

## **Master Syllabus**

**1. \*Full course title:**

Emissions, energy and ecosystems: foundations for carbon and greenhouse gas management

**2. \*Course Number and Level**

ESS 524

**3. \*Important information for Students**

All students should fill out a student-specific symptom checker each day before coming to class (<https://covidrecovery.colostate.edu/daily-symptom-checker/>). In addition, please utilize the symptom checker to report symptoms, if you have a positive test, or exposed to a known COVID contact. If you know or believe you have been exposed or are symptomatic, it is important for the health of yourself and others that you report it through this checker. You will not be in trouble or penalized in any way for reporting. If you report symptoms or a positive test, you will receive immediate instructions on what to do and CSU's Public Health Office will be notified. Once notified, that office will contact you and most likely conduct contact tracing, initiate any necessary public health requirements and/or recommendations and notify you if you need to take any steps. For the latest information about the University's response, please visit the CSU COVID-19 site (<https://covidrecovery.colostate.edu/>).

**4. \*Credit hours for the course:**

3 Credit Hours

**5. \*Recommended prerequisites or other special information:**

Student should have a Bachelors Degree with prior coursework that supports understanding basic chemical transformations of carbon and other greenhouse gases, budgeting tools, and policy analysis. Solid communication and mathematical skills and the ability to think broadly and solve problems will also contribute to student success in this course.

**6. \*Short course description for the catalog:**

Demonstrate understanding of the principles involved in energy use, carbon emissions, and terrestrial carbon cycling. Focus on past, present, and future human impacts on the carbon cycle and the design of policies and programs to control atmospheric carbon dioxide.

**7. \*Long course description:**

This course examines carbon cycle science and greenhouse gas management, including carbon cycling in natural systems, anthropogenic greenhouse gas emissions by sector, measurement and monitoring, and mitigation opportunities. Students will explore all aspects of carbon cycle science in several types of organization: energy, manufacturing, service, natural resource management, transportation, land use, and waste sectors.

**8. \*Description of the major goals and objectives of the course, and specific student learning outcomes. (Goals should be broad, general statements about outcomes, and objectives should be specific, measurable outcomes representing specific competencies)**

The goal of this course is to provide students with theoretical underpinnings and conceptual frameworks needed to understand the role of a variety of organizations in greenhouse gas emissions and emission reduction strategies, design, and opportunities.

Learning objectives:

- Compare and contrast different frameworks for greenhouse gas accounting
- Describe key components of national and project-level greenhouse gas accounting
- Characterize greenhouse gas emissions by sector
- Justify country-level perspectives on greenhouse gas emission reduction commitment and analyze costs and impacts
- Enumerate energy types, use, and emissions for countries, regions, and organizations
- Explain the challenges of integrating renewable electricity into the grid
- Summarize the global carbon and nitrogen cycles and explain the fate of anthropogenic emissions
- Analyze and forecast national decarbonization rates
- Interpret emission inventory data, including converting units and calculating greenhouse gas equivalencies
- Analyze greenhouse gas tradeoffs associated with land use
- Evaluate emission reduction and offset strategies

**9. \*List of general course topics, recommended contact hours per topic and recommended sequencing.**

List of General Course Topics:

- Carbon and greenhouse gases in natural ecosystems
- Carbon and greenhouse gases in our economy
- Emissions trends – past and present
- International emissions profiles
- Emission trajectories and drivers
- Food production systems and emissions
- Emission reduction / sequestration strategies

Expanded Course Topics and recommended sequencing:

*1-Perspectives on GHG accounting*

- Intensity
- Efficiency
- Individual accounting
- Production vs. consumption accounting

*2-Energy*

- Primary movers
- Electricity generation

- Energy efficiency
- CO2 and energy
- Carbon intensity

### 3-Land use and carbon

- Global C cycle
- Land C accounting
- Tradeoffs
- Leakage

### 4-Agricultural emissions

- Global N use / N2O emissions
- Global CH4 emissions
- Biomass energy + C capture/storage
- Measurement, reporting, verification
- Leakage, additionality
- Project-level accounting, boundaries
- Life cycle assessment

### 5-Other mitigation opportunities

- Geoengineering
- Carbon capture/storage

### 6-Decarbonization

- International negotiation

## 10. Library requirements or other special resources recommended for inclusion in the course, such as web links, supplementary readings, or multimedia content:

### *Nature and Science magazines*

- <http://www.nature.com/nature/index.html>
- <http://www.sciencemag.org/magazine.dtl>

## 11. Specific pedagogical techniques, or recommended course activities:

- Class exercises to facilitate student interaction/discussion
- Student project designed to review emerging greenhouse gas emission issues
- Student-led discussions on emerging issues
- Guest speakers with experience in carbon management implementation
- Student-led evaluation of emerging greenhouse gas management-related career options

## 12. Grading

- Class participation 11%
- Problem sets 10%
- Short answer/essay 28%
- Group projects 24%
- Quizzes/formative evaluation 15%
- Final exam 12%