

COURSE: **GGR 348F: CARBON-FREE ENERGY**  
INSTRUCTOR: Danny Harvey, SS 5032, Telephone: 978-1588  
Email: [harvey@geog.utoronto.ca](mailto:harvey@geog.utoronto.ca) (include GGR348 in the subject line)  
LOCATION: SS2110  
TIME: Wed 5-7, occasional tutorials Wed (7:10 until 8:00 or longer if needed)  
OFFICE HOURS: MF11-1 and W11-5 or by appointment

### **Outline**

The course examines the options available for providing energy from the major carbon-free energy sources: solar, wind, biomass and nuclear, as well as through 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 by combining the main conclusions from GGR 347F concerning the prospects for reducing energy demand through improved energy efficiency, with the conclusions drawn in this course concerning the feasibility of large-scale carbon-free energy, to generate scenarios of future greenhouse gas emissions, showing the range of possible consequences for global mean temperature, sea level rise, and ocean acidification.

### **Text**

The course text is my own book, *Energy and the New Reality, Volume 2: C-Free Energy Supply* (Earthscan, April 2010), and is available in the university bookstore for \$118. An ebook version can be purchased at <http://www.routledge.com/books/details/9781849710732/> for US\$59.

Powerpoint files for the lectures have been or will be posted on Blackboard.

### **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.

### **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.

**Exclusion:** GGR 333

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

Week Number	Topic	Fall 2017 Date
1	Introduction	13 Sept
2	Wind (Chapter 3)	20 Sept
3	Wind	27 Sept
4	Biomass (Chapter 4, selected sections)	4 Oct
5	Biomass	11 Oct
6	Geothermal (Chapter 5), Hydro power (Chapter 6)	18 Oct
7	Term Test	25 Oct
8	Solar (Chapter 2)	1 Nov
9	Solar	8 Nov
10	Nuclear (Chapter 8)	15 Nov
11	Carbon sequestration (Chapter 9)	22 Nov
12	Scenarios (Chapter 12)	29 Nov

**GGR 348F - PROBLEM SETS**

PS #	Topic	Assigned	Due	Taken Up	% Contribution to final mark
1	Wind energy	20 Sept	11 October, in class	18 Oct	25
2	Solar energy	1 Nov	22 November, in class	29 Nov	25

**GGR 348F – DATES OF WEDNESDAY TUTORIALS**

Date	Activity
27 Sept	Discuss/explain Part 1 of PS#1 (emailed to class by Sept 20 <sup>th</sup> )
4 Oct	Discuss/explain Part 2 of PS#1
18 Oct	Take up PS#1, answer questions about upcoming term test
1 Nov	Take up term test
8 Nov	Discuss/explain Part 1 of PS#2 (emailed to class nu Nov 1 <sup>st</sup> )
15 Nov	Discuss/explain Part 2 of PS#2
29 Nov	Take up PS#2