

University of Waterloo
Department of Economics
Economics 255
Introduction to the Economics of Natural Resources, Fall 2018
11:30-12:20, MWF, EV3 3412

Instructor Information

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Office Hours:
Mon/Wed 4-5 pm, or by appointment

Course description

Humanity depends on natural resources for survival; yet increasing population and economic growth have put pressure on key natural resources such as forests, fisheries, and water. In addition, the economies of the world's wealthier countries are highly dependent on depletable natural resources which are major sources of carbon emissions – coal, oil and natural gas, in particular. In this course we will use the theory and tools of economics to explore key issues of natural resource use and management. We will seek to understand the meaning and implications of natural resource scarcity and how the insights of economics might be used to promote a more sustainable path for our future. We begin with basic economic concepts such as static and dynamic efficiency, property rights and market failure. We then apply these concepts to the management of key natural resources such as energy resources, fisheries, and water.

Course objectives and learning outcomes

The objective of the course is to apply the normative economic concepts of static and dynamic efficiency to questions concerning society's exploitation of natural resources.

Upon completion of the course students should be able to:

- Explain the determination of the efficient level of extraction over time for renewable and non-renewable resources and distinguish between efficiency and equity
- Explain the importance of property rights in the management of natural resource use
- Explain the significance of discounting in economic decisions about natural resources and the associated ethical dilemmas
- Analyze market failures in specific examples and the need for government intervention to support a more efficient allocation of natural resources
- Evaluate government natural resource policies for efficiency, equity and societal welfare.

Textbook

Tom Tietenberg and Lynne Lewis (**T&L**), Environmental and Natural Resource Economics, Pearson, eleventh edition, 2018. The 11th edition is available in the bookstore. The 10th edition is also acceptable and is available on-line through the library (3 copies).

Other References

(Required readings are denoted by a *. **Note that some of the links will only work if you are on campus or logged into your library account from home.** Articles without links are available through the library.)

- *Arrow K.; B. Bolin; R. Costanza; *et al* (1995) '[Economic growth, carrying capacity, and the environment](#)', *Ecological Economics*, 15, 91-95.
- *Bassi, Samuela; Maria Carvalho, Baran Doda and Sam Fankhauser (2017) '[Credible, effective and publicly acceptable policies to decarbonise the European Union, Final Report](#)', Grantham Research Institute on Climate Change and the Environment.
- *Bergstrom, Theodore (2010) 'The Uncommon Insight of Elinor Ostrom,' *Scandinavian Journal of Economics*, 112(2), 245-261. https://journals-scholarsportal-info.proxy.lib.uwaterloo.ca/details/03470520/v112i0002/245_tuioeo.xml
- *Cropper, M (2013) '[How should benefits and costs be discounted in an intergenerational context?](#)' *Resources Magazine*: 183, Resources for the Future.
- *Covert, T.; M. Greenstone; C. Knittel (2016) 'Will we ever stop using fossil fuels?', *Journal of Economic Perspectives*, 30, p. 117-138.
- **The Economist*, (2016) 'Unbalancing the Scales,' Print edition, July 16, 2016. Available on LEARN.
- *Gee, Marcus (2018) 'Even without rose-tinted glasses, life's till a lot rosier,' *Globe and Mail*, print edition, August 25, 2018. Available on Learn.
- Environmental Protection Agency (2014) '[Guidelines for Preparing Economic Analyses](#)', National Center for Environmental Economics, Office of Policy, U.S. Environmental Protection Agency, Chapter 6.
- *Hardin, Garrett (1968) 'The Tragedy of the Commons', *Science*, 162, 1243-1248.
- *Kopecky, Arno (2018) 'It is the best of times, it is the worst of times', *Globe and Mail*, print edition, August 25, 2018. Available on Learn.
- *Kroetz, Kailin; and James N. Sanchirico (2015) '[The Costs of Competing Goals in Fishery Management](#),' *Resources Magazine*: 190, Resources for the Future, September 2015.
- National Energy Board (NEB) (2017) 'Canada's Adoption of Renewable Power Sources Energy Market Analysis,' May 2017. <https://www.nbe-one.gc.ca/nrg/sttstc/lctrct/rprt/2017cnddptnrnwblpwr/2017cnddptnrnwblpwr-eng.pdf>
- Olmstead, S.; and R. Stavins (2009) '[Comparing price and nonprice approaches to urban water conservation](#)', *Water Resources Research*, 45.
- Ostrom, Elinor (2009) 'Design principles of robust Property Rights Institutions: What have we learned?' in *Property Rights and Land Policies*, Gregory Ingram and Yu-Hung Hong, eds., Lincoln Institute of Land Policy, Cambridge, Massachusetts.
- *Pearce, D.; B. Groom; C. Hepburn; and P. Koundouri (2003) '[Valuing the future: recent advances in social discounting](#)', *World Economics* 4(2): 121-41.

*Renzetti, S. (2017) “Water Pricing in Canada”, in *Water Policy and Governance in Canada*, S. Renzetti and D.P. Dupont (eds).

Sustainable Prosperity (2011) ‘[Economic instruments for water management in Canada: Case studies and barriers to implementation](#)’, Policy Brief, Sept. 2011.

Course Assessment

Evaluation	Percent of final grade	Date
Participation	5%	In-class and on-line participation in assigned exercises throughout the term
Midterm 1	15%	Monday, Oct 1
Assignment 1	10%	Monday, Oct 22
Midterm 2	15 %	Monday November 5
Assignment 2	10 %	Friday, November 23
Final Exam	45 %	Scheduled by the registrar

Outline of topics to be covered

1. Introduction
 - 1.1. Scarcity and limits to growth
 - 1.2. Natural resources and the economy
2. Static efficiency: a normative criteria for decision making
 - 2.1. Review of basic concepts: willingness-to-pay, marginal and total cost, consumer and producer surplus, Pareto optimality
 - 2.2. Property rights and efficient market allocations
 - 2.3. Externalities as a source of market failure
 - 2.4. Public goods
 - 2.5. The pursuit of efficiency
3. Discounting, dynamic efficiency, and sustainable development
 - 3.1. What is dynamic efficiency?
 - 3.2. How should the discount rate be chosen for public policy decisions?
 - 3.3. Discounting over long time periods
4. Non-renewable resource management
 - 4.1. Characterizing the resource stock
 - 4.2. Optimal extraction over time in a competitive industry
5. Transitions in energy markets from depletable to renewable resources
 - 5.1. Optimal resource extraction with environmental costs
 - 5.2. Are fossil fuel resources becoming scarcer?
 - 5.3. Transitioning electric power generation away from fossil fuels
6. Fisheries
 - 6.1. Introduction
 - 6.2. A model of the fishery
 - 6.3. Dynamics of open access
 - 6.4. Determining the socially optimal harvest level

- 6.5. Extinction in a steady state model
- 6.6. Regulation of the fishery
- 6.7. Case study: Pacific halibut
- 7. Water economics
 - 7.1. Introduction
 - 7.2. Efficient water allocation
 - 7.3. Property rights
 - 7.4. Sources of inefficiency
 - 7.5. Water pricing in practice

Tentative course schedule

Note: I will not follow this schedule rigidly, but will adapt the timing of topics as needed to best make use of class time. Additional readings may be assigned throughout the term. Check LEARN regularly for an up-to-date reading list. An asterisk indicates a required reading. Other readings are optional.

T&L refers to the Tietenberg and Lewis textbook. Page numbers are given for the 11th edition. However I have also given the names of relevant sections so you can determine the appropriate pages in the 10th edition.

Week	Lecture	Date	Schedule notes	Topic	Readings
1	1	7-Sep		1. Introduction 1.1 Scarcity and the limits to growth	T&L, Ch 1* K. Arrow <i>et al</i> (1995)* Gee (2018)* Kopecky (2018)*
	2	10-Sep		1.2 Natural resources and the economy	
	3	12-Sep		2. Static efficiency 2.1 Review of basic concepts	T & L, Ch 2 and Ch 3 (Normative Criteria for Decision Making); Your Ec101 textbook as needed
2	4	14-Sep		2.1 continued	
	5	17-Sep		2.2 Property rights and efficient market allocations	Hardin, pages 1243 – 1245* Bergstron*
	6	19-Sep		2.2 continued	
3	7	21-Sep		2.3 Externalities as a source of market failures	
	8	24-Sep		2.4 Public goods	
	9	26-Sep		2.4 continued	
4	10	28-Sep		2.5 The pursuit of efficiency	
	11	1-Oct	Midterm #1	Midterm	
	12	3-Oct		3. Discounting and dynamic efficiency 3.1 What is dynamic efficiency?	- T & L, Ch 3, [Dynamic efficiency; The treatment of

					risk; Distribution of benefits and cost; Choosing the discount rate; Divergence of social and private discount rates]
5	13	5-Oct		3.2 Determining the discount rate for public policy decisions	- Pearce <i>et al</i> (2003)* ; - Cropper (2013)* ; - Environmental Protection Agency (2014), Ch 6.
		8-Oct	Thanksgiving	No Class, Thanksgiving	
		10-Oct	Study day	No Class, Study day	
	14	12-Oct		3.2 (continued)	
	15	15-Oct		3.2 (continued)	
6	16	17-Oct		3.3 Discounting over long time periods	
				4. Non-renewable resource management 4.1 Characterizing the resource stock 4.2 Optimal extraction over time in a competitive industry	-T & L, Ch. 5 (Introduction, A Two-Period Model)*; - T&L, Ch 6 (including appendix)*
	17	19-Oct			
	18	22-Oct	Assignment 1 due	4.2 continued	
7	19	24-Oct		4.2 continued	
	20	26-Oct		4.2 continued	
	21	29-Oct			
8	22	31-Oct		5. Transitions in energy markets from depletable to renewable resources 5.1 Optimal resource extraction with environmental costs	-T&L, Ch 6, Market Allocations of Depletable Resources, p. 134-139*
	23	2-Nov		5.2 Are fossil fuels becoming more scarce?	
	24	5-Nov	Midterm #2	Midterm	
9	25	7-Nov		5.3 Transitioning electric power generation away from fossil fuels	- T&L, Ch 7, (Electricity, the role of depletables; Electricity: transitioning to renewables) pp 158-163*; - Bassi et al (2017)* - NEB (2017);

					- Covert (2016) *
	26	9-Nov		5.3 (continued)	
	27	12-Nov		5.3 (continued)	
10	28	14-Nov		6. Fisheries 6.1 Introduction to fisheries; 6.2 A model of the fishery	- T&L, Chapter 12*
	29	16-Nov		6.2 (continued)	
	30	19-Nov		6.3 (continued) 6.3 Dynamics of open access	- Economist (2016)*
11	31	21-Nov		6.4 Determining the socially optimal harvest level;	
	32	23-Nov	Assignment 2 due	6.5 Extinction in a steady state model 6.6 Regulation of the fishery	- Kroetz and Sanchirico (2015)*
	33	26-Nov		6.6 (continued) 6.7 Case study – Pacific Halibut	
12	34	28-Nov		7. Water Economics 7.1 Introduction to water economics 7.2 Efficient water allocation	- T&L, Ch 9*
	35	30-Nov		7.3 Property rights 7.4. Sources of inefficiency in water allocation	- Olmstead and Stavins (2009); - Renzetti (2017)*
	36	3-Dec		7.5 Water pricing in practice Wrap up class material	

Required Background

- The prerequisite is Econ101.
- Students are expected to be competent with skills in basic algebra, such as solving two linear equations in two unknowns, and working with exponents and logarithms.

Readings and notes on LEARN

- Course notes, announcements etc can be found on LEARN.
- The course notes provide an outline of important points, but leave out many details. It is recommended that you bring the relevant notes to class each week so that you can fill in missing sections.

Midterm

- A student who misses the midterm due to illness or other extenuating circumstances may seek approval from me to have the weighting of the test shifted to the final exam. Approval will be granted only if appropriate documentation is submitted. If the student does not receive my approval, then a mark of zero will be assigned for the missed midterm. Appropriate documentation in the case of illness is the University's Verification of

Illness Form completed by the University of Waterloo Health Services or an Ontario physician. **Students must submit their documentation within one week of the missed midterm.**

- Students with a concern about the marking of a midterm must consult with me **within two weeks** of the date that it is returned in class. After two weeks I will not make any adjustments to a midterm mark.

Assignments

- Assignments may be completed individually or in groups of two. For group assignments, each student will receive the same mark. It is very important that each student in a group contributes equally to the assignment and understands the material. Exam questions will draw on assignment materials.

Participation

- Throughout the term students will be asked to complete in-class exercises in small groups. In addition, some group discussion exercises may be assigned on LEARN. Each participation exercise will be worth 2 points. The best 75% of your participations assignments will count towards your participation grade.

Policy on late assignments

- A deduction of 5% per day will be applied to an assignment handed in late.

Final Exam

- The final exam is cumulative.
- Students are responsible for material covered in lectures and assigned readings.

Electronic Device Policy

Students are welcome to bring laptop computers or other electronic devices to class for note taking. Browsing the internet during class is not permitted. Please turn off cell phones during class time.

Attendance Policy

Consistent attendance is required in order to do well in this course. Course notes available on LEARN are intended as an aid to understanding, not a substitute for classes.

Economics Department Deferred Final Exam Policy

The Deferred Final Exam Policy is found at <https://uwaterloo.ca/economics/undergraduate/resources-and-policies/deferred-final-exam-policy>

Statements and links to be included on all course outlines

Cross-listed course

Please note that a cross-listed course will count in all respective averages no matter under which rubric it has been taken. For example, a PHIL/PSCI cross-list will count in a Philosophy major average, even if the course was taken under the Political Science rubric.

Academic Integrity

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and responsibility. See the [UWaterloo Academic Integrity](#) webpage and the [Arts Academic Integrity](#) webpage for more information.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When

misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to [Policy 71 - Student Discipline](#). For typical penalties check [Guidelines for the Assessment of Penalties](#).

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. [Read Policy 70 - Student Petitions and Grievances](#), Section 4. When in doubt, please be certain to contact the department’s administrative assistant who will provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to [Policy 72 - Student Appeals](#).

Accommodation for Students with Disabilities

Note for students with disabilities: [The AccessAbility Services office](#), located on the first floor of the Needles Hall extension (1401), collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AS office at the beginning of each academic term.

If you are using Turnitin® in your course

Turnitin.com: Text matching software (Turnitin®) will be used to screen assignments in this course. This is being done to verify that use of all material and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin®. In the first week of the term, details will be provided about arrangements and alternatives for the use of Turnitin® in this course.

Note: students must be given a reasonable option if they do not want to have their assignment screened by Turnitin®. See [guidelines for instructors](#) for more information.

Mental Health Support

All of us need a support system. The faculty and staff in Arts encourage students to seek out mental health supports if they are needed.

On Campus

- Counselling Services: counselling.services@uwaterloo.ca / 519-888-4567 ext 32655
- [MATES](#): one-to-one peer support program offered by Federation of Students (FEDS) and Counselling Services
- Health Services Emergency service: located across the creek from Student Life Centre

Off campus, 24/7

- [Good2Talk](#): Free confidential help line for post-secondary students. Phone: 1-866-925-5454
- Grand River Hospital: Emergency care for mental health crisis. Phone: 519-749-433 ext. 6880
- [Here 24/7](#): Mental Health and Crisis Service Team. Phone: 1-844-437-3247
- [OK2BME](#): set of support services for lesbian, gay, bisexual, transgender or questioning teens in Waterloo. Phone: 519-884-0000 extension 213

Full details can be found online at the Faculty of ARTS [website](#)

Download [UWaterloo and regional mental health resources \(PDF\)](#)

Download the [WatSafe](#) app to your phone to quickly access mental health support information

Territorial Acknowledgement

We acknowledge that we are living and working on the traditional territory of the Attawandaron (also known as Neutral), Anishinaabeg and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations that includes six miles on each side of the Grand River.

