University of Toronto Scarborough

Department of Physical and Environmental Sciences

ESTC40H3S Technical methods for climate change mitigation

Winter 2024

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Location:	BV 359
Day and time:	Thursdays from 18:00 to 20:00 (in-person)
Office hours (Zoom):	Tuesdays from 12:00 to 13:00 pm by Zoom (if this time does not work for you, please send me an email and we can find a time and day that works best for you) Zoom link: https://utoronto.zoom.us/j/83905855454 Meeting ID: 839 0585 5454 Passcode: 374378

1. Course details

Course Description: With the adoption of the Paris Agreement, the global community committed to limiting "the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels" (United Nations 2015). To achieve this long-term temperature goal, rapid reductions of anthropogenic greenhouse gas (GHG) emissions by sources and enhancement of removals by sinks are required. The achievement of the Paris Agreement and the overall goal of the United Nations Framework Convention on Climate Change (UNFCCC) requires designing and implementing effective climate change mitigation targets, strategies, and policies and actions at different governance levels. In light of these challenges, this course takes its focus on the technical methods of mitigation of climate change. The framing questions for this course are: What is climate change mitigation? How are GHG reduction targets defined? How are mitigation policies and actions designed and measured through time in different sectors? And how are climate strategies designed?

Climate change mitigation refers to the efforts to control anthropogenic sources of greenhouse gases (GHGs) and enhance removals of GHGs by sinks. Effective climate change mitigation requires understanding the historical and possible pathways of GHG emissions to set realistic and ambitious GHG reduction targets. Setting GHG mitigation targets is both a technical and political challenge. Mitigation policies and actions are carefully designed to assist in meeting the GHG reduction targets; this requires understanding the drivers of GHG emissions and monitoring its effectiveness through time. In this course students will learn the various technical methods required in climate change mitigation, including estimating GHG emissions by source and removals by sinks, setting GHG reduction goals, designing climate change mitigation actions or policies and measuring their GHG effects throughout time. By the end of the course, students will have the skills to design and measure climate change mitigation actions and policies, define GHG mitigation targets, and design action plans to reduce GHG emissions by sources and enhance removals by sinks.

The course has been divided in four sections to cover critical aspects of climate change mitigation. The first part will set the stage on what climate change mitigation is, explore the critical debates surrounding climate change mitigation, provide the required skills to understand how to estimate GHG emissions, and explore how climate change mitigation is informed by science. The second part will cover the basis of how GHG emissions targets and climate change mitigation policies and actions are designed and implemented, what are the key challenges to climate change mitigation and how policies and actions can be measured thorough their implementation period. The third part of the course will focus on the role of climate change mitigation at a sector level where students will learn about how climate change mitigation differs from sector to sector by looking at a variety of climate change mitigation actions and policies. The fourth part will explore the concept of net zero and what national and subnational governments are doing to achieve climate change mitigation strategies.

In addition, two tutorials with practical exercises will cover additional technical elements that are used in climate change mitigation. In the first tutorial, students will learn how to estimate and report GHG emissions and what is the importance of knowing these methodologies for climate change mitigation experts. In the second tutorial, students will dissect a mitigation policy in Canada and identify the causal GHG effects of the policy and identify potential indicators and metrics that could be used to monitor the policy and inform decision makers through time. Both tutorials will be taught during class and a recording will also be uploaded to Quercus with additional information on each of the two topics.

Course objectives: The objectives of this course are five-fold: 1) to understand the purpose and requirements of the different types of climate change mitigation targets (*learning content*), 2) to know how knowing historical GHG emissions can assist when developing mitigation targets and actions (*develop critical thinking*), 3) to know how to design climate change mitigation policies, actions, and projects and measure their GHG effects through time (*develop professional skills*), 4) to question the effectiveness of mitigation targets already established and find ways to enhance these (*implementing knowledge to practice*), and 5) to understand what is the role of climate change mitigation (*learning content*).

2. Course overview:

Week	Topic	Due dates
Section I: Introduction		
January 11 (Week 1)	Introduction to the course and climate change mitigation	N/A
January 18 (Week 2)	Justice, equity, and responsibility: Intragenerational versus intergenerational equity	N/A
January 25 (Week 3)	GHG emissions inventories and historical emissions **First tutorial:** Estimating GHG emissions at a city level	N/A
Section II: From target setting to policies and actions		
February 01 (Week 4)	Setting climate change mitigation goals and targets.	N/A
February 08 (Week 5)	Designing and measuring the progress of climate change mitigation policies and actions. **Second tutorial:** Measuring a GHG reduction policy through time	**Tutorial assignment 1 due**

Week	Topic	Due dates
Section III: Climate change mitigation by sector		
February 15 (Week 6)	Climate change mitigation in the energy sector.	**Staged report: climate change mitigation strategy (stage 1: Analysis of historical GHG emissions) due**
February 22 (Week 7)	***No classes – Reading week***	
February 29 (Week 8)	Climate change mitigation in the transport sector.	**Tutorial assignment 2 due**
March 07 (Week 9)	Climate change mitigation in the industry and waste sectors.	**Staged report: climate change mitigation strategy (stage 2: Setting up a GHG reduction target) due**
March 14 (Week 10)	Climate change mitigation in the agriculture, forestry, and other land use (AFOLU) sector.	N/A
March 21 (Week 11)	Carbon capture and storage and the transition away from fossil fuels	**Staged report: climate change mitigation strategy (stage 3: Defining mitigation measures) due**
Section IV: Achieving climate change strategies		
March 28 (Week 12)	Understanding net zero and how this concept has influenced the development of climate change strategies	N/A
April 04 (Week 13)	Decarbonisation and the role of national and subnational governments	**Staged report: climate change mitigation strategy (stage 4: Final report) due**
April 12 – 26 (Week 15)	***Final exam***	

* Starting from Week 2, one reading will be assigned each week to start the lecture with a brief discussion of the study. This will count as part of your participation marks.

3. Total grade breakdown

Course component	Points	Due
Class attendance and participation (including in-class discussion of weekly readings)	5%	Various dates
Presentation of a GHG emissions reduction policy or action	15%	Various dates
Staged report: climate change mitigation strategy	30%	Various dates
Tutorial assignment 1	7.5%	Week 5
Tutorial assignment 2	7.5%	Week 8
Final exam	35%	Week 13

4. Policies and students' expectations

Equity diversity and inclusion

The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Handing in Your Assignments

All assignments for this course are to be submitted via Quercus as a PDF.

Email and communication

I will be holding weekly office hours. If for any reason you are not able to attend office hours, you can also reach me by email. If you do so, consider the following:

- You are expected to write from your University of Toronto email.
- This is a course designed to train professionals in climate change mitigation, for this reason I expect emails be written in a professional manner and style.
- I do not respond to emails on evenings or weekends and may not be able to respond rapidly at all times, so please have this in mind before asking any urgent requests.

Illness

Students who are absent from academic participation for any reason (e.g., COVID, cold, flu and other illness or injury, family situation) and who require consideration for missed academic work should report their absence using the online absence declaration on ACORN and on the DPES online form. The declaration is available on ACORN under the Profile and Settings menu. Students should also advise their instructor of their absence via the DPES online form.

Extensions

Students MUST submit a request for extension in ADVANCE of the deadline in order to receive a decision. For extensions of time beyond the examination period you must submit a petition through the Office of the Registrar.

Please follow the University of Toronto procedure to be completed in order to be considered for academic accommodation for any course work such as missed tests or late assignments. Verification of Student Illness or Injury forms can be found on the Office of the Registrar's webpage.

Missed Term Work

No due dates will be extended unless discussed with and agreed upon with the instructor. Penalty for late assignments will be 5% of the assignment mark per day late, including weekends. Late assignments will be accepted only for one week after the due dates. Assignments submitted later will not be reviewed and assessed. The only exemption from these penalties will be for work that is late for health reasons, provided that students submit the proper documentation by way of the Absence Declaration Tool on ACORN.

Academic integrity

On the use of AI writing or coding assistants

The use of generative artificial intelligence tools or apps for assignments in this course, including tools like ChatGPT and other AI writing or coding assistants, is prohibited. In other words, the knowing use of generative artificial intelligence tools, including ChatGPT and other AI writing and coding assistants, for the completion of, or to support the completion of, an examination, term test, assignment, or any other form of academic assessment, will be considered an academic offense in this course.

This course policy is designed to promote your learning and intellectual development and to help you reach course learning outcomes.

Cheating and plagiarism

University of Toronto Code of Behaviour on Academic Matters states that "it shall be an offence for a student knowingly: to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e., to commit plagiarism" For accepted methods of standard documentation formats, including electronic citation of internet sources please see the University of Toronto writing website at:
http://advice.writing.utoronto.ca/using-sources/documentation
The full Code of Behaviour regulations could be found from consulting:
https://www.sgs.utoronto.ca/policies-guidelines/academic-integrity-resources/

Normally, students will be required to submit their course essays to the University's plagiarism detection tool (Ouriginal) for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq).

Potential offences include, but are not limited to:

In papers and assignments:

- Using someone else's ideas or words without appropriate acknowledgement.
- Submitting your own work in more than one course without the permission of the instructor in all relevant courses
- Making up sources or facts

- Obtaining or providing unauthorized assistance on any assignment

On tests and exams:

- Using or possessing unauthorized aids
- Looking at someone else's answers during an exam or test
- Misrepresenting your identity

In academic work:

- Falsifying institutional documents or grades
- Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the University of Toronto website on Academic Integrity).

Material, recordings, and use of intellectual property

The presentations and course materials are intellectual property and only meant for the ESTC40 course. Sharing and/or redistribution of the course material (e.g., presentations, documents, recordings, etc.) is expressly prohibited. Students are prohibited from creating audio or video recordings without written permission from the instructor.

Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download lecture materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct. For questions about recording and use of videos in which you appear please contact your instructor.

5. Accessibility and communication policies

Accessibility

Students with diverse learning styles and needs are welcome in this course! In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and Accessibility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronnto.ca

Writing and English language

As well as the faculty writing support, please see English Language and writing support at University of Toronto: http://www.sgs.utoronto.ca/currentstudents/Pages/English-Language-and-Writing-Support.aspx

The following readings are also useful:

Sylvan Barnett, A Short Guide to Writing About Art. (New York: Harper-Collins, 1997)

William Strunk Jr., E.B. White. The Elements of Style (New York: MacMillan Publishing)

Communicating With You

The best way to communicate with me is during office hours. However, I also respond to student emails within two business days (Monday-Friday) and within business hours (9am-5pm). Please note that emails sent to me Friday after 5pm and during the weekends will be responded the next Monday during business hours.

6. Lecture description

The course will be divided in four sections that will start from a general understanding of climate change mitigation and its main debates and challenges (Section 1) and will transition to approaches used to define mitigation pathways and develop policies and measures (Section 2), moving on understand climate change mitigation approaches at a sectoral level (Section 3), and will wrap up with the most novel approaches that a variety of stakeholders are taking to achieve climate change mitigation (Section 4). **Readings will be assigned each week starting from week 2 and will be uploaded to Quercus under each lecture module**.

Section I: Introduction

Week 1: Introduction to the course and climate change mitigation

What is climate change mitigation? For the first class, we will set the scene to understand what mitigation means in the context of climate change, what is the purpose and the limitations of climate change mitigation, and what are some of the most significant challenges that we face in the upcoming years to reduce GHG emissions in every economic sector.

Week 2: Justice, equity, and responsibility: Intragenerational versus intergenerational equity

This week, we will cover one of the most contentious debates that have taken place since the adoption of the UNFCCC. What is the role of justice, equity, and responsibility in climate change mitigation? Past, present, and future GHG emissions' contributions to the atmosphere became one of the central debates around climate change mitigation. Understanding how responsibility should be assigned and understood has shaped the climate change agenda over the last two decades. Understanding the intragenerational versus intergenerational equity debate is necessary to comprehend why climate change mitigation can be deconstructed in different ways.

Week 3: GHG emissions inventories and historical emissions

This week, we will learn about the first tool that we have to inform climate change mitigation. Estimating and analyzing historical GHG emissions and reporting them in GHG emission inventory reports has become a practice seen as necessary if effective mitigation is desired. Understanding how GHG emissions can be estimated and reported is one of the first steps to inform the development of climate change goals and targets. We will also look at the limitations and blind spots that GHG emission inventory reports have.

Section II: From target setting to policies and actions

Week 4: Setting climate change mitigation goals and targets.

This week, we will explore the different types of targets and goals that are used that define how climate change mitigation will be achieved. We will learn how to use the mitigation goal standard—a widely used approach to setting GHG reduction goals and targets. We will also explore the strength and limitations of the different types of targets, which will help to understand why countries have used different types of targets in their nationally determined contributions.

Week 5: Designing and measuring the progress of climate change mitigation policies and actions.

How are climate change mitigation policies and actions designed? This week we will learn how to design mitigation policies using the Policy and Action standard. We will also explore how the effects of mitigation policies and actions can be measured and enhanced over time, and the perils of falling into a *dangerous incrementalism*.

Section III: Climate change mitigation by sector

Week 6: Climate change mitigation in the energy sector.

This week, we focus our attention in one of the key sectors for climate change mitigation—the energy sector. Reducing the GHG emissions from the production of electricity and heat is a significant challenge. In this class we will explore the main challenges to reduce GHG emissions from energy systems, what are the possible mitigation options for energy systems, and what is a just low-carbon energy transition.

Week 8: Climate change mitigation in the transport sector.

This week, we will focus on the transport sector. Reducing GHG emissions from transportation activities and infrastructure has been a significant challenge to subnational and national governments. We will have an overview of the transport sector, what systemic changes are required, and what mitigation options are available for land-based transport, aviation, and shipping. Finally, we will have a discussion on how feasible it is to implement swift actions to reduce GHG emissions in the transport sector.

Week 9: Climate change mitigation in the industry and waste.

Climate change mitigation has a role in the supply chain of the industry sector. By implementing mitigation policies, measures, and individual projects in the industry sector, a whole range of co-benefits—or non-GHG effects—can be achieved in addition to the GHG effects achieved. This week we continue exploring climate change mitigation with a sector lens, exploring the opportunities and challenges to reduce GHG emissions at the industry sector and the supply chain that enables it. We will also explore a variety of options to reduce GHG emissions in the cement, iron and steel, and mining industries.

Week 10: Climate change mitigation in the agriculture, forestry, and other land use (AFOLU) sector.

This week, we continue exploring mitigation options with a sectoral lens by focusing on the AFOLU sector. To study climate change mitigation in the AFOLU sector, we will focus in four strategies: 1) reduction and prevention of GHG emissions to the atmosphere, 2) sequestration of GHG emissions, 3) substitution of fossil fuels and energy intensive products, and 4) demand-side options (e.g., lifestyle changes). We will explore how AFOLU mitigation policies and measures are designed and the main existing barriers.

Week 11: Carbon capture and storage and the transition away from fossil fuels

What is carbon capture and storage? And is it necessary for climate change mitigation? This week we will explore why carbon capture and storage has been widely contested by some experts and seen as a silver bullet by others. We will also explore what does it mean to transition away from fossil fuels from different perspectives.

Section IV: Achieving climate change strategies

Week 12: Understanding net zero and how this concept has influenced the development of climate change strategies

This week, we commence to wrap up the course exploring one key piece of the climate mitigation puzzle, net zero. This concept has cascaded to become the standard to climate change mitigation. In this class, we will discuss what this concept is and how it has influenced the development of climate change strategies, what are the different understandings and problematics around net zero, and we will explore why some experts are cautious about this concept and also why some experts argue that net zero could be the enabler for achieving the Paris Agreement goal.

Week 13: Decarbonisation and the role of national and subnational governments

Is climate change mitigation and decarbonization the same? This week we wrap up the course by focusing on the concept of decarbonization and how, similar to net zero, has been adopted as a main goal for climate change mitigation. And finally, to wrap up the course, we will explore what national and subnational governments are doing and what are the challenges ahead for climate change mitigation.

7. Assignments description

Class attendance and participation (including in-class discussion of weekly readings):

Students are required to attend to all lectures and have an active participation. Active participation in this class includes asking questions, participating in weekly class discussions and activities, sharing your thoughts, and listening to the contributions from other students.

Presentation of a GHG emissions reduction policy or action (maximum 7 slides – 15 minutes):

It is fundamental that climate change mitigation experts understand what a GHG reduction policy or action is and what information is necessary for its design and implementation. This assignment will prepare students to understand the different elements considered in GHG reduction policies or actions. Students will prepare a short presentation (maximum 7 slides and no more than 15 minutes) of a policy or action of their choice. Each group will have to select a policy or action aimed to reduce GHG emissions for a sector of their choice. Presentations will take place between Week 6 and Week 11 of the course, depending on the sector the student has signed up to. A sign-up list will be open on Quercus during Week 2 for students to select the sector of their choice.

Each presentation will consist of an introduction to the GHG reduction policy or action, what problem aims to solve, what would be the baseline of the policy or action (i.e., what would happen if the policy or action is not implemented), a summary of the primary sources, sinks and reservoirs (SSR) affected by the

policy pr action, the type of GHGs, and challenges of barriers that may affect the effectiveness of the policy or action has faced (or similar policies and actions have faced).

Staged report: climate change mitigation strategy (max 13 pages; times new roman font size 12; single spaced):

Students will work through four staged activities that will culminate in a climate change mitigation strategy by the end of the course. Each staged activity refers to a key element of a climate change mitigation strategy. For this assignment, students will assist a country of their choosing to prepare develop climate change mitigation strategy. The final assignment will take the form of a report that is meant to be addressed to the country chosen by each student.

The **first stage** of this assignment starts with the analysis of historical GHG emissions of a country of their choosing, using the most recent national communication and biennial update report (developing country) or biennial report (developed country) published in the UNFCCC website to write an analysis of how historical GHG emissions have behaved nationally and at a sectoral level (*two pages*).

For the **second stage** of this assignment, students will design a GHG reduction target based on the analysis of historical GHG emissions and will have justify the decisions to include or exclude sectors as well as justifying the type of target chosen (*two pages*).

The **third stage** will require students to define between four mitigation measures for the most significant sectors and will and justify why this mitigation measure is needed (*five pages*).

By the **fourth stage** of this assignment, students will assemble each of the previous activities into a report (maximum 13 pages) and will include an explanation of how the concepts of equity, equality, and justice should be considered by the country during the implementation of the climate change strategy (1-2 pages), as well as a brief reflection of what could the future of the country could look like once the GHG reduction targets proposed in the strategy have been met (1-2 pages).

Stage	Activity	Due
1	Analysis of historical GHG emissions	Week 6
2	Setting up a GHG reduction target	Week 9
3	Defining mitigation measures	Week 11
4	Final report	Week 13

Tutorial assignments (times new roman font size 12; single spaced): After each tutorial, students will have to submit two brief reports with specific questions about the topics discussed during each session.

First tutorial (2 pages max): As part of the first tutorial, students will have to analyse the GHG emissions inventory report of a city and will have to answer three questions about the transparency and effectiveness of the report.

Second tutorial (4 pages max): For the assignment of the second tutorial, students will have to trace the process in which a GHG mitigation policy leads to GHG effects and non-GHG effects (i.e., co-benefits) and write a report. Using the Policy and Action Standard as guidance, students will have to map a causal chain and analyse a policy in Canada where at least four stages of proximate effects are identified. Students will identify indicators that can be used to monitor GHG effects and non-GHG effects of the policy or action. Finally, students will have to describe the benefits and disadvantages of using a causal chain approach as a tool for climate change mitigation.

8. References:

Allan, Jen Iris. 2019. "Dangerous Incrementalism of the Paris Agreement." Global Environmental Politics 19 (1):4-11. doi: 10.1162/glep_a_00488.

Ari, Izzet, and Ramazan Sari. 2017. "Differentiation of developed and developing countries for the Paris Agreement." Energy Strategy Reviews 18:175-182. doi: https://doi.org/10.1016/j.esr.2017.09.016.

Bernstein, Steven, and Matthew Hoffmann. 2019. "Climate politics, metaphors and the fractal carbon trap." Nature Climate Change. doi: 10.1038/s41558-019-0618-2.

DeLonge, Marcia, and Andrea Basche. 2018. "Managing grazing lands to improve soils and promote climate change adaptation and mitigation: a global synthesis." Renewable Agriculture and Food Systems 33 (3):267-278.

Findlay, Alyssa. 2021. "Climate mitigation through Indigenous forest management." Nature Climate Change 11 (5):371-373. doi: 10.1038/s41558-021-01042-5.

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IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme. Edited by Eggleston H.S, Buendia L., Miwa K., Ngara T. and Tanabe K. Japan: IGES.

IPCC. 2007. "Policies, measures and instruments to mitigate climate change." In Climate Change 2007: Mitigation of Climate Change. Contribution of the Working Group III to the Fourth Assessment report of the Intergovernmental Panel on Climate Change, ed. by. Cambridge, United Kingdom: Cambridge University Press.

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Linton, Samantha, Amelia Clarke, and Laura Tozer. 2021. "Strategies and Governance for Implementing Deep Decarbonization Plans at the Local Level." Sustainability 13 (1):154.

McKenna, Christine M., Amanda C. Maycock, Piers M. Forster, Christopher J. Smith, and Katarzyna B. Tokarska. 2020. "Stringent mitigation substantially reduces risk of unprecedented near-term warming rates." Nature Climate Change. doi: 10.1038/s41558-020-00957-9.

Okereke, Chukwumerije. 2008. "Equity Norms in Global Environmental Governance." Global Environmental Politics 8 (3):25-50. doi: 10.1162/glep.2008.8.3.25.

Ott, Hermann E, Harald Winkler, Bernd Brouns, Sivan Kartha, MJ Mace, Saleemul Huq, Yasuko Kameyama, Agus P Sari, Jiahua Pan, and Youba Sokona. 2004. "South-North Dialogue on Equity in the Greenhouse: A proposal for an adequate and equitable global climate agreement."

Peñasco, Cristina, Laura Díaz Anadón, and Elena Verdolini. 2021. "Systematic review of the outcomes and trade-offs of ten types of decarbonization policy instruments." Nature Climate Change. doi: 10.1038/s41558-020-00971-x.

Robiou du Pont, Yann, and Malte Meinshausen. 2018. "Warming assessment of the bottom-up Paris Agreement emissions pledges." Nature Communications 9 (1):4810. doi: 10.1038/s41467-018-07223-9.

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Winkler, Harald. 2017. "Mitigation (Article 4)." In The Paris Agreement on climate change: Analysis and commentary, edited by Daniel Klein, María Pía Carazo, Meinhard Doelle, Jane Bulmer and Andrew Higham, 141-165. Oxford University Press.

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WRI. 2005. The GHG Protocol for Project Accounting.

WRI. 2014a. Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

WRI. 2014b. Mitigation Goal Standard. An accounting and reporting standard for national and subnational greenhouse gas reduction goals.

WRI. 2014c. Policy and Action Standard. An accounting and reporting standard for estimating the greenhouse gas effects of policies and actions.