Lesson Plan: Teaching Opportunity Costs of Greenhouse Gas Emissions

As an **Undergraduate Economics** teacher, you can use this set of computer-based tools to help you in teaching about **opportunity costs** using an in-class experiment of **trading emissions permits** for the use of a hypothetical fuel that emits greenhouse gases.

Global warming due to greenhouse gas emissions from the burning of fuel, is an important aspect of climate change. This lesson plan will enable your students to apply their understanding of opportunity costs for the use of a greenhouse gas emitting fuel in product manufacturing. This resource will allow your students to experiment with **individual/consumer choices** and **budget constraints** for production decisions by trading emissions permits at a **fixed market price** in an interactive classroom experiment.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Economics**.

Use this lesson plan to help your students find answers to:

- What is opportunity cost in economics? Give an example.
- How is opportunity cost calculated?
- What are tradable pollution/emissions permits and how do they work?
- What are the economic policy measures used to address the opportunity cost of carbon emissions?

About the Lesson Plan

Grade Level	Undergraduate
Discipline	Economics
Topic(s) in Discipline	Opportunity Sets, Opportunity Costs, Individual Choices, Consumer Choices, Budget Constraints, Fixed Market price, Becker-DeGroot-Marshak (BDM), Market Failures and Externalities, Tradable Pollution/ Emission Permits, Emission Permit Allocation, Cap and Trade Schemes.
Climate Topic	Energy, Economics, and Climate Change; Climate Mitigation and Adaptation
Location	Global
Access	Online, Offline
Language(s)	English
Approximate Time Required	45 – 60 min

Contents

1	Teaching Module (15 min)	A teaching module to introduce individual/consumer choices, budget constraints, and opportunity costs. This can be accessed at: https://openstax.org/books/principles-economics-2e/pages/2-1-how-individuals-make-choices-based-on-their-budget-constraint
2	Classroom Activity (30 – 45 min)	An in-class interactive activity to teach opportunity costs of product manufacturing through the trading of hypothetical emissions permits. This can be accessed at: https://www.economicsnetwork.ac.uk/iree/v9n2/holt.pdf
3	Suggested questions/assignments for learning evaluation	• What is opportunity cost in economics? Give an example. • How is opportunity cost calculated? • What are tradable pollution/emissions permits and how do they work? • What are the economic policy measures used to address the opportunity cost of carbon emissions?

Step-by-step User Guide

(Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.)

1	Topic introduction and discussion	Use the teaching module, '2.1 How Individuals Make Choices Based on Their Budget Constraint' by OpenStax™, Rice University, to introduce the topic of opportunity costs in economics. Use the tool to explain individual/consumer choices based on budget constraints and how this gets factored into opportunity costs. Use the exercises given in the text to illustrate these economic concepts. You may also choose to use another teaching module by CORE Project (link given in additional resources section) to enable better understanding of

		opportunity costs using several other examples and exercises given in text. This can be accessed at: https://openstax.org/books/principles-economics-2e/pages/2-1-how-individuals-make-choices-based-on-their-budget-constraint
2	Apply understanding	Use the academic paper, 'Teaching Opportunity Cost in an Emissions Permit Experiment' by Charles Holt et al., International Review of Economics Education, provided by The Economics Network, UK, to conduct an in-class individual choice experiment to teach your students to identify and account for opportunity costs in production decisions. The students play the role of producers and must make production quantity decisions based on the costs of fuel input and the associated emissions permits. Explain what these tradable pollution/emissions permits are and how they affect the opportunity costs of production. Follow the instructions given in the paper to conduct the classroom activity. This activity is designed to be paper-based or conducted online using the Veconlab software (details given in text). Use the suggested extensions and discussion points given in the paper to initiate classroom discussions about the use of tradable emissions permits, the cap and trade schemes, and the permit allocation systems. Finally, discuss how these decisions based on opportunity costs in production are relevant in the context of human induced climate change. This can be accessed at: https://www.economicsnetwork.ac.uk/iree/v9n2/holt.pdf
3	Questions/Assignments	Use the tools and the concepts learned so far to discuss and determine answers to the following questions: • What is opportunity cost in economics? Give an example. • How is opportunity cost calculated? • What are tradable pollution/emissions permits and how do they work?

		• What are the economic policy measures used to address the opportunity cost of carbon emissions?

Learning Outcomes

The tools in this lesson plan will enable students to:

- learn about opportunity sets and opportunity costs
- explain individual/consumer choices and budget constraints
- calculate opportunity costs for given economic conditions
- evaluate tradable pollution/emissions permits for a given product
- discuss the opportunity costs of carbon emissions in the context of climate change

Additional Resources

(If you or your students would like to explore the topic further, these additional resources will be useful.)

1	Teaching Module	A teaching module by the CORE Project to further your students' understanding of opportunity costs in economics through in-built examples and exercises. This can be accessed at: https://core-econ.org/the-economy/book/text/03.html#33-opportunity-costs
2	Reading	An academic paper, 'An experimental study of auctions versus grandfathering to assign pollution permits' by Jaco K. Goeree et al., Journal of the European Economic Association April–May 2010 8(2–3):514–525. This can be accessed at: https://core.ac.uk/download/pdf/4884775.pdf

Credits/Copyrights

1	Teaching Module; "2.1 How Individuals Make Choices Based on	By OpenStax™, Rice University.

	Their Budget Constraint"	
2	Classroom Activity, "Teaching Opportunity Cost in an Emissions Permit Experiment"	By Charles Holt et al., International Review of Economics Education, provided by The Economics Network, UK.
3	Additional Resources	CORE Project CORE by The OPEN University and JISC, UK.