

COURSE: **GGR 348F: CARBON-FREE ENERGY**
INSTRUCTOR: Danny Harvey, SS 5032, Telephone: 978-1588
Email: harvey@geog.utoronto.ca (include GGR348 in the subject line)
LOCATION: SS1072
TIME: Wed 5-7, occasional tutorials Wed (7:10 until 8:00 or longer if needed)
OFFICE HOURS: W1-5, F11-12 and 3-4 or by appointment

Outline

The course examines the options available for providing energy from the major carbon-free energy sources: solar, wind, biomass, geothermal and hydropower, and briefly touches upon nuclear energy and sequestration of carbon from fossil fuel sources. For each carbon-free energy source covered, the physical principles, physical or biophysical limits, efficiencies, and other constraining factors are discussed, as well as examples of current applications, current and projected future costs, and possible future scenarios. The course concludes with selected studies for various regions of the world of scenarios for achieving 100% renewable energy supply systems by 2050, in line with requirements needed to (hopefully) limit global mean warming to no more than 2-3°C.

Text

Selected chapters (or portions thereof) of my own book, *Energy and the New Reality, Volume 2: C-Free Energy Supply* (Earthscan, April 2010) are required reading. The book can be purchased at <http://www.routledge.com/books/details/9781849710732/> as an ebook for about Cdn\$60, and will also be on library overnight loan. Powerpoint files for the lectures have been or will be posted on Quercus.

Requirements

There will be 2 major computational assignments to give students a hands-on feel for the subject matter and to develop quantitative skills in a progressive manner. The assignments will involve using Excel spreadsheets. The assignments will be worth 25% each, and thus worth 50% of the final mark in total.

There will be one mid-term test and a 2-hour exam (with the exam covering only the second half of the term work). The term test and exam will each be worth 25% of the final mark and will include questions related to the problem sets.

Cellphone policy

As a condition for taking this course, cellphones should be turned off and placed *out of sight* during the lectures and tutorials. Your continued enrollment in this course constitutes your acceptance of this condition.

Penalty for late work:

5% per weekday. No marks will be given after an assignment is taken up in class, which is usually one week after it is due, so plan your work carefully.

If you miss term test: Notify me **within 24 hours** and present medical documentation. Only cases of severe illness or other extreme situations will be accepted.

Pre-requisite: Some first-year math and/or physics will be very helpful. *Ontario Grade 11 Physics (or the equivalent from elsewhere)* is an absolute minimum pre-requisite.

**GGR 348F – Carbon-Free Energy
OUTLINE OF LECTURES**

Week Number	Topic and Textbook Chapter	Fall 2019 Date
1	Introduction	11 Sept
2	Wind (Chapter 3)	18 Sept
3	Wind	25 Sept
4	Biomass (Chapter 4, selected sections)	2 Oct
5	Biomass	9 Oct
6	Geothermal (Chapter 5), Hydro power (Chapter 6)	16 Oct
7	Term Test	23 Oct
8	Solar (Chapter 2)	30 Oct
-	Reading Week – No lecture	6 Nov
9	Solar	13 Nov
10	Storage techniques for variable renewable energy	20 Nov
11	Nuclear energy, Carbon sequestration	27 Nov
12	Scenarios for 100% renewable energy supply by 2050	4 Dec

GGR 348F - PROBLEM SETS

PS #	Topic	Assigned	Due	Taken Up	% Contribution final mark
1	Finance	11 Sept	23 Sept, before 5 PM*	25 Sept	10
2	Wind energy	25 Sept	14 October, before 5 PM*	16 Oct	20
3	Solar energy	30 Oct	27 November, in class	4 Dec	20

* Place in the Drop Box next to the Geography Department office (5th floor, Sidney Smith)

GGR 348F – DATES OF WEDNESDAY TUTORIALS

Date	Activity
11 Sept	Discuss/explain PS #1
25 Sept	Take up PS#1, discuss/explain PS #2
16 Oct	Take up PS#2, answer questions about upcoming term test
30 Oct	Take up term test, Discuss/explain PS#3
13 Nov	Answer questions on PS#3
4 Dec	Take up PS#3