

REVISED March 27, 2020

## Economics 323 (L01) (Natural Gas Markets)

Instructor: Lucija Muehlenbachs  
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Lecture Location: ST 139  
Lecture Days/Time: TR 11:00 - 12:15

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Office: SS 410

Office Hours: R 12:30-13:30 F 11:15-12:30

Winter 2020

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### Course Description:

Operation of the natural gas industry in North America. Economics of exploration, development, production, marketing and transportation of natural gas. Impact of government regulations and deregulation.

### Course Objective:

Students will understand issues in natural gas supply (including exploration, storage, transportation, pricing, and local distribution) and demand (including environmental externalities, and substitutes for natural gas use). Students will gain expertise in conducting literature reviews, plotting data in R, and use economics to evaluate policies.

### Course Learning Outcomes:

- a. Understand natural gas markets, from exploration and development, to transmission, distribution, and end use.
- b. Introduce theory of extraction of exhaustible resources.
- c. Build on economic theory of regulating externalities. Understand the current regulatory system in Canada for methane emissions. Understand positive and negative trade-offs from natural gas-fired electricity generation.
- d. Introduce natural gas transportation networks and how this impacts natural gas pricing and policies.
- e. Develop theory of price ceilings. Introduce allocative costs of price ceilings and the historical context of inefficient regulations. Empirical literature on estimating the size of the inefficiency.
- f. Build on theory of monopoly pricing in the context of local natural gas distribution companies. Examine empirical literature on determining efficiency of natural gas utility rates.
- g. Gain expertise in synthesizing information from the academic literature.
- h. Get practice in writing computer code in R.

### Course Outline:

Topics and readings include:

### 1 Overview

Natural Resources Canada's Natural Gas Primer: <https://www.nrcan.gc.ca/energy/natural-gas/5641>

"Understanding Natural Gas Markets," American Petroleum Institute, 2014.

"Energy Primer A Handbook of Energy Market Basics," FERC, November 2015

Natural Resources Canada's Natural Gas Facts: <https://www.nrcan.gc.ca/energy/facts/natural-gas/20067#details-panel4>

"Natural Gas Liquids Primer – With a Focus on the Appalachian Region" US Dept of Energy, June 2018 (page 2 has table of uses for natural gas liquids; page 33 describes ethylene crackers).

"Alberta at a Crossroads: Royalty Review Advisory Panel Report"

### 2 Natural gas supply: upstream exploration and extraction

Newell RG, Prest BC, Vissing AB. Trophy Hunting versus Manufacturing Energy: The Price Responsiveness of Shale Gas. *Journal of the Association of Environmental and Resource Economists*. 2019 Mar 1;6(2):391-431. (pages 1-9)

Catherine Hausman and Ryan Kellogg, "Welfare and Distributional Implications of Shale Gas," Brookings Papers on Economic Activity, Spring 2015, (Section III.A. and III.C)

Mark Agerton "Learning Where to Drill: Drilling Decisions and Geological Quality in the Haynesville Shale," Working Paper, (Pages 2-3)

Chapter 6 from Markets and the Environment by Keohane Olmstead

Jacobsen, Grant D. and Dominic P. Parker "The Economic Aftermath of Resource Booms: Evidence from Boomtowns in the American West" *Economic Journal* (2014) (pages 1-2)

### 3 Natural gas supply: externalities

Lade, Gabriel, and Ivan Rudik, "Costs of Inefficient Regulation: Evidence from the Bakken," Working Paper (pages 1-3)

"Upstream Petroleum Industry Flaring and Venting Report Industry Performance for Year Ending December 31, 2017," Alberta Energy Regulator

Manual 15 AER: "Estimating Methane Emissions," December 2018  
<https://www.aer.ca/documents/manuals/Manual015.pdf>

"Incremental CH<sub>4</sub> and N<sub>2</sub>O mitigation benefits consistent with the US Government's SC-CO<sub>2</sub> estimates" Alex L. Marten, Elizabeth A. Kopits, Charles W. Griffiths, Stephen C. Newbold & Ann Wolverton, *Climate Policy*

Muehlenbachs, Spiller, Timmins, 2015 "The Housing Market Impacts of Shale Gas Development," *American Economic Review* (Pages 1-2)

#### 4 Natural gas pricing

"What Drives Natural Gas Prices?", Stephen P. A. Brown and Mine K. Yücel, *Energy Journal*, 2008 (pages 1-4)

McRae, Shaun, "Crude Oil Price Differentials and Pipeline Infrastructure," NBER Working Paper No. 24170. 2017. (section 3.1)

"Open Access and the Evolution of U.S. Spot Market for Natural Gas" Doane and Spulber, *Journal of Law and Economics* (Part II: overview of institutions) (section 2)

#### 5 Natural gas transportation

"Linking Natural Gas Markets – Is LNG Doing its Job?" Anne Neumann, *Energy Journal*, 2009 (Section 2)

#### 6 Consumption: demand elasticities and effect of price ceilings

Davis, Lucas W., and Lutz Kilian. "The allocative cost of price ceilings in the US residential market for natural gas." *Journal of Political Economy* 119, no. 2 (2011): 212-241. (Sections 1-3)

"Natural Gas Price Elasticities and Optimal Cost Recovery Under Consumer Heterogeneity: Evidence from 300 million natural gas bills," 2018 NBER Working Paper, by Maximilian Auffhammer and Edward Rubin (pages 1-4)

#### 7 Consumption: natural monopoly regulation

Chapters 11 and 12 of Economics of Regulation and Antitrust by W. Kip Viscusi, Joseph E., Jr. Harrington, and John M. Vernon

Muehlegger, Erich; Davis, Lucas W "Do Americans consume too little natural gas? An empirical test of marginal cost pricing" *The RAND Journal of Economics* 2010 (sections 1 and 4)

Muehlenbachs, Lucija and Catherine Hausman " Price Regulation and Environmental Externalities: Evidence from Methane Leaks," *Journal of the Association of Environmental Economists*. 2019 (Section 1)

#### 8 Consumption: natural gas in the electricity sector

"Vertical Market Power in Interconnected Natural Gas and Electricity Markets," Levi Marks, Charles F. Mason, Kristina Mohlin and Matthew Zaragoza-Watkins (pages 1-3)

"Measuring market power and the efficiency of Alberta's restructured electricity market: An energy-only market design," David P. Brown Derek E. H. Olmstead *Canadian Journal of Economics*

Holland, Stephen P., Erin Mansur, Nicholas Z. Muller, and Andrew J. Yates "Are There Environmental Benefits from Driving Electric Vehicles? The Importance of Local Factors" *American Economic Review*, Volume 106, Issue 12, December 2016, Pages 3700–3729

#### 9 End-of-life Issues

"All's Well that Ends Well: Addressing End-of-Life Liabilities for Oil and Gas Wells" (Page 3, Figure 1)

Boomhower, Judson. 2016. "Drilling Like There's No Tomorrow: Bankruptcy, Insurance, and Environmental Risk."

Muehlenbachs "80,000 Inactive Oil Wells: A Blessing or a Curse?" SPP Briefing Paper, 2017.

**Prerequisites/corequisites:**

Economics 201 and 203

**Required Textbook(s):**

None

**Recommended Textbook(s):**

Markets and the Environment by Keohane Olmstead

**Books on Reserve:**

None

**Desire2Learn:**

This course will make use of the Desire2Learn (D2L) platform. Students who are registered in the course can log on at <http://d2l.ucalgary.ca> through their student centre. Please note that D2L features a class e-mail list that may be used to distribute course-related information. These e-mails go to your University of Calgary e-mail addresses only.

**Grade Determination and Final Examination Details:**

MIDTERM EXAM	30%
FINAL EXAMINATION	50%
ASSIGNMENTS	<u>20%</u>
	100%

The official grading system will be used. See <http://www.ucalgary.ca/pubs/calendar/current/f-1-1.html>.

A passing grade on any particular component of the course is not required for a student to pass the course as a whole.

If a student's letter grade on the final exam exceeds their midterm(s) letter grade, the weight of the midterm(s) is (are) transferred to the final exam. The student must have written the midterm(s) or provided supporting documentation for the absence(s) such as a medical note or statutory declaration.

As per the Writing Across the Curriculum Statement in the Calendar, writing and grading thereof will be a factor in the evaluation of student work. See <https://www.ucalgary.ca/pubs/calendar/current/e-2.html>.

Any student work which remains undistributed after the last day of classes will be available to students through the instructor's office during the instructor's office hours.

The final examination will be an open-book, take-home exam. The exam will be available on D2L 24 hours before the end of the Registrar's scheduled final exam time. Students will hand in their exam in pdf format on D2L prior to the end of the scheduled completion time of their final exam using DropBox.

If a student cannot write their final exam during this interval, they need to apply for a deferred exam at [www.ucalgary.ca/registrar/exams/deferred\\_final](http://www.ucalgary.ca/registrar/exams/deferred_final). Under no circumstance will this be accommodated by the Department.

Tests and exams will involve multiple choice questions.

Programmable calculators, cellphones, textbooks, course notes, and other electronic devices will not be allowed during the writing of tests or final examinations. Students are reminded that simply being able to access their cellphone during an exam is academic misconduct.

The exact date for the in-class midterm will be announced at least one week in advance.

THERE WILL BE NO MAKEUP OR DEFERRED QUIZZES/TESTS/EXAMS under any circumstances, nor may the quizzes/tests/exams be written early. Students unable to write the quizzes/tests/exams because of documented illness, family emergency, religious observance, or university-sanctioned event will have the weight shifted to the final examination; otherwise a grade of zero will be assigned.

**Reappraisal of Grades and Intellectual Honesty:**

*For Reappraisal of Graded Term Work, see Calendar I.2*

<http://www.ucalgary.ca/pubs/calendar/current/i-2.html>

*For Reappraisal of Final Grade, see Calendar I.3*

<http://www.ucalgary.ca/pubs/calendar/current/i-3.html>

*Statement of Intellectual Honesty, see Calendar K.4*

<http://www.ucalgary.ca/pubs/calendar/current/k-4.html>

*Plagiarism and Other Academic Misconduct, see Calendar K.5*

<http://www.ucalgary.ca/pubs/calendar/current/k-5.html>

**Academic Accommodations:**

Students seeking an accommodation based on disability or medical concerns should contact Student Accessibility Services. SAS will process the request and issue letters of accommodation to instructors. Students who require an accommodation in relation to their coursework based on a protected ground other than disability should communicate this need in writing to their Instructor. The full policy on Student Accommodations is available at <http://www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf>.

**Freedom of Information and Protection of Privacy (FOIP) Act:**

Personal information is collected in accordance with FOIP. Assignments can only be returned to the student and will be accessible only to authorized faculty and staff. For more information, see <http://www.ucalgary.ca/legalservices/files/legalservices/faq-students.pdf> and [http://www.ucalgary.ca/legalservices/files/legalservices/faq-faculty\\_0.pdf](http://www.ucalgary.ca/legalservices/files/legalservices/faq-faculty_0.pdf).

**Internet and Electronic Communication Device information:**

The use of cell phones for any purpose in class is prohibited. Computers and tablets may be used for note taking only unless otherwise authorized by the instructor.

**Copyright Legislation:**

See the University of Calgary policy on Acceptable Use of Material Protected by Copyright at [www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright.pdf](http://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright.pdf).

Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy.

**Recording of Lectures:**

Recording of lectures is prohibited, except for audio recordings authorized as an accommodation by SAS or an audio recording for individual private study and only with the written permission of the instructor. Any unauthorized electronic or mechanical recording of lectures, their transcription, copying, or distribution, constitutes academic misconduct. See <https://www.ucalgary.ca/pubs/calendar/current/e-6.html>.

**Important Dates:**

Please check: <http://www.ucalgary.ca/pubs/calendar/current/academic-schedule.html>.

**Student Organizations:**

Faculty of Arts Students' Association (F.A.S.A.):

Economics Department Representative

Office: SS 803, E-mail: [econrep@fasaucalgary.ca](mailto:econrep@fasaucalgary.ca) and Web: [www.fasaucalgary.ca](http://www.fasaucalgary.ca).

Society of Undergraduates in Economics:

<https://www.ucalgarysue.com/>.

Society of Undergraduates in Economics is a student run organization whose main purpose is to assist undergraduate economics students to succeed both academically and socially at the University of Calgary. Services include access to the exam bank, career events such as Industry Night and information sessions, mentorship programs, and social events for members. They invite you to join by contacting SUE at [societyofundergradsineconomics@gmail.com](mailto:societyofundergradsineconomics@gmail.com).

**Faculty of Arts Program Advising and Student Information Resources:**

- Have a question, but not sure where to start? The Arts Students' Centre is your information resource for everything in Arts! Drop in at SS102, call them at 403-220-3580, or email them at [artsads@ucalgary.ca](mailto:artsads@ucalgary.ca). You can also visit the Faculty of Arts website at <http://arts.ucalgary.ca/undergraduate>, which has detailed information on common academic concerns, including program planning and advice.
- For registration (add/drop/swap), paying fees and assistance with your Student Centre, contact Enrolment Services at 403-210-ROCK [7625] or visit them in the MacKimmie Library Block.

**Student Support and Resources:**

- See <https://www.ucalgary.ca/registrar/registration/course-outlines> for information on campus mental health resources, the Student Ombuds' Office, Student Success Centre, Safewalk, and Emergency Evacuation and Assembly.
- Online writing resources are available at <https://ucalgary.ca/student-services/student-success/writing-support>.

**Notes:**

1. Students are responsible for all assigned material, e.g., supplementary material posted on D2L, regardless of whether or not the material was covered in class.

