Course Form for PKU Summer School International 2025

Course Title	Title in English: Climate Change and Sustainable Development
	Title in Chinese: 气候变化与可持续发展
Teacher	Hancheng Dai
First day of classes	June 30, 2025
Last day of classes	July 11, 2025
Course Credit	3 credits
Course Description	
Objective：	
It is increasingly recognized that climate change is intricately linked to sustainable development, not just in terms of joint underlying drivers, but also with respect to synergistic policy choices. Well-designed climate change mitigation policy can lead to significant co-benefits for sustainable development in air pollution control, energy security enhancement and resource efficiency improvement. To effectively inform decision making on these issues, whether at the national or international level, science must take an integrated and holistic perspective. The course aims to give an overview on the latest scientific consensus on climate change, climate impacts, climate change adaptation and mitigation, and the nexus between climate change mitigation and sustainable development goals such as high-quality economic growth, energy security, food security, air pollution control and human health improvement. Furthermore, it will briefly introduce how the complicated nexus could be understood and uncovered from system analysis perspectives.	
Pre-requisites /Target audience	
English proficiency, basic economics. Undergraduate students and graduate students who are interested in climate science, energy and climate economics and policy	
Proceeding of the Course	
Assignments (essay or other forms)	
➢ Homework (1-2 Short essays and multiple literature review reports) ➢ Mid-term presentation ➢ Final presentation (critical review of a subject)	
Evaluation Details	

1. Weekly homework (70%);
2. Final presentation (30%).

Text Books and Reading Materials

Academic Integrity (If necessary)

Students will follow the academic principles of honesty, fairness, respect, and accountability and make a pledge as follows:
"I will not lie, cheat, or steal in my academic endeavors;
I will conduct myself responsibly in all my endeavors; and
I will act if the academic principles are compromised."

CLASS SCHEDULE
(Subject to adjustment)

Session 1： *Climate change 1: observations*	Date: 30th June

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)
Morning session (3 hours): To introduce course objectives, the structure, and the participation from students. To demonstrate the phenomenon of climate change based on observations from different earth systems.
Afternoon session (2 hours): Group discussion

【Questions】

1. What is the scientific evidence that could support the existence of climate change?
2. What influences the trend in global average temperature?
3. What are the greenhouse effects and its relationship to climate change?

【Readings, Websites or Video Clips】

1. [video] https://www.youtube.com/watch?v=EuwMB1Dal-4 (what is climate change?)
2. [video] https://www.youtube.com/watch?v=bu3J0oDuNwQ (what causes climate change?)
3. [video] https://www.youtube.com/watch?v=f89wdXRcBec (climate change challenges)
4. [video] https://www.youtube.com/watch?v=T9CeECpxtx8 (climate change 2023: synthesis Trailer)

[video] https://www.youtube.com/watch?v=bulhsb4IZFQ (climate change 2023: synthesis report, Duration: 1h13min)

【Assignments for this session (if any)】

Please search for evidence-based on observations that support climate change.

Session 2： ***Climate change 2: impacts***	Date: 1st July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)
Morning session (3 hours): To introduce the impacts of climate change on agriculture, precipitation, sea level etc.
Afternoon session (4 hours): Afternoon: Study tour (4h)

【Questions】
What are/will be the impacts of climate change on nature and human systems?

【Readings, Websites or Video Clips】
1. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-1 (Figure caption: Climate change has already caused widespread impacts and related losses and damages on human systems and altered terrestrial, freshwater and ocean ecosystems worldwide)
2. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/ figure-spm-2 (Figure caption: Projected changes of annual maximum daily maximum temperature, annual mean total column soil moisture and annual maximum 1-day precipitation at global warming levels of 1.5° C, 2° C, 3° C, and 4° C relative to 1850 – 1900.)
3. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-3 (Figure caption: Projected risks and impacts of climate change on natural and human systems at different global warming levels (GWLs) relative to 1850-1900 levels.)
4. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-4 (Figure caption: Subset of assessed climate outcomes and associated global and regional climate risks.)
5. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-5 (Figure caption: Global emissions pathways consistent with implemented policies and mitigation strategies.)
6. [Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-6 (Figure caption: The illustrative development pathways (red to green) and associated outcomes (right panel) show that there is a rapidly narrowing window of opportunity to secure a liveable and sustainable future for all.)
[Figure] https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-7 (Figure caption: Multiple Opportunities for scaling up climate action)

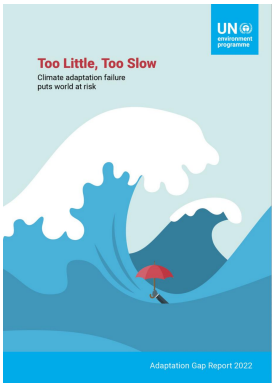
【Assignments for this session (if any)】

Session 3：*Climate adaptation*	Date: 2nd July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)
Morning session (3 hours): To introduce how human beings could adjust to actual or expected climate and its effects.
Afternoon session (2 hours): Breakout discussion

【Questions】
1. Why do we need to adapt to climate change?
2. How could we adapt to climate change effectively?

【Readings, Websites or Video Clips】



1. [Docments] *adaptation gap report 2022 (https://www.unep.org/resources/adaptation-gap-report-2022)*
2. [Docments] https://wedocs.unep.org/bitstream/handle/20.500.11822/41080/AGR2022_KMEN.pdf?sequence=10 (adaptation gap report 2022, key messages) 2 pages, can be printed for students.
3. [video] https://www.youtube.com/watch?v=ZVTpsOorJ_s (how can we adapt to the climate crisis?)

[video] https://www.youtube.com/watch?v=PKVhzdzrF44 (adaptation gap report 2022 raises alarm on climate finance)

【Assignments for this session (if any)】

Session 4：Climate change mitigation 1	Date: 3rd July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To describe various efforts to reduce or prevent the emission of greenhouse gases. To understand the challenge of long-term low-carbon transition.

Afternoon session (2 hours): ***practice:*** To learn the Climate negotiation tool

【Questions】

What are the main countermeasures to bring down GHG emissions from technological, management and consumption behavioral perspectives?

【Readings, Websites or Video Clips】

1. [Website] **https://www.epa.gov/climateleadership/ghg-reduction-programs-strategies (GHG reduction programs & strategies from EPA)**

2. [Website] https://www.ipcc.ch/2022/04/04/ipcc-ar6-wgiii-pressrelease/ (The evidence is clear : the time for action is now. We can halve emissions by 2030.)

3. [Website] **https://www.unep.org/resources/emissions-gap-report-2023 (emissions gap report 2023)**

【Assignments for this session (if any)】

Session 5：Climate change mitigation 2	Date:4th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To describe various efforts to reduce or prevent the emission of greenhouse gases. To understand the challenge of long-term low-carbon transition.

Afternoon session (2 hours): ***Afternoon: self learning: Climate negotiation***

【Questions】

What are the costs of climate mitigation?

【Readings, Websites or Video Clips】

1. [Video] **https://www.youtube.com/watch?v=NvNjz1dnwqQ&t=1s (emission gap report 2023)**

[Video] **https://www.youtube.com/watch?v=whrM0g186zU (circular economy, a key enabler to raise the ambition of climate commitments)**

【Assignments for this session (if any)】

Session 6：*Carbon neutrality*	Date: 7th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To introduce the concept of carbon neutrality, carbon sink and carbon reduction

Afternoon session (2 hours): ***presentation: Climate negotiation (2h)***

【Questions】

1. What are the major sources of greenhouse gas (GHG) emissions in the various parts of the world?
2. What are the emission spaces for the globe to achieve 1.5 and 2-degree targets?

【Readings, Websites or Video Clips】

1. [Video] https://www.youtube.com/watch?v=kY9XESNFrxI (what is the difference between net-zero and carbon neutral?)
2. [Video] https://www.ted.com/talks/tim_kruger_can_we_stop_climate_change_by_removing_co2_from_the_air (can we stop climate change by removing CO_2 from the air?)
3. [Website] https://www.clientearth.org/latest/news/what-is-a-carbon-sink/ (what is a carbon sink?)
4. [Website] https://climatechange.chicago.gov/ghgemissions/sources-greenhouse-gas-emissions (sources of greenhouse gas emissions)

[Website] https://climateanalytics.org/comment/understanding-the-paris-agreements-long-term-temperature-goal (understanding the Paris Agreement's long-term temperature goal)

【Assignments for this session (if any)】

Session 7：*Energy and climate change*	Date: 8th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To understand how energy supply and consumption affect greenhouse gas emissions globally.

Afternoon session (2 hours): Practice: To learn the online energy simulator (2h)

【Questions】

1. What is primary energy and secondary energy?
2. How energy supply and consumption contribute to climate change and what is the regional disparity worldwide?

【Readings, Websites or Video Clips】

1. [documents] https://unstats.un.org/unsd/envaccounting/londongroup/meeting13/lg13_12a.pdf (definition of primary and secondary energy)
2. [website] https://ourworldindata.org/energy-definitions (why are there different ways of measuring energy?)
3. [website] https://www.iea.org/reports/co2-emissions-in-2022 (CO2 emissions in 2022)

[video] https://www.youtube.com/watch?v=EFxqvaysOEI (climate change & energy consumption)

【Assignments for this session (if any)】

Session 8：*Climate change driving forces*	Date: 9th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To demonstrate the socioeconomic driving forces of climate change in the historical periods after the Industrial Revolution. To introduce possible future climate change trends under different development pathways.

Afternoon session (4 hours): *Study tour (4h)*

【Questions】

1. What are the key driving forces of climate change related to human beings?
2. How could future socioeconomic development affect climate change?

【Readings, Websites or Video Clips】

1. [paper] (The human driving forces of global climate change)
2. [website] (causes and effects of climate change)
3. [video] https://www.youtube.com/watch?v=G4H1N_yXBiA (cause and effect of climate change)
4. [website] (how are socioeconomic development and climate change connected)
5. [website] (what are the economic impacts and potential solutions?)

【Assignments for this session (if any)】

Session 9：*Sustainable development goals*	Date: 10th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To provide a knowledge framework for achieving sustainable development. To introduce a framework for and fundamental concepts of sustainable development goals.

Afternoon session (2 hours): To use the online energy simulator

【Questions】

1. What are the key concerns and elements of sustainable development?
2. How are the goals interconnected?

【Readings, Websites or Video Clips】

1. [video] (sustainable development goals explained)
2. [website] https://sdgs.un.org/goals (all 17 SDGs)
3. [website] (addressing policy coherence and finance gaps in the pursuit of SDG localization and multilevel governance)
4. [website] (the interconnection of sustainable development goals)

【Assignments for this session (if any)】

Session 10：*Final exam (Presentation)*	Date:11th July

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

Morning session (3 hours): To make a final presentation about addressing climate change, taking a typical region as an example.

Afternoon session: None (Leave)

【Questions】

Depending on which target region you choose, what is the most appropriate strategy to address climate change, and what are the potential synergies and tradeoffs on other development goals.

【Readings, Websites or Video Clips】

【Assignments for this session (if any)】

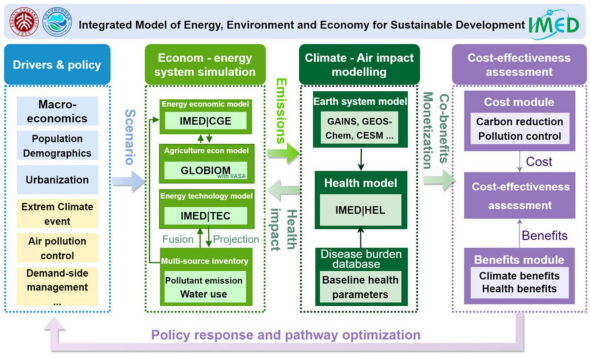
A CV of 250-300 words and a high-resolution personal photo should also be provided

Dr. Dai is an Associate Professor with Tenure and Director of the Department of Environmental Management in the College of Environmental Sciences and Engineering at Peking University. He is also a joint appointment research fellow of the Institute of Carbon Neutrality at Peking University. Dr. Dai's research focuses on green and low-carbon transformation and human and planetary health at the local, national and global scales. By developing and applying the state-of-the-art integrated assessment model, key questions are explored on the mitigation costs of achieving ambitious climate targets and their co-benefits on improvements in air pollution, human health and resource efficiency. Dr. Dai was ranked as the World's Top 2% most-cited scientists released by Stanford University from 2020 to 2023. Due to his academic excellence, Dr. Dai was awarded the Outstanding Young Scholar by the National Natural Science Foundation of China in 2022. His main publications, including 16 ESI 1% highly cited papers, are on energy economics and policy-related journals such as Nature Food and One Earth. Dr. Dai is active in multiple international and domestic science programs by serving as the Lead Author of the

Global Environment Outlook Sixth Edition (GEO-6) for Cities, Contributing Author of the IPCC 6th Assessment Report. He is also the Standing Committee Member of the Branch of Ecological and Environmental Systems Engineering, Systems Engineering Society of China, as well as Committee Member of the Branch of Climate Change of Chinese Society for Sustainable Development. He has also frequently provided professional consulting services to various well-known non-governmental organizations such as the Energy Foundation China (EFC), Environmental Defense Foundation (EDF), and Natural Resources Defense Council (NRDC). More information can be found here: http://scholar.pku.edu.cn/hanchengdai.

LEEEP 北京大学能源环境经济与政策研究室
Laboratory of Energy & Environmental Economics and Policy, PKU

The LEEEP team at Peking University specializes in **environmental** and **climate policy** research through its self-developed **IMED integrated assessment model**, focusing on key scientific breakthroughs and policy demands essential for green and low-carbon transition to support national and global **sustainability** targets.



Prof. Hancheng Dai

- Director of the Department of Environmental Management
- Founder of the Laboratory of Energy & Environmental Economics and Policy (LEEEP)
- Contact: dai.hancheng@pku.edu.cn

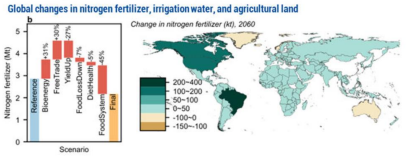
Food security

nature food

Enhanced food system efficiency is the key to China's 2060 carbon neutrality target

Ren M,... Dai H*, **Nature Food**. 2023

Global changes in nitrogen fertilizer, irrigation water, and agricultural land



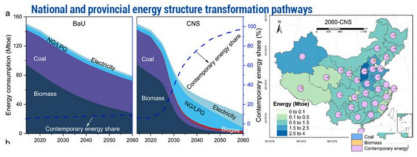
Human health

nature communications

Costs and health benefits of the rural energy transition to carbon neutrality in China

Ma T,... Xie Y*, **Nature Communications**. 2023

National and provincial energy structure transformation pathways



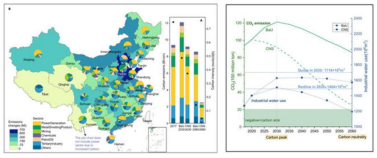
Water sustainability

One Earth

Achieving carbon neutrality enables China to attain its industrial water use target

Liu X†, Dai H†,... Liu Y*, **One Earth**. 2022

A synergetic pathway of carbon reduction and water conservation



IAM training workshop

China's First Carbon Neutrality Integrated Assessment Model Training Workshop

- ✓ Held in 2023 by LEEEP, PKU
- ✓ Lasting a whole week
- ✓ Training top-down & Bottom up IAM models
- ✓ Over 50 participants from 30+ institutes

More information:
Homepage: http://scholar.pku.edu.cn/hanchengdai
IMED online model: https://www.imedmodel.com

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