MASTER
Sustainable Development and Global Governance
Universidad Carlos III de Madrid

Course
CLIMATE CHANGE, ENERGY AND GLOBAL GOVERNANCE

Spring 2023
Professor: Pablo del Río.
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ECTS Credits: 3

COURSE DESCRIPTION

The aim of this course is to introduce students on the main concepts, methods, elements and empirical dimensions of the complex relationship between energy and climate change, with a focus on technological, institutional and behavioural changes and policy issues. It will allow students to understand the importance of energy production and consumption processes in the carbon intensity of the economies, the determinants of greenhouse gas (GHG) emissions across countries and the role of different technologies and institutional and behavioural changes in the transition towards a decarbonised energy system, with a particular focus on electricity generation technologies and, specially, renewable electricity technologies. The course will also provide insights on the costs and potentials of different GHG mitigation technologies in the energy sector and the barriers and drivers to their uptake. It will introduce students to the policy dimension of mitigation, providing them with a deep knowledge of the public policies to support a decarbonised energy transition and the tools for the comparative economic analysis of those policies, which will allow them to identify their advantages and drawbacks as well as their applicability in different contexts. Finally, an introduction to the functioning of the global/EU-level governance institutions and mechanisms related to the energy transition will be provided.

The course is organised in three parts. Part I is an introduction to the basic concepts and methods in the analysis of energy and climate change. Part II will focus on the methods and measures to analyse the determinants of CO2 emissions (in general, and in the energy sector) and their evolution (decomposition analyses), as well as the contribution of technological and behavioural changes to a decarbonised energy transition, their costs and potentials. Part III will provide a systematic overview of barriers to GHG mitigation in the energy sector and the policies to address those barriers. Part IV will focus on the analysis of the global governance institutions and mechanisms for the energy transition.

COURSE REQUIREMENTS

Attendance to lectures is mandatory. Active participation by the students in the class is expected, based on the readings proposed for the course. Therefore, students should read them before the corresponding lecture. Optional readings are voluntary. Additional short readings may be assigned over the course of the semester (complementing or substituting those listed in the syllabus).

The course is designed as consisting of lectures. Additionally, there will be group presentations on areas related to the course. Finally, a final paper (an individual assignment) will be required, which should address an issue area related to the content of this course. It might be written in one of the three distinct formats: a policy paper, a position paper or an empirical research paper. A list of potential topics and respective instructions will be uploaded on Aula Global. Students should inform the professor regarding the topics and the format they choose by February 21st, 2022. Students will also have to pass a final exam.

GRADING

The break-up of overall grading based on specific assignments is listed below.

- Presentations (group assignment): 20%
- Class attendance and participation (individual): 10%
- Final paper (individual): 40%
- Final exam: 30%

COURSE SCHEDULE

PART I

Week 1 (January 30th)

1. Introduction. In this session the professor will explain the structure, organization and assessment of the course.

2. Basic concepts in energy will be provided, including a brief overview of conceptual frameworks in energy analyses (environmental economics, innovation economics, innovation studies) and research methods in energy analyses in social sciences.

3. A general perspective on the energy transition and climate change, with a focus on the contribution of energy production and consumption to climate change, i.e., on the role of energy in climate change and climate change mitigation.

Required readings:

<u>Conceptual frameworks:</u>

> del Río et al (2012). Assessment criteria for identifying the main alternatives - Advantages and drawbacks, synergies and conflicts. A report compiled within the European IEE project beyond2020. Intelligent Energy – Europe (IEE), ALTENER (Grant Agreement no. IEE/10/437/SI2.589880). Available at: https://www.res-policy-

beyond2020.eu/pdffinal/Assessment%20criteria%20for%20identifying%20the%20main%20alternatives%20(beyond2020%20-%20D2-2).pdf (see pages 9-16).

Del Río, P. and Kiefer, C. (2023). Drivers and barriers to renewable electricity technologies. Lessons from the technological innovation system approach. In: del Río and Ragwitz (eds.). The Economics of Renewable Energy. Edward Elgar. Pages 1-10.

Methods: Sovacool , B . K . , Axse n , J . , Sorrel l , S . , 2018 . Promotin g novelty, rigor, an d styl e in energy social science: toward s code s of practice fo r appropriat e method s an d research design . Energy Res. Social Sci. 45 , 12 –42 .
https://doi.org/10.1016/j.erss.2018.07.007 .

Energy and climate change (basic concepts and the energy transition and climate change):

IRENA (2022). World energy transitions Outlook 2022. 1.5° C pathway. Chapter 1, pages 30-41. https://www.irena.org/publications/2022/mar/world-energy-transitions-outlook-2022

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.
https://report.ipcc.ch/ar6/wg3/IPCC_AR6_WGIII_Full_Report.pdf Chapter 2 (pages 19-32), Chapter 6 (pages 6-11)

Optional:

Marechal, K. 2007. The Economics of climate change and the change for climate in economics. Energy Policy, 35(10), 5181-5194.

Hoffer and Caldeira (2004). Climate Change and Energy, Overview. Encyclopedia of Energy, Volume 1, p.359-380.

PART II

Week 2 (February 13th)

4. Methods and measures to analyse the determinants of CO2 emissions (in general, and in the energy sector) and their evolution (decomposition analyses). The role of technological and behavioural changes in climate change mitigation related to energy production and use.

Required readings (decomposition analysis):

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 2, pages 41-46

Hoffer and Caldeira (2004), pages 362-363.

Optional readings (decomposition analysis):

Vicent Alcántara, Emilio Padilla & Pablo Del Río (2021) The driving factors of CO2 emissions from electricity generation in Spain: A decomposition analysis.

Energy Sources, Part B: Economics, Planning and Policy,
doi 10.1080/15567249.2021.2014604

Lima, F.M. L. Nunes J. Cunhaand A. F. P. P. Lucena, 2016. A cross-country assessment of energy-related CO2 emissions: An extended Kaya Index Decomposition Approach. Energy, 115, 1361- 37 1374, doi:10.1016/j.energy.2016.05.037

Required readings (behavioural changes):

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Technical summary, pages 98-106. Chapter 2 (pages 61-68), Chapter 6 (pages 63-65, pages 120-123).

Week 3 (February 20th)[1]

5. Contribution of different (energy) technologies to current GHG emissions, mitigation and mitigation costs in the energy sector. Analysis of the contribution of different energy technologies to GHG mitigation (renewable technologies, energy efficiency, carbon capture and storage, hydrogen and others). Overview of costs and potentials.

Required readings:

IRENA (2022). World energy transitions Outlook 2022. 1.5° C pathway. Chapter 2, pages 54-101. https://www.irena.org/publications/2022/mar/world-energy-transitions-outlook-2022

Overview of mitigation costs and potentials per sector: IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 12 (pages 12-34).

Optional:

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 6 (pages 22-48, 48-52 and 52-62).

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Technical summary, pages 52-60 and pages 107-108

IRENA (2019). Global energy transformation: A roadmap to 2050 (2019 edition), International Renewable Energy Agency, Abu Dhabi.

IEA (2022). World Energy Outlook.

[1] 3 sessions

PART III

Week 4 (February 27th)[2]

6. A systematic overview of barriers to GHG mitigation in the energy sector. Market failures vs. systemic failures. The problem of carbon lock-in. Specific drivers/barriers per energy technology.

Required readings (market failures vs. systemic failures):

Del Río, P. (2011). Climate Change Policies and new Technologies. In: Cerdá, E. and Labandeira, X. (eds.). Climate change policies: global challenges and future prospects. Edward Elgar, Cheltenham (U.K.) (see pages 6-8).

Optional (market failures vs. systemic failures):

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. chapter 16.3.

BLEDA, M., DEL RIO, P. 2013. The market failure and the systemic failure rationales in technological innovation systems. Research Policy 42(5), 1039-1052

Required readings (carbon lock-in):

Seto, K. C., S. J. Davis, R. B. Mitchell, E. C. Stokes, G. Unruh, and D. Ürge-Vorsatz, 2016: Carbon Lock-In: Types, Causes, and Policy Implications. Annu. Rev. Environ. Resour, 41, 425–452, https://doi.org/10.1146/annurev-environ-110615-085934.

Optional (carbon lock-in):

Unruh, G. C., 2000: Understanding carbon lock-in. Energy Policy, 28(12), 817–830 doi:10.1016/S0301-4215(00)00070-7.

Unruh, G. C., 2002: Escaping carbon lock-in. Energy Policy, 30(4), 317–325, doi:10.1016/S0301- 44 4215(01)00098-2.

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 2 (pages 68-73), Chapter 6 (pages 112-116).

Required reading (specific drivers/barriers per energy technology)

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 6 (pages 22-48) and page 68.

In-focus: renewable energy technologies. Costs, benefits, drivers and barriers in the context of the decarbonised energy transition.

[2] 3 sessions

Required readings:

Panny et al (2023). Costs and benefits of the energy transition. In del Río and Ragwitz (eds). Alternatively: Breitschopf, B., Held, A., 2014. Guidelines for assessing costs and benefits of RET deployment: DiaCore, D4.1, 42 pp. http://www.diacore.eu/images/files2/D4.1_FhISI_Cost_Benefit_Approach_DIACORE.pdf (accessed 5 May 2015).

Kiefer, C., del Río, P. 2020. Analysing the barriers and drivers to concentrating solar power in the European Union. Policy implications. Journal of Cleaner Production Volume 2511 April 2020.

Optional:

Way, R., Mealy, P. and Farmer, D. (2021). Estimating the costs of energy transition scenarios using probabilistic forecasting methods. INET Oxford Working Paper No. 2021-01.
https://www.inet.ox.ac.uk/files/energy_transition_cost_INET_working_paper_with_SI1.pdf

Del Río, P. and Kiefer, C. (2022). ¿Cuál será el coste de las tecnologías de generación eléctrica renovable en el futuro? Papeles de Economía Española 74.

IRENA (2022) Power generation costs. Abu Dhabi.

Week 5 (March 6th)

5. Economic analysis of policies for the energy transition in the context of climate change mitigation: economic, regulatory and information instruments. Policy packages, policy integration, policy mix, policy interactions.

Required readings:

Park, W., Stephenson, K. (2003). Use of a Tradable Pollution Allowance Simulation in Teaching Resource and Environmental Policy. National Conference on Student Writing and Critical Thinking in Agriculture, held in Jackson, Wyoming, April 3-5,2003 (the file will be uploaded in Aula Global).

IPCC (2022). Climate Change 2022. Mitigation of Climate Change. Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Technical summary (pages 109-132), Chapter 2 (pages 76-82), Chapter 6 (118-120), Chapter 6 (policies for behavioural changes: 120-123), Chapter 13 ((pages 38-57, policy instruments and evaluation) and pages 57- (13.7 Integrated policy packages for mitigation and multiple objectives)).

Optional:

Peñasco, C., L. D. Anadón, and E. Verdolini, 2021: Systematic review of the outcomes and trade-offs of ten types of decarbonization policy instruments. Nat. Clim. Chang., 11(3), 274–, 16 doi:10.1038/s41558-021-00992-0.

Grubb, M. et al., 2021: Induced innovation in energy technologies and systems: a review of evidence and potential implications for CO2 mitigation. Environ. Res. Lett., 16(4), 043007, doi:10.1088/1748-9326/abde07

IRENA (2022). World energy transitions Outlook 2022. 1.5° C pathway. Chapter 2 (pages 108-111) and chapter 3 (pages 113-129).
https://www.irena.org/publications/2022/mar/world-energy-transitions-outlook-2022

PART IV

Week 6 (March 13th)

6. Analysis of the global and EU governance institutions and mechanisms for the energy transition. Structures and challenges. the IEA and its structure, governance mechanisms and deficiencies. The EU's Energy Strategy, its mechanisms and challenges.

Required readings:

EEFIG Energy Efficiency Financial Institutions Group (2022). Further improvements of energy efficiency in industry. Final report. European Commission
https://op.europa.eu/en/publication-detail/-/publication/9f7388b4-79d4-11ed-9887-01aa75ed71a1/language-en?WT.mc_id=Searchresult&WT.ria_c=37085&WT.ria_f=3608&WT.ria_ev=search&WT.URL=https%3A%2F%2Fenergy.ec.europa.eu%2F

European Commission (2022). Policy scenarios for delivering the European Green Deal
https://energy.ec.europa.eu/data-and-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en

European Commission (2022). Energy union indicators webtool
https://energy.ec.europa.eu/data-and-analysis/energy-union-indicators-webtool_en