

## Fall School on Transformation to Climate Neutrality

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October 17-21, 2022, Hotel Garni Seggauberg

The goal of the fall school is to develop a common interdisciplinary understanding of the challenges in and solutions to achieve climate neutrality. The school also intends to support and stimulate students to develop interdisciplinary joint publications.

The overall theme 'Transformation to Climate Neutrality' is approached from various perspectives (social sciences, normative science, sustainability science, economics, physics) in a number of sessions. The topics are:

- **Remaining Carbon Budget:** Physical science basis; normative dimensions, alternative distribution rules for remaining budget across countries and sectors.
- **Societal Transformation:** Triggers of behavioral change; the role of social groups, status, norms; the role of institutions; radical transformation; social tipping dynamics.
- **Role of the Private Sector in Transformation:** Decarbonization pathways for sectors (e.g., energy, mobility, industry); alternative business models; biomass-based economy; bottom-up initiatives.
- **International Negotiations:** Cooperative vs. non-cooperative solutions, unilateral vs. multilateral UNFCCC deliberations, including climate finance; border carbon adjustment.

Each topic is addressed by a group of faculty members in the field, and complemented by impulse talks by key researchers from the Center of Excellence and doctoral contributions.

### Faculty:

Birgit Bednar-Friedl (economics), Thomas Brudermann (sustainability science), Katja Corcoran (psychology), Michael Finus (economics), Markus Hadler (sociology), Gottfried Kirchengast (physics), Lukas Meyer (philosophy), Alfred Posch (sustainability science), Romana Rauter (sustainability science), Karl Steininger (economics), Tobias Stern (sustainability science)

External faculty: Keywan Riahi (energy and climate specialist, IIASA)

The **course load** of the Fall School is 4 ECTS, divided into 50 hours during the Fall School and 50 hours of preparatory reading and writing of an essay (until December 2022).

**Grading** is based on active participation during the fall school and writing of an essay (approx. 5000 words on one of the topics of the school).

**Registration:** By email to [karin.osibow@uni-graz.at](mailto:karin.osibow@uni-graz.at) until **September 15**. Please indicate the topic of your thesis, your supervisor and semester of study.

# PROGRAM

Monday, 17 October 2022

## Get together and Introduction

**14:00-14:30** Welcome by organizers

## Remaining Carbon Budget I Lukas Meyer & Karl Steininger

**14:30-16:00** **Ethically qualified understandings of the allocation of carbon budgets**  
**Lukas Meyer**

We will discuss competing views on how the remaining carbon budget should be allocated (at global, regional, national and sectoral levels). The focus will be on analyzing what difference it makes to take ethical considerations into account. In particular, we will explore how the main allocation mechanisms (contraction & convergence and equal-per-capita) can be qualified by minimal equity considerations, such as meeting basic needs, historical responsibility of states for past emissions since 1995, and equalizing the impacts of pre-1995 emissions-generating activities. If time allows, we will also look into what implications the budget allocation view has for individual persons' budgets for their leisure activities.

**16:00-16:15** *Break*

**16:15-17:45** **Economic aspects of allocating the remaining carbon budget**  
**Karl Steininger**

Building upon the physical basis of the remaining carbon budget (lecture by Gottfried Kirchengast) and normative allocation across nations (lecture by Lukas Meyer) we will here break down the national carbon budget to (subnational) regions, municipalities and economic sectors. Subtleties and perspectives one can follow differ. While there is no international standard yet, general principles emerge. Ultimately the issue is one to achieve net zero emissions in all sectors and across all agents, on this path remaining within the available budget. We will discuss economic and normative criteria that lend themselves for designing such a pathway.

**17:45-18:00** Introduction to Climate Treaty Role Play

**18:15-19:30** *Dinner*

## Tuesday, 18 October 2022

### Societal Transformation I

Thomas Brudermann & Katja Corcoran

In this session we will discuss how the nature of human decision making relates to climate change. We will explore reasons why the change towards climate-friendly behavior can be a difficult task, even if problem awareness is high and intentions are good. We will also reflect on suggestions for how to overcome the “psychological barriers” to climate change mitigation. We will furthermore discuss the limits to individual responsibility and the role of climate-friendly structures.

**09:00-12:30** Theory and exercises

*12:45-14:00 Lunch break*

### Remaining Carbon Budget II

Keywan Riahi & Gottfried Kirchengast

It is the physical climate science basis that underpins all of climate change science and societal implications, including the impacts of global warming and related environmental and socio-economic changes. The latter include critical challenges such as irreversible losses and damages, the need for adapting to changes already ongoing, and, above all, the need for phasing out greenhouse gas (GHG) emissions in order to limit against catastrophic climate risks. To achieve climate neutrality, there are alternative global and regional pathways, for instance regarding the role of carbon dioxide removal and demand side changes.

**14:00-15:30** **The physical science basis: New insights on global warming, the remaining carbon budget, and implications for the transformation to climate-neutral societies**

***Gottfried Kirchengast***

In this lecture, I will highlight fundamentals of the physics of anthropogenic climate change and recent advances in understanding global warming. This provides key insights how GHG emissions, the associated atmospheric GHG concentrations and other influences evolve and drive radiative forcing, Earth's energy imbalance, and climate system responses, most prominently global surface air temperature increase. It also implies how much emission budget remains for avoiding undue risks, in accord with the Paris climate goal. Accepting the physical realities together with basic societal values, I will then address some of the profound obstacles but also solution options that arise in the transformation to climate-neutral and climate-resilient societies within the few decades to mid-century.

*15:30-16:00 Coffee break*

**16:00-17:30** **Analyzing the remaining carbon budget and its relevance for assessing pathways to climate neutrality**

***Keywan Riahi (IIASA and TU Graz)***

The Paris Agreement calls for a stabilization the climate between 1.5C and 2C global temperature change. This requires rapid and deep cuts of emissions, reaching net zero CO2 globally between 2050 and 2070. The

lecture illustrates alternative global and regional pathways of the recent Sixth Assessment Report of the Intergovernmental Panel on Climate Change. This will comprise a review of the necessary systemic changes as well as individual mitigation options, related investment needs, and economic opportunities and barriers (for reaching climate neutrality). Specific focus will be given to the role of demand-side changes and the potential of novel service provisioning systems. Furthermore, the potential contribution of carbon dioxide removal options, as necessary complements to mitigation efforts, will be discussed. The lecture will close with exploring the distributional implications of climate policies and synergies as well as trade-offs with other societal objectives such as the SDGs.

**17:45**      ***Short walk around Seggauberg***

**19:00-20:15**      ***Dinner at Hotel***

## Wednesday, 19 October 2022

### Societal Transformation II Markus Hadler

In this session, we will discuss the contribution of sociology and survey research to climate research. We address the questions of which behaviors are of climate relevance, who is engaging in these behaviors, in which contexts do these behaviors occur, and which individual perceptions and values are related to them. Profound and exponential changes in human lifestyles, social institutions, governance, infrastructure, and technology are needed to meet the goals of climate mitigation policy.

**09:00–12:30** Theory and exercises

*12:45–14:00 Lunch break*

### Role of the Private Sector I Romana Rauter & Karl Steininger

In this session, we will explore the role of businesses and their challenges in transforming and innovating their business models in the context of climate neutrality, and sustainability in general. The challenges do differ across company scales, e.g. by different market power of large companies and small and medium enterprises. We will combine the macro and micro perspective to outline potential solutions and strategies. In terms of method, inputs by the lecturers and group work activities will be mixed.

**14:00–17:30** Theory and exercises

*18:00–19:15 Dinner*

### BarCamp Facilitator: Romana Rauter

BarCamps (see also <https://en.wikipedia.org/wiki/BarCamp>) are open and participatory conference and workshop-events. Participants provide the content and therefore play a major role in it. We will use this BarCamp idea and design as setting to discuss students' topics of interest (related to their PhDs).

**19:30–21:00** BarCamp

## Thursday, 20 October 2022

### Role of the Private Sector II Alfred Posch & Tobias Stern

#### Climate change mitigation strategies on the supply and demand side

In this session we will elaborate and analyse different strategies for mitigating climate change from both perspectives, the supply side and the demand side. We will distinguish between avoid, shift and improve strategies and relate them to concepts such as efficiency, consistency and sufficiency. Using concrete examples from bio-based economy, the energy and mobility sector, we will work out the respective barriers and limits and derive the necessary factors and institutional framework conditions.

**09:00–12:30** Theory and exercises

*12:45–14:00 Lunch break*

### Climate Treaty Role Play Facilitators: Birgit Bednar-Friedl & Michael Finus

In this role play, students will negotiate as parties (countries or group of countries) in preparation of the upcoming UN Climate Change Conference 2022 (UNFCCC COP 27). One student will represent the UNFCCC Secretary General and lead the negotiations.

**14:00–15:00** Preparation time for negotiation groups

**15:00–17:30** Role Play

**17:30–18:00** Debriefing

*18:00–19:15 Dinner*

## Friday, 22 October 2022

### International Negotiations

Michael Finus & Birgit Bednar-Friedl

In this session, we will review the theoretical foundations of climate treaty making and elaborate why treaties are often weak in ambition and/or participation. We cover the following topics: compliance: monitoring, verification and credible enforcement mechanisms, membership: single vs multiple agreements, minimum participation clauses, natural tipping points, focal vs consensus treaties, asymmetry and transfers, mitigation, adaptation and geoengineering. Further policy instruments include border carbon adjustments, climate finance and technology transfer in order to scale up mitigation.

**09:00–12:30** Theory and group work

### Synopsis and Closing

**12:30–13:00** Closing session

*13:00 Thanks, sandwiches and good bye*

# Preparatory reading list:

## **Remaining Carbon Budget I (Meyer & Steininger):**

Steininger, K. W., Meyer, L., Nabernegg, S., Kirchengast, G. (2020). Sectoral carbon budgets as an evaluation framework for the built environment. *Buildings and Cities* 1(1), 337-360.

<https://doi.org/10.5334/bc.32>

Steininger, K.W., Williges, K., Meyer, L.H. et al. (2022). Sharing the effort of the European Green Deal among countries. *Nature Communications* 13, 3673 <https://doi.org/10.1038/s41467-022-31204-8>

Williges, K., Meyer, L.H., Steininger, K.W., Kirchengast, G. (2022). Fairness critically conditions the carbon budget allocation across countries, *Global Environmental Change* 74, 102481, <https://doi.org/10.1016/j.gloenvcha.2022.102481>

## **Remaining Carbon Budget II (Riahi & Kirchengast):**

Riahi, K., R. Schaeffer, J. Arango, K. Calvin, C. Guivarch, T. Hasegawa, K. Jiang, E. Kriegler, R. Matthews, G.P. Peters, A. Rao, S. Robertson, A.M. Sebbit, J. Steinberger, M. Tavoni, D.P. van Vuuren, 2022: Mitigation pathways compatible with long-term goals. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

[https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC\\_AR6\\_WGIII\\_Chapter\\_03.pdf](https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter_03.pdf)

Matthews, H.D., Tokarska, K.B., Nicholls, Z.R.J. et al. (2020). Opportunities and challenges in using remaining carbon budgets to guide climate policy. *Nat. Geosci.* 13, 769–779

<https://doi.org/10.1038/s41561-020-00663-3>

[Section 2](#) (4p.) and [Section 4](#) (11p.) of:

Kirchengast, G. Danzer, J., Hölbling, S. (2021) Carbon Management: a new approach to achieve Paris-compliant climate goals. Wegener Center Research Brief, Graz,

<https://doi.org/10.25364/23.2021.1>

## *Supplementary reading:*

K Riahi, C Bertram, D Huppmann, J Rogelj, V Bosetti, AM Cabardos, et al, 2021, Cost and attainability of meeting stringent climate targets without overshoot, *Nature Climate Change* 11 (12), 1063-1069, <https://doi.org/10.1038/s41558-021-01215-2>

JS Kikstra, A Mastrucci, J Min, K Riahi, ND Rao, et al, 2021, Decent living gaps and energy needs around the world, *Environmental Research Letters* 16 (9), 095006, <https://doi.org/10.1088/1748-9326/ac1c27>

C Bertram, K Riahi, J Hilaire, V Bosetti, L Drouet, O Fricko, A Malik, et al, 2021, Energy system developments and investments in the decisive decade for the Paris Agreement goals, *Environmental Research Letters* 16 (7), 074020, <https://doi.org/10.1088/1748-9326/ac09ae>

## **Societal Transformation I (Corcoran & Brudermann):**

Clayton, S., Devine-Wright, P., Stern, P. C., Whitmarsh, L., Carrico, A., Steg, L., ... Bonnes, M. (2015). Psychological research and global climate change. *Nature Climate Change*, 5(7), 640–646.

<https://doi.org/10.1038/nclimate2622>



Buunk, A.P., Dijkstra, P., & van Vugt, M. (2021) *Applying social psychology: From problems to solutions* (3<sup>rd</sup> Edition; Chapter 1). London: Sage. (pp.14-20).

*Supplementary reading:*

Thaller, A., Fleiß, E., & Brudermann, T. (2020). No glory without sacrifice — drivers of climate (in)action in the general population. *Environmental Science & Policy*, 114, 7–13.  
<https://doi.org/10.1016/j.envsci.2020.07.014>

**Societal Transformation II (Hadler & Otto):**

**Chapter 1 Introduction** (12 p.) of:

Hadler, M., Klösch, B., Schwarzing, S., Schweighart, M., Wardana, R. and Bird, D.N. (2022). *Surveying Climate-Relevant Behavior: Measurements, Obstacles, and Implications*. Springer Nature. <https://link.springer.com/book/10.1007/978-3-030-85796-7>

Otto IM, Donges J, et al., (2020) Social tipping dynamics for stabilizing Earth's climate by 2050. *Proc. Natl. Acad. Sci. U.S.A.* 117, 2354–2365. <https://doi.org/10.1073/pnas.1900577117>

Otto IM, Wiedermann M, et al. (2020) Human agency in the Anthropocene, *Ecological Economics* 167, 106463. <https://doi.org/10.1016/j.ecolecon.2019.106463>

**Role of the Private Sector I (Rauter & Steininger):**

Bachner, G., Wolking, B., Mayer, J., Tuerk, A., Steininger, K.W. (2020), Risk assessment of the low-carbon transition of Austria's steel and electricity sectors, *Environmental Innovation and Societal Transitions* 35: 309-332. <https://doi.org/10.1016/j.eist.2018.12.005> [sections 1-3.2.1 (incl.) and 5]

Carbon to Product Austria (C2PAT): [https://www.omv.com/en/news/200624\\_lafarge-omv-verbund-and-borealis-join-hands-to-capture-and-utilize-co2-on-an-industrial-scale](https://www.omv.com/en/news/200624_lafarge-omv-verbund-and-borealis-join-hands-to-capture-and-utilize-co2-on-an-industrial-scale) [get project overview]

Geissdoerfer, M., Vladimirova, D., Evans, S. (2018). Sustainable business model innovation: A Review. *Journal of Cleaner Production*, 198, 401-416. <https://doi.org/10.1016/j.jclepro.2018.06.240>

**Role of the Private Sector II (Posch & Stern):**

Technical Summary of IPCC WGIII AR6, Section TS.5 “[Mitigation responses in sectors and systems](#)”:  
M. Pathak, R. Slade, P.R. Shukla, J. Skea, R. Pichs-Madruga, D. Ürges-Vorsatz, 2022: Technical Summary. In: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.002

**International Negotiations (Finus & Bednar-Friedl):**

Sections 14.2-14.3 of IPCC WGIII AR6 Chapter 14:

Patt, A., L. Rajamani, P. Bhandari, A. Ivanova Boncheva, A. Caparrós, K. Djemouai, I. Kubota, J. Peel, A.P. Sari, D.F. Sprinz, J. Wettestad, 2022: International cooperation. In *IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera,

M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)). Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.016  
[IPCC AR6 WGIII Chapter 14.pdf](#)

Section 13.6.6 of IPCC WGIII AR6 Chapter 13:

Dubash, N.K., C. Mitchell, E.L. Boasson, M.J. Borbor-Cordova, S. Fifita, E. Haites, M. Jaccard, F. Jotzo, S. Naidoo, P. Romero-Lankao, M. Shlapak, W. Shen, L. Wu, 2022: National and sub-national policies and institutions. In IPCC, 2022: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)). Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.015  
[IPCC AR6 WGIII Chapter 13.pdf](#)

An overview article (non-technical) about the game-theoretic analyses of international environmental agreements:

Finus, M. and A. Caparrós (2015), Introduction. In: Finus, M. and A. Caparrós, *Handbook on “Game Theory and International Environmental Cooperation: Essential Readings”*, Edward Elgar, 2015, pp. xvii-xliv.

#### *Supplementary reading*

Further interesting sections are found in previous IPCC reports:

Section 10.2 and 10.4.1-10.4.2 of [IPCC WGIII, TAR, Chapter 10](#)

Section 13.3 of [IPCC WGIII, AR4, Chapter 13](#)

Section 13.3-13.4 of [IPCC WGIII, AR5, Chapter 13](#)