrastructure/Remodel-Requires proof of correspondence with OPC Administration .

Late Submission (Deadlines: Fall 3/14, Spring 10/15)-Requires explanation for emergency funding.

Fiscal Management: Project Sponsor's program will be responsible for all costs incurred over and above what is funded through the IRA award and will be responsible for seeing that any revenue that is intended to offset the amount of the IRA award is transferred accordingly.

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Requirements and Signatures

Please provide the following in your application:

1. **Brief Activity Description.** Describe the activity and its relationship to the educational objectives of the students' program or major.

   The Biology and Chemistry departments are organizing a symposium in Fall of 2009 entitled "Climate Change in the 21st Century". The topic of human influence on climate, and the resulting global warming scientists are observing, has been seriously studied in the last decades. Each year, scientific discoveries have built upon the understanding of climate change with large amounts of data, more sophisticated analysis, and more extensive exploration of the phenomenon. It has become globally recognized problem that touches on many aspects of our civilization. It is difficult to think of topic that is now being studied in a more interdisciplinary way, and by a wider range of disciplines and scientific expertise, than global climate change. In 2007, the Intergovernmental Panel on Climate Change's (IPCC) published their 4th Assessment Report on the topic. This brought focused the world's attention on this primarily scientific issue like never before. For their work, the IPCC was honored with the Nobel Peace Prize.

   The purpose of this symposium is to educate the campus community on the ongoing research on the topic of climate change. The Biology Program has organized a symposium for each semester since spring 2005. This is an excellent tradition we would like to maintain to promote science, especially interdisciplinary sciences on our campus. Such activities are in complete support of our university mission and help to build a solid reputation of our academic programs in our community as well.

   An attachment lists the proposed speakers, their affiliations, and their research interests.

2. **Relation to IRA to Course Offerings.** All IRAs must be integrally related to the formal instructional offerings of the University and must be associated with scheduled credit courses. Please list all classes that relate to the program proposed.

   This symposium will be a required or elective component for a number of courses offered in the Biology and Chemistry programs, including: Biol 100 (Exploring the Living World), Biol 170 (Foundations of Life Science), Biol 200 (Principles of Organismal and Population Biology), Biol 335 (The Biosphere), Biol 433 (Ecology and the Environment), Chem 121 (General Chemistry I), Chem 301 (Environmental Chemistry-Atmosphere and Climate). In addition to the above programs, instructors in ESRM, Geology, Physics, and other programs may find the topics interesting and relevant, such that they may request their students to attend the symposium.

3. **Activity Assessment.** Describe the assessment process and measures that the program will use to determine if it has attained its educational goals. **Please note a report will be due at the end of the semester.**

Students attending the seminar series will be given a number of questions on the subject matter of the talks. The questions are to be answered and turned in toward assessment of the knowledge they gained from the seminar.

4. **Activity Budget.** Please enclose a complete detailed budget of the entire Activity **bold** specific items of requested IRA funding. (Page 4)

The requested funds are necessary to invite the well-known individual speakers that are listed on the attached program page. $1000 per individual is requested to cover the honorarium and travel expenses for each speaker. Six individuals will make up the final list of speakers. Additional funds are necessary to advertise the series to the local community, including newspapers, broadcast media, and other PR venues.

5. **Sources of Activity Support.** Please list the other sources of funding, and additional support for the activity.

IRA funding will support the event. Biology and Chemistry faculty members, staff, and student assistants will support the event with time and work as needed. Some supplies will be provided by these programs as well.

7. **Acknowledgment.** Project Sponsor and Program Chair acknowledge that they have reviewed and accepted the Conditions and Considerations detailed on page 2.

Signatures and Dates

Project Sponsor — Simone Aloisio — 2/26/9 — Date

Program Chair/Director — Ching-Hua Wang — 2/27/09 — Date

Dean — Ashish Vaidya — 2/27/09 — Date

Application
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ACTIVITY BUDGET FOR **2008-2009**

1. Operating Expense Budget

A. Supplies	
B. Vendor Printing	$800 (Includes printing supplies)
C. In-State Travel	
D. Out-of-State Travel	
E. Equipment Rental	
F. Equipment Purchase	
G. Contracts/Independent Contractors	
H. Honorarium	$6000 (including travel)
I. OPC Chargeback	$200
J. Copier Chargeback	
K. Other (Please Specify)	$70 Carbon Offsets for all speakers
TOTAL Expenses	$7070

2. Revenue

A. Course Fees	
B. Ticket Sales	
C. Out of Pocket Student Fees (exclusive of course fees)	
D. Additional Sources of funding (Please specify And indicate source)	
E. Requested Allocation from IRA	
Total Revenue	

Potential Speakers

Actual speakers will be determined if this proposal is funded. This is a list to give the committee an idea of the types of speakers we will ask to give a symposium presentation. It is likely that we will ask these speakers to present their work, but it is also likely that many will decline because of other commitments. This list represents a slightly ambitious, but still reasonable sample of what the symposium speaker list might look like.

Susan Soloman, Ph.D., is an atmospheric chemist with the National Oceanic and Atmospheric Administration. She is a lead co-author of the IPCC AR4 report on climate change, and a member of the National Academy of Sciences. Widely recognized as a leading scientist in the field of climate change, and quite a public figure today, she was the first person to correctly describe the chemical mechanism of Antarctic ozone depletion.

Jeff Price, Ph.D., is a biology professor at CSU Chico's department of Geological and Environmental Sciences. Dr. Price studies the vulnerability and adaptation of species to climate change. He is most well known for his study of what the potential impact climate change will have on birds.

Randy Friedl, Ph.D., is Chief Scientist at NASA's JPL Directorate of Earth Science and Technology. His research interests are the kinetics of atmospheric reactions. He has leader in NASA's Earth Science Directorate, with experience at NASA Headquarters, in directing the study of our planet by that agency.

Paul Wennberg, Ph.D., is the R. Stanton Avery Professor of Atmospheric Chemistry and Environmental Engineering at the California Institute of Technology. He is best known for developing instruments that are utilized to make airborne measurements. Among other honors, Prof. Wennberg is a recipient of a MacArthur "Genius Award".

John Birks, Ph.D., is the president of 2B Technologies in Boulder Colorado. He is most well known for his development of portable instruments designed to measure ozone and nitrogen oxides in the atmosphere with a high degree of precision and accuracy. His instruments are being used widely to detect air pollution, including by researchers measuring ground level ozone in the arctic, by the National Park Service at several locations, and right here at CSUCI.

Joseph S. Francisco, Ph.D., is the William E. Moore Distinguished Professor of Chemistry at Purdue University. He is most well known for his research of novel gas phase species and their role in atmospheric chemistry. He is also the President-elect of the American Chemical Society (ACS), and is integral in leading the Society's efforts in the area of climate change research, education, and public awareness.

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Instructional Related Activities
Report Form

SPONSOR	DEPARTMENT
Simone Aloisio	Biology/Chemistry

ACTIVITY TITLE	DATE (S) OF ACTIVITY
Poe Symposium: Climate Change in 21st Century	Spring 2010 April 16th 2010

PLEASE EXPLAIN (1) DESCRIPTION OF ACTIVITY; (2) HOW DID THE ACTIVITY RELATE TO A COURSE(S); AND (3) WHAT YOU LEARNED FROM THE PROCESS.

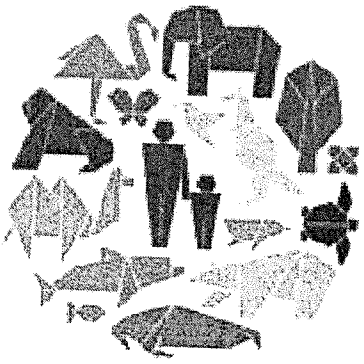
1) THE POE SYMPOSIUM IS THE ANNUAL SCIENCE SYMPOSIUM AT CSU CI, HELD EACH SPRING. THIS WAS THE SIXTH POE SYMPOSIUM, BUT THE FIRST ONE I ORGANIZED. THE TOPIC WAS CLIMATE CHANGE. THERE WERE SIX SPEAKERS OF INTERNATIONAL ACCLAIM, AND THE PROVOST GAVE OPENING REMARKS. THE EVENT WAS VERY WELL ATTENDED BY STUDENTS, FACULTY, AND COMMUNITY MEMBERS. THERE WAS A NICE ARTICLE IN THE VENTURA COUNTY STAR ABOUT THE SYMPOSIUM. TRAVEL EMISSIONS FROM BOTH THE SPEAKERS AND AUDIENCE MEMBERS WAS OFFSET BY TERRAPASS SO THAT THE EVENT WAS NEAR CARBON NEUTRAL, AND THE UNIVERSITY RECEIVED A PLAQUE TO COMMEMORATE THIS. THIS IS ON DISPLAY IN ALISO HALL. I AM ATTACHING A POSTER ABOUT THE SYMPOSIUM, THAT WAS PRESENTED AT THE CELEBRATION OF EXCELLENCE LAST YEAR.

2) SEVERAL SCIENCE COURSES LAST SPRING REQUIRED THEIR STUDENTS TO ATTEND THE SYMPOSIUM, INCLUDING **CHEM 301** AND **BIOL 311**. SEVERAL OTHER INSTRUCTORS ENCOURAGED THEIR STUDENTS TO ATTEND THE TALKS. FOR BOTH OF THE CLASSES MENTIONED ABOVE, STUDENTS HAD ASSIGNMENTS RELATED TO THE TALKS, AND SAMPLES OF THESE ARE PROVIDED.

3) I LEARNED HOW MUCH WORK IT WAS TO PUT TOGETHER A SYMPOSIUM LIKE THIS. IT WAS AN INTERESTING LEARNING EXPERIENCE FOR ME. IF I WERE TO HOLD ANOTHER SYMPOSIUM LIKE THIS, I WOULD PROBABLY WANT A LARGER VENUE. THERE WERE OVER **200** PEOPLE IN **AL150** AT THE BEGINNING OF THE PRESENTATIONS, AND PEOPLE COULD NOT GET INTO THE ROOM. LUCKILY, THE PRESENTATION WAS VIDEOTAPED, AND THESE WERE MADE AVAILIBLE ONLINE TO THE CAMPUS COMMUNITY. AT LEAST ONE CLASS INSTRUCTOR HAD HER STUDENTS WATCH THE VIDEOS IF THEY COULD NOT GET INTO THE ROOM FOR THE TALKS.

E-mail to the Dean's Office 30 days after activity

Conserving Biodiversity During Rapid Global Change



Katie McKendry
Chemistry 301
May 10, 2010

"Welcome to Subway, what can I get you?"

"I'd like a foot long turkey on wheat bread with lettuce, tomatoes, avocado, cheese and pepperoncinis please."

Everything you just ordered is an example of biodiversity. According to Healy Hamilton, director of the Center for Applied Biodiversity Informatics, biodiversity is the variation of life at all levels of biological organization. It is the total of all genes, species and ecosystems and all of them are being impacted by global warming. If we don't change the trajectory of global warming today, everything we know will be affected, including things as simple as the ingredients on your sandwich.

Dr. Hamilton gave numerous examples of biodiversity during her speech at the April 16, 2010, Poe Symposium. The examples were given to show the benefits nature provides and what the cost would be if the resources were destroyed by climate change. Hamilton's first example of biodiversity was food. More than 30,000 plants have edible parts and 7,000 are used for human consumption. Soil microorganisms and aquatic organisms contribute to our food by providing genetic resistance to diseases and pests such as insects that would otherwise destroy the food source.

Hamilton's next example of biodiversity was human health. She stated that "eighty percent of people rely on drugs derived from natural sources; twenty thousand species are used for medicinal purposes, and of all the pharmaceuticals on the market twenty-five percent of them are derived from plants." Examples of some plant derived pharmaceuticals include Quinine used to treat malaria, aspirin for pain, vincristine to treat childhood lymphoma, and taxol for the treatment of breast and ovarian cancer.

Organisms are also examples of biodiversity. Bat saliva is being studied for its potential use in blood and stroke treatments because of its ability to slow blood coagulation. Frogs secrete extremely potent antibiotics from their skin that are being studied as a potential HIV treatment.

Biodiversity also provides materials essential for life including cotton and linen for our clothes, timber for construction, and biofuels such as ethanol and biodiesel provide the fuel for the economy. Researchers are learning from what nature has designed to develop biomimicry systems to better design products. This is being done by mimicking nature's design of trees and bones to optimize the strength of structures as well as designing systems that create flow without friction by studying snail shells.

The ecosystem has provided the world with services that have saved billions of dollars every year. If the world didn't have bees, birds, bats, and other pollinators, it would cost the world $3 billion every year to do it themselves. Coral reefs, wetlands, and mangroves save $23 billion every year by providing protection from floods and storm surges. The rain forest provides drinking water saving another $4 billion every year and tourism of coral reefs, fishing, camping and other outdoor recreation is a $30 billion industry provided by natures allure.

According to Hamilton, threats to biodiversity are great and have been accelerated due to humanity's capacity to alter habitats, overexploit and eliminate recourses, pollute the air, streams, and environment, and by introducing invasive species that do not belong to that region, thus eliminating native species. Hamilton continued by providing solutions to mitigate detrimental human activities to help save species and the environment while preventing further damage.

In recent years there have been many approaches to conserving the diversity of life. One approach is species based; great efforts have been made to save certain species such as the

California condor. Though efforts have been costly the condors have been protected. There has also been an ecosystem-based focus, done by implementing controlled burns to protect the environment from devastating fires in the future. The gathering of invasive species has also been done to protect environments. Ex situ conservation has protected species by keeping them in zoos, aquariums, and botanical gardens.

Education, outreach, and legislation are also approaches for conserving diversity. Legislation has designated areas such as wildlife refuges to be protected from human impacts. Ten percent of the country has been set aside for the protection of animals and their habitats as seen in Figure 1 provided by Global Forest Watch. Figure 2, provided by World Resources Institute, shows the massive global investment that has been made to do the same. But with climate change, animals are migrating out of the protected areas and are at risk again.

Another main point Hamilton gave was that species distribution is determined by climate. As the climate changes the species can either adapt or go extinct. A response in systems has already been seen. Plants are flowering earlier and migration is occurring earlier. There has been a 6 kilometer movement north per decade by animals trying to move towards cooler climates. New combinations of hot and wet or dry and cold may be appearing in new places and species adaptation is necessary. Ecological forecasting using climate models has been developed to predict how the climate may affect the way species will adapt and where they may migrate in the future. This forecasting will be useful because it will allow for the design of new protected areas and make sure man made structures such as new highways won't be built there.

Further research on the topic has resulted in the creation of climate models which were produced by John Williams, Stephen Jackson, and John Kutzbach using A2 and B1 emission scenarios produced for the Fourth Assessment Report in order to identify regions projected to

experience high magnitudes of local climate change. According to the models "novel climates are projected to develop primarily in the tropics and subtropics, whereas disappearing climates are concentrated in tropical montane regions and the poleward portions of continents. Under the high-end A2 scenario, 12–39% and 10–48% of the Earth's terrestrial surface may respectively experience novel and disappearing climates by 2100 AD. Corresponding projections for the low-end B1 scenario are 4–20% and 4–20%. Already, CO_2 concentrations exceed any recorded for the last 650,000 years and, without a substantive intervention, are projected to increase to 540–970 ppm (140–263% relative to 2000 levels) by 2100 AD." Figure 3 provided by the National Academy of Sciences shows mapped indices of climate change risk for local climate change (A and B), novel 21st-century climates (C and D), and disappearing 20th-century climates (E and F).

Impacts of climate change is further supported by Jessica Forest from the World Resources Institute, who states "global climate has already increased by more than 0.6 °C during the past 100 years and is thought to be the direct result of anthropogenic activities such as fossil fuel burning and forest clearing. Warming trends are expected to continue throughout the next century, and the planet is expected to be 1.4 to 5.8 °C warmer in the year 2100 as compared with today." Figure 4 shows a graph of past and future climate trends.

It is known that there is a drastic influence on biodiversity due to climate change and conservation is needed. Hamilton provided six principles in conservation. First, locations that have a low human impact should remain suitable for species even if the identities of those species change. Second, areas of high environmental heterogeneity provide greater buffering of climate change and should be protected. For example, mountains provide a microclimate for organisms and provide a buffer to climate change. Third, concentrate new conservation efforts

on areas of high species diversity, endemism, and genetic diversity. Next, reduce existing stressors on the environment by reducing pollution, deforestation, and other negative environmental influences. Also, place an honest value on goods and services that flow from biodiversity and ecosystems while eliminating perverse subsidies. And don't use tax dollars to undercut the environment. For example, don't use tax dollars to build roads through Yellowstone destroying environments that need protection. Last, improve landscape connectivity to support species to track shifting climates.

Landscape connectivity is the most important principle in conservation by helping species with climate change adaptation. Regions of existing and proposed landscape connectivity around the world can be seen in Figure 5 provided by Wikipedia. Connectivity is going on worldwide; species are migrating from Yellowstone to the Yukon, and from southeast Australia to northeast Australia in order to adapt to climate change and efforts need to be made to support the movement.

According to conservationists, Locke and Mackey, "Large-scale nature conservation is a first order climate change strategy for both mitigation and adaptation. Keeping green carbon stored in large intact natural landscapes is a mitigation strategy. Connectivity conservation is an adaptation strategy. Both are needed. Such action is also necessary to address the biodiversity extinction crisis and preserve the ecosystem services such as freshwater on which all humans rely."

Today, public awareness, data, and political movements for ecological economies have all increased, but still more needs to be done to conserve biodiversity. The only way for conservation change is if people care. Efforts are being made to educate people of the impact each individual has in reducing their carbon footprint. Going carbon neutral can change the

trajectory of the global warming curve and conserve biodiversity, the future of the world depends on it.

Figure 1. Protected Areas of North America provided by Global Forest Watch

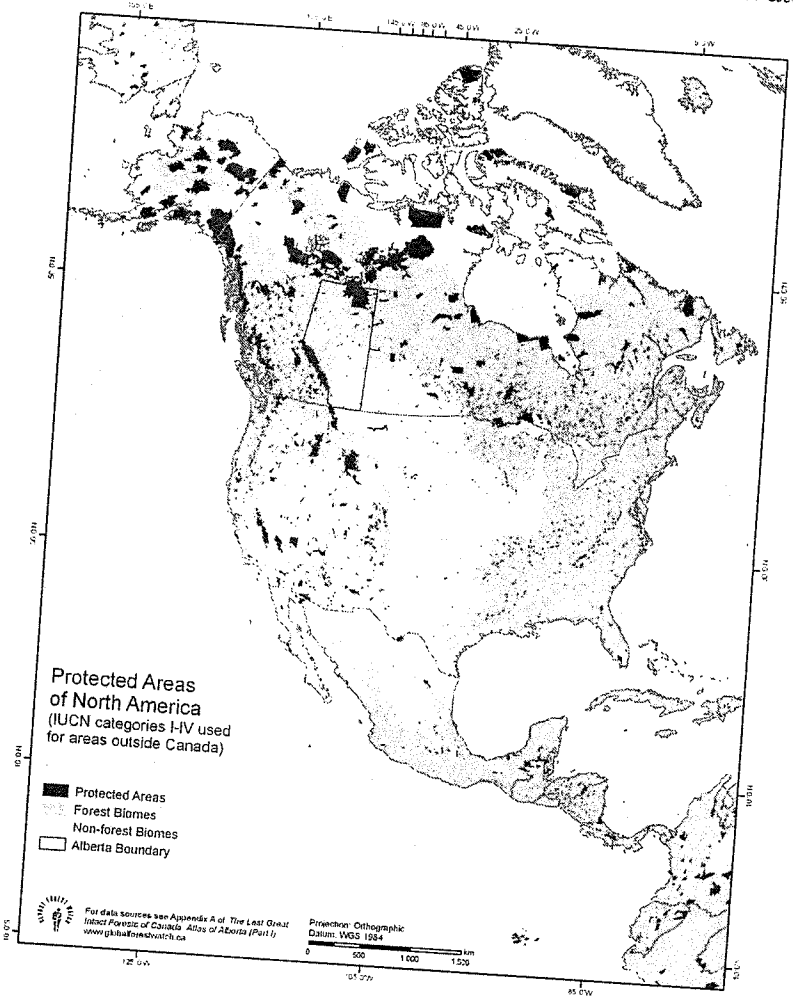


Figure 2. Global Protected Areas provided by the World Resources Institute

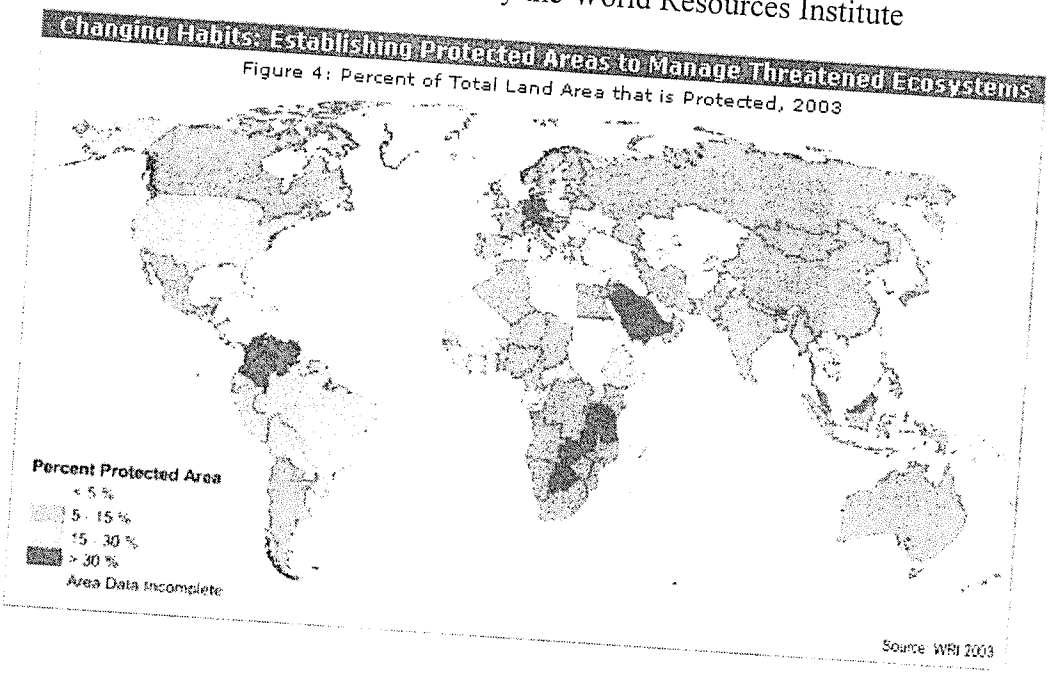


Figure 3. A2 and B1 climate change scenarios provided by the National Academy of Sciences

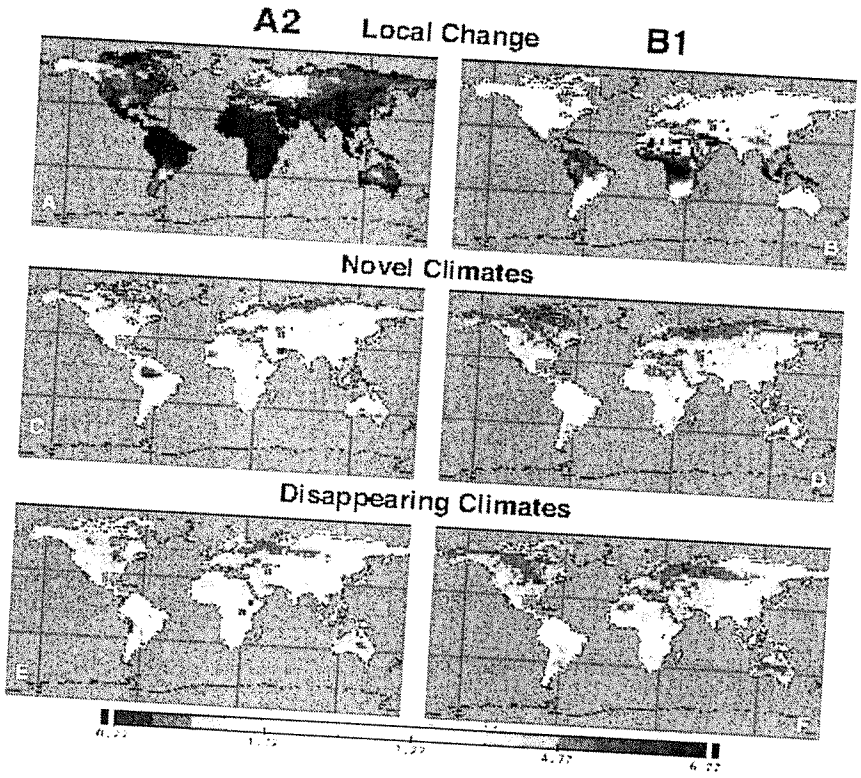


Figure 4. Projected global warming trends provided by the World Resource Institute of the United States of America

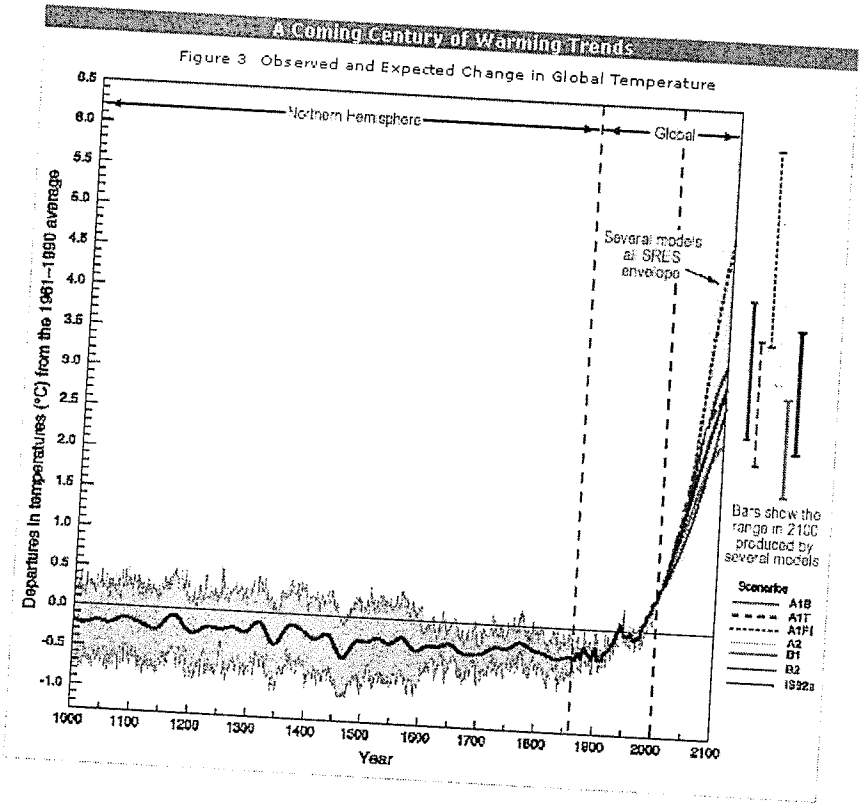
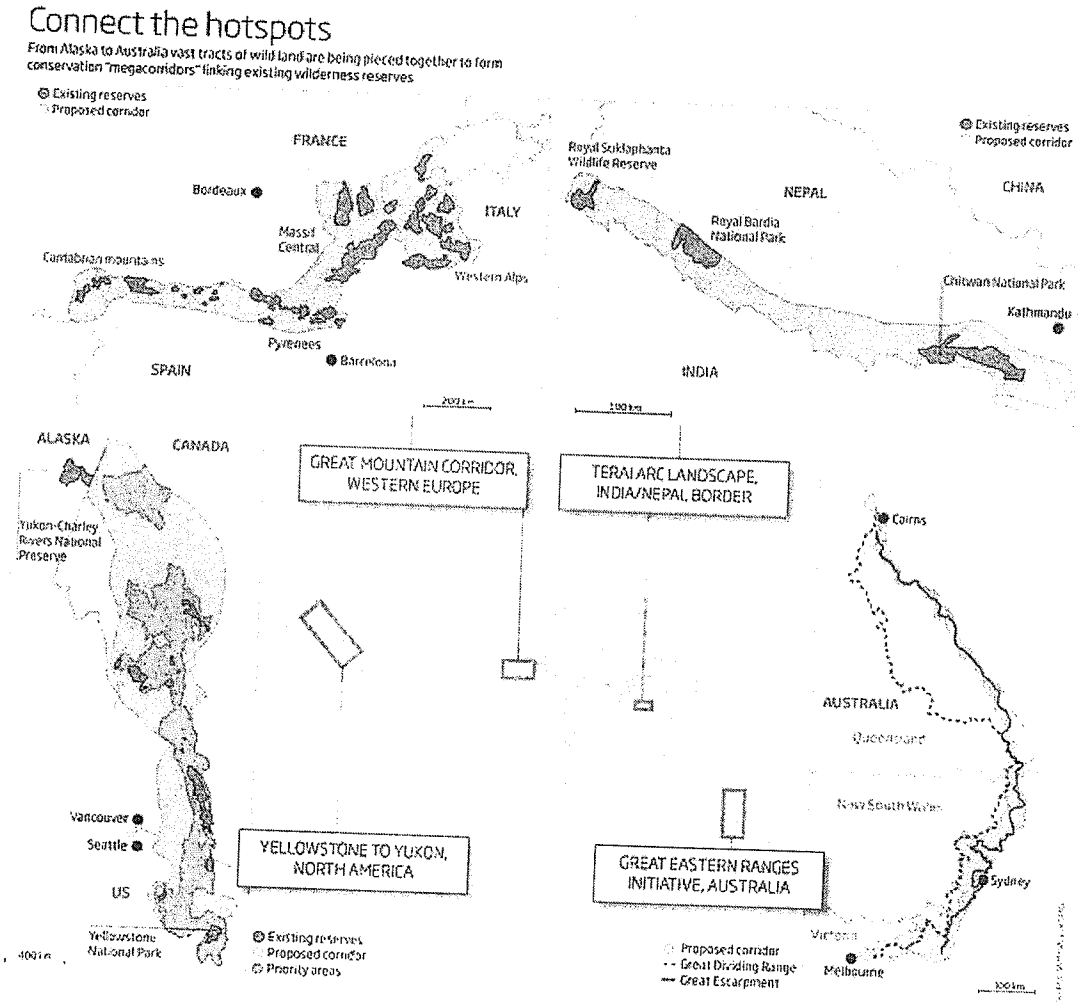


Figure 5. Regions of landscape connectivity provided by Wikipedia



References

Forest, Jessica. "Projecting Ecosystems in a Changing World." Global Resources Institute. July 2003. 17 Apr. 2010. <http://images.google.com/imgres?imgurl=http://earthtrends.wri.org/images/bio_fea_protect_fig4.gif&imgrefurl=http://earthtrends.wri.org/features/view_feature.php%3Ftheme%3D7%26fid%3D47&usg=__uXP5IEqZ_YGqFnHS6Orn6lsm1gk=&h=332&w=555&sz=32&hl=en&start=9&um=1&itbs=1&tbnid=LgUuK4P8cmzwvM:&tbnh=80&tbnw=133&prev=/images%3Fq%3Dprotected%2Bareas%2Bglobal%26um%3D1%26hl%3Den%26rls%3Dcom.microsoft:en-us:IE-SearchBox%26rlz%3D1I7IRFA%26tbs%3Disch:1>.

Hamilton, Healy. "Conserving the Diversity of Life in an Era of Rapid Global Change." Poe Symposium, Camarillo. 16 Apr. 2010.

"Harvey Locke." Wikipedia.org. 30 Mar. 2010. 17 Apr. 2010. <http://en.wikipedia.org/wiki/Harvey_Locke>.

Locke, Harvey, and Mackey, Brendan. "The Nature of Climate Change: It is Time to Reunite International Climate Change Mitigation Efforts with Biodiversity Conservation and Wilderness Protection." The Wild Foundation. August 2009. 17 Apr 2010. <http://www.wildeurope.org/attachments/053_Climate%20Change%20--%20Wilderness%20and%20Biodiversity_%20Locke_and_Mackey%20IJW%20in%20press.pdf>

"The Last Great Intact Forest Landscapes of Canada: Atlas of Alberta (Part I)." World Resources Institute. 17 Apr. 2010. <www.globalforestwatch.ca/.../maps-partI.htm>.

Williams, John, Jackson, Stephen, and Kutzbach, John. "Projected distributions of novel and disappearing climates by 2100 AD." Proceedings of the National Academy of Science of the United States of America. 27 Mar. 2007. 17 Apr. 2010 <http://www.pnas.org/content/104/14/5738.full.pdf+html>.

Paulina Kolic

May 4, 2010

Chem 301

Poe Symposium: Dr. Paul Wennberg

Monitoring global carbon dioxide emissions

Dr. Paul Wennberg is currently a professor at California Institute of Technology. He received his B.A. in Chemistry from Oberlin College, and his Ph.D. in Physical Chemistry from Harvard. Dr. Wennberg's work is concerned with measurements of carbon dioxide, mechanisms related to the carbon cycle, and the oxidative chemistry of trace gases in the troposphere.

The main focus of Dr. Paul Wennberg's research is the measurement of carbon dioxide (CO_2) globally, in order to gain a more well-rounded understanding of the carbon cycle and its sources and sinks. The carbon cycle describes the cycling of carbon from first appearance (source) in the environment to the eventual consumption (sink). Sources of CO_2 include natural sources such as: human and animal respiration, and volcanic activity; and anthropogenic sources such as fossil fuel combustion and land use changes. Carbon dioxide sinks include temporary sinks like partial solubility in water and absorption by terrestrial plants during photosynthesis; and a permanent sink where CO_2 to form $CaCO_3$, which is deposited on the ocean floor. In temporary sinks, the CO_2 that is absorbed is later re-emitted. The only permanent sink of CO_2 is a relatively slow process, which can take hundreds of years.[3] Figure 1 shows a schematic diagram of the carbon cycle and its sources and sinks.

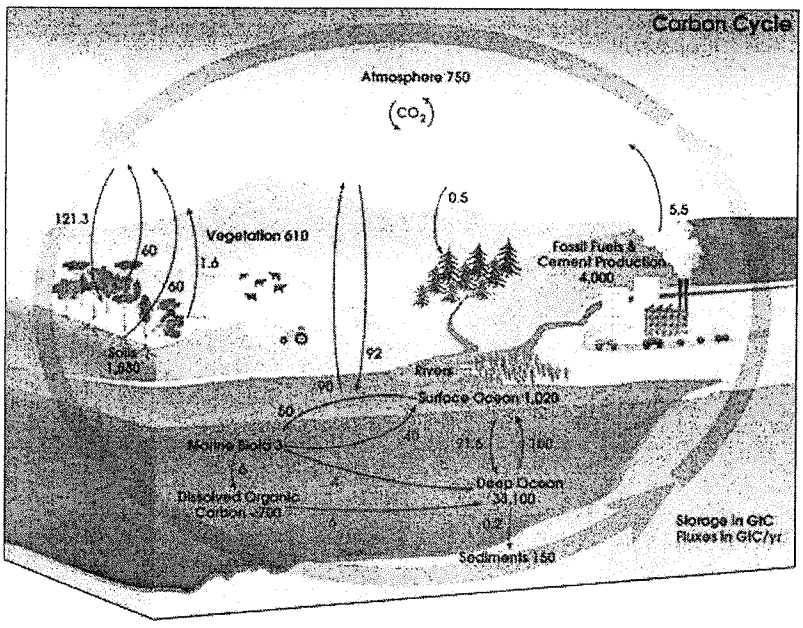


Figure 1. Schematic diagram of the carbon cycle, including sources (Fossil fuel combustion, vegetation, land use changes) and sinks (ocean and terrestrial plants).[4]

In the past 160 years, beginning with the industrial revolution, increasing amounts of greenhouse gases have been measured in the atmosphere. As seen in Figure 2, the concentration of CO_2, CH_4, and N_2O have risen astronomically.

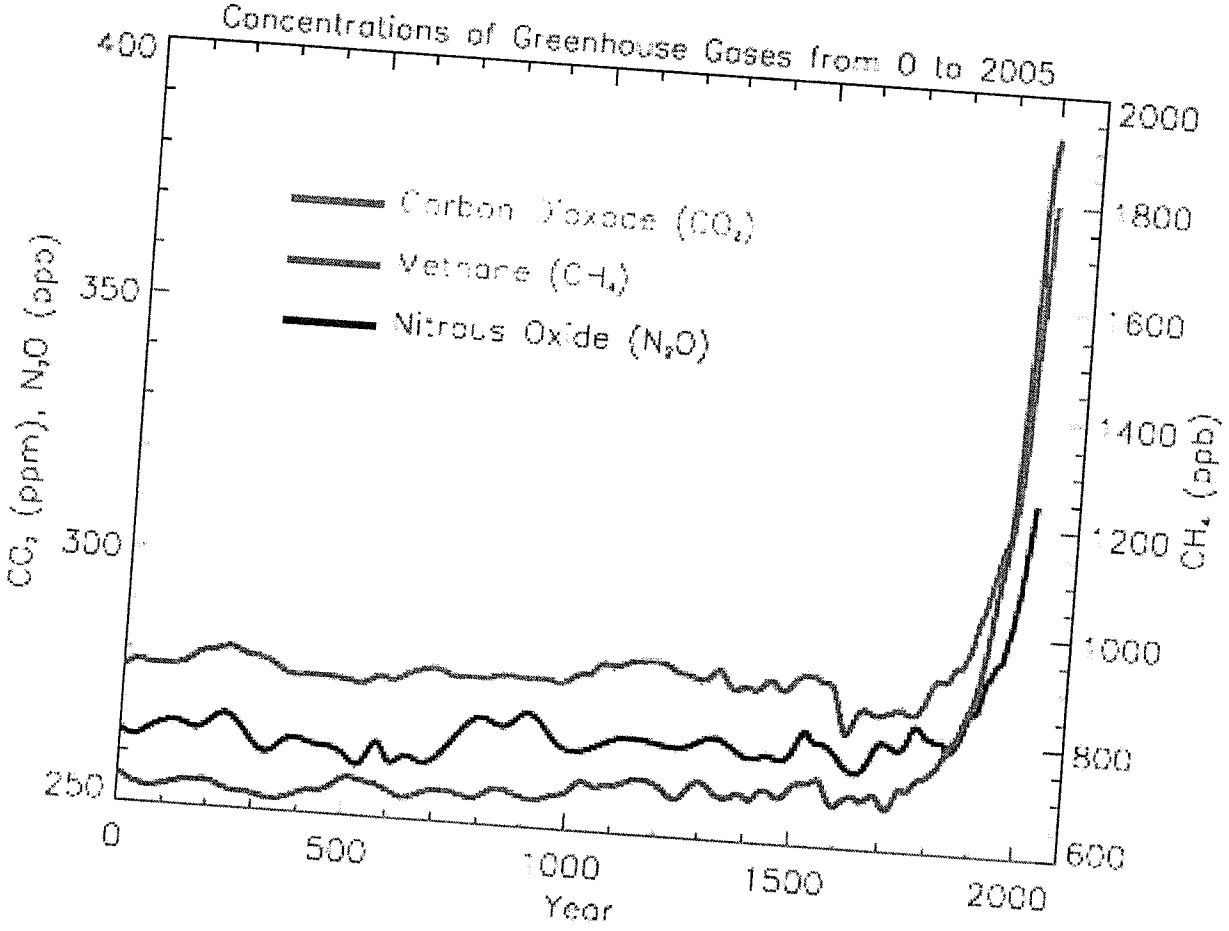


Figure 2. Concentrations of CO_2, CH_4, and N_2O versus time.[7]

Carbon dioxide is the most important greenhouse gas (behind water) because it has a larger radiative forcing than all other long lived greenhouse gases combined. As shown

in Figure 3, a radiative forcing of 1.66 W/m^2 is associated with CO_2, the largest of all anthropogenic sources.

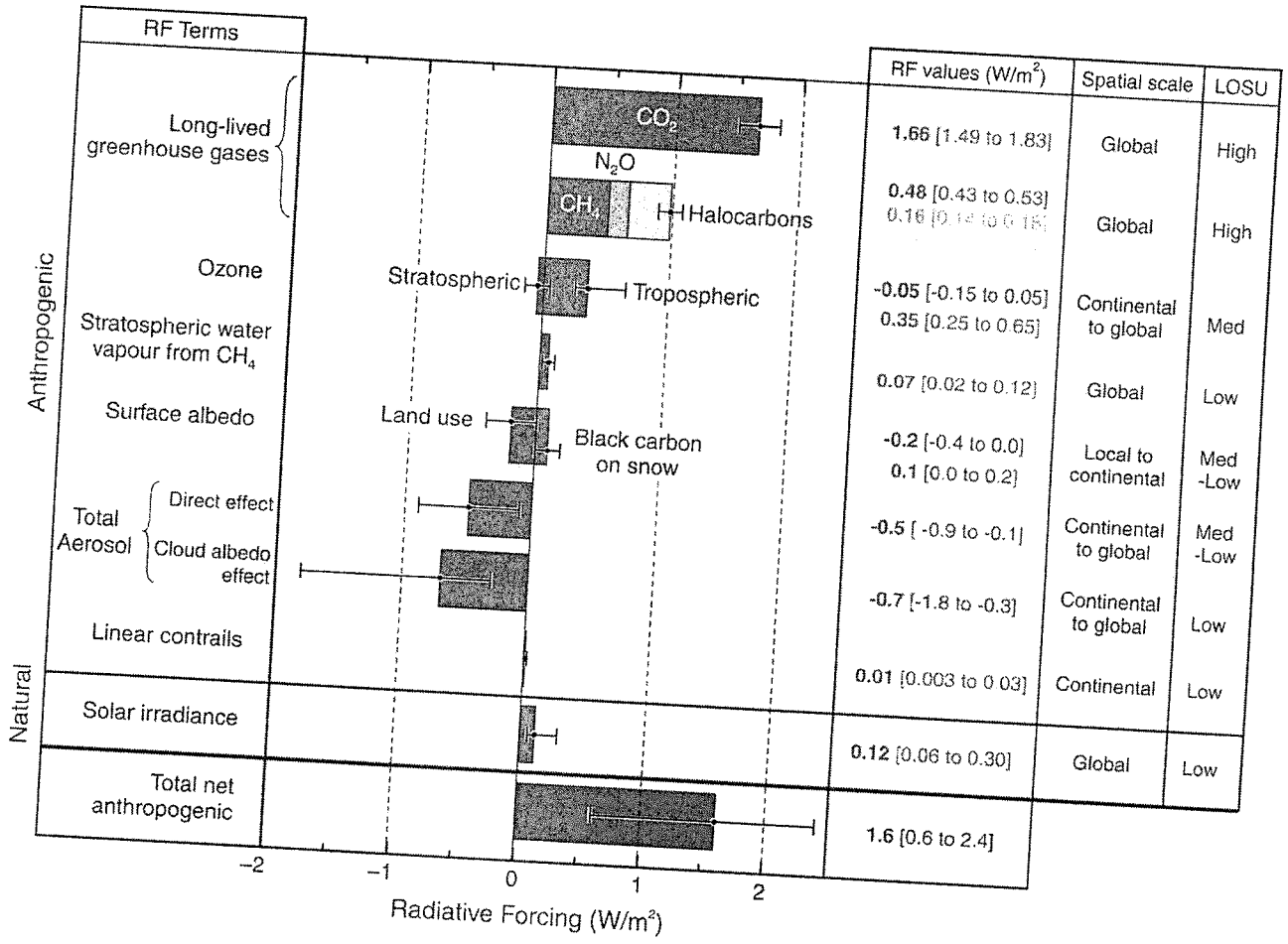


Figure 3. Components of radiative forcing (RF) and the amount of RF associated with them.[5]

Baseline CO_2 concentration is 280 ppm[1], and current levels are 390 ppm. Figure 4 shows the concentration of CO_2 from 1960 to 2010. It is important to note that most of the increase since preindustrial times has occurred in the past 50 years. This rise is

largely due to land use changes (25%) and fuel consumption (75%). The CO_2 emissions are especially rising because of the increasing amount of coal used in China as the country industrializes; the United States is also a major contributor. The rise in CO_2 levels also occurs because the CO_2 sinks that exist are not sufficient enough to destroy the copious amounts produced by human activity. Each year the efficiency of the CO_2 sinks fluctuates, for example, solubility of CO_2 in the ocean decreases with increasing temperature. El Niño, a weather phenomenon which associated with causing warmer ocean temperature can causes changes in the global carbon sources and sinks. Because of the uncertainties in the carbon cycle, it is very hard to accurately predict CO_2 concentrations in the future.

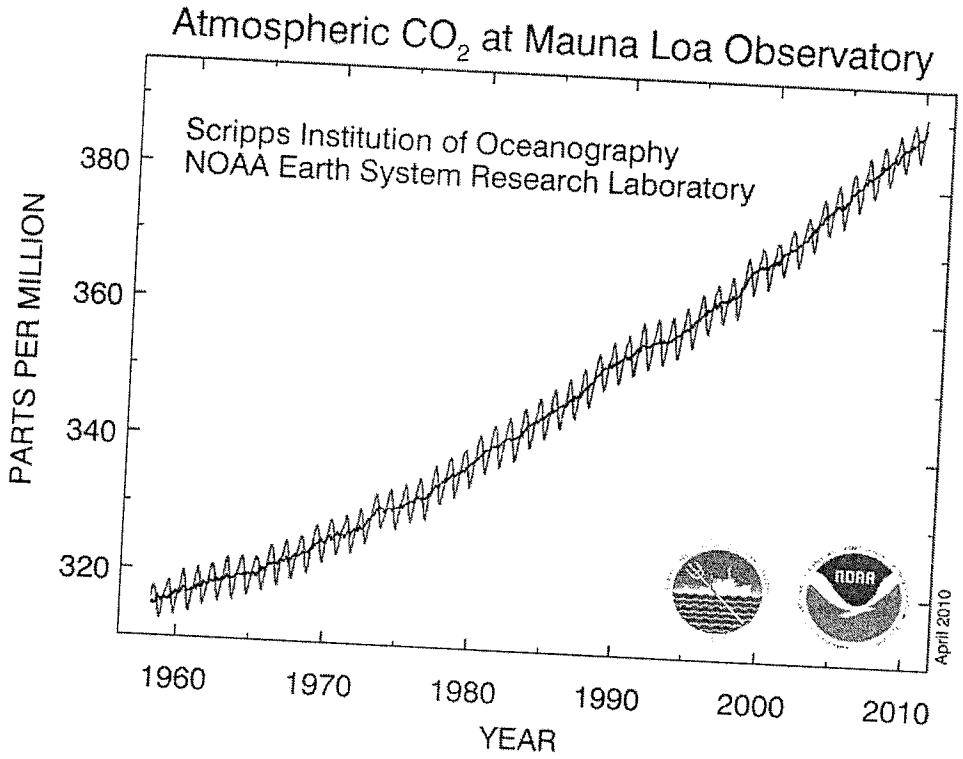


Figure 4. Keeling curve which shows the atmospheric CO_2 concentrations versus time.[6]

The sun emits light through the atmosphere, which eventually reaches the surface of the earth. About two thirds of this light reaches the ground with the other third being reflected (albedo). Most of the light that is absorbed by the earth is reradiated into the atmosphere; however, some of this light becomes trapped by greenhouse gases, which absorb the light then reradiate it to the surface. This results in the enhanced greenhouse effect, or global warming (climate change). The earth emits light between 2 μM to 100 μM. Some molecules (greenhouse gases) absorb some of that light, H_2O (water) being the most efficient at absorbing, then HDO, CO_2 (carbon dioxide), O_3 (ozone), and finally N_2O (nitrous oxide). Carbon dioxide very effectively absorbs light at 15 μM, therefore trapping the light and warming the surface of the earth. When human activities such as driving and cement production increase the concentration of greenhouse gases, a warming effect is created.

Earth is not the only planet that undergoes the greenhouse effect. Mars, who has comparable amounts of CO_2 to earth is conversely very cold in comparison to Earth. Unlike Earth, Mars does not have an atmosphere filled with H_2O or N_2, which enhances the greenhouse effect. On the other hand, Venus is largely hotter in comparison to Earth with temperatures reaching 700 K as a result of an atmosphere being composed mainly of CO_2 and some nitrogen. Venus, as quoted by Wennberg, is an 'efficient greenhouse' with a 'carbon cycle run amuck.'

Human activity is very much responsible for the increase in CO_2. As described by Dr. Wennberg, there is about a 3 ppm, (1%) variation of the CO_2 concentrations between the northern and southern hemispheres. The northern hemisphere has a larger land mass and therefore CO_2 emissions are higher than the southern

hemisphere. The difference in CO_2 levels is attributed to the continuous pouring of CO_2 into the atmosphere, as it takes about 1 year for the concentration to equilibrate between the northern and southern hemisphere.

There is much uncertainty and research needed to be done to completely understand the carbon cycle. For example, what processes limit the amount of CO_2 absorbed in the ocean and into the land? As shown in Figure 5, various models give significantly different predictions for the amounts of greenhouse gases released and the surface warming accompanied by those emissions.

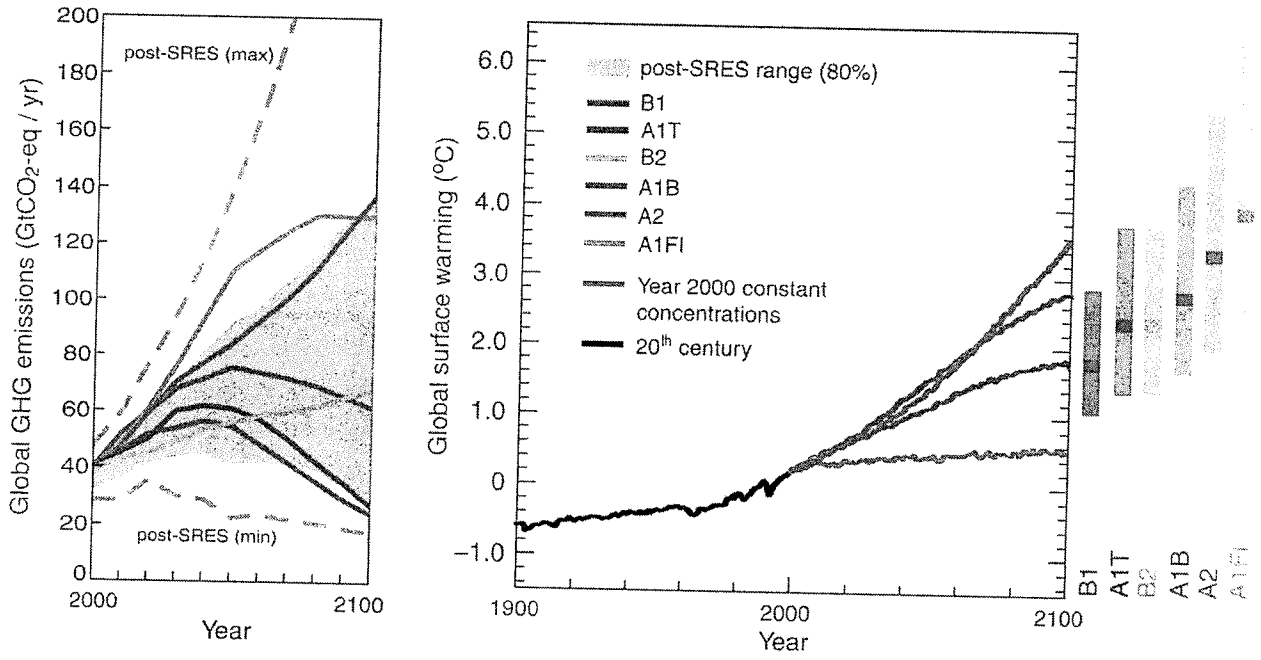


Figure 5. Projection of global surface warming using different models.[5]

Dr. Wennberg's project is based on developing a space based measurement of carbon dioxide. Such a system would provide a global perspective on sources and sinks of CO_2 and enable more precise predictions of CO_2 concentrations. The current CO_2 monitoring system, also another project of Dr. Wennberg, is the Total Carbon Column Observing Network (TCCON). It is a ground based system that uses Fourier Transform spectrometers to measure the concentrations of CO_2 and other and other gases, based on near infrared spectra. However, ground based systems do a poor job at giving the overall picture of CO_2 sources and sinks as there are few stations in the oceans, tropics, and developing countries.[2] The NASA Orbiting Carbon Observatory (OCO) was developed to suit these needs. The OCO orbits around the Earth and takes measurements of the sunlight reflected off the surface of the Earth. It does this through the use of three bore sighted grating spectrometers which measure the O_2 band at 0.76 μm and the CO_2 band at 1.68 μm and 2.06 μm.[1,2] The system makes measurements based on CO_2 dry air mole fraction (X_{CO2}) by using the spectra of the near infrared (NIR) which is preferred as it has a higher sensitivity, compared to thermal infrared.[2] Thermal infrared measures the CO_2 band at 4.3 μm and 15 μm, however, this measurement can vary with temperature.[2] Target precision for the OCO is within 1 ppm.[2] Data retrieved from the OCO can be compared to ground based systems that also use NIR.

The OCO was set to launch in 2009 for two years with monthly readouts. The OCO was launched on February 24, 2009, but failed to reach orbit. Another launch is scheduled for February 2013.

The global carbon cycle is of major scientific interest. Carbon dioxide is the major anthropogenic source associated with 0.74°C temperature rise that has occurred over

the last 100 years. Understanding the carbon cycle and the sources and sinks of CO_2 is significant in determining future concentrations of CO_2 and the increase in temperature that will result, however, the carbon cycle is not completely understood by scientists. The cycle is further complicated by yearly fluctuations in the CO_2 sinks. The measurements given by the OCO will be monumental in understanding the intricacies of the global carbon cycle.

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CSUCI Poe Symposium 2010

Speaker: Joseph Francisco, Ph.D.

Jose M. Medina

April 19, 2010

Class: Environmental Chemistry

Dr. Francisco talked about the problems with current man-made materials, their effect on the atmosphere, and potential replacements. In his discussion about the design of green molecules, Dr. Francisco described the general framework of the molecules to be designed, their ability to absorb in the infra red region, and their global warming capability based on the type and number of halogens in the molecule.

The goal of the research done in Dr. Francisco's laboratory is to determine the fate of a chemical system once it is released into the atmosphere and how the system affects it's atmospheric environment. Some man-made compounds released into the atmosphere include CFC's and HCFC's, which were used as aerosol propellants and refrigerants. The use of these two types of molecules has decreased dramatically due to easy to replace greener molecules, but older refrigerators and air conditioning systems still contain them. These systems are ideal in that they are non- toxic, non-flammable, stable, and have great thermo-physical properties; but they are also insoluble in water and have long enough lifetimes (75 – 200 years). This gives them the ability to make it from the troposphere to the stratosphere where they are decomposed by UV light. When decomposed, these molecules release chlorine radicals which react with many molecules of ozone to form molecular oxygen and thereby contributing to the depletion of ozone.

In the stratosphere, ozone is needed because it absorbs ultra violet light in the range of 410 and 760 nm, reducing the amount of it that reaches earth's surface. Ultra violet light is high energy light that causes skin cancer by rearrangement of DNA, eye problems, and dead vegetation. A decrease in stratospheric ozone means an increase of UV light reaching the surface of the earth, which in turn means higher occurrence of skin cancer, eye problems, and dead vegetations. This fact is the driving force for Dr. Francisco's research. The goal is to analyze what a chemical system does in the environment in order to be able to design molecules with similar beneficial properties and minimal negative environmental impact.

One technique commonly used in Dr. Francisco's lab is computational simulations. An example of such is the use of the GAUSSIAN 92 program to perform molecular orbital calculations and optimize geometries for reactants, reaction intermediates, and products. This technique was used for the reaction between HCO and H_2 and the reaction between FCO and H_2 (1). The use of this computer

program allowed comparison of the transition states of the two reactions. The observed bond length of the new C-H bond in the HCO reaction is 1.265 Å, while the bond length of the new C-H Bond in the FCO reaction is 1.340 Å. The comparison of OCH bond angle also revealed structural differences. This bond angle for the HCO reaction showed to be 121.8°, the bond angle for the FCO reaction showed to be 126.7°. This indicated that non-bonded repulsions were greater for the FCO reaction than for the HCO reaction. The role of the computer program is to help predict how bond angles and lengths are affected from molecule to molecule depending on the type, position, and number of halogens present in the molecule. This may lead to ozone friendlier molecules by being able to predict what atoms make molecules more water soluble and let them keep their thermo-physical properties and stability.

The use of similar computer programs can be used to map a molecule's Global Warming Potential (GWP). The GWP is directly related to the concentration of the new molecule in the environment and its life time. Although the concentration of the molecule will ultimately depend on the uses industry finds for it, the molecule's lifetime can be estimated with theoretical concentrations. Lifetime of a molecule is directly related to how much ozone it will remove or in general how much damage the molecule will do. The mathematical definition of GWP is

$$\mathrm{GWP}_i = \frac{\dfrac{\partial}{\partial e_i}\left[\int_0^h F(t)\,\mathrm{d}t\right]}{\dfrac{\partial}{\partial e_0}\left[\int_0^h F(t)\,\mathrm{d}t\right]} = \frac{\int_0^h \Delta C_i(t) R_i(t)\,\mathrm{d}t}{\int_0^h \Delta C_0(t) R_0(t)\,\mathrm{d}t}$$

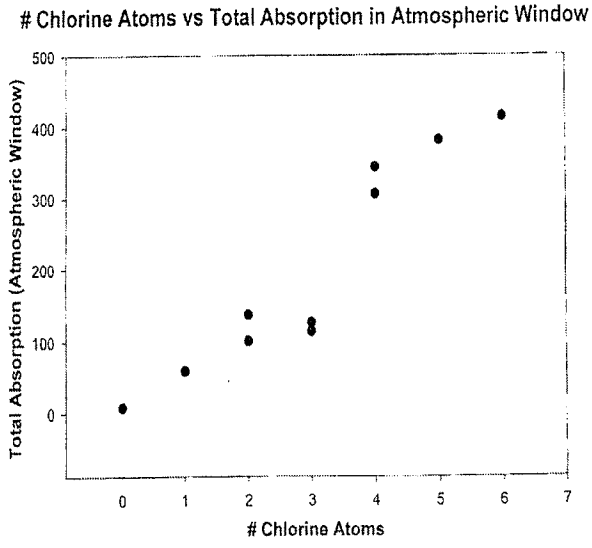
where C = atmospheric concentration, R = radiative forcing per unit, F (t) = total radiative forcing at time t, and h = specified time horizon (2).

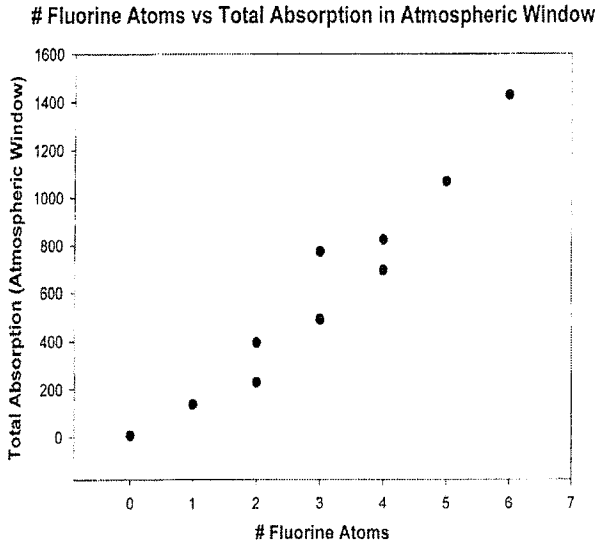
GWP is a model normalized to carbon dioxide measurements. This means that both concentration and lifetime must be around the values for carbon dioxide. Inaccuracy of the model will increase as these values deviate from those of CO_2. This model has been used to theorize potential molecules that, if

developed, might find uses in industry and will likely be better on the environment and warming than CO_2.

The potential molecules being derived in Dr. Francisco's lab have three different frames. The frameworks are CX3-CX3, CX3-O-CX3, and CX3-S-CX3 where X can be hydrogen, fluorine, or chlorine. As it is evident, these molecules can have as little as one halogen and as many as six. As far as being water soluble and easily removed from the atmosphere, the ether backbone seems the most favorable as the oxygen will be able to hydrogen bond to surrounding water as a hydrogen bond acceptor. The strength of the hydrogen bond will decrease as more halogens are placed on the neighboring carbons due to steric effects. The halogens, being larger than hydrogen, will create a bigger gap between the oxygen's electrons and the bonding water decreasing the strength of the intermolecular bond.

Some details about the results were given, however the specific molecules that the results were acquired from were kept confidential, as the results are not yet published. In regards to the CX3-CX3 backbone, the results indicate that as the number of chlorine atoms increases, the molecule's ability to absorb frequencies increases as well.





As the graphs show, whether the halogen is chlorine or fluorine, as the number of halogens increases so does the ability of the molecule to absorb in the atmospheric window (2). This can be explained with basic chemistry. As more chlorine or fluorine atoms bond to the central carbon, the dipoles of the molecule become amplified. The more amplified dipoles have greater vulnerability and can therefore be vibrated by a larger range of frequencies resulting in a greater radiative forcing potential for molecules containing a larger number of halogens. This increased ability to absorb IR makes the molecule a bad candidate since its more likely that it will be a greenhouse gas so an optimum value must be found, balancing the minimal number of halogens a molecule can have and still keep it beneficial properties.

It is also worth noting that molecules containing fluorine rather than chlorine have much higher global warming potential, as shown by the graphs. Fluorine being much more electronegative makes the central carbon more positively charged, especially when more of them are added, resulting in a greater dipole and an increased capability to absorb IR frequencies. In addition to the amplification of the dipole moment, fluorine containing molecules tend to be very stable. This stability reduces the ability of the molecule to be reduced by the hydroxyl radical especially as more fluorines are added, increasing molecular lifetime and its global warming potential.

It is known that if global warming wasn't in the picture, fluorine containing molecules would be an ideal replacement for the chlorine containing molecules . Havingh less chlorine containing molecules in the stratosphere would decrease the number of chlorine radicals released. This would let more ozone in the stratosphere by not catalizing its convertion to oxygen. Considering global warming, fluorine containing substitutes make better greenhouse gasses due to their stability and increased dipole moment. The solution to one problem amplifies the other. The research in Dr. Francisco's lab is aimed at finding the optimum balance between ozone depletion potential and global warming potential of the

three types of molecules described above. The overall effect of the system on its environment both in the short and long term will dictate whether it's a suitable replacement for current HFC's being used.

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Poe Symposium:

"The Discovery of Global Warming"

By Spencer Weart

Student's Name: THUY VU
Date: 04/26/2010
Class: Chem 301, Environmental Chemistry

Everyone has heard of the prediction that the greenhouse effect will significantly affect climates around the world in the future. The term *global warming* simply means that average global air temperature will increase several degrees as a result of the buildup of carbon dioxide and other greenhouse gases in the atmosphere. The story of how scientists reached their conclusion is told in the book titled "*The Discovery of Global Warming*". Spencer Weart explained the emerging science, introduced us to the major players, and showed us how the Earth's irreducibly complicated climate system was mirrored by the global scientific community that studied it. The book also portrays scientists working on bits and pieces of a topic so complex that they could never achieve full certainty; however, it is so important to human survival that provisional answers were essential. By the end of the book it has become an epic tale where entire governments, national publics, and communities of scientists press upon one another. During his presentation, Weart talked and mentioned the most important events in the history of climate change science gathered in chronological sequence.

The greenhouse effect is the process by which absorption and emission of infrared radiation by gases in the atmosphere warm a planet's lower atmosphere and surfaces. It was discovered by Joseph Fourier in 1824. Fourier calculated that the Earth would be far colder if it lacked an atmosphere. It was also investigated quantitatively by Svante Arrhenius in 1896. Arrhenius published first calculation of global warming from human emissions of carbon dioxide. A global warming trend since late 19^{th} reported in 1930s (Figure 1). Northern Hemisphere Temperature went up in 1940 and fall down in 1960. The global carbon dioxide fluctuations follow the seasons of the Northern Hemisphere, since there is so much more land mass and hence much more vegetation there compared to Southern Hemisphere. Although more greenhouse gases are

emitted in the Northern than Southern Hemisphere this does not contribute to the difference in warming because the major greenhouse gases persist long enough to mix between hemispheres.

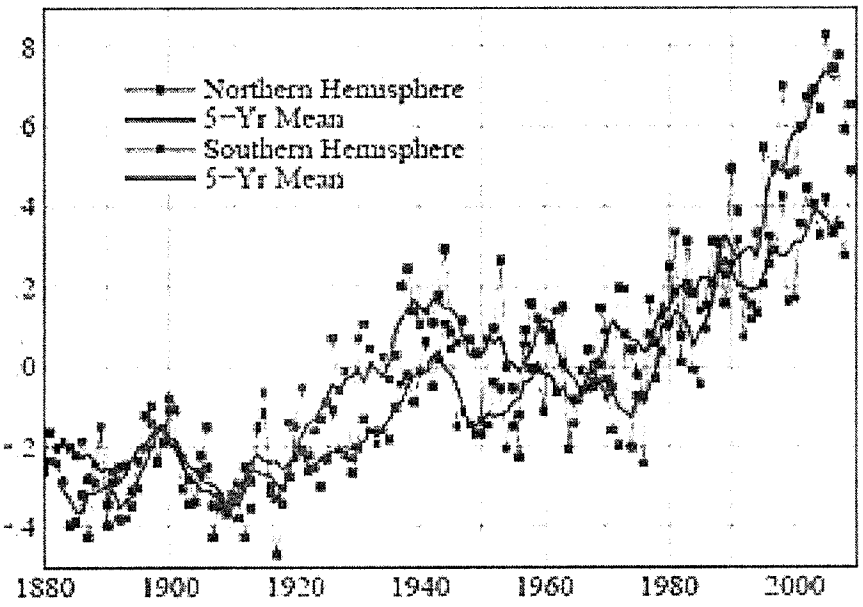

Figure 1. *The NASA global temperature data separated into Northern and Southern Hemisphere curves. Note the greater variation in the North. (Warming was especially pronounced in the Arctic, as predicted.)*

During the 1940s only a few people looked into the question of warming. A prominent example was the Swedish scientist Hans Ahlmann, who voiced concern about the strong warming seen in some northern regions since early in the century. But in 1952, he reported that northern temperatures had begun to fall again since around 1940 [1]. Another person who also concerned the question of warming was Guy Stewart Callendar. Callendar argued that carbon dioxide greenhouse global warming is underway. Reviving an old theory that human emissions of carbon dioxide gas (CO_2) from burning fossil fuel could cause a "greenhouse effect," Callendar said this was the cause of the warming.

In 1960 David Kelling accurately measured CO_2 in the Earth's atmosphere and detects an annual rise (Figure 2.). The level is 315 ppm. Mean global temperature is 13.9°C. Carbon dioxide concentration increased every five years.

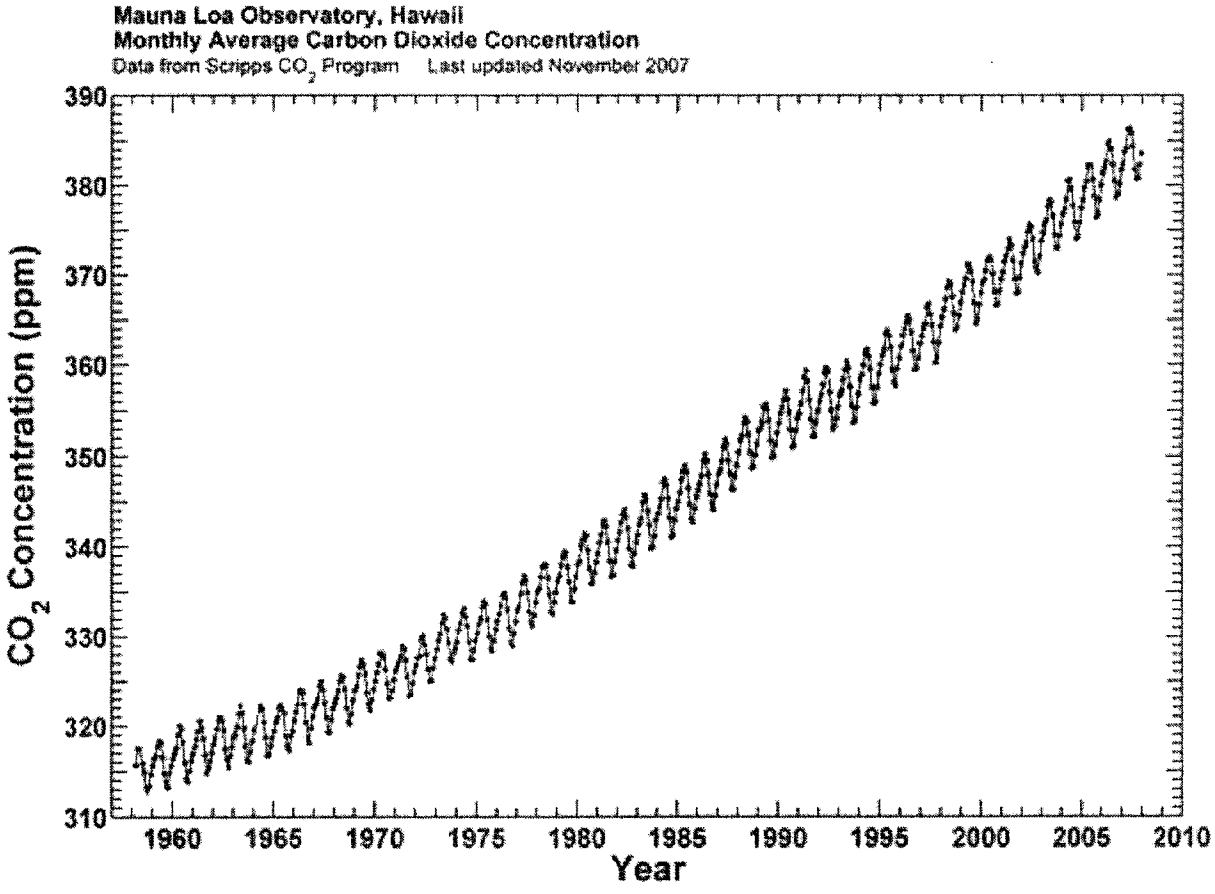

Figure 2. CO_2 Concentration increases every five years

Acknowledging that the increasing amount of CO_2 in the atmosphere should give a tendency for warming, Murray Mitchell tentatively suggested that smoke from recent volcanic eruptions and perhaps cyclical changes in the Sun might partly account for the reversal. But he rightly held that "such theories appear to be insufficient to account for the recent cooling," and he could only conclude that the downturn of global temperature since the early 1940s [3]. A 1967 calculation suggested that average temperatures might rise a few degrees within the next century. The next century seemed too far, however, the calculations were plainly speculative.

In the early 1970s, alongside the greenhouse effect, some scientists suggested that human activity was putting dust and smog particles into the atmosphere, where they could block sunlight and cool the world. Serious droughts since 1972 increased concern about climate, with cooling from aerosols suspected to be as likely as warming; scientists are doubtful as journalist's talk of a new ice age. One expected discovery was that the level of certain other gases was rising, which would add seriously global warming. CFCs were found in 1975, and also methane and ozone were found in 1976. Some of these gases also degraded the atmosphere's protective ozone layer. Moreover, by the late 1970s global temperature had evidently begun to rise again. U.S National Academy of Sciences report found it was highly credible that doubling CO_2 would bring 1.5 – 4.5°C global warming.

In 1981 Jim Hansen showed that sulfate aerosols could significantly cool the climate, raising confidence in models showing future greenhouse warming (Jim Hansen's Seasonal Climate Model). When Mt. Pinatubo exploded, Hansen predicted cooling pattern, and he verified computer models of aerosol effects (1991).

With rising global temperature, international panels of scientists warned the world to take active steps to cut greenhouse gas emissions. This claim about climate change caught wide public attention. Due to many scientific uncertainties and the sheer complexity of climate, Intergovernmental Panel on Climate Change (IPCC) was established in 1988, which gave scientists the most reliable possible advice, as negotiated among thousands of climate experts and officials. At this point the discovery of global warming was completed. Now scientists knew what the most important things were when climate could change and predicted how it could change during the 21st century.

Since 2001 from improved computer models and an abundance of data strengthened the conclusion that human activity or emissions are very likely to cause climate change. How the climate actually changes depends on what policies humanity chooses for its greenhouse gas emissions.

At the end of presentation, Weart also discussed that global warming was a human-caused reality. The temperature is very likely to rise by 1.4 to 5.8oC by the end of the century. The world is getting warm. Although only a small fraction of this warming had happened, effects could be predicted visibly in some regions, such as more deadly heat waves, rising sea level, stronger floods and droughts, the spread of tropical diseases and the decline of sensitive species. Therefore, we should take an action to stop it. Individual citizens not only participate in this action, but government is also responsible for greenhouse effect. As we learned that greenhouse gases contain carbon dioxide, water vapor, nitrous oxide and methane. CO_2 is the main chemical in the air. This gas collects light and heat, produced by the sun, and this makes the earth warmer. There are some ways to reduce this greenhouse gas, for example, planting trees and recycles. Taking action on climate change can also make our economy more internationally competitive by creating growth and jobs while producing less waste, pollution and greenhouse gases.

In conclusion, from Weart's presentation we know how the term "global warming" was discovered by scientists from ideas and observation of climate change to calculations of carbon dioxide since 1980s. Now we also know that climate may already be changing because of the existing buildup of greenhouse gases in the atmosphere. Therefore, we must be prepared to adapt to those changes and must start planning now on adaptive responses. By doing so, we may help to lessen some of the environmental, economic and social costs of climate change.

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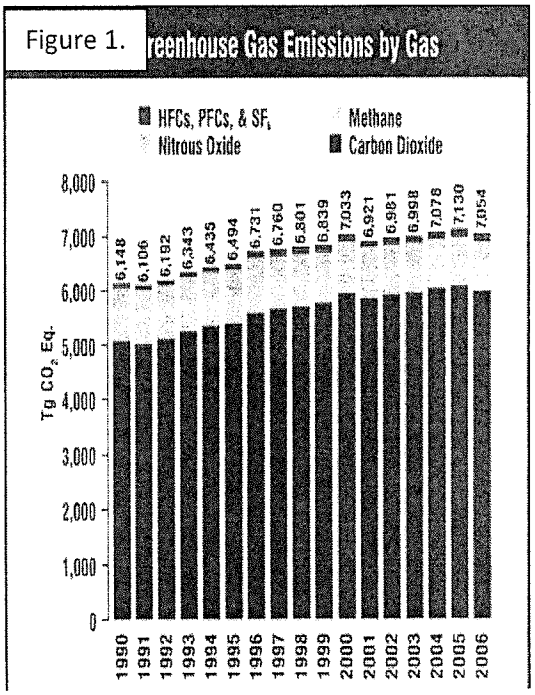
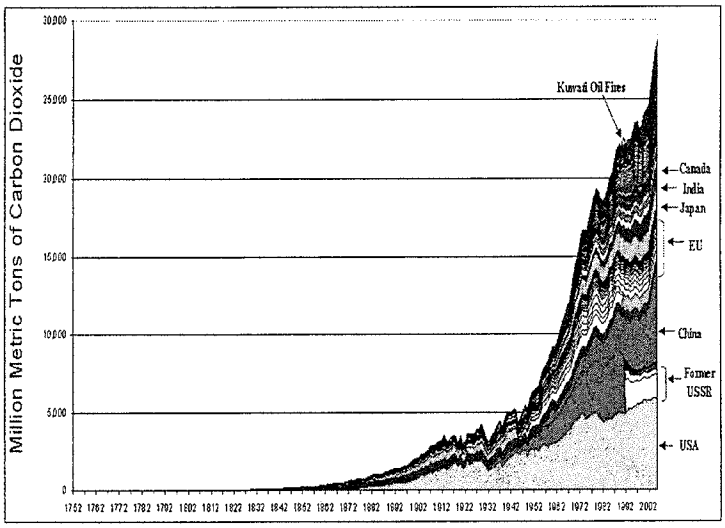
Tyler Nestved

Climate change is a big deal today, and growing to be a bigger hotter deal tomorrow. There is a lot of controversy that surrounds climate change; however, it is clear that the temperature is rising and that humans have a very large, not so divine, hand in the cause. People have caught greenhouse gases red handed as the global warming culprit and humanities contributions through carbon emissions the smoking gun to the crime. What can civilization do about it? How can people curve the curve? The goal is to reduce the human carbon footprint and live carbon neutral lives. If humanity can offset and reduce the same amount of carbon as they emit, the net difference would be neutral to the environment. Through the Environmental Protection Agency (EPA) and various carbon offset companies, such as TerraPass, the US can see where they stand as a nation and what people can do about it as individuals. It is very significant to the future of the planet that everyone is educated on the issues and does what they can to become carbon neutral.

One of the first steps toward carbon neutral success is to understand what

Figure 1. reenhouse Gas Emissions by Gas

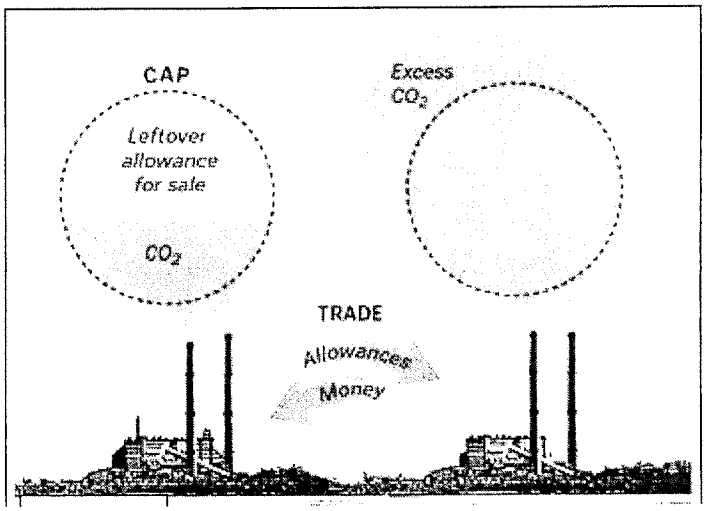




exactly it is that people are emitting. Figure 1 and 2 are from the EPA's website, and confirms that the US carbon emissions are enormous. Figure 1 shows that the primary greenhouse gas emitted by the US is carbon dioxide. Figure 2 shows that by comparison to other countries; the US is responsible for just over a fifth of all the anthropogenic carbon dioxide emissions. The US needs to significantly reduce these numbers and offset as much as they possibly can. An effective way to start doing that is through carbon offsets.

What is a carbon offset, and how does it help reduce emissions? A carbon offset is a credit or certificate that is either given to you or purchased for the reduction of one metric ton of carbon dioxide emissions. It is given to you if you do something that you wouldn't have already done in order to reduce your carbon emissions. For example when a small time dairy farmer builds a structure that traps their methane emissions, and then burns that methane for energy. The farmer is then given a certificate of carbon offset, under the condition that the farmer would not have built the structure for any other reason than to reduce emissions. Or a person can buy the certificates and the money goes to carbon offset projects to reduce emissions such as the example I just gave. The offset certificates can be traded and are part of the economic market. Thus putting a dollar amount on carbon, which calculates to be between $10~$30 per metric ton depending on whom you ask.

The economic market and legislation are entwined with US emissions as well as carbon offsets.



The most common name that is associated with emission standards is cap and trade. Cap and trade is an environmental policy that sets a maximum cap for industry emissions, yet allows certain flexibilities. As shown in figure 3 if one company is easily able to reduce emissions far under the cap while another is not able to, they can sell emission space to each other. Due to the potentially huge cost it can take for very large factories to reduce emissions, buying cap and trade space from another facility can end up being significantly cheaper. On the other hand if it is relatively easy to reduce emissions for a particular factory it can act as incentive for facilities to go the extra mile to reduce emissions because they can profit from selling that extra emission space. Successful cap and trade programs reward innovation and efficiency, while providing strict environmental responsibility.

Now that we know what we emit and some tools for offsetting and reducing those emissions where do all these greenhouse gases, particularly carbon dioxide and methane get emitted from? Carbon dioxide is emitted through the burning of fossil fuels; thus motor vehicle transportation, electricity generation, and industrial processes can account for the most major percentages of the carbon dioxide emissions. Methane is emitted from the production and transport of coal, natural gas, and oil. As well as from the decomposition of livestock waste and landfills. Most of these things are very high in demand and are very difficult to reduce. The individual person also constantly emits greenhouse gasses throughout their daily lives.

An individual might look at these sources of greenhouse gases and say that they have little impact on such big industry. That is just not the case. Industries that spend the money on carbon offsets use it as marketing and are able to say their product is

"green". A single person or family can then choose to purchase recycled materials and "green" products helping to make carbon offsetting and carbon reduction more favorable. Emission standards are political, and voting on the issues is very significant. A family can also go to TerraPass.com or any other carbon offset provider and calculate their own carbon footprint, and work to reduce it. They can purchase carbon offsets to help fund carbon reduction projects. Driving less, carpooling, taking the bus, or purchasing more fuel efficient cars is a tremendous help to reducing carbon emissions. No one thing is a cure all solution, but through good practice of all of these becoming carbon neutral and turning global warming and climate change around is not impossible.

Humanity has a huge role in climate change for better and for worse. The EPA's data has shown us that the US is a major emitter of greenhouse gases thus having the largest effect on global warming. Carbon dioxide and methane are the most predominant greenhouse gases emitted by the US, and are emitted at alarming rates. To reduce the amount of emissions we have many tools. Cap and trade is an environmental policy that is reducing emissions at the industrial level. Legislation and policies can be voted on and passed to reduce emissions. Carbon offsets are investing in the development of carbon neutral practices and significantly reducing the emissions. Individuals can invest in carbon offsets as well as work to reduce their own carbon footprint. Humanity needs to act fast to curve the curve. Please do all that you can to reduce carbon emissions before the world sees sever negative impacts. Just by making the US alone carbon neutral is not enough! However, the US is seen as a major role model for the world, and if the US can set a good example, I am confident the world will follow.

CHEM/Enviromental 301
4/26/2010

Poe Symposium 2010

Spencer Weart Presentation Review
"The Discovery of Global Warming"

By Aaron Satterlee

Introduction:

Weart covered the historical figures that contributed to our understanding of climate change. This was from both scientific contributions and society's reaction to their discoveries. This quest for knowledge is keyed to reoccurring cycles, most notably ice ages. Weart's focus is on the collective efforts that map out the deviation from these natural cycles.

The history of these discoveries made are important. They remind us that this problem is still new, confirmed, and vital to global climates. From early detections of CO2 above the arctic, to the actions of the Toronto Conference there have been many advancements. Though, the possibility of climate change was apparent much earlier in history.

The History:
With an introduction to who's who among the climate community, Weart began with Joseph Fourier. When considering distance and albedo, Fourier determined that the Earth's average global temperature should be -19 Celsius. This is outside any livable condition, which sparked interest in what made up the missing energy. In 1824 he first published his work on a missing factor in Earth's temperature. Fourier principles were built around a thermal model on balance. As any body should put out as much energy as it takes in. Not so, when it came to Earth. This marks the beginning of atmospheric theories, and understanding.

John Tyndall pushed forth atmospheric knowledge by directly analyzing the radiative absorption of gasses. 2) Primarily through the use of thermocouples that transferred thermal energy into electrical energy, he concluded that water vapor was the strongest greenhouse gas. With that he also studded the contributions of primary and trace gases in the atmosphere.

Svante Arrhenius was later able to correlate these findings into an equation, derived from the Boltzmann distribution and absorbency coefficients. Arrhenius then predicted an increase in temperatures if carbon dioxide concentrations were to double. And vise-versa if [CO2] was halved. (3)At the time he calculated that it would take 3000 years for this doubling effect to take place. This initial calculation is based on pre-industrialized coal consumption, and is thought to be highly inaccurate.

Guy Stuwart Callendar aided in the understanding of anthropogenic CO2 by direct measurements. A steady rise in the gas was mapped, and was thought to be beneficial. Callendar thought increased temperatures would help reduce the effects for ice ages. (3) From his studies in London, England between 1898 and 1900 he determined CO2 concentrations to be 274 +/- 5 PPM. With the knowledge that CO2 solubility in oceans is low, he predicted future buildup in CO2 attributed to fossil fuel use. Callendar calculated [CO2] in the year 2100 to be 346–358, which we have already surpassed.

These early figures laid the foundation for modern researchers. Those who must build a case to convince public and political groups of this problem's severity.

Human contribution:
"The Balance of Nature" played a significant role in the early arguments of human contribution to our globe. Simply stated, it assumes that human activities are so minute to global dynamics that we have no power to change the world around us. This may have held more substance in the pre-industrial era but many observations made in the early 20th century began to contradict this theory. Most notably that there are many positive feed back loops attributed to climate change. This goes against the classical ideals that "balanced systems" will reach equilibrium through negative feedback. Ocean vapor pressure and reduced solubility of Ocean-CO2 are two examples of positive feed back contributors.

This falsehood in "the balance of nature" was not alone. Weart continued with other debunked theories that people often use in denying climate change. Solar cycles (Earth tilt) were often blamed . It is true that solar cycles will affect the Earth's light exposure, but computer modeling disproved it's reliance. For the first time in the 1970's green house gases became a larger contributor to warming than the sun's natural cycles. From here the oceans were thought to retain balance by their ability to uptake CO2. Research done on Oceanic chemistry by Roger Revelle (1957) reviled how weak the Ocean's solubility of CO2 really is. Later Revelle showed rising temperatures were linked to lowered CO2 solubility, and secondly increased evaporation that adds water vapor to the atmosphere (a known greenhouse gas).

The rise of two "smoking guns" would finally shift public opinion (at least the majority). Charles Keeling affiliated with the Scripps Institution used ground based measurements to log year-round CO2 measurements in Antarctica. Two observations were made in this study. A steady overall increase in concentration, and a seasonal fluctuation. This minor fluctuation was thought to be the carbon sinking of forest growth in the norther latitudes. Once Winter and Fall came, an increase was seen, as plant CO2 uptake dropped off. This Keeling curve produced in 1961 was the first red flag that showed accelerated CO2 build up. Keeling's contributions were later supported by the ice core sampling done at the Vostock station (also in Antarctica). While Keeling could only map a small window of 40 years, ice cores store atmospheric concentrations going back hundreds of thousands of years. This builds the natural cycles found before the industrialized lifestyle. Once the rising Keeling curve is imposed over ice core records, anthropogenic activity is impossible to miss.

Computer Modeling:
Some of the most convincing tools came about from accurate climate models. This was also covered in a historical context, starting with early, crude models, covering basics in model building, advancements in variables and finally verification with backwards modeling.

MANIAC I (Mathematical And Numerical Integrator And Computer) was the first computer to be used in climate predictions.1) It was originally used in Los Alamos National Laboratories for DNA sequence determination(1953), but was later revamped for climate modeling (using high level assemblage language(1954)). By today's standards it's variables where basic, but once carbon dioxide and atmospheric water were accounted for, it was able to predict an increase in average global temperature. This was later confirmed by the Vostock ice core findings.

No model is complete without back comparisons to the volstock records. This has become a leading test of a models integrity. Modern science not only asks for a model to predict the future, but to also accurately predict the past.

Conclusion:
Weart left the audience with a thought on Government subsidized oil. He basically said the last hurdle in this fight is political, not scientific. The science has proven its self, we are now waiting for governing bodies to cooperate with the scientific community's results. The presentation proved to be a great summary on exactly why and how they discovered global climate change. This was not a few individuals, but thousands, who all had converging results. At this point groups and governing bodies are beginning to listen but their actions will lag as policies exist to keep energy cheap and widely available.

1) Los Alamos Science, p.132-141, "Computing & Computers", Francis H. Harlow and N. Metropolis, (1983).

2) "Details of Tyndall's device for measuring the infrared absorptive power of a gas"(2005). Historical Perspectives on Climate Change. Oxford University Press. pp. 69–70.
3) A lone voice in the greenhouse : Article : Nature. Available at: http://summit.csuci.edu:3178/nature/journal/v448/n7151/full/448254a.html [Accessed April 26, 2010].

"Going Green," what seemed to be one of the common themes at this year's Poe Symposium. The symposium was filled with a wide range of environmental chemists who were able to make an argument on what they felt was important in minimizing the global warming effects on earth. The conditions of the environment have been unpredictable due to the lack of knowledge of the field. Dr. Joseph Francisco, Ph.D. from Purdue University, was generous enough to enlighten the people of the California State University, Channel Islands community, with his knowledge and research in the environmental field. Francisco's main focus was "Global Warming Friendly Molecules; what happens to them and how do they transform?"

Francisco pointed out, that as people grow in the industrial world, so does the chemistry. In other words as new inventions are made new sediments are produced, which can potentially affect earth's environment. This problem brought up the question with Francisco's research group "Is there a way to strategically minimize global warming aspects of molecular systems?" To answer this question Francisco and his research team mapped out common problems for global warming, so they could focus on the areas of chemistry, which would not affect global warming. Francisco went back to the basics by looking at the formation and the destruction of ozone as shown in Fig. 1. He used this to distinguish what type of aerosols contribute to global warming and looked for new ways to minimize these problems.

Figure1. The ozone cycle reactions.

$$O_2 + hv \text{ ---> } 2O$$

$$M + O + O_2 \text{ ---> } M + O_3$$

$$O_3 + hv \text{ ---> } O_2 + O$$

In Francisco's talk he discussed the properties of commonly used chlorofluorocarbons (CFC's); good thermo physical properties low toxicity, low flammability, and high stability. He stated that each of these properties is ideal for refrigeration systems. However, he also pointed out, that when they created these compounds they overlooked the small radiation it takes to break down the compounds when they are released into the atmosphere. The CFC's discharge atomic Chlorine into the atmosphere. The chlorine then works as the catalyst in the catalytic cycle of ozone depletion. Francisco elaborated on this problem, to show that this needed to be fixed. He briefly discussed a CFC replacement as hydro-chlorofluorocarbons (HCFC's) and how he published a paper in 1996 concerning the affects HCFC's have on ozone. The research found that HCFC's do contribute to global warming potentials, but only a fraction of the amount that CFC's supply.

The replacement for the HCFC's as of recent times are Hydro-fluorocarbons (HFC's). However, Francisco found that trifluoromethoxy radicals (CF_3O) is an intermediate species formed during the atmospheric degradation of HFCs having the form CF_3CHX_2, where X_2 represents a combination of H and F atoms. Since the rate of attack from hydroxyl radical is temperature dependent the hydroxyl radical

takes too long to break down these compounds and they reach the stratosphere. There they can undergo the same degradation process as shown in Figure 1.

During the modeling research set up by Francisco the (fluoroformyl)oxyl radical (FC(O)O) was discovered and characterized to be an intriguing intermediate formed in the atmospheric degradation of HFC's, HCFC's and CFC's. Francisco found that this radical arises from the degradation of compounds of the form CF_3CHX_2 and how its reaction with NO produces CF_2O, as shown in Figure 2. This compound has a short-wavelength UV radiation, which is found in the middle to upper stratospheres and leads to the formation of FC(O)O. FC(O)O an interesting radical because it is essentially a carbon dioxide molecule with a fluorine attached. This radical is involved in many atmospheric reactions that lead to the formation of CO_2, as shown in figure 3. When translating these reactions to global warming terms, HFC's do contribute to global warming, but the global warming potentials are only a fraction of the CFC's values, because of their significantly shorter atmospheric lifetimes. It is likely that the extent to which global warming is perceived to be a threat will determine the extent of the long-term use of HFC's

Figure 2. The NO reaction with CF_3CHX_2 to produce CF_2O.

$$CF_2XCl + hv \rightarrow CF_2X + O_2 \rightarrow CF_2XO_2 + NO \rightarrow CF_2XO \text{ (X=F, no reaction X= Cl, elimination)} \rightarrow CF_2O$$

Figure 2. CF_2O reaction to form FC(O)O.

$$CF_2O + hv \rightarrow FCO + O_2 \rightarrow FC(O)O_2 + NO \rightarrow FC(O)O$$

Another good question Francisco brought up, "What are the common dominating factors or collection of factors that make certain molecules effective greenhouse gases and others ineffective?" His first observations led him to see certain bond vibrational modes, which are ideally suited for occurring in the atmospheric IR window region. Table 1 shows the percent-integrated infrared intensities in the atmospheric IR widow and the dipole derivatives for different gasses. In the article Francisco recently published in 2009 Francisco says, "As a rule of thumb a large atomic electronegativity leads to polar bonds by drawing charge from its bonding partner. The total bond polarity or the bond dipole moment increases as the electronegativity difference increases, and a larger bond dipole yields a larger bond dipole derivative leading to a large IR intensity." Therefore, the greater the change in the dipole moment the larger the greenhouse effect from the corresponding gas. This investigation helps chemists who know the framework and the combination of atoms to dictate/predict how molecules emitted into the atmosphere will effect global warming and to what extent.

Table 1. Dipole Derivatives and their % Intensity in the Infrared window

industrial name		dipole derivative Debye/Å		% intensity in IR window
carbondioxide	CO_2	CO	5.540	4.1
		OCO	1.354	
nitrousoxide	N_2O	NN	2.844	3.88
		NO	5.900	
methane	CH_4	CH	0.725	40.4
methylfluoride	CH_3F	CF	4.660	49.4
HFC-32	CH_2F_2	CF	5.242	75.9
HFC-23	CHF_3	CF	5.218	80.2
PFC-14	CF_4	CF	4.710	98.8
CFC-13	$CClF_3$	CF	5.055	97.9
		CCl	2.883	
CFC-12	CCl_2F_2	CF	5.216	99.0
		CCl	3.239	
CFC-11	CCl_3F	CF	5.248	99.7
		CCl	3.348	
methylchloride	CH_3Cl	CCl	2.121	23.9
methylenechloride	CH_2Cl_2	CCl	3.101	84.8
trichloromethane	$CHCl_3$	CCl	3.309	98.2
carbontetrachloride	CCl_4	CCl	3.356	99.9
ammonia	NH_3	NH	0.248	78.0
nitrogendihydrofl	NH_2F	NF	3.220	72.5
difluoro	NHF_2	NF	4.329	90.5
nitrogentrifluoride	NF_3	NF	4.863	99.3

Francisco's presentation was one of the better talks at the symposium; he was able to clearly paint a picture for the audience about how the small things are important. He showed how he was able to take basic chemistry concepts and apply

it to a system. A system that will hopefully be used as a foundation for anyone that tries to invent new technology. He made a valid argument that people must gain control at an early stage if they want to be able to maintain the Earth as an adequate place of living. To allow this transformation people must enlighten their peers, so they can do it together, because the earth is a big place and it is impossible for anyone to grasp a complete understanding of it.

"Review of Senator Fran Pavley's 'Climate Change and California' Speech"

Melissa Gray

April 26, 2010

CHEM 301- Environmental Chemistry

Global warming and climate change is probably the most controversial subject to date. Global warming is true. It is not scientists and experts that debate about it but politicians. On Friday, April 16, 2010, the Senator of California, Fran Pavley, gave a speech "on the policies and politics of climate change" (Pavley). Senator Fran Pavley discussed the issues and impacts of global warming on the state of California, the need for reduction and adaptation strategies for climate change impacts, and the benefits and success of moving forward with energy efficiency.

The speech began with Pavley introducing the effects of climate change on California (Figure 1). The diagram shows that with the result of climate change, a rise in sea level, temperature, and a change in precipitation patterns, with some extremes, results in the following: health risks (e.g. poor air quality), agricultural problems (less crop yields, demand for irrigation, etc.), fewer forests (bad forest health and productivity, more wildfires, etc.), depleted water resources, disappearing coastal areas, and animal/habitat endangerment. Only a few of these concerns were addressed by Senator Pavley. The first topic touched upon was the noticeable difference in California's summers. Pavley states, "...grow[ing] up in the San Bernadino Valley, hot summer days, warmer temperatures, air quality is worse. The hotter summers and bad air quality bring about respiratory illnesses to civilians in which Pavley described as a "health concern and a budget concern, a rising healthcare crisis". The senator then discussed California's depleting water reserves. Southern California is for the most part dependent on the Sierra Nevada snowpack. Pavley stated that for the past 4 years, California has had a severe problem with droughts "with reservoir capacity down to about 25%". These conditions force California officials to take extreme measures with cutting off water deliveries and enforcing pumping restrictions. Reporter James Holman for Oregon Environmental News interviewed Resources Agency Secretary Mike Chrisman who stated "water levels are so low [in California] that the Board of Directors may have to vote for mandatory water rationing". This is a major crisis for farmers and agriculture who use about 75-80% of California's water; therefore, "conserving water has become *incredibly* important and is a direct link to climate change, not only because of earlier and faster melt of the Sierra Nevada snowpack, but because of 20% of all the energy we use in California is moving and treating water" (Pavley). The last concern discussed by Senator Pavley was climate change affecting California's coastal areas. Global warming brings about warmer temperatures which melt icecaps and glaciers of frozen areas and increase the sea level which affects the water supply particularly for

agriculture products and puts civilians living near coastal areas in danger. Rising sea levels erode beaches, intensify flooding, and increase the salinity of rivers, bays, and water reservoirs. Additionally, measures that people take to protect private property from rising sea level may have unfavorable effects on the environment and public uses of beaches and waterways. Areas such as New York City, Philadelphia, and California's Central Valley obtain some of their water from portions of rivers that are slightly upstream from the point where water is salty during droughts. If the rising sea level pushes the salty water upstream, then, during dry periods, the existing water intakes might draw salty water. Salt water in estuaries can also harm aquatic plants and animals that cannot tolerate high salinity levels (EPA 2009). All of this would force California to spend more of its money for preserving and protecting its coastal lands and civilians.

Fran Pavley continued the discussion with the need for reducing greenhouse gas emissions and adaptation strategies to prepare California for certain effects resulting from climate change (see Figure 2). The senator talked about the deterioration of California's 1100 mile long delta levy system and how very costly it will be to maintain: "The levys are susceptible to flooding, earthquakes... and [they] have been half hazardly built over the last 150 years in California history". Over the years, there have been breaks in the levy system which cause saltwater to come down into California's agricultural areas. What makes matters worse, is that there is now over 500,000 people who now live below the levy system and are at great risk. Adaptation strategies are greatly needed to help preserve the delta. If action is not taken, it will cost California billions of dollars not only with the increasing cost and demand for energy because of the lack of energy efficiency but also losing money in tourism especially in the Sierra Nevada's ski industry (see Figure 3). According to the image, "additional $1-$8 billion to consumer bills (if energy efficiency is not reached), annual losses to agriculture, forestry, and fisheries could reach $4.3 billion dollars, losses to tourism revenues could reach $7.5 billion..., [for wildfires], already spending hundreds of millions of dollars annually in recent years...and MANY BILLIONS MORE for new water infrastructure, flooding, and health care costs"(Pavley, Figure 3). The senator continuede "Our ski industry is very concerned, as you can imagine, on what that will do to their economy especially in the Sierra Nevada mountains where a lot of the rural communities rely on a vibrant industry." Gus Jarvis confirms global warming is definitely reducing the amount of snow fall which is effecting the ski industry and the United States as a whole: "Snow cover across the Northern Hemisphere has decreased by approximately three to nine percent since

1978, with especially rapid declines in the western U.S...These continued impacts may not be good to the estimated $66 billion contributed to the U.S. economy from skiing, snowboarding and other winter sports." Pavley continued with the discussion of how California no longer experiences wildfire season anymore but instead year round. It now is not just affecting our local governments but also our state governments as well especially when state fire departments need to assist local fire departments with controlling the wildfires. The funds come directly out of California's state budget, and with the fires occurring too frequently, more money is being consumed and taken away from other projects such as California's education system. Part of California's and the United States' problem with energy and greenhouse gas emissions is linked to the dependence on foreign oil. Dependence is so bad that "58% of the nation's oil comes from foreign government. Most of them do not really care about the United States. They can hold us economically hostage..." (Pavley). It is recommended by military experts that the United States should quit the fossil fuel dependence and begin investing in newer and cleaner sources here in the county so we can have control over it. The military is also using and trying to to adapt to alternative clean energy sources. Pavely stressed the fact that this is "not just an environmental issue; it is also a Nation Security issue, an economic issue, and it has the possibility to create the new jobs and businesses of the future".

There is some good news, thankfully. Even with the downturn of the economy, green jobs in California have been growing a lot faster (see Figure 4). The figure not only shows the increase of green jobs, but also lists the possible jobs for Ventura County civilians. For example, Green Logistics, which is the management of the movement of goods, people and energy that proves to be environmentally and economically beneficial, is only currently available in the Bay Area but is a rapidly growing field that will soon be available to all of California. Pavley also addressed the major opportunities for jobs in Ventura County alone: "You can open up the Ventura County Star [newspaper] almost any day, and there's always a story whether it is a large sloar firm in Camarillo, or winter by manufacturing facility in Santa Paula. Ventura County could place itself in a very good area as far as getting these new clean tech start-up companies coming right here". California began its first step in 2006 with its emission reduction standards. Assembly Bill 32 required all significant greenhouse gas emitters to report the number of emissions they have manufactured to the California Air Researchers Board. The bill also wanted to encourage more policies that would reduce greenhouse gas emissions by ay least 25% by the year 2020. The senator stated

that the major goal of the bill was to "roll back greenhouse gas emissions to 1990 levels which is about 15% reduction from today's energy use, and it would [increase] to about 25-30% by 2020 if we went business as usual". In the bill itself, there is a "scoping plan" which lists the probable future regulations California hopes to reach to achieve major reductions of greenhouse gas emissions (see Figure 5).
The "Scoping Plan", made by the California Air Researchers Board, is requiring automobiles to operate more efficiently (more fuel mileage and an alternative for gasoline), building more efficient appliances, and increasing the total amount of energy to come from clean renewable sources. Pavley continued, "Right now, the law is 20% of all the energy we use should come from clean renewable sources, and each of our major utility companies are mandated to comply with that law through the Public Utilities Commission... and eventually it will be going up to 33%". With the passing of AB 32, a rising interest in "green tech investment" has occurred. Rising fuel costs, dependence on foreign oil, concerns on global warming, and the like have all encouraged private sector companies to express an interest in research and discovery of alternative energy sources. By reducing the amount of emissions with the adoption of AB 32, in the last 4 years, California's new start-up companies have received over $6 billion to create a market for newer and cleaner energy usage. California has succeeded in passing the Assembly Bill 1493 (a.k.a "Pavley" law) in 2002 which "required the California Air Resources Board and their engineers to come up with cost effective strategies to reduce greenhouse gas emissions" (Pavley). After 8 struggling years, the bill paved the way for the setting of nationwide standards for greenhouse gas emissions from new cars and trucks, and Pavley excitedly noted that the original rejection of the bill by former President George W. Bush was revisited by President Obama and he announced "the California standard will become the new national standard...which will save [the American people] a lot of money...we are reducing dependence on foreign oil, we are potentially saving money at the pump making our cars more energy efficient, and we are reducing air pollution which is a tremendous health problem here in California". The American Council for an Energy- Efficient Economy supports Senator Pavley's topic by saying, "Investments in energy efficiency are highly cost-effective. At a cost of $0.03 per kilowatt-hour saved, efficiency improvements are significantly less expensive than building new plants and power lines and burning more fuel. [It] also reduces the harm to public health and the environment from air and water pollution, mining, and other aspects of power production. In addition, efficiency improvements enhance the reliability of electricity

supplies by reducing system loads and stresses". California is leading the way and setting the example for the rest of the nation to go green and start putting a cap on the amount of greenhouse gases emitted (see Figure 6). In just 2007 alone, a total of fourteen states have adopted California's car standards, and the nation is becoming increasingly competitive amongst the states. Pavley shared her personal conversational experience with a Minnesota legislator stating that he hoped the venture capitalist money stopped coming to California and started going to Minnesota to increase the potential jobs. This is good news for America because we can boost our own economy while competing amongst ourselves to be more energy efficient and clean up our environment, and, eventually, encourage outside nations to do the same.

With all the issues and solutions addressed by Senator Pavley on climate change, the whole picture can seem overwhelming. This situation did not occur overnight but has steadily built itself into a major crisis for the entire planet which will take much time, debating, and action to resolve it. In regards to global warming and climate change, California faces many major threats to its land and citizens which stresses the importance of reducing emissions which will benefit not only itself, but the nation and world as a whole.

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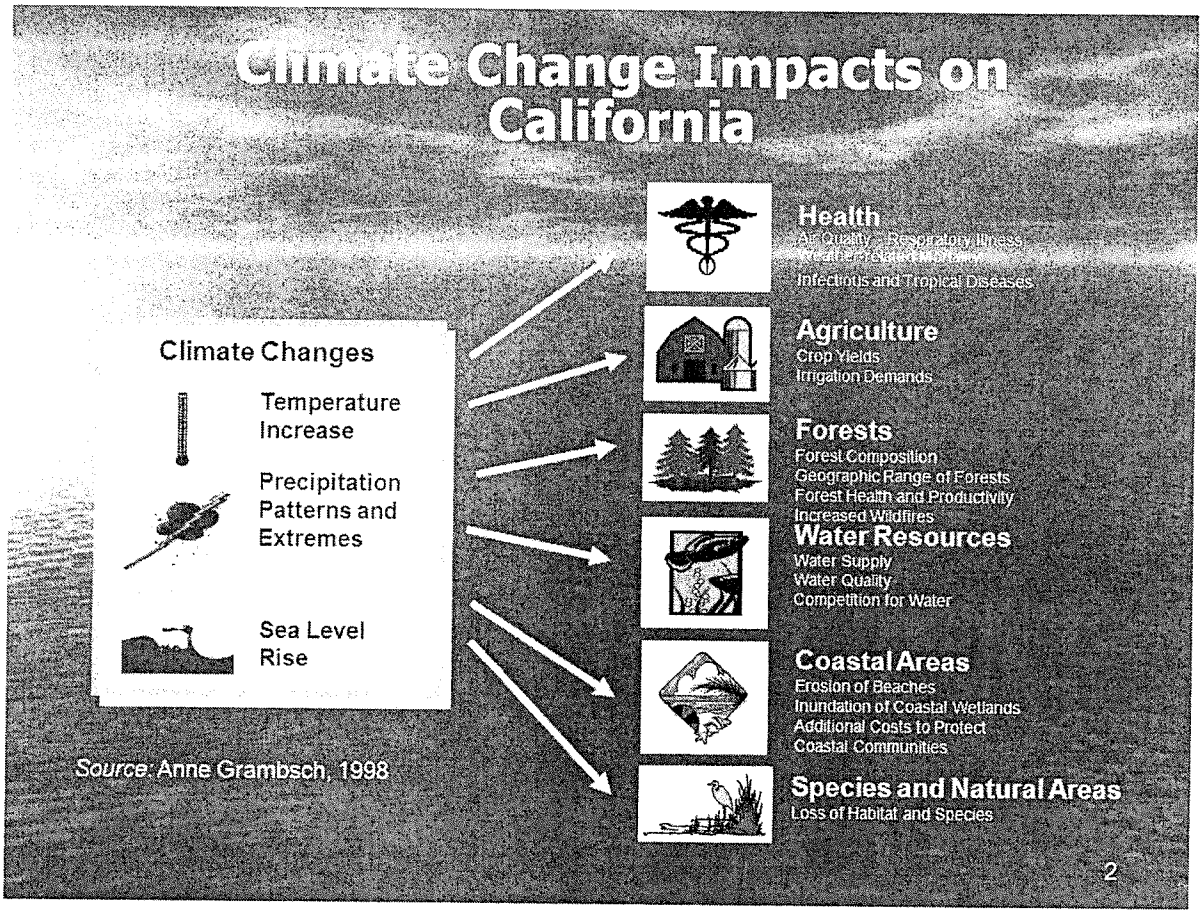

Figure 1: The result of climate change and the impacts it has on people and the land.

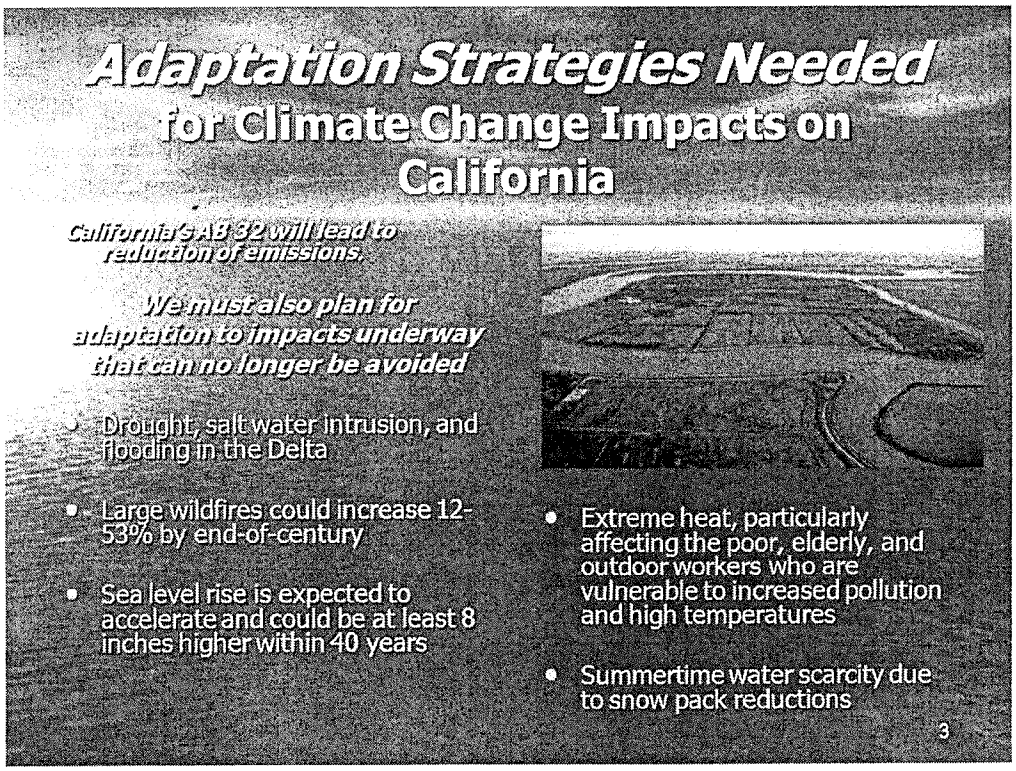

Figure 2: A list of occurrences that prove there is a need for adaptation in California.

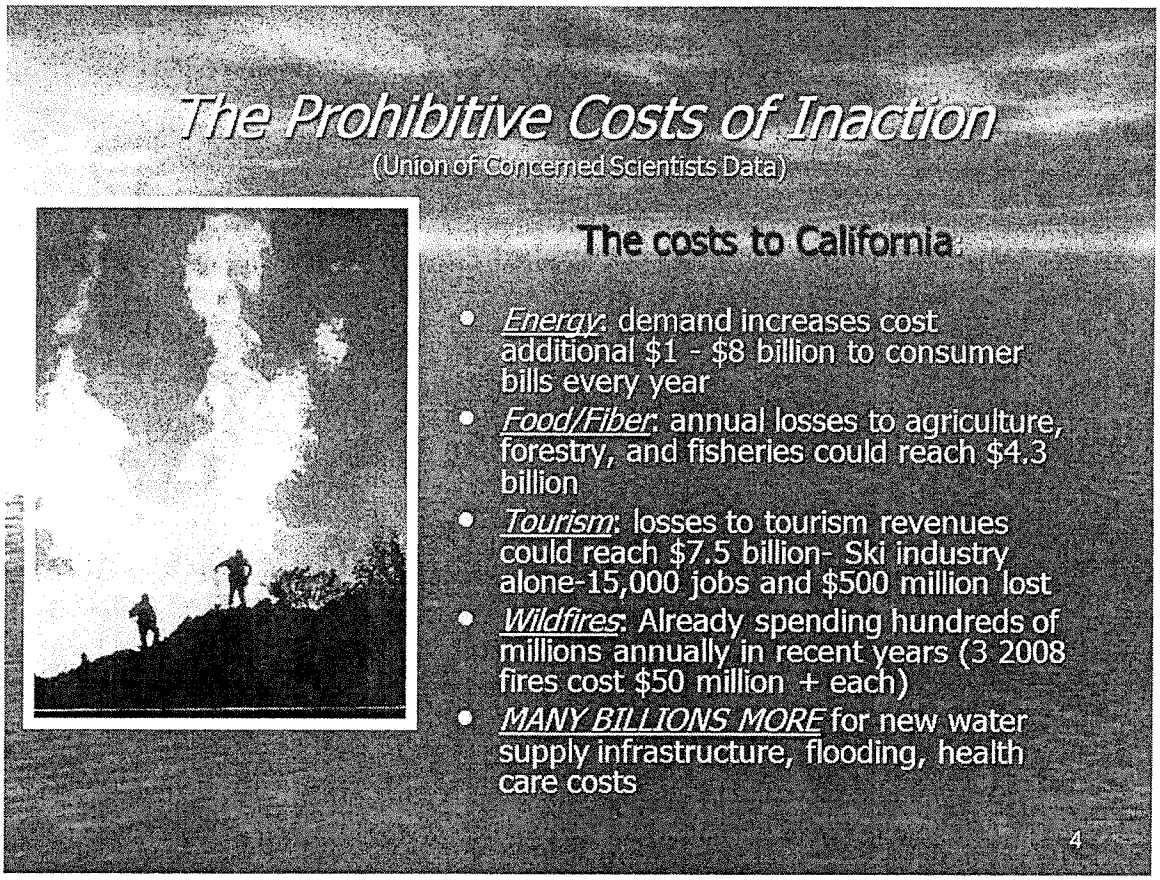

Figure 3: Consequences of California refusing to take action and the amount of money the state will lose.

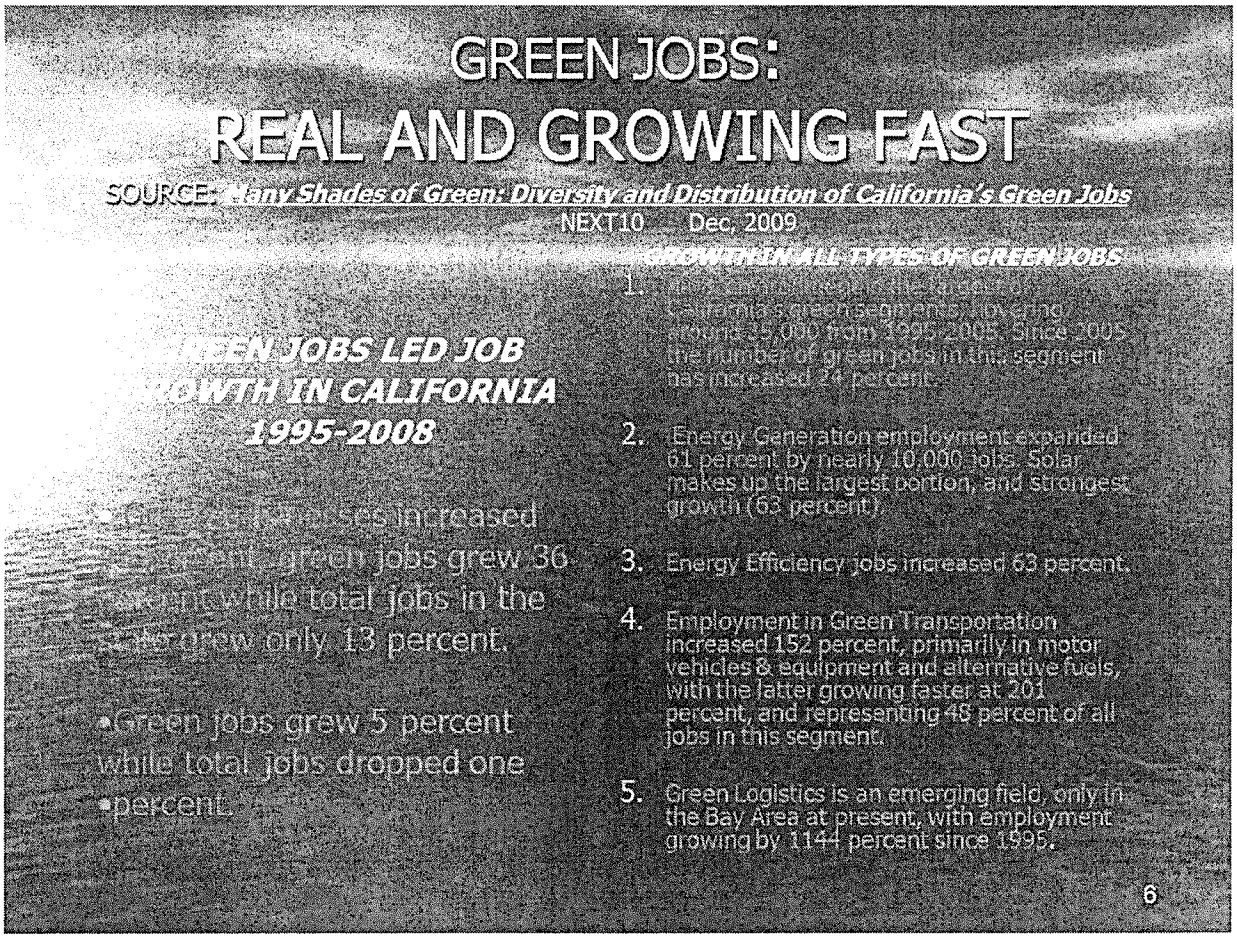

Figure 4: Green jobs growing in California.

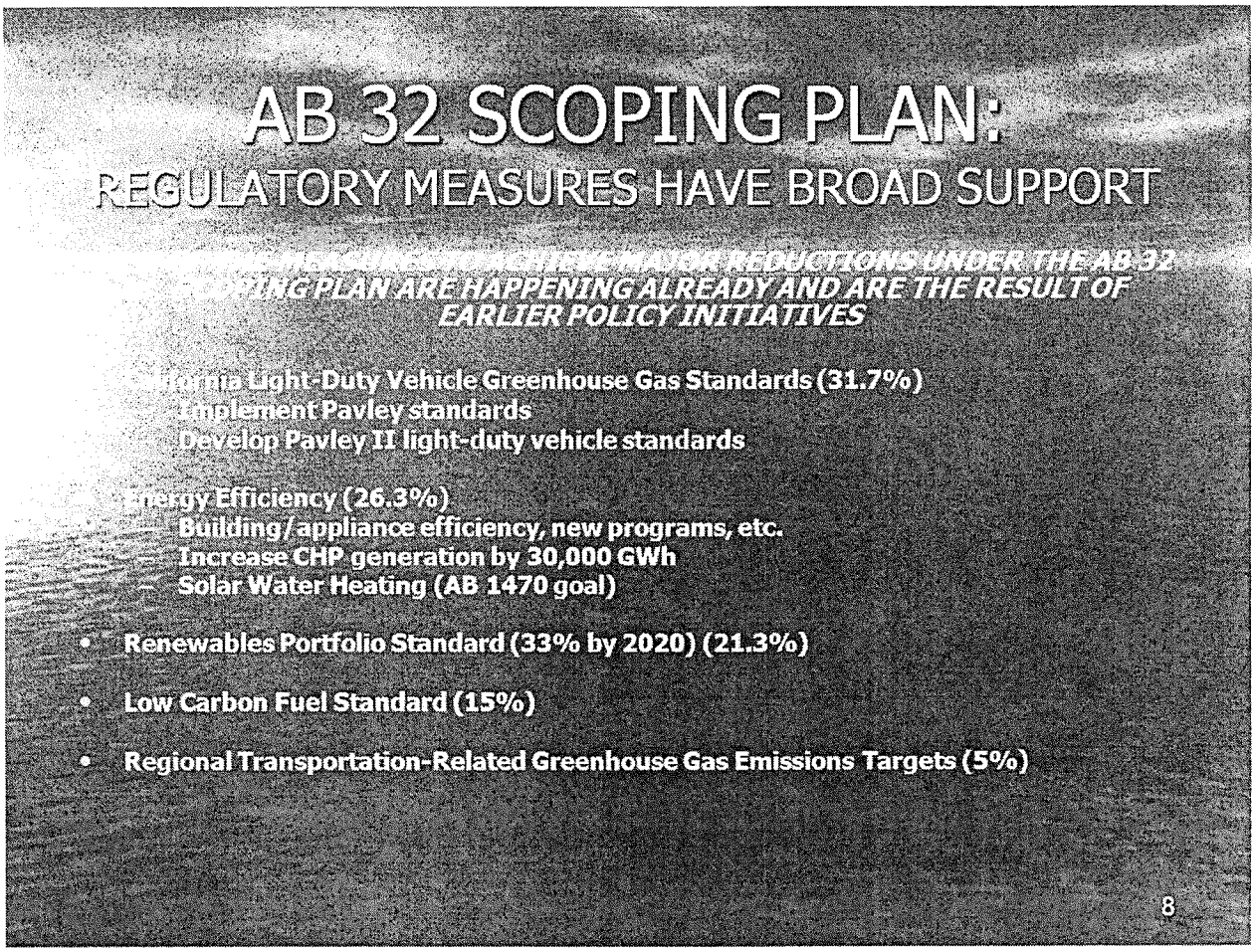

Figure 5: The goals and achievements of AB 32.

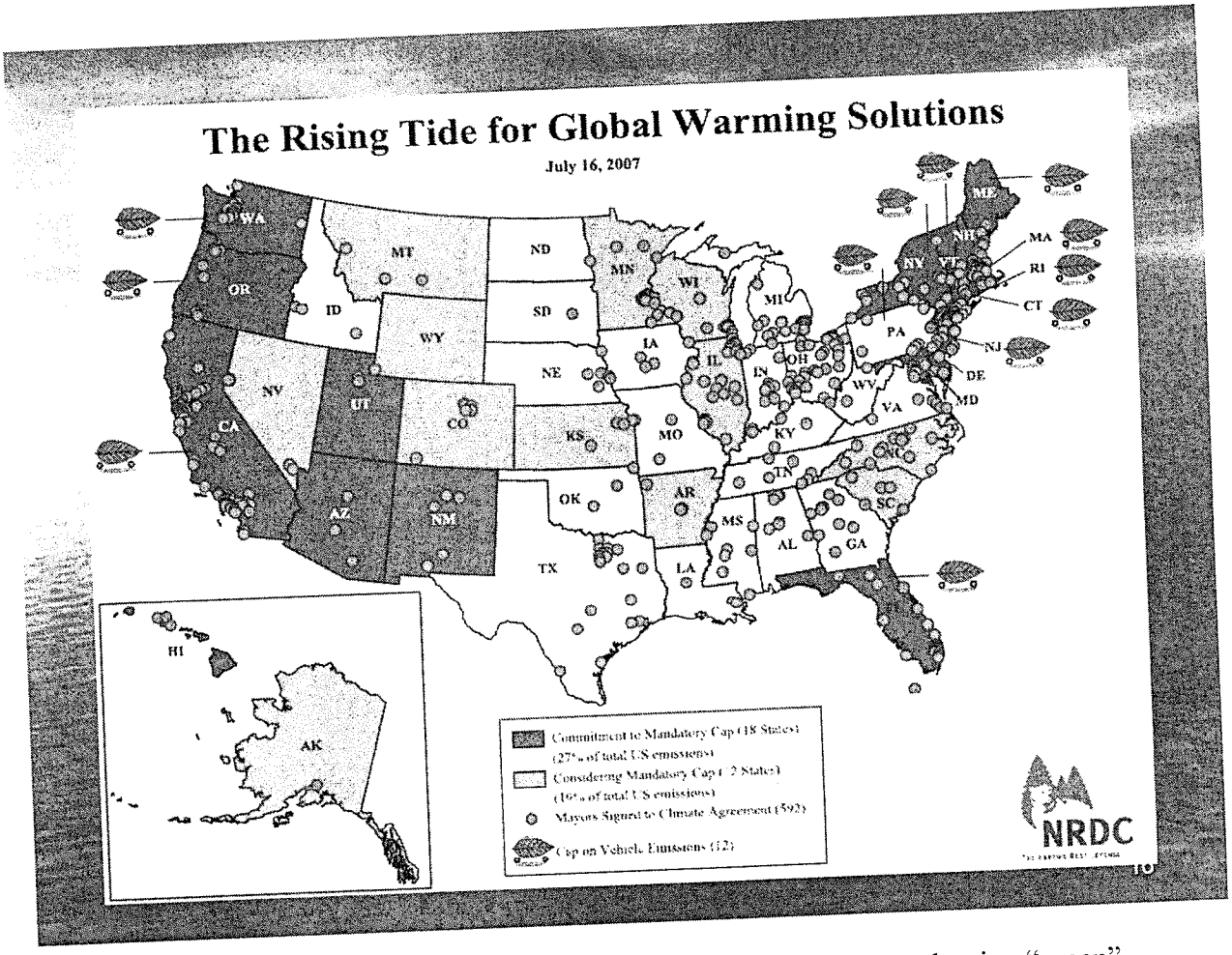

Figure 6: Map of U.S.A. Competitiveness is building with more states adopting "green" methods and reducing the amount of greenhouse gases.

The Importance of Biodiversity in a Changing World:

A Review of Healy Hamilton's Poe Symposium Presentation

Cassidy Adlof

Chem 301 : Environmental Chemistry

April 17, 2010

The Poe Symposium

The Poe Symposium focused on the topic of climate change. Healy Hamilton was one of the speakers and presented on the topic of how biodiversity will be affected by climate change.

What is Biodiversity?

Hamilton starts off by talking about what biodiversity is and its three levels of organization; genetic, species, and ecosystem. Genetic biodiversity refers to variation within a species. This is important to ensure that if something happens to a species there will be enough variation to allow at least a population to survive. An example of this involved corn. When a disease spread through the corn population most of the species died. However, there was some genetic variation so a small population survived and was able to be used to rebuild the entire population. Species biodiversity deals with different types of creatures. This is important because different species tend to need each other as they all fill different niches in the ecosystem. Ecosystem diversity deals with the overall variation between climate region and the different life that lives there.

Biodiversity is important for many reasons, including parts of our everyday lives. Examples include food, medicine, materials (timber, paper, textiles...), fuel, energy efficiency (biomimicry), industrial designs, and ecosystem services.

Ecosystem services place a value on how much it would cost without them. Dr. Hamilton gave examples including pollination, storm serge protection, water, and tourism/recreation. The idea of ecosystem services is one that is regularly debated in

science. The journal article "Linking Ecology and Economics for Ecosystem Management" gives examples of ecosystem services and an overview of different ways that they are evaluated. The article broke the types of evaluation into two main methods; conventional economic valuation and nonmonetizing valuation. (Farber et al., 2006).

Conventional economic valuation includes several types. The first is revealed-preference approaches, which includes the cost it takes for people to use the area, either recreationally or for materials. The second is stated-preference approaches, which involves directly asking people to rank their preference of a series of option for an area. It involves a compromise between people paying and accepting compensation for a change in the area's use. The last is cost-based approaches, which involves avoidance costs and replacement costs. Replacement costs deal with how much it would be to restore the area back to its previous condition. Avoidance costs deal with the costs avoided by keeping the area as it is, damage avoiding by using the area as a storm buffer. (Farber et al., 2006).

Nonmonetizing valuation, unlike the conventional valuation, doesn't put a money amount on the area. Instead in involves ranking based on models and voting on what people feel is best. (Farber et al., 2006).

Approaches to Conservation

Dr. Hamilton then moved onto threats to diversity and approaches for conservation. She talked about how species and ecosystem recovery based approaches tended to be isolated and can be expensive. She also talked about how there were ex situ (conserved

in zoos, aquariums, gardens, museums...) and legislative (protection acts) that also played a part in conservation. The last one discussed was protected areas.

Protected areas and how climate change is making it difficult for them to work is an important topic in current conservation principles. Species are climate specific and as climate changes and moves upward/north species need a way of doing the same. These protected areas; however, are static boundaries.

Principles of Conservation in a Rapidly Changing Climate

Dr. Hamilton finished the presentation with the 6 principles of conservation in a rapid climate change. The first principle was to keep intact areas with low human impact. Protect the area, even if the climate causes the species in that area to change. This is important because it maintains species diversity. The ecosystem may be changing, but by allowing a safe area to move into it keeps many species from becoming trapped in an area. The third principle closely relates to the first. It is that it is important to conserve areas of high species diversity and high genetic diversity. This is also to maintain diversity and to give a species the chance to survive even if most of its population won't.

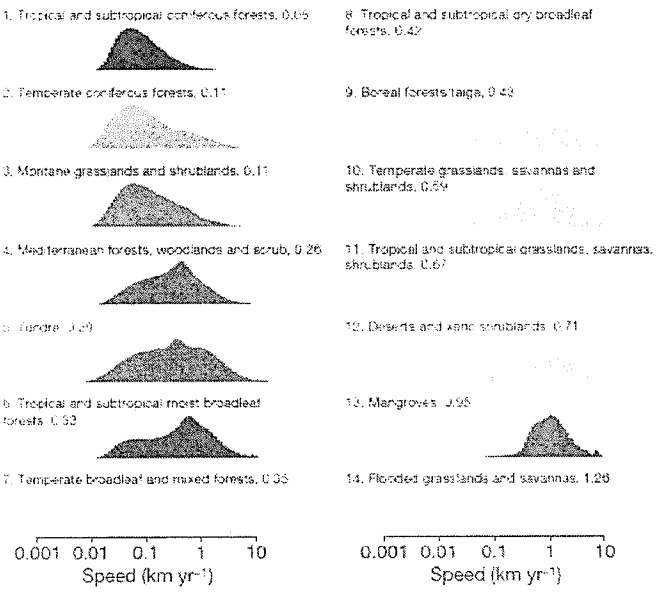

Figure 1: Velocity of Climate Change (Loarie et al., 2009).

The second principle is that areas of high heterogeneity provide higher buffers to change. This principle is

based off of "the Velocity of Climate Change". This article shows how much different biomes, portions of the earth defined by a particular set of species, are predicted to change in km/yr. As shown in figure 1, the predictions are based off of a variety of models and presented as a series of histograms, giving the mean and the possible variation of change. The fastest changing is grasslands/savanna, which will change around 1.26 km/yr. The slowest is forests, especially coniferous and broadleaf forests that tend toward mountain climate. (Loarie et al., 2009).

The forth principle was to reduce existing stressors/pollutants. Stressors include things that are going on to affect climate in a negative way, such as the rising CO_2 levels, as well as other things such as invasive species. The fifth was to place an honest value on the services from biodiversity. This is important so that when deciding whether or not to develop an area, a set value will be used to decide which is more important, rather than unspecific arguments. Setting this value; however, is difficult since there are so many different was to determine what the value of something is.

Dr. Hamilton expressed that the sixth principle was the most important. It is to improve landscape connectivity by creating corridors that connect throughout the continent. Corridors are areas of land or passages that connect one area to the natural area to another. They are meant to allow a path for different species to move through as the climate changes and natural areas become increasingly fragmented.

The effectiveness of corridors is under debate, however. It hasn't been determined that corridors work for a range of species. "Corridor Use by Diverse Taxa" deals with part of that problem. Most experiments involving corridors work with a single large organism, such a medium to large mammal or a bird. Most studies don't look at insects,

small mammals, or plant species. This is a problem since it is insects, plants, and small mammals that are the base support for the rest of the ecosystem. In this study; however, the authors examined a range of different organisms. They found that corridors seemed to direct the movement of each of the species studied; however, there results weren't definite for 5 of the 10 species they examined. (Haddad et al., 2003). This needs to be researched further since corridors need to work for most species, not just a few, in order to maintain a diverse ecosystem.

Biodiversity and Climate Change

Biodiversity is a very important part of our everyday lives. As the climate changes so will every other part of the world, biomes and biodiversity included. Biodiversity is something that has to be maintained since so many things we use everyday come, in one way or another, from nature. Techniques such as corridors have to continue to be developed to give the opportunity for species to change and adjust to the new climate in order to maintain the diversity we rely on.

References

Farber, S., Costanza, R., Childers, D. L., Erickson, J., Gross, K., Grove, M., ... Wilson, M. (feb., 2006). Linking Ecology and Economics for Ecosystem Management. *BioScience*, *56*(2), 121-133. Retrieved April 23, 2010, from JSTOR. http://www.jstor.org/stable/4099589

Haddad, N. M., Bowne, D. R., Cunningham, A., Danielson, B. J., Levey, D. J., Sargent, S., & Spira, T. (mar. 2003). Corridor Use by Diverse Taxa. Ecology, 84(3), 609-615. Retrieved April 23, 2010, from JSTOR. http://www.jstor.org/stable/3107855

Hamilton, H. (2010, April 16). *Conserving the Diversity of Life in an Era of Global Change*. Speech presented at Poe Symposium : Climate Change in the 21st Century in CSUCI, Camarillo.

Loarie, S. R., Duffy, P. B., Hamilton, H., Asner, G. P., Field, C. B., & Ackerly, D. D. (dec 2009). The Velocity of Climate Change. Nature, 462(24), 31st ser., 1052-1055. Retrieved April 18, 2010, from Nature.

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ORIGINAL
PAGE NO. 1 OF 1
INVOICE # 348088
INVOICE DATE 04/26/10
PURCHASE ORDER 103147037
ACCOUNT # 487167
BILL TO # EMPPUR

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85

2 90

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Loc	Order Date	Ship Date	Ordered By	Shipped Via	Shipping Terms - FOB	Federal I.D.
85	04/22/10	04/26/10		DDP 1	PREPAID	82-0100960

Detail

Qty.	Unit	Product Code	Description	Price Per Unit	Amount
1	EA	S1 C4813A	INKJET,PRINTHEAD HP11 YW ALTSRC=U85 1EA Shipping from whse in CITY OF INDUSTRY, CA Item MAY arrive separately	25.06 EA	25.06
1	EA	S1 C4913A	INK,CTG NO.82 YELLOW	26.68 EA	26.68
1	EA	S1 C4844A	HP BLK INK CART FOR-HP20	27.47& EA	27.47
1	EA	S1 C4912A	INK,CTG NO.82 MAGENTA	26.68 EA	26.68
1	EA	S1 C4911A	INK,CTG NO.82 CYAN	26.68 EA	26.68
5	RL	P8 C1860A	PAP,INKJT BRIGHT WHT 24"	11.07 RL	55.35
		$3.95 SMALL ORDER FEE IF ORDER LESS THAN $50			
				MDSE AMOUNT	187.92
				SALES TAX	15.50
			LOCAL -	S & H CHARGED	5.63
				S & H ALLOWED	5.63-
				TOTAL INVOICE	203.42
			AMT PAID VI	A CREDIT CARD	203.42-
				TOTAL DUE	.00

Hi MARY,
THIS WAS CHARGED TO
TK910-720-90249
FOR POE
CATHY H.

TP1 00000(urn information and other terms and conditions... 0 W4 00 EDI 888

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PAGE NO.	1 OF 1
INVOICE #	370606
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Detail

Qty.	Unit	Product Code	Description	Price Per Unit	Amount
1	EA	S1 Q2613A	CARTRIDGE,TONER BK 13A	50.39& EA	50.39
		$3.95 SMALL ORDER FEE IF ORDER LESS THAN $50			
				MDSE AMOUNT	50.39
				SALES TAX	4.15
			LOCAL -	S & H CHARGED	1.51
				S & H ALLOWED	1.51-
				TOTAL INVOICE	54.54
			AMT PAID VIA	CREDIT CARD	54.54-
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INVOICE #	370606
INVOICE DATE	04/27/10
PAYMENT TERMS	PAID BY CREDIT
INVOICE AMOUNT	0.00

Channel Islands
CALIFORNIA STATE UNIVERSITY

COST RECOVERY EVENT
Work Order

5/3/2010

CR-EV 021515

021515

Location ID :	011-0150 ALISO HALL, 1ST FLOOR, AUDITORIUM, ROOM 150	**Room:**	
Equipment ID :		**Requester:**	MARY DEVINS
Serial :		**Contact:**	MARY DEVINS
PM Number:		**Phone :**	3253
Account:	660832-TK910-720-90249-00000-00000		

Request : EVENT: POE SYMPOSIUM TO BE HELD IN ALISO HALL, ROOM 150 ON FRIDAY 4/16 FROM NOON - 6 PM.

Status :	COMP CR1	**Open Date :**	4/14/2010	**Procedure :**	
Priority :	1	**Comp Date :**	4/23/2010	**Craft :**	EVENT
Assigned :		**Target Date :**	4/23/2010	**Crew :**	

Estimates Hours (0) $0.00 Materials $0.00 Tools $0.00 Service $0.00 Total $0.00

Tasks

Task #	Desc	Memo	Account
1	CARPENTERS: HANG BANNER OUTSIDE ALISO HALL BETWEEN TREES WITH BUNGEE CORDS.		

Actuals Hours (1) $28.76 Materials $3.90 Tools $0.00 Service $0.00 Total $32.66

Labour

Employee	Craft	TransDate	Description	Account	Hours
AMES1	FAC	4/15/2010	PUT UP BANNER AT ALISO	580094-GD901-330-00000-00000-00000	0.5
AMES1	FAC	4/19/2010	TAKE DOWN BANNER AND RETURN	580094-GD901-330-00000-00000-00000	0.5

Materials

Item #	Description	Unit	Account	Qty	$/Unit	Total $
3423	ROPE, POLYPROP/POLESTER, 1/2"	FOOT	660003-GD901-370-00000-00000-00000	15	$0.24	$3.90

Credit Summary

Account	Amount
580094-GD901-330-00000-00000-00000	$28.76
660003-GD901-370-00000-00000-00000	$3.90
Grand Total:	$32.66

Comp Remark:
JOB COMPLETE ALL MATERIALS ADDED

[x] Complete	**EQ Meter:**	**By:**	**Date:** 4/23/2010	**Hours:** 1

Department Approval: _____ **Date:** 5/11/10

SIGN AND RETURN TO OPC

Printed by Karl Monday, May 03, 2010 14:58:56 PM

REQUEST FOR GOODS & SERVICES (RGS)

CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

PO #: 290
Procurement use only

Date: 3/30/2010

New Vendor: ☑ Yes ☐ No
Vendor Name: Spencer Weart
Address: 12 Buena Vista Dr
City/State/Zip: Hastings on Hudson, NY 10706
Phone: 914-478-2074
Fax:
E-mail: sweart1@gmail.com
Sales Rep: Dr. Spencer Weart

Requestor Name: Mary Devins
Phone: x3253
Dept #/Name: 720 Biology
* Delivery Date: 4/16/2010
Quote #:
(Please attach all quotes)
Matching rules: ☐ 2-way ☐ 3-way
* E-mail copies to: mary.devins@csuci.edu
receiving@csuci.edu
Receiving instructions: Bldg: Rm #:

Catalog/Part #	Description	UOM	QTY	Unit Price	Ext. Price	Account #	Fund	Dept #	Program	Class	Project
					$0.00						
					$0.00						
					$0.00						
					$0.00						
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					$0.00						
					$0.00						
					$0.00						
					$0.00						
					$0.00						
					$0.00						
				Taxed Subtotal	$0.00						
NON-TAXABLE ITEMS											
	Honorarium for Spencer Weart	dlr	1	$1,700.00	$1,700.00	613802	TK910	720	90249		
	Poe Symposium April 16, 2010				$0.00						
					$0.00						
					$0.00						
					$0.00						
					$0.00						

Contract Services:
Check one: ☐ MEA ☐ CMAS
☐ Contract proposal attached
State Contract #:
Contract Administrator:
Phone:
E-mail:

Subtotal	$1,700.00
Tax	$0.00
Shipping	
Total	**$1,700.00**

Comments:
Honorarium for Spencer Weart, keynote speaker for 6th Poe Symposium. Check requested for 4/16/10.

Signatures/Approvals **Print name/Signature**

IT/OPC Mgr (if required)
If order is IT related: An approval signature must be obtained.
Chair/Dept. Budget:
Dean/Director:
Division VP/Designee:
President (if required):

* required

CALIFORNIA STATE UNIVERSITY
CHANNEL ISLANDS

Division of Academic Affairs

290

Dear Dr. Weart,

Thank you again for your participation in our 6th Poe Symposium, the topic of which is Climate Change. This letter is to formalize the invitation and let you know some of the details of the event. I think it is going to be great learning experience for our campus community.

The symposium will be held on April 16th, 2010 in the lecture hall in Aliso Hall, Room 150. I am including a schedule, but the list is very much under construction. The symposium will start sometime between 11:00 AM and 1:00 PM. I am scheduling you to speak immediately following opening remarks. I will tentatively schedule 40 minutes for each speaker, which provides some time for questions and the inevitable unforeseen incidents. If you would like more or less time, please let me know as there will be room for some adjustment.

Our first draft of the schedule of speakers is:

12:30 PM – 12:40 PM	Opening remarks by CSUCI Provost Dawn Neuman
12:40 PM – 1:20 PM	Spencer Weart, Author of The Discovery of Global Warming
1:20 PM – 2:00 PM	Joseph Francisco, Purdue Univeristy
2:40 PM – 3:20 PM	Paul Wennberg, California Institute of Technology
3:20 PM – 3:40 PM	Break
3:40 PM – 4:20 PM	Fran Pavley, State Senator of California
4:20 PM – 5:00 PM	Healy Hamilton, California Academy of Sciences
5:00 PM – 5:40 PM	Peter Freed, Project Developer, TerraPass

We are pleased to offer you an honorarium of $1700 in gratitude for your participation, and to cover your expenses. We will have a parking pass for you; and I will either get that to you before the event, or I will send instructions on how to pick it up when you get to campus. I would to assist in facilitating your travel arrangements in any way. I will certainly send updates via e-mail as needed. Please be in touch if any issues arise.

Sincerely,

Simone Aloisio
Associate Professor and Chair of Chemistry
California State University Channel Islands
Camarillo CA 93012
(805)437-8999
simone.aloisio@csuci.edu

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Name: TerraPass Inc

Address 1: 527 Howard Street 4th Floor

Address 2:

City, State Zip: San Francisco, CA 94105

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Freed Honorarium

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☒ Honorarium/Speaker	☐ Permit/License	☒ IRA Activity
☐ Interpreting/Note taking	☐ Registration/Conference	☐ Other–**must** be explained

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DESCRIPTION AND/OR EXPLANATION OF PAYMENT:

Honorarium for Peter Freed, speaker for the Poe Symposium, an IRA Sponsored event. See attached offer letter and flyer. 204 form attaced and previously faxed to Procurement.

ACCOUNTING & APPROVAL:

Account	Fund	Dept ID*	Program	Class	Project/Grant**	Amount
613802	TK910	720	90249			$1,200.00
					Total	$1,200.00

*Depts. 2xx,3xx,4xx,6xx,9xx require additional approval as designated by VP Finance & Admin.

Requestor: Mary Devins — Printed Name & Extension | Signature | 4-12-10 Date

Approver: Dan Wakelee — Printed Name & Extension | Signature | 4-12-10 Date

Approver: (If required) — Printed Name & Extension | Signature | Date

California State University Channel Islands
Check Request Form

290

To be used for transactions not requiring a purchase order, service agreement or travel & expense reimbursement

MAKE CHECK PAYABLE TO:

Name: Joseph Francisco

Address 1: 4663 Woods Edge Drive

Address 2:

City, State Zip: Zionsville, IN 46077

PeopleSoft Vendor ID: _new_
Note: New vendors must complete a Form 204

Check Instructions:
- ☐ Mail to payee
- ☒ * **Pick up at Cashier - Ext** 3253
- ☐ Mail attachments with check – include copies

Description to appear on reports (30 characters)
Francisco Honorarium

Amount: $ 1300.00 ***Check will only be held for 48 hours after notification before being mailed out.**

TYPE OF PAYMENT:

☐ Advertising	☐ Lodging (Camarillo area) **	☐ Subscription/Periodical
☐ Art Model	☐ Membership/Dues	☐ Tax Remittance*
☐ Bank Fee*	☐ Parking	☐ Utility/Telephone
☐ Freight/Postage	☐ Payroll	
☒ Honorarium/Speaker	☐ Permit/License	☒ IRA Activity
☐ Interpreting/Note taking	☐ Registration/Conference	☐ Other–**must** be explained

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DESCRIPTION AND/OR EXPLANATION OF PAYMENT:

Honorarium for Joseph Francsico, speaker for the Poe Symposium, an IRA Sponsored event. See attached offer letter and flyer. 204 form attaced and previously faxed to Procurement.

ACCOUNTING & APPROVAL:

Account	Fund	Dept ID*	Program	Class	Project/Grant**	Amount
613802	TK910	720	90249			$1,300.00
					Total	$1,300.00

*Depts. 2xx,3xx,4xx,6xx,9xx require additional approval as designated by VP Finance & Admin.

Requestor: Mary Devins — Printed Name & Extension — Signature — 4-12-10 Date

Approver: Dan Wakelee — Printed Name & Extension — Signature — 4-12-10 Date

Approver: (If required) — Printed Name & Extension — Signature — Date

290

cafe press

Shipping To:
Catherine E Hutchinson
1 University Drive
Biology
Camarillo,CA 93012, US

Order # 104666611
Date: 3/22/2010 3:49 PM
Ship: Standard

Item # and Description	Qty	Each	Total
Organic Women's T-Shirt www.cafepress.com/Poe6.437041548	2	$25.99	$51.98
Organic Women's T-Shirt www.cafepress.com/Poe6.437041548	1	$25.99	$25.99
Organic Women's T-Shirt www.cafepress.com/Poe6.437041548	1	$25.99	$25.99
Organic Men's T-Shirt www.cafepress.c	1	$25.99	$25.99

Enjoy this
For mo

Hi Mary

These are charges I made to TK910 720 90249 FOR THE Science Symposium

Cathy H.

BIG SHOTS
3201 Corte Malpaso
Suite 307
Camarillo, CA 93012
805-484-9111

290

Invoice

Date	Invoice #
4/1/2010	5178

PAID

Bill To	Ship To
CSUCI Cathrine Hutchinson One University Drive Camarillo, CA 93012-8599	CSUCI One University Drive Camarillo, CA 93012-8599

P.O. No.	Terms	Ship Date
	Credit Card	4/1/2010

Qty	Description	Rate	Amount
1	POE Banner: 48" x 120" Full color UV Print on 15-mil Nylon Reinforced Vinyl Scrim with 4-grommets on top and two on the bottom and wind slits, Trim to size and roll packed	260.25	260.25T
1	POE Posters: 36" x 48" Full color UV print, Matte UV lamination, Mounted to 3/16" Black Gatorboard, trim to size and Kraft wrap	98.50	98.50T

Thank you for your business.

Sales Tax (8.25%)	$29.60
Total	**$388.35**

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April Talk

Aloisio, Simone [Simone.Aloisio@csuci.edu]

290

Sent: Tuesday, February 02, 2010 2:26 PM
To: Francisco, Joseph S
Attachments: Payee Data Record std204.doc (59 KB)

Dear Joe,

I have two questions:

Could you please complete the attached form and send it to Mary Devins via fax ((805) 437-8864) or e-mail (Mary.Devins@csuci.edu) as soon as possible?

I have heard back from all of the speakers on the list and wanted to see if this updated schedule would work for you:

12:50 PM – 1:00 PM	Opening remarks by CSUCI Provost Dawn Neuman none
1:00 PM – 1:40 PM	Fran Pavley, Author of AB 32 (Global Warming Solution Act) and State Senator of California
1:40 PM – 2:20 PM	✓ Spencer Weart, Author of The Discovery of Global Warming; previous Director for the Center for History of Physics, American Institute of Physics ✓ $1700
2:20 PM – 3:00 PM	✓ Paul Wennberg, R. Stanton Avery Professor of Atmospheric Chemistry and Environmental Engineering, Director of the Linde Center for Global Environmental Science, California Institute of Technology $300
3:00 PM – 3:20 PM	Break
3:20 PM – 4:00 PM	✓ Joseph Francisco, W.E. Moore Distinguished Professor of Chemistry, Purdue University ✓ $1200
4:00 PM – 4:40 PM	Healy Hamilton, Director, Center for Applied Biodiversity Informatics, California Academy of Sciences ✓ $1200
4:40 PM – 5:20 PM	Peter Freed, Carbon Offset Project Developer, TerraPass ✓ $1000

Thank you!

Simone

$1300

$1200

CSUCI CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

Division of Academic Affairs

290

Dear Dr. Francisco,

Thank you again for your participation in our 6th Poe Symposium, the topic of which is Climate Change. This letter is to formalize the invitation and let you know some of the details of the event. I think it is going to be great learning experience for our campus community.

The symposium will be held on April 16th, 2010 in the lecture hall in Aliso Hall, Room 150. I am including a schedule, but the list is very much under construction. The symposium will start sometime between 11:00 AM and 1:00 PM. I am scheduling you to speak third, which is currently at 1:20 PM. I will tentatively schedule 40 minutes for each speaker, which provides some time for questions and the inevitable unforeseen incidents. If you would like more or less time, please let me know as there will be room for some adjustment.

Our first draft of the schedule of speakers is:

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4:00 PM – 4:40 PM	Healy Hamilton, Head of the Center for Biodiversity Research and Information, California Academy of Sciences
4:40 PM – 5:20 PM	Peter Freed, Carbon Offset Project Developer, TerraPass

We are pleased to offer you an honorarium of $1300 in gratitude for your participation, and to cover your expenses. We will have a parking pass for you; and I will either get that to you before the event, or I will send instructions on how to pick it up when you get to campus. I would to assist in facilitating your travel arrangements in any way. I will certainly send updates via e-mail as needed. Please be in touch if any issues arise.

Sincerely,

Simone Aloisio
Associate Professor and Chair of Chemistry
California State University Channel Islands
Camarillo CA 93012
(805)437-8999
simone.aloisio@csuci.edu

California State University Channel Islands
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MAKE CHECK PAYABLE TO:

Name: TerraPass Inc

Address 1: 527 Howard Street 4th Floor

Address 2:

City, State Zip: San Francisco, CA 94105

PeopleSoft Vendor ID: _new_
Note: New vendors must complete a Form 204

Check Instructions:
- ☐ Mail to payee
- ☒ * **Pick up at Cashier - Ext** 3253
- ☐ Mail attachments with check – include copies

Description to appear on reports (30 characters)
Freed Honorarium

Amount: $ 1000.00 ***Check will only be held for 48 hours after notification before being mailed out.**

TYPE OF PAYMENT:

☐ Advertising	☐ Lodging (Camarillo area) **	☐ Subscription/Periodical
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☐ Bank Fee*	☐ Parking	☐ Utility/Telephone
☐ Freight/Postage	☐ Payroll	
☒ Honorarium/Speaker	☐ Permit/License	☒ IRA Activity
☐ Interpreting/Note taking	☐ Registration/Conference	☐ Other–**must** be explained

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DESCRIPTION AND/OR EXPLANATION OF PAYMENT:

Honorarium for Peter Freed, speaker for the Poe Symposium, an IRA Sponsored event. See attached offer letter and flyer. 204 form attaced and previously faxed to Procurement.

ACCOUNTING & APPROVAL:

Account	Fund	Dept ID*	Program	Class	Project/Grant**	Amount
613802	TK910	720	90249			$1,000.00
					Total	$1,000.00

*Depts. 2xx,3xx,4xx,6xx,9xx require additional approval as designated by VP Finance & Admin.

Requestor:	Mary Devins Printed Name & Extension	Mary Devins Signature	3-30-10 Date
Approver:	Dan Wakelee Printed Name & Extension	Dan Wakelee Signature	3-30-10 Date
Approver: (If required)	Printed Name & Extension	Signature	Date

CALIFORNIA STATE UNIVERSITY
CHANNEL ISLANDS

Division of Academic Affairs

290

Dear Mr. Freed,

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4:20 PM – 5:00 PM	Healy Hamilton, Head of the Center for Biodiversity Research and Information, California Academy of Sciences
5:00 PM – 5:40 PM	Peter Freed, Carbon Offset Project Developer, TerraPass

We are pleased to offer you an honorarium of $1200 in gratitude for your participation, and to cover your expenses. We will have a parking pass for you; and I will either get that to you before the event, or I will send instructions on how to pick it up when you get to campus. I would to assist in facilitating your travel arrangements in any way. I will certainly send updates via e-mail as needed. Please be in touch if any issues arise.

Sincerely,

Simone Aloisio
Associate Professor and Chair of Chemistry
California State University Channel Islands
Camarillo CA 93012
(805)437-8999
simone.aloisio@csuci.edu

California State University Channel Islands
Check Request Form

290

To be used for transactions not requiring a purchase order, service agreement or travel & expense reimbursement

MAKE CHECK PAYABLE TO:

Name: Healy Hamilton

Address 1: 42 Bayview Drive

Address 2:

City, State Zip: San Rafael, CA 94901

Amount: $ 1200.00

PeopleSoft Vendor ID: _new_
Note: New vendors must complete a Form 204

Check Instructions:
- ☐ Mail to payee
- ☒ * **Pick up at Cashier - Ext** 3253
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Description to appear on reports (30 characters)
Hamilton Honorarium

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TYPE OF PAYMENT:

- ☐ Advertising
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- ☒ IRA Activity
- ☐ Other–**must** be explained

*Accounting Use Only **Hampton Inn/Country Inn/Courtyard Marriott

DESCRIPTION AND/OR EXPLANATION OF PAYMENT:

Honorarium for Healy Hamilton, speaker for the Poe Symposium, an IRA Sponsored event. See attached offer letter and flyer. 204 form attaced and previously faxed to Procurement.

ACCOUNTING & APPROVAL:

Account	Fund	Dept ID*	Program	Class	Project/Grant**	Amount
613802	TK910	720	90249			$1,200.00
					Total	$1,200.00

*Depts. 2xx,3xx,4xx,6xx,9xx require additional approval as designated by VP Finance & Admin.

Requestor: Mary Devins (Printed Name & Extension) — Signature — 3-30-10 (Date)

Approver: Dan Wakelee (Printed Name & Extension) — Signature — 3-30-10 (Date)

Approver: (If required) _____ (Printed Name & Extension) — _____ (Signature) — _____ (Date)

CALIFORNIA STATE UNIVERSITY
CHANNEL ISLANDS

Division of Academic Affairs

290

Dr. Hamilton,

Thank you again for your participation in our 6th Poe Symposium, the topic of which is Climate Change. This letter is to formalize the invitation and let you know some of the details of the event. I think it is going to be great learning experience for our campus community.

The symposium will be held on April 16th, 2010 in the lecture hall in Aliso Hall, Room 150. I am including a schedule, but the list is very much under construction. The symposium will start sometime between 11:00 AM and 1:00 PM. I am scheduling you to speak fifth, which is currently at 4:20 PM. As we discussed, you requested that your presentation be later in the day. I will tentatively schedule 40 minutes for each speaker, which provides some time for questions and the inevitable unforeseen incidents. If you would like more or less time, please let me know as there will be room for some adjustment.

Our first draft of the schedule of speakers is:

12:30 PM – 12:40 PM	Opening remarks by CSUCI Provost Dawn Neuman
12:40 PM – 1:20 PM	Spencer Weart, Author of The Discovery of Global Warming; previous Director for the Center for History of Physics, American Institute of Physics
1:20 PM – 2:00 PM	Joseph Francisco, President of the American Chemical Society and Professor, Purdue University
2:40 PM – 3:20 PM	Paul Wennberg, Professor of Atmospheric Chemistry and Environmental Engineering, Director of the Linde Center for Global Environmental Science, California Institute of Technology
3:20 PM – 3:40 PM	Break
3:40 PM – 4:20 PM	Fran Pavley, Author of AB 32 (Global Warming Solution Act) and State Senator of California
4:20 PM – 5:00 PM	Healy Hamilton, Head of the Center for Biodiversity Research and Information, California Academy of Sciences
5:00 PM – 5:40 PM	Peter Freed, Carbon Offset Project Developer, TerraPass

We are pleased to offer you an honorarium of $1200 in gratitude for your participation, and to cover your expenses. We will have a parking pass for you; and I will either get that to you before the event, or I will send instructions on how to pick it up when you get to campus. I would to assist in facilitating your travel arrangements in any way. I will certainly send updates via e-mail as needed. Please be in touch if any issues arise.

Sincerely,

Simone Aloisio
Associate Professor and Chair of Chemistry
California State University Channel Islands
Camarillo CA 93012
(805)437-8999
simone.aloisio@csuci.edu

California State University Channel Islands
Check Request Form

290

To be used for transactions not requiring a purchase order, service agreement or travel & expense reimbursement

MAKE CHECK PAYABLE TO:

Name: Joseph Francisco

Address 1: 4663 Woods Edge Drive

Address 2:

City, State Zip: Zionsville, IN 46077

PeopleSoft Vendor ID: _new_
Note: New vendors must complete a Form 204

Check Instructions:
- ☐ Mail to payee
- ☒ * **Pick up at Cashier - Ext** 3253
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Description to appear on reports (30 characters)
Francisco Honorarium

Amount: $ 1200.00 ***Check will only be held for 48 hours after notification before being mailed out.**

TYPE OF PAYMENT:

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- ☐ Lodging (Camarillo area) **
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Approver: Dan Wakelee — Printed Name & Extension — Signature — 3-30-10 Date

Approver: (If required) — Printed Name & Extension — Signature — Date

Lisa Myers
Botany
Climate Change Symposium Extra Credit
April 16, 2010

+10

1. Dr. Spencer Weart, The Discovery of Global Warming

Dr. Weart gave a fascinating talk about the history of global warming. Starting in 1824, he chronicled the historical events that lead to the discovery of global warming, as we know it today. He touched on key players, like Joseph Furier, who first calculated that the planet would be -19 F, but that the green house affect accounts for the additional heat. Prior to the 1930's, humans generally believed that we our actions were too inconsequential to affect the Earth one way or another. The days of the dust bowl and the atomic bomb quickly changed that. In 1958, research by David Keeling woke up scientists to the fact that CO2 levels were rising exponentially. In 1988, Jim Hansen declared that green house gases were indeed causing an extensive disruption, and in 1995 the International Panel on Climate Change announced that the balance of data suggests that humans are having a discernable impact on the Earth's temperature.

I found Dr. Weart's talk fascinating and incredibly educational. It is interesting to understand how we have reached the scientific conclusions of today.

2. Dr. Healy Hamilton, Biodiversity Adaptation to Climate Change

I think Dr. Healy Hamilton's presentation really hit at the heart of the devastation that global warming will bring - biodiversity loss. Species are distributed based on climactic regimes, and in every system that we have some understanding of, scientists are seeing changes. Healy took us through climate change models of a couple of the species that will see significant changes in the future. She showed models that had two endings: one if we do nothing to stop climate change (CO2 levels of 950 ppm), and one if we act now and slow it down to 550 ppm. I think this type of research is extremely beneficial to conservation efforts. If we apply strategic principles of conservation in this rapidly changing world, we can help give endangered species a fighting chance. The principles she mentioned included saving areas with low impacts; protecting areas with high environmental heterogeneity; concentrate conservation efforts on area with high species diversity, endemism and genetic diversity; reduce existing stressors; and place honest values on the goods and services that flow from biodiversity and ecosystems. She also emphasized the importance of connectivity, which is the number one recommendation for climate change adaptation. By creating and protecting corridors between suitable habitats, mobile species will be allowed the freedom to shift and move with their changing habitat. Ultimately, she asked us to "bend the curve" and work towards personal and legislative change that would bring us closer to being carbon neutral.

Vanessa Verity

April 19, 2010

Extra Credit

Speaker: Senator Fran Pavley

Title: Climate Change in California

Senator Pavely spoke about many different resources that climate change is effecting including: Health, agriculture, forests, water resources, coastal areas, species and natural areas. She is currently in the process of planning new adaptation stratergies for California because of the change in climate. Her major breakthrough happened when the AB 32 bill was passed that required the air resources board to monitor and reduce greenhouse gas emissions.

Speaker: Healy Hamilton

Title: Conversing the Diversity of Life in an Era of Global Change

Dr. Hamilton spoke how the effect global warming is having on all areas of life and how it is changing our biodiversity in all areas of the world. I like that she talked about how much money we would have to be spending on things we take for granted that is naturally provided to us for free from both biotic and abiotic things. She used the example of bees pollinating flowers and that it would cost a decent amount of money to have to pay someone to do that while bees provide it to us for free. She also spoke about the effect it is not only having an plants and animals but the effect it is having on cultural diversity by means of food, medicine, spirituality, religion, water and air, gas and oil, and clothing to name a few.

California is leading the country and also the world with its changes and laws that are helping to preserve our earth. Policies are in the making that state that by 2020 greenhouse gas emissions would be reduce by 25%. January 1, 2012 is when the emission limits begin. Things like biofuels, making cars more efficient, reducing energy costs, maintaining and reducing greenhouse gases, etc are all a part of making this actually happen. An interesting statement that Senator Pavely said that per capita in California has remained the same while the rest of the U.S. has increased dramatically in the energy that is being used.

Life on earth is changing in more ways that I had ever thought. I realize that animals are changing migratory times and that organisms are becoming extinct because of global climate change but I never even thought of effect on medicine and human health. We live in a time and place where you can go to a 24 hour pharmacy and get the medicine you need when you are sick. But what about the rest of the world? Many countries depend on plants as essential medicine providers and with the loss of these plants comes the loss of their medicine. Global climate change is affecting life and every level and I think this symposium was very important to have because the first step in trying to slow down climate change is to open up awareness of each and every avenue is it affecting so that it can touch individuals on a personal basis.

Kristin Beach

April 18,2010

Extra Credit:

Designing Global Warming Friendly Molecules

Joseph S. Francisco

This Lecture was about answering three in the process of creating ozone friendly molecules, what I mean by that is molecules that don't eat the ozone (O_3) molecules and will break down the Chloro-flouro-carbons (otherwise known as CFCs). The questions are as follows; 1) When you put something in the atmosphere how does it transform itself (such as fluorine, carbon, etc.), 2) Is there a way to predict the impact of a molecule on the ozone molecules in the atmosphere, and 3)Can you design a molecule that would have a minimum impact on global warming. Now the lecture was very chemically based, but what I got out of it was that there is a formula that you can use to calculate the impact of certain molecules on the ozone molecules, and what I thought was interesting was that most people are concerned about is the carbon dioxide output when we should really watch is these CFC molecules and other man made molecules that 'eat' up the ozone far more than CO_2 could do. As an example aside from the CFCs sulfer-hexafluoride's impact (which was the worst on the list he provided) is 22800 while CO_2 is 1.

Conversing the Diversity of Life in an Era of Rapid Global Change

Healy Hamilton

The lecture entailed how nature's diversity affects us as humans, the threats to this diversity and conserving this diversity. The Diversity of life concerning human survival includes anything from Engineering ideas (often called Bio-mimicing) to raw materials that we use to Ecosystem Services that nature provides for free, and the threat to this diversity is coming from one of the most dependent organisms on Earth, mankind. These threats come in many forms, such as fragmenting, over exploitation, introduction of invasive species, and climate change. Now how we approach the conservation aspect of it is often hidden but it is divided into the following groups; species, ecosystem, Ex Situ Conservation, legislative and protected areas. But what struck me as I'm sure it did for others, that we fail to realize that as the climates change the animals will follow the climate that they are more comfortable in. So what the speaker suggested and what some countries are doing now, is creating a protected Causeway for the animals migrating so that they can move without much interaction with civilization or any threat of humans. One such place is from Yellowstone to the Yukon, it is a wilderness corridor for wild animals to migrate to cooler climes.

Ivett Plascencia

Extra Credit
Sring 2010 Poe Symposiom
Climate Change

Senator Fran Pavely
Climate Change in California

Climate change should be a concern to Californians. It will cost us many things especially here in San Buena Ventura Country. We will have to sepend more in healthcare, Forest, water resources, species and natural areas because of global climate change. Water and Electric conservation is important to preserve because as global climate change our potable water storage on earth is going to go down. The military also is going green because it's a national security issue. Dependence on foreign energy is a national security issue because we get so much of it form overseas and that means that that country owns us. The new national law for emmisitons standards and such, that obama passed a coule of weeks ago was a califonria bill that he decided to adopt as national standards. We must bring green jogs to the USA but because she is the California senator she thinks California can lead in the green jobs and technlogy .

Spencer Weart
The Discovery of Global Warming

Spencer Weart spoke of the history of global warming in the science. In the late 1800's a scientist calculated that the earth with its physical characteristics should be at – 19 degrees Celsius but because we have an atmosphere and water that creates the greenhouse effect its not. In 1899 *Savante Arrhenius* predicted that is we added CO2 to the earth it would cool and if we took away CO2 it would get cold. This sparked some concern to people but because we did not believe human activity could be so big to change the chemistry of the entire earth especially after the discovery that the oceans take in CO2. Some scientist even wrote that we have a good outlook if earth warms because we will all be able to enjoy an warm tropic setting. Another idea that brought global warming concerns down was that the oceans succed up the CO2 therefore it would take a lot of CO2 from us to affect the atmosphere. But after the dust forms and then the invention of the atomic bombs people started to think of humans as able to change the earth in drastic manners. By the 1960 CO2 levels came in the of concern again because recent recording had alarming results. Soon measurements from the ice sheets and better CO2 measurements alarmed scientists. The Toronto Conference of scienticst in 1988 was the first meeting to discuss CO2 levels and global climate change. Scientist concluded that CO2 emissions were a threat to earth's climate and should be stabilized and then eliminated and they would need government regulation to do this. The main message he wanted to convey is that scientist agree that global climate change is a result of the high CO2 levels but now its up to the politics to do something about it.

Lloyd

Lustina

Extra Credit: Climate Change Symposium

1st speaker

The name of the speaker was Healy Hamilton. The title of her talk was Conserving the diversity of life in an era of global change. She talked about if you don't know how to photosynthesize; you will need biodiversity to live. She talked about how biodiversity helps us so much in our daily lives. For example, we get our medicine from plants and there are over 20,000 species of plants that are used for medicinal purposes. She also went into that every species has a niche and climate affects where the species chooses to live. Species can move to a new habitat if the current its living in is unsuitable. If the species cannot move, it has to adapt to its environment. Finally, if the species is not able to adapt then it will go extinct. At the end of the presentation, her final thought was we need to bend the curve and we have the power to think individually on how to promote and conserve biodiversity. I learned a new word which is biomimicry, learning from nature on how to create flow without friction. I also learned that without nature's help of pollination it would cost humans 3 billion dollars annually for pollination services. One cool thing I found fascinating was that bat saliva has the potential for preventing strokes.

Beatrice Villalta

Extra Credit: Poe Symposium- Climate Change

Senator Fran Pavley was the first guest speaker she focused more on climate change and California policies regarding global warming. She spoke about various legistation she contributed to such as AB-1493- clear car act and AB-32- global warming solution act. She also discussed various impacts global warming can have on California such as a rise in temperature, sea level rise and health implications. Global warming can affect health especially in California because as temperatures increase air qualtiy will decrease. She also discussed on our water resources and that we should focus more on adapting and investing in a more sustainable way of living.

Spencer Weart was our second speaker. He discussed the history and discovery of global warming. He discussed how in the past they were afraid of another ice age and thought that keeping the Earth's temperatures up would prevent it. They also believed that there was a balance of nature and the oceans will absorb the CO_2 but Roger Revelle discovered that not all CO_2 winds up in our oceans and thought that half of the CO_2 maybe doesn't. Rovelle asked David Keeling to measure CO_2 levels and he came up with the Keeling curve and he found that there is more CO_2 in our atmosphere.

Sarah Simily

Poe Symposium Extra Credit

Senator Pavley conducted the first lecture. Her lecture entailed her government action towards combating climate change. This included her bill on AB32 involves the global warming solutions act. Senator Pavley was a middle school teacher and has always been highly involved in working towards reducing the emissions of greenhouse gases. She also went over all the economic benefits of moving towards becoming a greener society. Overall Senator Pavley really enforced the idea that even though government involvement is important it is still important for people to get involved at the individual level.

The next speaker was Spencer Weart, he talked about the history of climate change. The important evidence he displayed was how the more scientific advancements have been made the more we have realized what a big impact we have had on global warming. He had great graphs showing temperature change, and well developed arguments for all of the opposing parties to climate change. He also showed what a large influence the media can have on perceptions of climate change. The thing that most stuck with me about this lecture was when he stated the following "Global warming is no longer a scientific problem but a political one."

Amanda Goldstein
Poe Symposium Extra Credit
19 April 2010

Monitoring the release and tracking the fate of carbon dioxide in Earth's atmosphere
Paul Wennberg

Paul Wennberg's talk at the Poe Symposium was more scientific than the previous ones. He started off talking about the green house gas effect and the impact of the atmosphere on climate change. He then went on to explain the differences between Earth, Mars, and Venus, specifically about the amount of water and carbon and its impact on green house gasses. The differences between the northern and southern hemisphere were then explained; how the north has more forests which causes more fluctuations in carbon dioxide levels. He ended with how space based measurements can provide an overall picture of the green houses gasses worldwide.

I learned a lot from this lecture. Although I did have some background knowledge about what green house gasses were, the information presented went in to more depth and detail. It was really interesting to learn about the differences in the gasses between the hemispheres. I never realized how the distribution of forests globally had an impact on the effects of climate change. Overall this lecture was very interesting and informative.

Crystal Anderson
Bio 311

6th Poe Symposium – Climate Change

The first speaker was Fran Pavley, author of AB1493 and AB32 who gave a talk on Climate Change and California. She mentioned several of the impacts of climate change and highlighted how it related to health, water resources and coastal areas of California. Twenty percent of the energy used in California is used to move and treat water! Adaptation strategies are even more important now that 500,000 people were living on land around the Sacramento Delta that was below water level. She also went over the costs of inaction, green jobs and ended it with an overview of AB32 and AB1493 mentioning that California's higher emission standards are becoming the new National standard and that Canada has indicated it will adapt the standard as well. Senator Pavley also mentioned a program to give incentives for reducing emissions, however, it seems that if one takes emissions away from an entity and sells them to another to use, the net emissions are not reduced – they are just transferred.

The second speaker was Spencer Weart, whose presentation "Discovery of Global Warming" was my favorite. He presented a historical perspective on the scientific evolution of global warming studies. It was interesting to see the progression of ideas from just thinking about the temperature of the Earth in 1824 to the 1988 draft report on climate change, to now. I thought one of the best parts was when the speaker presented a graph of the gases analyzed from the Vostok Station Ice Core. This graph showed a CO2 and temperature correlation dating back 160mya, which gave nearly identical information as that predicted by the computer climate models.

He also spoke about how people have perceived human impacts on the Earth over time. For a very long time, it was a common belief that human activities could not affect the planet, and that there existed this "balance of nature." As scientists started to discover effects of global warming, people ignored them. People still believed humans didn't have the power to affect change to the planet on a mass scale. That perception changed with the advent of the nuclear age and by 1995 the general consensus was reached that a problem exists. Even with the modern view that there is a global warming problem, and that energy policy needs to be made to reduce CO2 emissions, there is still a segment of the population that is actively opposing this movement.

Erica Villanueva

12:50 pm
Opening Remarks
Dawn Neuman
Provost, CSU Channel Islands

Simone Aloisio
Chair of Chemistry, CSU Channel Islands

1:00 pm
Climate Change in California
Senator Fran Pavley

1:40 pm
The Discovery of Global Warming
Spencer Weart
Author of The Discovery of Global Warming; previous Director for the Center for History of Physics, American Institute of Physics

2:20 pm
Monitoring the release and tracking the fate of carbon dioxide in Earth's atmosphere
Paul Wennberg
R. Stanton Avery Professor of Atmospheric Chemistry and Environmental Engineering, Director of the Linde Center for Global Environmental Science, California Institute of Technology

3:00 pm
Break

3:20 pm
Designing Global Warming Friendly Molecules
Joseph Francisco
W.E. Moore Distinguished Professor of Chemistry, Purdue University

4:00 pm
Conserving the diversity of Life in an era of global change
Healy Hamilton
Director, Center for Applied Biodiversity Informatics, California Academy of Sciences

4:40 pm
The State of the US Carbon Market: Regulation, Value and Participants
Peter Freed
Carbon Offset Project Developer, Terrapass

Printed on recycled paper

Erica Villanueva
April 19, 2010
Biology 311

Poe Symposium – Climate Change

Senator Fran Pavley spoke about climate change in California, which has been known for a long time and has been an accelerating issue. It results in many concerns: health, agriculture, forests, water resources, coastal areas, species and natural areas. Due to the impacts that climate change has on California, there are many costs that need to be paid such as the energy bill, food/fiber, tourism, wildfires, water supply, infrastructure, flooding and health all adding up to more than 21 billion dollars in costs. Climate change is not only an environmental issue; it is also a national, economic, and military matter as well. She is in charge of two main legislative issues: AB32 which is the Global Warming Solutions Act passed on 9/26/2006 and AB1493 called the Clean Car Act. AB32 requires mandatory recording of how many missions reported to quantify reductions and to come up with policies by reducing greenhouse effects by 20% by the year 2020. This will be done by making vehicles more efficient, energy efficiencies, renewables portfolio standards and low carbon use. Every other legislative issue was able to be passed except for AB1493 which was more difficult to get through. California is the only state under this act. This allows cars to have a 35.5 mile per gallon (standard) which reduces air pollution.

Dr. Spencer Weart spoke about the discovery and history of global warming. It all started with the ice age. In 1824, Joseph Fourier States that the earth's atmosphere keeps it warm. John Tyndall said that the H20 and CO2 in the atmosphere impedes heat from

#1 climate change

1. Senator Fran Pavley

Climate change in California

AB 32 - global warming solutions act → 09/27/2006

AB 1493 - clean car law

climate changes impacts on california has been known for a long time. accelerating issue. (1998)

health concern. agriculture. forests. water resources, coastal areas, species and natural areas.

Sierra snow cap is melting

25% of energy from water

- adaptation strategies
  1. Drought, salt water intrusion, flooding Delta
  2. wildfires increase 12-53% @ end of century
  3. sea level rise
  4. extreme heat, increased pollution, high temp.
  5. summertime water scarcity due to snow pack reductions
- costs to California
  energy - 1-8 billion
  food/fiber - losses can reach 4.3 billion
  tourism - losses $7.5 billion
  wildfires - yearly spending hundreds of millions
  more due to new water supply infrastructure, flooding health cost.
- energy, climate, and national security

  threat:

  benefit:
  import less oil.

38% oil comes from foreign places (they don't really care - not best)

Took 8 yrs AB 1493
2 yrs to legislature

CA - only state under federal clean air act.
permission to adopt stringent things from cars - efficiency

all 50 petitions/legislative issues has been approved.
except for clean air act.
California standard becomes new national standard.

35.5 mi/gal
↳ standard ⇒ reduces air pollution

spending alot of $$ to keep our lawns green.
↓
need to recycle water.

- SB 375 VMT reduction
↳ vehicle miles travel
public transport, transit opportunities

- energy efficiency works
- cheaper to invest in green than build new powerplant
- @ the end, those who will implement these acts is us, local gov. etc

2010 Ballot initiative
no on valero.com
↳ suspends AB32 potential drops in $ & jobs

PACE program - option of putting solar panels. but too expensive, not mandatory.
↓
assess yourself on property tax
↓
(+) 1. deduct
2. stays w/ property
3. benefits right away - do decreasing utility bills

#2
2. Spencer Weart
the discovery of Global Warming

past
started w/ ice - ice age

its not scientific argument — its political.
not most important but very telling

#3

(3) Paul Wennberg.

Sun drives climate of earth
passes through atmosphere
radiation gets trapped in atm.
radiation also comes back to us.

atm acts as blanket made up of molecules
but there are many holes.

CO_2 is allowing things to be trapped ; keep us warm
light is coming all the way in the ground.
look down from space - see CO_2. (cold)

H_2O (vapor) most important gas.
2. HDO
3. CO_2
4. O_3
5. N_2O

Mars - really cold
has CO_2 - missing H_2O and N.

N allows blanket to spread out more.

Venus - all Carbon is baked out of crust
efficient greenhouse

Earth - perfect amt of every gas.
alot of C in earths crust.
alot flowing between ocean and air

amount of energy

Half CO_2 goes away.

SO_2 → power plants

25 million tns of SO_2 comes from China

amount of rain is important to growth of tree
CO_2 increase makes trees grow, but temporarily, then goes back to normal.

Talia Dominello April 16,

Climate change in California
Senator Fran Pavley

We've been documenting changes in California since 1998. Climate affects our health, Coastal areas, water resources and agriculture. We need to figure ways to adapt to these changes. While it's expensive to adapt the costs of not acting is much higher.

Green jobs are growing fast.

AB 32 - companies to report the emission of green house gases.

requires cars to operate more efficiently.

CA, only state under Federal clean air act

CA standards will be adopted by ~~Canada~~ and the whole U.S

It is nice to see people beginning to catch on to this green movement. While of course oil companies are complaining about the new AB32 act - I think it gives them a run for their money. No longer can they monopolize how cars run and a whole new area of jobs are being created. Sometimes competition initiates good changes and now we're seeing many lines of cars come out with their version of a hybrid. Oil companies will have to get out of their comfort zone and evolve to the new changes.

Talia Dominello

Monitoring the release + tracking the fate of CO_2 in the atmosphere
Paul Wennberg

CO_2 alone doesn't act great as a "blanket" - it needs water and even N to make a nice even atmosphere that keeps the earth warm.

Using ice we can measure and figure out what the atmosphere was like in the past.

The last 1000's years Green house gases are stable & until industrial revolution. In N. Hemisphere there's exchange in CO_2 with plants ~~~ but in southern hemisphere we dont see that variation —.

It's because of the lack of plants / land in S. Hemisphere. Even if ↑ in CO_2 makes more plants grow - water is the determining factor.

Madison Rose

Plant Biology

April 19, 2010

Global Warming Symposium

Senator Fran Pavley on Climate Change in California

Senator Pavely discussed the effects of climate change on wellbeing, agriculture, water resources, forest health, coastal areas, and ect. She also talked about the cost of reforming policies on climate change, although they are expensive, the costs of not being proactive will be much higher. California is leading the way in the United States in terms of the federal clean air act. At the moment Senator Pavley is developing new adaptation strategies for California climate change policies. She was a major contributor to the AB 32 bill that was passed in that required the air resources board to monitor and reduce greenhouse gas emissions and requires companies to report their emissions of green house gases.

Healy Hamilton on Conversing the Diversity of Life in an Era of Global Change

Dr. Hamilton discussed the effect global warming is having on all areas of life and its effect on the planets biodiversity. We learned about the amount of money we could possibly be spending on things we take for granted, in biotic and abiotic resources. She used bees pollinating flowers as an example of this; a resource that would cost humans money if bees did not pollinate. She discussed the effects of loss of biodiversity on all aspects of life. Not only are plants and animals suffering, but the loss of biodiversity is having an effect on cultural diversity; this includes means of producing food, advances in medicine, religion, the quality of water and air, gas and oil, and clothing.

Ryane Cox

Poe Symposium

Senator Fran Pavley
Climate Change and California

During her speech, Senator Pavley discussed the impacts that climate change would have on California. Some of the topics she focused on were health, forests, water, and the coast. She talked about some of the adaptation strategies that are going to be needed and used AB-32 as an example of how changes could be made. She mentioned the cost of inaction and used the increasing number of fires in California as an example of how not doing anything could cost Californians a lot of money. One thing that I learned during her speech was that the California standard for gas emissions from cars is now the new national standard. I also learned that the military is using biofuels and I thought that was interesting.

Spencer Weart
The Discovery of Global Warming

Mr. Weart discussed climate change from a historical perspective. He mentioned key scientists who studied climate change in the past. He discussed the ice ages and the balance of nature. He talked a lot about past theories on climate change and how they are, and continue to change as we gain more information. One theory that I found interesting was that scientists used to think that CO2 was good because it allowed for a warmer climate and this could allow more food to be produced and create more hospitable environments. This past theory shows people that as more research is conducted and we continue to learn more, our knowledge on climate change will grow and allow for a better response to the changes. He did talk about a few things I did not know, including the fact that as CO2 increases, water vapor increases, and this causes more green house gases to be trapped. I thought his topic was very informative and I liked that it talked about past theories and not just the numbers part.

Jessica Warren

Biology 311

Poe Symposium

1. The first speaker was Senator Fran Pavley, and the title of her talk was Climate Change in California. Senator Pavley talked about the impacts of climate change, specifically on California and it's residents. She also spoke about what needed to be done in order to battle climate change, like creating new laws and regulations. AB-32, a law that she pioneered, was a major point of her presentation. AB-32 required mandatory recording for the large greenhouse gas emitters, as well as coming up with new policies to reduce greenhouse gas emissions by twenty-five percent by 2020. Pavley also stated that the California standards are now becoming models for other places, like Canada and even for our own national standard. I was very interested in Senator Pavley's presentation because I was not knowledgeable about the work she has done. I also liked how she talked about green jobs leading to growth in California. The fact that going green provides many new jobs gets often overlooked, so I think by her approaching the subject in this way people will be a lot more willing to listen.

2. The fifth speaker was Healy Hamilton from the California Academy of Sciences, and her presentation was called Conserving the diversity of Life in an era of global change. Hamilton spoke mostly about biodiversity, and how it is related to climate change, and our society. She related biodiversity to food, human health