



SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

Name	User ID	College	Department
ALEXANDER NIKOLOV HRISTOV	anh13	Agricultural Sciences (AG)	Not Available
KENNETH DAVIS	kjd10	Earth and Mineral Sciences (EM)	Not Available
JENNIFER BAKA	jeb525	Earth and Mineral Sciences (EM)	Not Available

Academic Home: Agricultural Sciences (AG)

Type of Proposal: Add Change Drop

Message for Reviewers:

Course Designation

(ANSC 332N) Science and policy of global greenhouse gas emissions and management

Course Information

Cross-Listed Courses:

GEOG 332N(EM) METEO 332N(EM)

Prerequisites:

ENGL 15

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Greenhouse Gas Science- Policy

Discipline: General Education

Course Listing: Inter-Domain

Special categories for Undergraduate (001-499) courses

Foundations

Writing/Speaking (GWS)

Quantification (GQ)

Knowledge Domains

Health & Wellness (GHW)

Natural Sciences (GN)

Arts (GA)

Humanities (GH)

Social and Behavioral Sciences (GS)

Additional Designations

Bachelor of Arts

International Cultures (IL)

United States Cultures (US)

Honors Course

Common course number - x94, x95, x96, x97, x99

Writing Across the Curriculum

First-Year Engagement Program

First-Year Seminar

Miscellaneous

Common Course

GE Learning Objectives

GenEd Learning Objective: Effective Communication

GenEd Learning Objective: Creative Thinking

GenEd Learning Objective: Crit & Analytical Think

GenEd Learning Objective: Global Learning

GenEd Learning Objective: Integrative Thinking

GenEd Learning Objective: Key Literacies

GenEd Learning Objective: Soc Resp & Ethic Reason

Bulletin Listing

Minimum Credits: 3

Maximum Credits: 3

Repeatable: NO

Department with Curricular Responsibility: Animal Science (UPAG_ANSC)

Effective Semester: FA 2018

Travel Component: NO

Course Outline

A brief outline or overview of the course content:

Students completing this course will have a broad and comprehensive understanding of all aspects of GHG emission sources, including inventories, mitigation, and the social and policy implications of various mitigation options. The course will have 2 main sections – Greenhouse Gas Emissions from Natural Sources and Energy Production (Section 1) and Greenhouse Gas Emissions from Agriculture and Food Production (Section 2). The GS component will cover climate change governance and environmental policy analysis and will be integrated in both sections. Section 1 will discuss GHG emissions from fossil fuel and alternative energy sources, natural sources and sinks of GHGs, and climate management options. Section 2 will discuss GHG emissions from agriculture (livestock and crops) and food processing and distribution. Both sections will discuss the history, key concepts, and challenges of climate change governance and will evaluate policy options for climate change mitigation, alternative energy, and food choices.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:

Section 1: Greenhouse gas emissions from natural sources and energy production

Week 1: History of GHG in the earth's atmosphere and correlation with climate

Week 2: Introduction to environmental policy, climate management strategies and environmental ethics

Week 3: Overview of the global carbon cycle

Week 4: Terrestrial ecosystem carbon cycle

Week 5: History of energy use and sources

Week 6: Future energy options and scenarios

Week 7: Radiation management options, including geoengineering

Week 8: Assignment 1: GHG management, Part 1

Section 2: Greenhouse gas emissions from agriculture and food production

Week 9: Greenhouse gas emissions from agriculture and land use change

Week 10: Livestock greenhouse gas emissions

Week 11: Carbon footprint of food

Week 12: Introduction to agriculture policy

Week 13: Global climate change policy

Week 14: Frontiers in climate and energy policy: city, regional initiatives and private governance

Week 15: Assignment 2: GHG management, Part 2

Course Description:

This interdomain course introduces students to the science and policy of greenhouse gas emissions. The course focuses on emissions from natural sources, energy production and food production. Policy components will introduce students to the fundamentals of environmental policy and examine key policy options for mitigating and managing emissions. Global in scope, the course will also address how emissions and policy options differ in developed and developing countries. Topics will include overviews of the global carbon cycle, agriculture and land use change emissions, history of global energy use and production, overview of global climate change policy, frontiers in climate, energy and agriculture policy, amongst others.

The name(s) of the faculty member(s) responsible for the development of the course:

| Name: ALEXANDER NIKOLOV HRISTOV (anh13)

Title:

Phone:

Address:

Campus: UP

City:

Fax:

| Name: KENNETH DAVIS (kjd10)

Title:

Phone:

Address:

Campus: UP

City:

Fax:

| Name: JENNIFER BAKA (jeb525)

Title: ASST PROF GEOGRAPHY

Phone: +1 814 865 9656

Address: 0302 WALKER BLDG

Campus:

City:

Fax:

Course Justification

Instructional, Educational, and Course Objectives:

This section should define what the student is expected to learn and what skills the student will develop.

By the end of this course the students will be able to:

1. List GHG that change the earth's climate.
2. Describe the major sources and sinks of natural and anthropogenic GHG.
3. Describe, quantitatively and qualitatively, the contribution of various human activities to global GHG inventories.
4. Formulate sector-specific GHG mitigation practices and policies and analyze their potential efficacy.
5. Evaluate the climate, economic, and ethical impacts and implications of specific GHG mitigation strategies, considering available resources, projected population growth, and cultural constraints.
6. Analyze the policy tradeoffs of GHG management and mitigation strategies from more than one socio-economic or cultural perspective.
7. Integrate and apply concepts from the natural and social sciences to evaluate different policy options for mitigating GHG emissions.

Evaluation Methods:

Include a statement that explains how the achievement of the educational objective identified above will be assessed.

The procedures for determining students' grades should be specifically identified.

Weekly quizzes (13 quizzes, 40 pts each) - 520 points (52% of final score)

Assignments (2 assignments, 175 pts each)* - 350 points (35% of final score)

Participation through Discussion Forums - 130 points (13% of final score)

Total 1,000 points (100%)

*Assignments:

Assignment 1, case-study 1 = 175 points

Assignment 2, case-study 2 = 175 points

Grades: (93-100%=A; 90-92%=A-; 87-89%=B+; 83-86%=B; 80-82%=B-; 77-79%=C+; 70-76%=C; 60-69%=D; < 60%=F)

Quizzes are 20 min each and cover material taught during the week. Quizzes will be electronically graded.

Assignments will be given following each course section and will consist of a written, synthetic and integrative proposal by the student for GHG management options for a stakeholder within the particular GHG domain. For example, students have to discuss the environmental, social, and economic aspects of management solutions for mitigation of Natural and Energy-related GHG (Section 1), or GHG from Agricultural activities and Food production (Section 2).

Discussion Forums: Students will be required to participate in Discussion Forums with a minimum of one involved post (5 pts) and one reply (5 pts); an involved post is considered a post with a minimum of 150 words.

Examples of discussion posts: Week 1: How they feel about history of GHG in the earth's atmosphere? What is your first reaction following this lecture? Choose one example from the lecture and add one of your own and compare them. Choose optional reading from the list provided and react to it by connecting the reading to your own experiences and previous knowledge. What do you think about the material you read? Provide a link to your blogs if you are blogging about this class. When responding to a post, evaluate and react to it. Do you agree or disagree with the post? What would you say about the topic being discussed by your peers?

Students enrolled in the Honors option of the course will have to complete a capstone assignment at the end of the course. This assignment will require the students to integrate anthropogenic GHG emission mitigation approached into an overall global management approach.

Relationship/Linkage of Course to Other Courses:

This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course's role as a prerequisite for other courses.
To the best of our knowledge, this is the first course of its type at PSU that attempts to integrate the natural and social sciences to examine GHG emissions.

Relationship of Course to Major, Option, Minor, or General Education:

This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.

As discussed below, the course will help to satisfy the following General Education objectives: critical and analytical thinking, integrative thinking, global learning, social responsibility and ethical learning.

A description of any special facilities:

This course will be offered as an online course. Therefore, students will be required to have access to a computer and an internet connection.

Frequency of Offering and Enrollment:

Once per year.

Alignment with General Education Objectives

EFFECTIVE COMMUNICATION – the ability to exchange information and ideas in oral, written, and visual form in ways that allow for informed and persuasive discourse that builds trust and respect among those engaged in that exchange, and helps create environments where creative ideas and problem-solving flourish.

KEY LITERACIES – the ability to identify, interpret, create, communicate and compute using materials in a variety of media and contexts. Literacy acquired in multiple areas, such as textual, quantitative, information/technology, health, intercultural, historical, aesthetic, linguistic (world languages), and scientific, enables individuals to achieve their goals, to develop their knowledge and potential, to lead healthy and productive lives, and to participate fully in their community and wider society.

CRITICAL AND ANALYTICAL THINKING – the habit of mind characterized by comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating a conclusion. It is the intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

INTEGRATIVE THINKING – the ability to synthesize knowledge across multiple domains, modes of inquiry, historical periods, and perspectives, as well as the ability to identify linkages between existing knowledge and new information. Individuals who engage in integrative thinking are able to transfer knowledge within and beyond their current contexts.

CREATIVE THINKING – the capacity to synthesize existing ideas, images, or expertise in original ways and the experience of performing, making, thinking, or acting in an imaginative way that may be characterized by innovation, divergent thinking, and intellectual risk taking.

GLOBAL LEARNING – the intellectually disciplined abilities to analyze similarities and differences among cultures; evaluate natural, physical, social, cultural, historical, and economic legacies and hierarchies; and engage as community members and leaders who will continue to deal with the intricacies of an ever-changing world. Individuals should acquire the ability to analyze power; identify and critique interdependent global, regional, and local cultures and systems; and evaluate the implications for people's lives.

SOCIAL RESPONSIBILITY AND ETHICAL REASONING – the ability to assess one's own values within the social context of problems, recognize ethical issues in a variety of settings, describe how different perspectives might be applied to ethical dilemmas, and consider the ramifications of alternative actions. Individuals should acquire the self-knowledge and leadership skills needed to play a role in creating and maintaining healthy, civil, safe, and thriving communities.

What component(s) of the course will help students achieve the General Education Learning Objectives covered in the course? Provide evidence that students in the course have adequate opportunities to achieve the identified learning objectives.

Critical and analytical thinking: Students in this course will learn the science of GHG emissions and mitigation in various sectors (Energy, Agriculture, etc.), the social and policy implication of mitigation options, and will be challenged to develop and critically evaluate emission sector-relevant policy options for GHG and climate change mitigation, alternative energy, and food choices.

Integrative thinking: This course, taught by experts in their respective fields, will offer to the students a lot of opportunities for cross-disciplinary integrative thinking. The very nature of the science of GHG emissions and mitigation crosslinks natural sciences, social sciences, and policy (i.e., human perception, acceptance, food choices).

Global learning: Students will be exposed to the diversity of the global energy and agricultural sectors and associated GHG emissions and will discuss the applicability and cultural, social, and economic implications of various GHG mitigation options.

Social responsibility and ethical reasoning: The course will introduce students to different ethical perspectives from philosophy. Students will be asked to apply these principles to determine how to value environmental policy tradeoffs and to consider the distribution of costs and benefits resulting from different policy options.

How will students be assessed to determine their attainment of the Learning Objective(s) of General Education covered in this course? This assessment must be included as a portion of the student's overall performance in this course.

Quizzes (13 quizzes, 40 pts each) - 520 points (52% of final score)
Assignments (2 assignments, 175 pts each)* - 350 points (35% of final score)
Participation through Discussion Forums - 130 points (13% of final score)
Total 1,000 points (100%)

*Assignments:

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Grades: (93-100%=A; 90-92%=A-; 87-89%=B+; 83-86%=B; 80-82%=B-; 77-79%=C+; 70-76%=C; 60-69%=D; < 60%=F)

Quizzes are 20 min each and cover material taught during the week. Quizzes will be electronically graded.

Assignments will be given following each course section and will consist of a written, synthetic and integrative proposal by the student for GHG management options for a stakeholder within the particular GHG domain. For example, students have to discuss the environmental, social, and economic aspects of management solutions for mitigation of Natural and Energy-related GHG (Section 1), or GHG from Agricultural activities and Food production (Section 2).

Discussion Forums: Students will be required to participate in Discussion Forums with a minimum of one involved post (5 pts) and one reply (5 pts); an involved post is considered a post with a minimum of 150 words.

Examples of discussion posts: Week 1: How they feel about history of GHG in the earth's atmosphere? What is your first reaction following this lecture? Choose one example from the lecture and add one of your own and compare them. Choose optional reading from the list provided and react to it by connecting the reading to your own experiences and previous knowledge. What do you think about the material you read? Provide a link to your blogs if you are blogging about this class. When responding to a post, evaluate and react to it. Do you agree or disagree with the post? What would you say about the topic being discussed by your peers?

Students enrolled in the Honors option of the course will have to complete a capstone assignment at the end of the course. This assignment will require the students to integrate anthropogenic GHG emission mitigation approached into an overall global management approach.

General Education Domain Criteria

General Education Designation: Inter-Domain

GN Criteria

- Explain the methods of inquiry in the natural science fields and describe how the contributions of these fields complement inquiry in other areas
- Construct evidence-based explanations of natural phenomena
- Demonstrate informed understandings of scientific claims and their applications
- Evaluate the quality of the data, methods, and inferences used to generate scientific knowledge
- Identify societal or philosophical implications of discoveries in the natural sciences, as well as their potential to address contemporary problems

What components of the course will help students achieve the domain criteria selected above?

- Construct evidence-based explanations of natural phenomena: after completing this course, students will be able to explain processes responsible for natural and anthropogenic GHG emissions.
- Demonstrate informed understandings of scientific claims and their applications: in this course, students will learn about various GHG sources and sinks and critically evaluate mitigation strategies and their environmental, social, and economic implications.
- Evaluate the quality of the data, methods, and inferences used to generate scientific knowledge: after completing this course, students will be able to evaluate GHG inventory approaches and measurement methods and understand the importance of method accuracy for GHG emission estimates and success of mitigation technologies.
- Identify societal or philosophical implications of discoveries in the natural sciences, as well as their potential to address contemporary problems: Students will study technologies available for mitigating GHG emissions, and how advances in these technologies could impact climate management strategies.

GS Criteria

- Explain the various methods of inquiry used in the social and behavioral sciences and describe how the contributions of these fields complement inquiry in other areas
- Identify and explain major foundational theories and bodies of work in a particular area of social and behavioral sciences
- Describe the ways in which many different factors may interact to influence behaviors and/or institutions in historical or contemporary settings
- Explain how social and behavioral science researchers use concepts, theoretical models and data to better understand and address world problems
- Recognize social, cultural, political and/or ethical implications of work in the social and behavioral sciences

What components of the course will help students achieve the domain criteria selected above?

Students will be introduced to the foundations of policy analysis with a specific focus on how the policy process applies to environmental governance. Students will use these concepts in their assessments. Students will also be introduced to the history of environmental and climate policy in order to better understand key shifts in the policy sciences within these domains.

A key element of the social science components of the course will be to emphasize the importance of perspectives. Students will be challenged to critically evaluate policy challenges from the perspectives of different participants, from rural land users, corporate executives, government officials, amongst others.

One week will be devoted to different ethical perspectives in policy analysis. Throughout the course students will be introduced to political implications of decision making. We will continually challenge students to return to these concepts in their assignments throughout the course.

Integrative Studies

Explain how the intellectual frameworks And methodologies of the two Knowledge Domains will be explicitly addressed in the course and practiced by the students.

Each section of the course contains lectures on foundational methods/concepts in the natural sciences – GHG and land use change science – and social sciences – policy sciences of environment, energy and climate policy. Students will be tasked with integrating concepts from the natural and social sciences in their course assessments. As an example, in Section 1 of the course, students will develop a country-specific case-study to evaluate the effectiveness of a GHG management/mitigation strategy for a domain (natural systems, energy, and geoengineering) integrating the economic, societal, political, and ethical implications of the mitigation scenario. Another assignment will utilize similar approach to evaluate mitigation strategies for the agriculture/food production domain.

Demonstrate that each Of the two domains will receive approximately equal attention, providing evidence from course topics, assignments, or other course components, and that students will integrate material from both domains.

As illustrated by the syllabus, the course is divided into two sections: GHG science and policy, land use science and policy. Each section contains roughly a 50:50 split between science and policy topics. Students will be tasked with integrating science and policy concepts in their course assessments.

Briefly explain the staffing plan. Given that each Inter-Domain course is approved for two Knowledge Domains, it will be taught by an instructor (or instructional team) with appropriate expertise in both domains.

The instructors will rotate teaching the course on a three-year basis. At this time period, we do not anticipate any TA support

Describe the assessments that will be used to determine students' ability to apply integrative thinking.

The quizzes and two course assignments will test students' knowledge of natural and social science concepts and will task students with applying these skills in two course exercises. Discussion forums will make up 13% of the final grade.

Campuses That Have Offered () Over The Past 4 Years

semester AB AL BK BR BW CR DS ER FE GA GV HB HN HY LV MA NK PC SH SL UP WB WC WS XC XP XS YK

Potential Impact

Pre-Requisites

is listed as a pre-requisite or concurrent course for the following courses:

Note: Not all courses may be listed here, due to lionpath requirement incompleion.

No pre-requisites or concurrent courses found

Review History

This section represents all consultation history that has occurred on this proposal

Legend



Approve



Rejected



Waiting Review



User Action Required



Pending Action(s)



Moved to Rejected Status



Approved

(#) - Review Order Sequence Number

Consultation



Recipient Name: [JEFFREY BROWNSON](#)

Department: Energy And Mineral Engineering

Position: Consultation

Campus: UNIVERSITY PARK CAMPUS

Title: ASSOC PROF ENERGY&MIN ENG



ANSC/GEOG/METEO 332N (3 credits) Science and policy of global greenhouse gas emissions and management

Fall Semester 2018

INSTRUCTORS:

Drs. Alexander N. Hristov, Department of Animal Science, College of Agriculture (352 ASI; 863-3669), Kenneth J. Davis, Department of Meteorology and Atmospheric Science, College of Earth and Mineral Sciences (512 Walker, 863-8601), and Jennifer Baka, Department of Geography, College of Earth and Mineral Sciences (307 Walker, 865-9656)

Office Hours: By appointment

Students are encouraged to contact the instructor with questions. Please call or send an e-mail for an appointment.

<u>Contact</u>	<u>Email Address</u>
Dr. Hristov	anh13@psu.edu
Dr. Davis	kjd10@psu.edu
Dr. Baka	Jeb525@psu.edu

DESCRIPTION:

ANSC/GEOG/METEO 332N, Science and policy of global greenhouse gas emissions and management is a **General Education, 3-credit online course with an Honors option** available to PSU campuses throughout the Commonwealth. The course is addressing Penn State's General Education domains: Natural Sciences (GN), and Social and Behavioral Sciences (GS). Students completing this course will have a broad and comprehensive understanding of all aspects of greenhouse gas (GHG) emission sources, inventories, mitigation, and the social and policy implications of various mitigation options. More information about the course can be found on Canvas.

REFERENCES:

*Lecture notes will be posted on Canvas and **ARE THE PRIMARY SOURCE OF INFORMATION FOR THIS CLASS.** Additional readings are listed at the end of this syllabus.*

GENERAL EDUCATION LEARNING OBJECTIVES covered by the course:

CRITICAL AND ANALYTICAL THINKING: Students in this course will learn the science of GHG emissions from natural and anthropogenic sources and mitigation options for various sectors (Energy, Agriculture, etc.), the social and policy implication of mitigation options, and will be challenged to develop and critically evaluate emission sector-relevant policy options for GHG and climate change mitigation, alternative energy, and food choices.

INTEGRATIVE THINKING: This course, taught by experts in their respective fields, will offer to the students opportunities for cross-disciplinary integrative thinking. The very nature of the science of GHG emissions and mitigation crosslinks natural sciences, social sciences, and policy (i.e., human perception, acceptance, food choices).

GLOBAL LEARNING: Students will learn about the diversity of the global energy and agricultural sectors and associated GHG emissions and will discuss the applicability and cultural, social, and economic implications of various GHG mitigation options.

SOCIAL RESPONSIBILITY AND ETHICAL REASONING: In this course students will learn about different ethical perspectives from philosophy. Students will be asked to apply these principles to determine how to evaluate environmental policy tradeoffs and to consider the distribution of costs and benefits resulting from different policy options.

COURSE-SPECIFIC LEARNING OBJECTIVES:

By the end of this course the students will be able to:

1. List GHG that change the earth's climate.
2. Describe the major sources and sinks of natural and anthropogenic GHG.
3. Describe, quantitatively and qualitatively, the contribution of various human activities to global GHG inventories.
4. Formulate sector-specific GHG mitigation practices and policies and analyze their potential efficacy.
5. Evaluate the climate, economic, and ethical impacts and implications of specific GHG mitigation strategies, considering available resources, projected population growth, and cultural constraints.
6. Analyze the policy tradeoffs of GHG management and mitigation strategies from more than one socio-economic or cultural perspective.
7. Integrate and apply concepts from the natural and social sciences to evaluate different policy options for mitigating GHG emissions.

GRADING:

Grades will be based on 1,000 points, distributed as follows:

Quizzes (13 quizzes, 40 pts each)	-	520 points (52% of final score)
Assignments (2 assignments, 175 pts each)*	-	350 points (35% of final score)
Participation through Discussion Forums	-	<u>130 points (13% of final score)</u>
Total		1,000 points (100%)

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Students enrolled in the Honors option of the course will have to complete a capstone assignment at the end of the course. This assignment will require the students to integrate anthropogenic GHG emission mitigation approached into an overall global management approach.

Academic Integrity: _____

Penn State takes violations of academic integrity very seriously. Faculty, alumni, staff and fellow students expect each student to uphold the University's standards of academic integrity both in and outside of the classroom.

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts. Academic integrity includes a commitment not to engage in or tolerate acts of falsification, plagiarism, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others (see Faculty Senate Policy 49-20 and G-9 Procedures) <http://studentaffairs.psu.edu/conduct/codeofconduct>).

A lack of knowledge or understanding of the University's Academic Integrity policy and the types of actions it prohibits and/or requires does not excuse one from complying with the policy.

Disability: _____

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources web site provides contact information for every Penn State campus: <http://equity.psu.edu/student-disability-resources/disability-coordinator>. For further information, please visit the Student Disability Resources web site: <http://equity.psu.edu/student-disability-resources>.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <http://equity.psu.edu/student-disability-resources/guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling and psychological services:_____

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

Counseling and Psychological Services at University Park (CAPS)
(<http://studentaffairs.psu.edu/counseling>): 814-863-0395

Counseling and Psychological Services at Commonwealth Campuses
(<http://senate.psu.edu/faculty/counseling-services-at-commonwealth-campuses>)

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400
Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

COURSE SCHEDULE:

Course introduction: Instructors introduction - field of expertise and experience. Introduction of course structure, evaluation, grading, discussion forums. Detailed explanation of assignments – expectations, material/lectures covered, evaluation; explanation of the Honors Option (Capstone Synthesis Assignment).

Section 1: Greenhouse Gas Emissions from Natural Sources and Energy Production.

Humans are changing the GHG content of the atmosphere and this has serious implications for the environment. Management is necessary. Doing nothing to address the problem is a management choice.

Week 1: History of GHG in the earth's atmosphere and correlation with climate. Discussion of the physics and demonstrated causal relationship between increased GHG and: (1) warming climate, (2) ocean acidification, and (3) impact on ecosystems. Temperature changes/warming; observed, projected, over the globe. Impacts of heat waves on humans. Impacts of temperature change on species distributions, including disease and pests. Impacts of temperature change on agricultural zones. Intensification of the hydrologic cycle; observed and projected. Increased intensity of floods and droughts. Examples: decrease in snowpack in the US west, drought in sub-Saharan Africa, floods in Pennsylvania. Sea level

rise: observed and projected. Paleorecord of sea level vs. carbon dioxide. Examples: ports – impacts in the industrialized world; flooding of homes; island nations, coastal cities (Miami, New Orleans), interaction with tropical storms. Loss of sea ice and tundra.

Week 2: Introduction to environmental policy, climate management strategies and environmental ethics. Brief history of environmental policy from the 1970s to present and overview of environmental policy process. Why intervene in the environment? What makes the environment different than other areas of policy interest? What were some of the key focusing events initiating environmental policy intervention in the US and abroad? How are issues of ethics considered? How are the distribution of costs and benefits from environmental policy considered? What improvements can be made to the current environmental policy process? Apply these concepts to climate management and policy. An overview of costs, benefits, and issues associated with climate management strategies such as mitigation of GHG emissions, adaptation to climate change, and management of the radiative input to the planet will be discussed. Who are the winners and losers of these GHG management approaches? What are the economic costs and natural damage?

Week 3: Overview of the global carbon cycle. Global scale budgets of methane and carbon dioxide. What do we know about current global budgets of these gases? How do we know it? Where are the uncertainties? What are the different GHG sources and sinks? Potential to manipulate these systems and their role in the global carbon balance. Ocean carbon cycle: Why is the ocean part of the global carbon cycle? Henry's Law and partial pressures, the buffer effect and ocean acidification, ocean circulation. El Nino, climate change, and air-sea gas exchange. The role of nutrients and biology in ocean carbon. Role of dust deposition. Ocean sediments and the 10,000 year lifetime for atmospheric carbon dioxide. Glacial/interglacial cycles. Methane in ocean sediments. Current ocean sources and sinks of carbon dioxide. Future ocean sources and sinks. Potential for manipulation of the ocean carbon cycle. Experiments in ocean fertilization.

Week 4: Terrestrial ecosystem carbon fluxes. What do we know about the current terrestrial ecosystem carbon cycle? How do we know it? Photosynthesis and respiration. Aerobic and anaerobic decomposition. Ecosystem growth and succession. Carbon pools in ecosystems (soil, biomass). Lakes, rivers, and wetlands – methane and burial of carbon, creation of fossil fuels. Current state of disequilibrium in the terrestrial carbon cycle. Hypotheses for this state (recovery from disturbance; fertilization by nitrogen, carbon dioxide; response to changing climate). Current knowledge about ecosystem methane sources. Future terrestrial ecosystem carbon cycle as climate, land use/agriculture, energy systems continue to change. Ecosystem management of the carbon cycle, and potential for sequestration in forests and soils. Disturbance and deforestation. Ability to measure these processes.

Week 5: History of energy use and sources. Parallel to history of atmospheric GHG. Emissions per unit energy of various energy sources. Overview of the Global Energy Assessment: <http://www.globalenergyassessment.org>. Energy use around the globe. International comparisons. How much do sources of energy, and energy use, and energy efficiency vary around the world? How does this translate into differences in GHG

emissions around the world? Introduce concepts of the "Energy Ladder" and "Energy Poverty", two of the main concepts in energy and development studies. What areas of the world suffer energy poverty and why? What are the advantages/disadvantages of moving up the energy ladder? Global energy needs, present and projected: (1) per country versus per capita measurements; (2) issues of embodied energy and energy trade; (3) how are emissions from production versus consumption assigned? Breakdown of energy emissions by sector – e.g. transportation, electricity, heating, industry, agriculture.

Week 6: Future energy options and scenarios. Potential energy production of various energy sources. Advantages and disadvantages of these systems. Potential for changes within energy sectors to mitigate GHG emissions. Carbon capture and sequestration with fossil energy sources. Bioenergy and carbon capture and sequestration. Renewable and other alternative energy sources. Grid development, management. Decentralized vs. centralized approaches. Case study of Sub-Saharan Africa and International Energy Agency efforts to intervene in the region. Mundane science approaches. How can small scale, decentralized interventions aid in alleviating energy poverty? Solar lighting. Transportation alternatives. Bus Rapid Transit Systems. Case Study: Bogota Colombia. Recent ban on fossil fuel vehicles in Paris.

Week 7: Radiation management options, including geoengineering. How can climate be managed in ways other than changing atmospheric GHG concentrations? What are some of the trade-offs and risks and benefits? Discuss altering solar radiation via changing the land surface (albedo), addition of stratospheric aerosols, and space radiation reflection. Historical record of large volcanic eruptions and their impacts on climate and society. Evaluate the costs, benefits, policy implications, and ethical issues associated with geoengineering.

Week 8: Assignment 1: GHG management, Part 1. Students will develop a case-study to evaluate the effectiveness of a GHG management/mitigation strategy for one of the following domains: natural systems (ocean, terrestrial), energy systems, and geoengineering. The case-study will be country-specific and will estimate the impact of the mitigation strategy on the country's GHG emission inventories. The evaluation will integrate the economic, societal, political, and ethical implications of the proposed mitigation scenario.

Section 2: Greenhouse Gas Emissions from Agriculture and Food Production. How to feed a growing population with limited resources and at the same time decrease GHG emissions from Agriculture and Food production?

Week 9: Greenhouse gas emissions from agriculture and land use change. Agricultural GHG sources. GHG emissions from crop production. Sources, inventories, global perspective (comparison of various production systems across the world). How to feed a growing world population with limited resources and at the same time decrease GHG emissions? Genetically modified crops. Emissions from organic vs. conventional production systems. Emissions from rice paddies. Fertilizer production and use. Soil sequestration – tillage options. Grasslands. Pastures and rangelands. Biodiversity and ecosystem services. Mitigation options.

Week 10: Livestock greenhouse gas emissions. Sources, inventories, global perspective. Ruminants vs. non-ruminants. Meat, milk, wool production. Enteric emissions. Manure emissions. Emissions in pasture-based system. Emissions from organic vs. conventional production systems. Genetically modified animals. Emissions from non-farm species: horses, wild ruminants. Mitigation options.

Week 11: Carbon footprint of food (Life Cycle Assessment of common foods). On-farm, transportation, processor, consumer emissions. Food waste. Land use change.

Week 12: Introduction to agriculture policy. Brief review of historic policy shifts from Green Revolution to today's Climate Smart Agriculture. How were these policies decided? What are their objectives? How are the costs and benefits of the policies distributed amongst different stakeholders in society? How well did the policies achieve their stated goals? How can agriculture policy be improved?

Week 13: Global climate change policy. Review of efforts to develop a global strategy for addressing climate change. Who are the main players? Who are the main stakeholders? What are the main points of consensus and disagreement? Introduction to the Intergovernmental Panel on Climate Change (IPCC). Review of key efforts to forge a global agreement, from Kyoto to Paris. Evaluate the implications of US withdraw from the Paris Agreement.

Week 14: Frontiers in climate and energy policy: city, regional initiatives and private governance. Evaluate emerging efforts to address climate and energy policy at a sub-national level. Examine: (1) the role of cities, states, regions in developing their own strategies for intervening in climate and energy policy; and (2) the role of private governance initiatives run by industry and civil society. Preliminary state/regional case studies will include California, London/Paris, Bogota, British Columbia. Private governance initiatives will include the Extractive Industries Transparency Initiative, FairTrade labeling, Forest Stewardship Council, amongst others. What are the advantages/disadvantages of such initiatives? How widespread might their impacts be? How will such initiatives achieve "success" and for whom? How might such initiatives enable/constrain wider adoption of similar initiatives in other regions?

Week 15: Assignment 2: GHG management, Part 2. Students will develop a case-study to evaluate the effectiveness of a GHG management/mitigation strategy for the agriculture/food production domain. The case-study will be country-specific and will estimate the impact of the mitigation strategy on the country's GHG emission inventories. The evaluation will integrate the economic, societal, political, and ethical implications of the proposed mitigation scenario. The course will close with presentations, reflections, and discussions.

Honors students will develop a **Capstone Synthesis Assignment** consisting of integration of sources, sinks, and mitigation strategies for various GHG emissions sectors.

READING MATERIALS:

The following reading materials are recommended for students taking this course.

US EPA (Environmental Protection Agency) GHG Reporting Program:

<https://www.epa.gov/ghgreporting>

US EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks:

<https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

National Academy of Sciences Anthropogenic Methane Emissions in the United States: <http://nas-sites.org/dels/studies/methane-study>

National Academy of Sciences Climate Science Special Report (2017): <http://nas-sites.org/americasclimatechoices/other-reports-on-climate-change/review-of-the-draft-climate-science-special-report-2017/>

Global Carbon Project synthesis of the global carbon cycle:

<http://www.globalcarbonproject.org/about/index.htm>

IPCC (Intergovernmental Panel on Climate Change) 5th Assessment Report:

<https://www.ipcc.ch/report/ar5/> (climate forcing, chapter 8; carbon cycle, chapter 6; energy, transportation, industry, chapters 7-10; agriculture, chapter 11)

Global Energy Assessment (IIASA): <http://www.globalenergyassessment.org>

Millennium Ecosystem Assessment (United Nations):

<http://www.millenniumassessment.org/en/index.html>

Mitigation of greenhouse gas emissions in livestock production: A review of technical options for non-CO₂ emissions (Food and Agriculture Organization of the United Nations);

<http://www.fao.org/docrep/018/i3288e/i3288e00.htm>

Greenhouse gas emissions from ruminant supply chains: A global lifecycle assessment (Food and Agriculture Organization of the United Nations);

<http://www.fao.org/docrep/018/i3461e/i3461e00.htm>

Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities (Food and Agriculture Organization of the United Nations);

<http://www.fao.org/docrep/018/i3437e/i3437e00.htm>