

FOR/GGR310 H1
Bioenergy from Sustainable Forest Management
Spring 2017

COURSE INSTRUCTOR:	C.T. Smith Professor and Dean Emeritus (Forestry) Office: 3038 ESC Email: tat.smith@utoronto.ca Phone: 416-978-4638 Office hours: 4:00-5:00 pm Wed or by appointment
TEACHING ASSISTANT:	Nicolas Tanguy Office: 2016 ESC Email: nicolas.tanguy@mail.utoronto.ca Office hours: 3:00-5:00 pm Wednesday or by appointment
COURSE TIME AND LOCATION:	Lecture: Tuesdays 5-7, Room 4001, ESC Tutorial: Thursdays 3-4, Room 4001, ESC
FIELD TRIPS:	All day, Saturday, 11 March
REQUIRED READINGS:	Readings will be assigned from a variety of sources. Books and journal articles may be placed on 2-hour reserve in the Noranda Earth Sciences Library, or found on the web, as indicated in the required reading list. There is one required text for this course: Richardson J, Björheden R, Hakkila P, Lowe A, Smith C, editors. Bioenergy from Sustainable Forestry: Guiding Principles and Practice. Dordrecht: Kluwer Academic Publishers; 2002. This book is available electronically through the University of Toronto library website, and hard copies are on reserve at the Noranda Earth Sciences library.
COURSE WEBSITE:	Course materials and updates will be posted to a Blackboard-based site throughout the semester. This site will also provide forums for discussion and interaction. Students in the class are encouraged to attend Blackboard training (provided through CTSI, Centre for Teaching Support & Innovation), and will be provided access to the site once registered for the course.
COURSE EVALUATION:	The course grade will be based on the following: <ul style="list-style-type: none"> • Active participation (including lectures, guest speaker interaction, student-led seminars): 10% • Discussion Leader: 10% • 2 Problem sets: 10% • Mid-term exam: 15% • Final term paper: 40% (incl. proposal & seminar) • Take home essay exam: 15%

Date	Topic
5 January (tutorial)	Course overview and introductions
10 Jan (lecture)	Setting the stage and framing the big issues - why bioenergy? - posing the major questions <i>Getting to know each other and our interests</i> <i>Discussion of the broader issues</i>
12 Jan (tutorial)	Biomass availability and bioenergy use in Canada and around the world - the resource base - major drivers
17 Jan (lecture)	Sustainable forest management – theory and practice
19 Jan (tutorial)	Evaluation of GHG balance benefits of forest bioenergy <i>Discussion of the issues</i>
24 Jan (lecture)	Supply chain management for bioenergy production - systems overview with Canadian examples
26 Jan (tutorial)	First problem set handed out – Biomass and bioenergy conversions -- <i>Problem set tutorial</i>
31 Jan (lecture)	The role of plantations in feedstock production - case study and discussion
2 Feb (tutorial)	Forest biomass – the science of feedstock and conversion processes I First problem set due
7 Feb (lecture)	Forest biomass – the science of feedstock and conversion processes II Mid-term review Term paper topic and outline due
9 Feb (tutorial)	Mid-term exam
14 Feb (lecture)	Social, economic and environmental sustainability <i>*student led discussions</i>
16 Feb (tutorial)	Social, economic and environmental sustainability <i>*student led discussions</i>
21&23 Feb	READING WEEK – NO LECTURE OR TUTORIAL
28 Feb (lecture)	Social, economic and environmental sustainability <i>*student led discussions</i>
2 Mar (tutorial)	Social, economic and environmental sustainability <i>*student led discussions</i>
7 Mar (lecture)	The business case in developing the forest bioenergy sector <i>*Guest speakers: Wayne Barnes and Joe Maure, Forestry Innovation Team, Ministry of Natural Resources and Forestry, Business Development Branch, Sault Ste. Marie (tbd)</i>
9 Mar (tutorial)	Second problem set handed out - Biorefinery concepts -- <i>Problem set tutorial</i>
Sat, 11 March	Field trip to Haliburton Forest (details to be provided)
14 Mar (lecture)	Policy framework for forest bioenergy <i>*Guest speaker: Kathleen McFadden, Assistant Deputy Minister, Forest Industry Division, Ministry of Natural Resources and Forestry, Sault Ste. Marie (tbd)</i>
16 Mar (tutorial)	Energy system reform <i>Discussion of the issues</i> Second problem set due
21 Mar (lecture)	Challenges and opportunities for sustainable forest bioenergy production in Canada <i>Where to from here?</i>
23 Mar (tutorial)	Term papers due Student term paper seminars
28 Mar (lecture)	Student term paper seminars
30 Mar (tutorial)	Student term paper seminars
4 April (lecture)	Student term paper seminars
6 Apr	Take-home exam uploaded to Blackboard at 5 p.m.
7 April	Take-home exam due 5 p.m.

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DATE.	TOPIC	REQUIRED READINGS
5 Jan (tutorial)	Course overview and introductions	
10 Jan (Lecture)	Setting the stage and framing the big issues	Richardson et al. pp. 1-15 ; UN-E. Sustainable Bioenergy – a Framework for Decision Makers. 64 p.
12 Jan (Tutorial)	Biomass availability and bioenergy use	Richardson et al. pp. 19-32; Bauen et al.; Klass, DL. Biomass for Renewable Energy and Fuels. 20 p.; Smith et al. 2015 pp. 1-50.
17 Jan (L)	Sustainable forest management	Richardson et al., 159-163, 165-185, 244-261; Sustainable Forestry for Bioenergy– Modules 4 & 5
19 Jan (T)	Evaluation of GHG balance benefits	Lippke et al. 2011
24 Jan (L)	Supply chain management for bioenergy production	Richardson et al. 67- 84, 84-107; Encyclopedia of Southern Bioenergy: “Management” and “Harvesting” sections
26 Jan (T)	-First problem set handed out -	
31 Jan (L)	The role of plantations in feedstock production	Richardson et al. 49- 67
2 Feb (T)	Forest biomass – the science of feedstock and conversion processes (I) - First problem set due -	Richardson et al. pp. 32-46, 107-117; Encyclopedia of Southern Bioenergy: “Utilization” section
7 Feb (L)	Forest biomass (II) Mid-term review -Term Paper Outline due –	Same as 2 February Mid-term review questions discussed
9 Feb (T)	- Mid-term exam -	
14 Feb (L)	Social, economic and environmental sustainability	<i>*Student assigned</i>
16 Feb (T)	Social, economic and environmental sustainability	<i>*Student assigned</i>
21&23 Feb	Reading week	
28 Feb (L)	Social, economic and environmental sustainability	<i>*Student assigned</i>
2 Mar (T)	Social, economic and environmental sustainability	<i>*Student assigned</i>
7 Mar (L)	The business case in developing the forest bioenergy sector	<i>*Guest assigned readings</i>
9 Mar (T)	-Second problem set handed out-	
11 Mar, Saturday	All-day field trip to Haliburton Forest	
14 Mar (L)	Policy framework for forest bioenergy	<i>*Guest assigned readings</i>
16 Mar (T)	Energy system reform -Second Problem set due-	tba
21 Mar (L)	Challenges and opportunities for sustainable forest bioenergy production in Canada	Ralevic et al. IEA Bioenergy Task 31 Country Report: Canada; Smith et al. 2016; Thiffault et al. 2016.
23 Mar (T)	Term papers due Student term paper seminars	
28 Mar (L)	Student term paper seminars	
30 Mar (T)	Student term paper seminars	
4 Apr (L)	Student term paper seminars	
6 Apr (T)	Take home exam posted to B’board	
7 April	Take home exams due 5 p.m.	

Required readings:

Bauen A. et al. 2009. Bioenergy - a sustainable and reliable energy source. A review of status and prospects. IEA BIOENERGY: ExCo: 2009:06. Available at:

<http://www.ieabioenergy.com/publications/main-report-bioenergy-a-sustainable-and-reliable-energy-source-a-review-of-status-and-prospects/>

Encyclopedia of Southern Bioenergy available online at:

<http://www.forestencyclopedia.net/p/p2>

Klass, DL. 2004. Biomass for Renewable Energy and Fuels. Originally published by Elsevier, Inc. for the Encyclopedia of Energy. Available from:

www.beraonline.org/yahoo_site_admin/assets/docs/cyclopediaofEnergy.35293015.pdf.

Lippke B, Oneil E, Harrison R, Skog K, Gustavsson L, Sathre R. 2011. Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. *Carbon Management*, 2 (3): 303-333.

Ralevic P., Karau J., Smith T., Richardson J. 2008. IEA Bioenergy Task 31 Country Report: Canada. Available at:

http://www.ieabioenergytask43.org/Task_31_Web_Site/IEA_Bioenergy_Task_31/IEA%20country%20Report-%20Canada%202008-%20Dec.%202008%20Final.pdf .

Richardson., J., Björheden, R., Hakkila, P., Lowe, A.T., and Smith, C.T. (eds.). 2002. *Bioenergy from Sustainable Forestry: Guiding Principles and Practice*. Kluwer Academic Publishers, Dordrecht, The Netherlands, 344 pp.

- Available electronically through the University of Toronto Libraries (access via the U of T webpage – search for title through the main catalogue, click on the electronic version, install “ebrary” plug-in if you do not have it), or on course reserve at Noranda Earth Sciences Library.

Smith, C.T., B. Lattimore, G. Berndes, N.S. Bentsen, I. Dimitriou, J.W.A. Langeveld, E. Thiffault (Eds.). 2015. *Mobilizing Sustainable Bioenergy Supply Chains -- Inter-Task Project Synthesis Report*. IEA Bioenergy ExCo: 2015:04. ISBN 978-1-910154-19-9 (printed paper edition). ISBN 978-1-910154-20-5 (eBook electronic edition). 170 pp.

Available at: <http://www.ieabioenergy.com/publications/mobilizing-sustainable-bioenergy-supply-chains/>

Smith CT, Lattimore B, Berndes G, Bentsen NS, Dimitriou I, Langeveld JWA, Thiffault E. Opportunities to Encourage Mobilization of Sustainable Bioenergy Supply Chains. *WIREs Energy Environ* 2016. doi: 10.1002/wene.237

Sustainable Forestry for Bioenergy and Bio-Based Products. Available online at:

<http://forestandrange.org/Biomass/index.asp>.

Thiffault, E, G Berndes and P Lamers. 2016. Challenges and opportunities for the mobilisation of forest bioenergy in the boreal and temperate biomes. pp. 190-213. In: Thiffault E, Berndes G, Junginger M, Saddler JN, Smith CT. eds. 2016. Mobilisation of Forest Bioenergy in the Boreal and Temperate Biomes: Challenges, opportunities and case studies. Academic Press, Elsevier. 239 pp.

UN-E. 2007. Sustainable Bioenergy: A Framework for Decision-Makers. Available online at: <http://www.fao.org/docrep/010/a1094e/a1094e00.htm>.

ADDITIONAL SUGGESTED READING MATERIALS AND WEBSITES

General

Klass, D. L. 2004. Biomass for Renewable Energy and Fuels. Originally published by Elsevier, Inc. for the Encyclopedia of Energy. Available at: www.beraonline.org/yahoo_site_admin/assets/docs/cyclopediaofEnergy.35293015.pdf

Richardson, J., Björheden, R., Hakkila, P., Lowe, A.T. and Smith, C.T. (eds.). 2002. Bioenergy from Sustainable Forestry: Guiding Principles and Practice. Kluwer Academic Publishers, Dordrecht, The Netherlands. 344 pp.

Smith, C.T., B. Lattimore, G. Berndes, N.S. Bentsen, I. Dimitriou, J.W.A. Langeveld, E. Thiffault (Eds.). 2015. Mobilizing Sustainable Bioenergy Supply Chains -- Inter-Task Project Synthesis Report. IEA Bioenergy ExCo: 2015:04. ISBN 978-1-910154-19-9 (printed paper edition). ISBN 978-1-910154-20-5 (eBook electronic edition). 170 pp. Available at: <http://www.ieabioenergy.com/publications/mobilizing-sustainable-bioenergy-supply-chains/>

Smith CT, Lattimore B, Berndes G, Bentsen NS, Dimitriou I, Langeveld JWA, Thiffault E. Opportunities to Encourage Mobilization of Sustainable Bioenergy Supply Chains. *WIREs Energy Environ* 2016. doi: 10.1002/wene.237

Thiffault E, Berndes G, Lamers P. 2016. Challenges and opportunities for the mobilisation of forest bioenergy in the boreal and temperate biomes. pp. 190-213. In: Thiffault E, Berndes G, Junginger M, Saddler JN, Smith CT. eds. 2016. Mobilisation of Forest Bioenergy in the Boreal and Temperate Biomes: Challenges, opportunities and case studies. Academic Press, Elsevier. 239 pp.

Canadian context, feedstock production and processing

Smith, C.T., P. Ralevic and B. Lattimore. 2009. Emerging Biofuels Sustainability Issues in Canada. Report prepared for Natural Resources Canada. 16 December 2009, Ottawa. 154 p.

Ralevic P., Karau J., Smith T., Richardson J. 2008. IEA Bioenergy Task 31 Country Report: Canada. Available at: http://www.ieabioenergytask43.org/Task_31_Web_Site/IEA_Bioenergy_Task_31/IEA%20country%20Report-%20Canada%202008-%20Dec.%202008%20Final.pdf .

Bradley D. 2008. Canada report on Bioenergy 2008. IEA Task 40. Available at: <http://www.bioenergytrade.org/downloads/canadacountryreportjun2008.pdf>.

Kumar A., Flynn P., Sokhansanj S. 2008. Biopower generation from mountain pine beetle wood in Canada: An economical opportunity for greenhouse gas mitigation. *Renewable Energy* 33: 1354-1363.

Tampier M., Smith D., Bribeau E., Beauchemin P.A. 2004. Identifying environmentally preferable uses for biomass resources. Stage 2 Report: Identification of Feedstock-to-Product Threads. Available at: <http://www3.cec.org/islandora/en/item/2130-identifying-environmentally-preferable-uses-biomass-resources-en.pdf>

Luxmore, C. 2008. Eyes on the North: Canada Ramps Up Bioenergy Activities. *Biomass Magazine*, July 2008 issue. Grand Forks, ND [online]. Available at: www.biomassmagazine.com/article.jsp?article_id=1739&q=canada%20ramps.

Sustainability

Environmental

Dyck WJ, Mees CA. 1990. Nutritional consequences of intensive forest harvesting on site productivity. *Biomass and Bioenergy* 22: 171-186.

Koh, LP and J Ghazoul. 2008. Biofuels, biodiversity, and people: Understanding the conflicts and finding opportunities. *Biological Conservation* 141(10): 2450-2460.

Franklin JF. 1993. Preserving biodiversity. *Ecological Applications* 3: 202-220.

Lattimore, B., C.T. Smith, B.D. Titus, I. Stupak, G. Egnell. 2009. Environmental factors in woodfuel production: risks, and criteria and indicators for sustainable practices. *Biomass & Bioenergy* 33(10): 1321-1342.

Mitchell CP, Bridgwater AV, editors. *Environmental Impacts of Bioenergy*. Newbury: CPL Press; 1994.

Socio-economic

Domac, J., Richards, K. and Risovic, S., 2005. "Socio-economic drivers in implementing bioenergy projects," *Biomass and Bioenergy* 28(2): 97-106.

Ravindranath NH, Hall DO. *Biomass, energy, and environment : a developing country perspective from India*. Oxford ; New York Oxford University Press; 1995.

Ignaciuk A., F. Vohringer, A. Ruijs, and E.C. van Ierland. 2006. Competition between biomass and food production in the presence of energy policies: a partial equilibrium analysis. *Energy Policy* 34: 1127-1138.

Peters J., S. Thielmann. 2008. Promoting biofuels: Implications for developing countries. *Energy Policy* 36: 1538-1544.

Nonhebel S. 2005. Renewable energy and food supply: will there be enough land? *Renewable and Sustainable Energy Reviews* 9: 191-201.

Greenhouse gas balances and lifecycle analyses

Bird N *et al.* 2011. Using a Life Cycle Assessment Approach to Estimate the Net Greenhouse Gas Emissions of Bioenergy. IEA Bioenergy:ExCo:2011:03. Available at: <http://www.ieabioenergy.com/MediaItem.aspx?id=7099>.

Cowie, A, Berndes, G, Smith, T. (2013). *On the timing of greenhouse gas mitigation benefits of forest-based bioenergy*. IEA Bioenergy: ExCo: 2013: 04. Available at: <http://www.ieabioenergy.com/publications/on-the-timing-of-greenhouse-gas-mitigation-benefits-of-forest-based-bioenergy/>

Forsberg G. 2000. Biomass energy transport: Analysis of bioenergy transport chains using life cycle inventory method. *Biomass and Bioenergy* 19: 17-30.

Hartmann D., Kaltschmitt M. 1999. Electricity generation from solid biomass via co-combustion with coal Energy and emission balances from a German case study. *Biomass and Bioenergy* 16: 397-406.

Jungmeier G, Resch G, Spitzer J. 1998. Environmental burdens over the entire life cycle of a biomass CHP plant. *Biomass and Bioenergy* 15: 311-323.

Lippke B, Oneil E, Harrison R, Skog K, Gustavsson L, Sathre R. 2011. Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. *Carbon Management*, 2 (3): 303-333.

Marland G, Schlamadinger B. 1995. Biomass fuels and forest management strategies - how do we calculate the greenhouse-gas emissions benefits? *Energy* 20: 1131-1140.

Marland G, Schlamadinger B. 1997. Forests for carbon sequestration or fossil fuel substitution? A sensitivity analysis. *Biomass and Bioenergy* 13: 389-397.

Searchinger T., Heimlich R., Houghton R.A. et al. 2008. Use of U.S. croplands for biofuels increases greenhouse gases through emission from land-use change. *Science* **319**: 1238-1240.

Biomass based technologies and bio-refineries (includes supply chains and LCA)

Tampier M, Beauchemin PA, Smith D, Bibeau E. Feb 16, 2006. Identifying environmentally preferable uses for biomass resources. BC Bugwood: Economics, technical feasibility and GHG implications of seven small to medium scale technologies. Final Report. Available at <http://www.for.gov.bc.ca/hfd/library/documents/bib97175.pdf>

Pehnt M. 2008. Dynamic life cycle assessment (LCA) of renewable energy technologies. *Renewable Energy* **31**: 55-71.

Uslu A., Faaij A.P.C., Bergmann P.C.A. 2008. Pre-treatment technologies, and their effect on international bioenergy supply chain logistics. Techno-economic evaluation of torrefaction, fast pyrolysis and pelletization. *Energy* **33**: 1206-1223.

Energy plantation forests

Paine LK, Peterson TL, Undersander DJ, Rineer KC, Bartelt GA, Temple SA, et al. 1996. Some ecological and socio-economic considerations for biomass energy crop production. *Biomass and Bioenergy* 10: 231-242.

Christian DP, Hoffman W, Hanowski JM, Niemi GJ, Beyea J. 1998. Bird and mammal diversity on woody biomass plantations in North America. *Biomass and Bioenergy* 14: 395-402.

Heller MC, Keoleian GA, Volk TA. 2003. Life cycle assessment of a willow bioenergy cropping system. *Biomass and Bioenergy* 25: 147-165.

Standards and certification

Lewandowski I, Faaij APC. 2006. Steps towards the development of a certification system for sustainable bio-energy trade. *Biomass and Bioenergy* 30: 83-104.

Rossmann D. 2009. Forest Lands and Brush Lands in Minnesota: The Minnesota Biomass Harvesting Guidelines. Available at:
<http://www.extension.umn.edu/environment/agroforestry/components/Forestlands-Brushland-Minnesota.pdf>

Roundtable on Sustainable Biofuels. Available at: <http://rsb.org/>

Stupak, Inge, Brenna Lattimore, Brian D. Titus, C. Tattersall Smith. 2011. Criteria and indicators for sustainable forest fuel production and harvesting: a review of current standards for sustainable forest management. *Biomass & Bioenergy* 35(8): 3287-3308.

Sustainable Biomass Partnership. Available
at: <http://www.sustainablebiomasspartnership.org/>

UN-E (United Nations Energy). Sustainable Bioenergy: A Framework for Decision-Makers. 2007. Available at: <http://www.fao.org/docrep/010/a1094e/a1094e00.htm>

van Dam, J. 2010. Update: Initiatives in the field of biomass and bioenergy certification. Available
at: <http://www.bioenergytrade.org/downloads/overviewcertificationsystemsfinalapril2010.pdf>

van Dam, J., M. Junginger, A.P.C. Faaij. 2010. From the global efforts on certification of bioenergy towards an integrated approach based on sustainable land use planning. *Renewable and Sustainable Energy Reviews* 14(9): 2445-2472.

Adaptive Forest Management

Lattimore, B., T. Smith, and J. Richardson. 2010. Coping with complexity: Designing low-impact forest bioenergy systems using an adaptive forest management framework and other sustainable forest management tools. *The Forestry Chronicle* 86 (1): 20-27.

Bormann, B.T., Hayes, R.W. and J.R. Martin. 2007. Adaptive management of forest ecosystems: Did some rubber hit the road? *BioScience* 57: 186-191.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. Adaptive Management Initiatives in the BC Forest Service. Available at:
<http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/land-based-investment/forests-for-tomorrow/adaptive-management>

McAfee, B.J., Malouin, C., and N. Fletcher. 2006. Achieving forest biodiversity outcomes across scales, jurisdictions and sectors with cycles of adaptive management integrated through criteria and indicators. *Forestry Chronicle* 82: 321-334.

SOME WEB SITES

Sustainable Forestry for Bioenergy and Bio-Based Products. <http://forestandrange.org/Biomass/index.asp>.

The Encyclopedia of Southern Bioenergy. <http://www.forestencyclopedia.net/p/p2>

BioenergyWiki. www.bioenergywiki.net.

IEA Bioenergy Task 43: Biomass Feedstocks for Energy Markets. <http://www.ieabioenergytask43.org/>

IEA Bioenergy Task 38: Climate Change Effects of Biomass and Bioenergy Systems. <http://task38.org/>

IEA Bioenergy Task 40: Sustainable Biomass Markets and International Trade to Support the Biobased Economy. www.bioenergytrade.org

Roundtable on Sustainable Biofuels. <http://rsb.epfl.ch>.

Roundtable on Sustainable Palm Oil. www.rspo.org.

Sustainable Biomass Partnership. <http://www.sustainablebiomasspartnership.org/>

Canadian Bioenergy Association (CANBIO). <http://www.environmental-expert.com/companies/canadian-bioenergy-association-cambio-34108>

Forest Stewardship Council (FSC). www.fsc.org

Programme for the Endorsement of Forest Certification (PEFC). www.pefc.org

Sustainable Forestry Initiative (SFI). <http://www.sfiprogram.org/>

Student led discussions

Student led discussions will take place on dates listed in the Topic Outline (14 & 16 Feb and 28 Feb & 2 March). Each person will be expected to assume a specific role and responsibility for the topic they have selected. Please allocate those roles in any way that works for individuals and the whole group. No one should be standing silently in the background; and no one should do it all alone. We will allocate specific time for each person's portion and for the whole team (25 minutes all together).

Be prepared to:

1. present the theoretical framework underpinning the relevant sustainability values, the ways the case study serves as a good example of the science supporting our knowledge of the sustainability of the system, as well as the opportunities and challenges involved (20 minutes for this portion); and
2. serve as discussion leaders (approximately 5 minutes for this portion) for the ways in which your topic and assigned readings contribute to our understanding of the sustainability of bioenergy from managed forests, and the linkages between science-based and traditional cultural knowledge, policy and management.

Please distribute the following materials to the class **one week prior to your presentation** so that everyone can prepare for a lively discussion.

Topic outline:	Please develop a brief outline of the material you will be presenting to the class. Your main focus should be on developing an overview including theoretical sustainability concepts, the opportunities and challenges underpinning the topic, and ways in which the case study helps us understand the relevant issues.
Reading list:	Please recommend 1 or 2 readings for the whole class to read prior to your topic being discussed. Readings might be drawn from peer-reviewed journals, trade magazines, government reports and policies, and reports from NGOs. Case studies should be selected on the basis of their ability to illustrate the salient points of the conceptual framework (context, issues, theory) and/or excellent examples of the challenges associated with implementing sustainable forest management for bioenergy.
Discussion Questions	Please develop a list of thought-provoking questions to stimulate active discussion of your topic.
Assessment	The basis for assessing presentations is below.

14 & 16 February, 28 Feb & 2 March – Social, economic and environmental sustainability

Sessions 1 to 10 (?)

Topic: tbd (e.g. economic sustainability below)

Suggested number of students: 4

Time: 25 min.

Structure:

Students lecturing (with accompanying Powerpoint) – 20 min (4 x 5 min each)

- Potential economic opportunities from forest bioenergy production (~ 5 min)
- Potential negative consequences (economics-related) of bioenergy production (~5 min)
- One economic case study from a developed region (i.e., Canada, Europe, the US) (~5 min)
- One economic case study from a developing region (i.e., Africa, Central/South America, Asia) (~5 min)

Class discussion – 5 min

- Student(s) in the group will have prepared a set of thought-provoking questions and will use these to actively lead the rest of the class in a discussion of their topic.

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Constructive Comments and Evaluation for Oral Presentations:

Course: _____ Date: _____

Presenter: _____

Title: _____

Objectives: Were there clearly stated goals to presentation?	1	2	3	4	5	6	7	8	9	10
Body of Presentation: Was information well explained and relevant?	1	2	3	4	5	6	7	8	9	10
Conclusions/Recommendations: Did these relate to presentation objectives/content?	1	2	3	4	5	6	7	8	9	10
Organization: Was there a logical flow to material and information?	1	2	3	4	5	6	7	8	9	10
Creativity: Flair and originality of ideas	1	2	3	4	5	6	7	8	9	10
Use of visual aids: Good use of audiovisual equipment? Table/figures of high quality and explained to audience?	1	2	3	4	5	6	7	8	9	10
Handling of questions and discussion period: Were questions well answered? Did speaker develop ideas and stimulate debate?	1	2	3	4	5	6	7	8	9	10
Targeted at Audience: Was material at appropriate depth for audience?	1	2	3	4	5	6	7	8	9	10
Rapport with Audience: Good eye contact, voice projection, confident speech etc.?	1	2	3	4	5	6	7	8	9	10
Time management: Was talk delivered within allotted time? If yes, circle 10; if No, deduct 1 mark for each minute over time	1	2	3	4	5	6	7	8	9	10

General Comments:

What were the strengths of the presentation?

Are there any areas that need further improvement?

Evaluator: _____ Overall Grade: _____

GUIDELINES FOR TERM PROJECT WORK

Term papers will provide an excellent opportunity for students to develop and strengthen library research skills, as well as the skills associated with critical analysis, synthesis and integration. Another major learning objective associated with this course is to develop student communication skills. Opportunities for developing oral and written communication skills include student lead discussions, term papers, and seminar presentations based on term projects. The following describes the assessment procedures to be used in this course so that students will have a clear understanding of the criteria for excellence.

TERM PAPER TOPIC AND OUTLINE (due 7 February 2017) (10% of semester grade):

There are four components I typically look for (all assumed to be in draft form/status):

1. Title
2. Concise paragraph stating the topic (conceptual background, justification and objectives)
3. Brief outline (depth to two or three levels of detail; demonstrating the main components of the paper and flow of concepts)
4. Current list of key references (demonstrating that you have made solid start on searching the literature on your topic and building confidence that the proposed topic and paper are well conceived)
5. Total length – One or two pages should be adequate.

It is assumed that, by week-5 in the semester, you will have made a solid start on conceiving the topic and approach to take; and also that you will probably revise the approach and maybe objectives as you learn more and begin writing the paper and work through the project. I am keen to see you demonstrate that you have given it a fair amount of thought; and certainly want to encourage you to revise the specifics of your project as you learn more and become more experienced in the topic.

TERM PAPER (due 23 March 2017) (20% of semester grade):

The Term Paper should be based on a critical, analytical review of published information that is related to the science and policies associated with bioenergy from sustainable forest management. Term paper topics should reflect the interests of each individual student. The rubric for evaluating papers is described in the attached that will also be made available on the course web site.

TERM PROJECT PANEL DISCUSSION PRESENTATIONS (23 March – 4 April 2017) (10% of semester grade):

The purpose of the student term paper presentations is to develop oral presentation and debating skills. Procedures:

- Each individual contributing to the panel discussion of (tba) topic should come prepared to defend or refute the statement posed (tba) for their topic by preparing one slide which makes their main points (for or against) and which is based on their term project.
- Each individual will be given 3 minutes to show their (1) slide and orally make their case for or against the statement.

- Following the individual statements, the floor will be opened up to other panel members and the class to discuss the points of view that have been presented and to identify if consensus has been achieved, or not.

FAQs regarding term papers:

The paper should be typed and double-spaced.

Length: 2500-3000 words, excluding graphics and citations

Citation format: See below

Line spacing and font size: Double-spaced, 12-point font

Use of sub-headings: Very much encouraged; improves structure

OUTLINES:

For a simple discussion of outlines, visit: <http://www.trentu.ca/history/workbook/effectiveoutlines.php>.

The type of outline I suggest you write is the "Formal Outline", as described on the Trent University web site and below.

Formal Outlines

A formal outline is hierarchical and linear. It shows the stages of development of the essay in relation to each other and the order in which they will be discussed. It also shows the evidence that you will use to support your ideas. Even when creating a formal outline, do not worry too much about which roman numerals or letters you are using. Just make sure that you are breaking your thesis down into smaller arguments, and then developing each argument through examples.

Below you will find the basic format for a formal outline.

- Introduction

- Major Point 1

- A. Evidence

- 1. detail

- B. Evidence

- Major Point 2

- A. Evidence

- B. Evidence

- 1. detail

- 2. detail

- a. even more detail

- i. even more detail

- Major Point 3, etc.

- Conclusion

SUGGESTION FOR REFERENCE FORMATTING:

<http://www.frontiersinecology.org/fron/>

<http://www.frontiersinecology.org/fron/instructions-to-authors/research-communications/>
Research Communications

+References Section: Examples

Article in Journal

Mathews R and Richter BD. 2007. Application of the indicators of hydrologic alteration software in environmental flow setting. *Am Water Resour As* **43**: 1400–13.

Romme WH, Allen CD, Bailey JD, *et al.* 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in pinyon–juniper vegetation of the western United States. *Rangeland Ecol Manag* **62**: 203–22.

Book

Ehrhart LM, Bagley DA, and Redfoot WE. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. In: Bolten AB and Witherington BE (Eds). *Loggerhead sea turtles*. Washington, DC: Smithsonian Books.

Chapter in Book

Lambers H, Chapin III FS, and Pons TL (Eds). 2008. Life cycles: environmental influences and adaptations. In: *Plant physiological ecology*. New York, NY: Springer.

Conference Proceedings

Schaefer M. 1975. Experimental studies on the importance of interspecies competition for the lycosid spiders in a salt marsh. *Proceedings of the 6th International Arachnological Congress*; 19–20 Mar 1974; Amsterdam. Amsterdam, The Netherlands: Nederlandse Entomologische Vereniging.

Scientific and Technical Reports and their Parts

IPCC (Intergovernmental Panel on Climate Change). 2007. *Climate change 2007.: synthesis report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: IPCC.

Grant GE, Lewis SL, Swanson F, *et al.* 2008. *Effects of forest practices on peakflows and consequent channel response: a state-of-science report for western Oregon and Washington*. Portland, OR: US Department of Agriculture. PNW-GTR-760.

Conference Presentations (Papers) and Abstracts

Smith RD. 1992. Little brown birds are really interesting. In: Jones X (Ed). Interesting birds of North America. Proceedings of the symposium at the 112th meeting of the American Birding Society; 1992 Mar 2-4; Los Angeles, CA. Washington, DC: American Birding Society.

Dissertations, Theses, and Their Parts

Feth JA. 1947. The geology of Northern Canelo Hills (PhD dissertation). Tucson, AZ: University of Arizona.

Websites

Poole A (Ed). 2005. The birds of North America online. Ithaca, NY: Cornell Laboratory of Ornithology. <http://bna.birds.cornell.edu/BNA>. Viewed 16 Sep 2009.

GVU's 8th WWW user survey. (nd). www.cc.gatech.edu/gvu/usersurveys/survey 1997–10. Viewed 8 Aug 2000.

Newspaper Articles

Baker JK. 1999. Switch to dollar bodes ill for Ecuador. *Washington Post*. Sept 12: Sect B: 2.

Documents In Press

Fulton RS. Predator–prey relationships in an estuarine littoral copepod community. *Ecology*. In press.

Term paper evaluation rubric

	Inadequate & Marginal	Adequate	Good	Excellent
Mark range	0-49% & <59%	60-69%	70-79%	80-100%
Knowledge	Little or no evidence of a familiarity with the information. Little evidence of use of information beyond that provided in lectures and assigned readings. Literature or other sources are outdated or primarily from grey literature. Inordinate use of non-refereed journals, web sites, etc. Fails to relate relevant information to the question, problem or task.	Some evidence of a familiarity with the information. Some evidence of use of information beyond that provided in lectures and assigned readings. Demonstrates an understanding of the question, problem or task. Literature (or other sources of information) is up-to-date and appropriate.	Strong evidence of a familiarity with and understanding of the information. Clearly relates the appropriate information to the question, problem or task. Literature (or other sources of information) reviewed is substantial, appropriate and up-to-date.	Demonstrates an exceptional understanding of the relevant information. Exceptional ability to identify the most critical information and relate it to the question, problem or task. Literature (or other sources of information) reviewed is extensive, appropriate and up-to-date.
Analysis & Synthesis	Simply "reports" on or summarizes information with only limited evidence of analysis. Little or no evidence of an understanding of the question, problem or task. Little or no attempt to incorporate information or ideas from other sources, jurisdictions, schools of thought, etc. Little or no evidence of original ideas relevant to the question, problem or task.	Some evidence of an ability to analyze the information and relate this to the question, problem or task. Some attempt to incorporate information from related issues or sources, jurisdictions, schools of thought, etc. Some evidence of original ideas relevant to the question, problem or task.	Clearly demonstrates an understanding of the question, problem or task. Strong evidence of an ability to analyze the information and relate this to the question, problem or task. Many (but appropriate) examples of the incorporation of information from related issues or other sources, jurisdictions, schools of thought. Strong evidence of original ideas relevant to the question, problem or task.	Exceptional analysis of the information with a very strong linkage to the question, problem or task. Carefully selected examples of the incorporation of information from related issues or other sources, jurisdictions, schools of thought, significantly strengthen the response. Extremely well-developed approach to solving the problem, answering the question or accomplishing the task. Original ideas relevant to the question, problem or task form a significant part of the response and are well supported.
Critical Thought	Little evidence of evaluation of competing arguments. Approach is unclear or unsupported. No conclusions and/or recommendations provided OR those that are provided are superficial and/or poorly defended or explained.	Some evidence of evaluation of competing arguments. Conclusion and/or recommendations are reasonable but lack substantial depth, explanation or support. Assumptions that conclusion (of the author or those of other sources) rest on are identified and addressed to some degree.	Many examples of an ability to assesses and weigh competing arguments. Develops a logical and well-reasoned approach to solving the problem (answering the question, or accomplishing the task). Clearly defined conclusions and/or recommendations. Assumptions that the conclusion (the authors or those of other sources reviewed) rest on are clearly identified and justified and limitations are recognized.	Demonstrates an exceptional ability to assesses and weigh competing arguments. Very in-depth and clearly defended conclusions/recommendation are presented and clearly relate to the questions, problem or task. Assumptions that the conclusion rest on are clearly identified and justified, and limitations are recognized. Measures to improve the approach used to address the question, problem or task are identified and explained to an appropriate degree.
Organization	Very poor organization. Detracts significantly from the answer to the question or solution to the problem. Lacks a logical flow.	Generally well organized with coherent sentence and paragraph structure. Some extraneous material. Some integration of conclusions, solutions and/or recommendations is evident.	Good organization and logical flow. Objective(s) and/or hypothesis (where appropriate) are/is presented. The approach is defined and results of the analysis or problem solving effort are clearly presented. Clearly addresses the question, problem or task. Provides appropriate and integrated conclusions, solutions and/or recommendations.	Exceptional organization. Focus on the problem or question is evident throughout. Very clearly articulated objectives (or hypothesis where appropriate), approach (or methods where appropriate), and results. Conclusions, solutions and/or recommendations are clearly related to the question or objectives (or hypothesis where appropriate).
Communication	Very poorly written. Frequent spelling mistakes or typographical errors that could clearly have been corrected by proof reading or the use of a "spelling checker". Inadequately referenced and/or inappropriately formatted referencing	Generally well written with some minor spelling or grammatical errors or awkward style. Some minor referencing issues. Minor editing would make this appropriate (based on the communications only) for submission to an outside review or audience.	Clearly and very efficiently written with no spelling or grammatical errors. All necessary references are provided and appropriately formatted.	Clearly and exceptionally well written with no spelling or grammatical errors. No extraneous information that does not add to the value of the document. All necessary references are provided and appropriately formatted. The level of writing is well-suited to the "audience". Ready for submission to an outside review or audience.

LEARNING OUTCOMES and COMPETENCIES

Critical and creative thinking

- Read analytically
 - Understand and analyze arguments
 - Scrutinize and pose questions and hypotheses
 - Gather, evaluate, and reason about evidence
 - Examine assumptions, biases, and theoretical underpinnings of questions, evidence or concepts
 - Use one's knowledge and skills in addressing real-world problems
 - Synthesize ideas and information into new patterns, theories or modes of understanding
 - Develop well-informed new ideas, advocate for them, and defend them
 - Apply knowledge to new situations and deal effectively with the unexpected
-
- Differentiate between types and qualities of biomass feedstock and the energy products that they produce
 - Compare and contrast different forest management techniques for forest fuel production and harvesting

Communication

- Organize ideas into coherent arguments supported by appropriate kinds of evidence
 - Structure one's communications for varying audiences and contexts
 - Produce effective written work
 - Present one's work orally and visually in a manner appropriate to the area of study
-
- Actively listen to the ideas and viewpoints of others
 - Participate willingly and actively in weekly discussions

Information literacy

- Develop familiarity with major resources for a discipline or field, including relevant search aids (e.g. library web pages, research guides), databases and tools for data creation
- Evaluate resources and the information they contain, assessing relevance, authority and reliability
- Identify investigative methods and use tools to analyze information to support a particular hypothesis or to produce an original argument

Quantitative reasoning

- Approach complex problems with an understanding of the value of quantitative reasoning
 - Make well-founded mathematical, numerical and statistical judgments
 - Develop skills to address problems that involve numerical data, uncertainty, statistics, or modeling
 - Understand and use a range of algebraic, geometric, statistical, graphical and computational tools when needed in one's fields of study and in one's life beyond university
-
- Explain basic forest science and energy conversion terminologies

- Assess the Canadian energy profile and where bioenergy might contribute
- Solve quantitative problem sets related to biomass and bioenergy production and basic forest science

Social and ethical responsibility

- Identify ethical dilemmas and consider one's own values in comparison with differing cultural, philosophical or historical perspectives
- Understand the political, social and environmental consequences of applying academic knowledge and evaluate those consequences
- Recognize and act in accordance with personal responsibility to local and global communities

- Evaluate the environmental, social and economic costs and benefits of bioenergy production in Canada and other parts of the world
- Demonstrate an awareness of the differences between the socio-economic concerns of developing and developed countries as they relate to energy production, use, and environmental protection
- Combine knowledge from a variety of subject areas (e.g., science, social science, economics) in the assessment of multidisciplinary topics
- Analyze sustainable forest management from economic, environmental, social and integrative viewpoints

Other skills

- Cooperate with other team members to produce group projects and presentations
- Organize time effectively

HOUSE RULES

Attendance

While no mark is allotted specifically for attendance, it is assumed that all students will attend classes and tutorials regularly. This is important for students to gain maximum benefit from the course. If a student does not attend regularly, this will be reflected in their participation mark.

Field trip

The field trip is a course requirement, and it is expected that students will make every arrangement possible to ensure that they can attend. If attendance is not possible due to prior obligations, please notify the instructor.

Academic integrity

The University of Toronto has a strict policy on plagiarism, which can be found in the Code of Behaviour on Academic Matters (available at <http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>).

The following excerpts from this document outline the university's policy:

It shall be an offence for a student to knowingly:

(d) to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e. to commit plagiarism (for a more detailed account of plagiarism, see Appendix "A") ;

(e) to submit, without the knowledge and approval of the instructor to whom it is submitted, any academic work for which credit has previously been obtained or is being sought in another course or program of study in the University or elsewhere;

(f) to submit any academic work containing a purported statement of fact or reference to a source which has been concocted.

Therefore, under no circumstances will plagiarism be accepted in this course, and students who engage in plagiarism will face strict penalties.

The following resource from the University of Toronto provides tips on how to avoid plagiarism:

<http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize>

It is also expected that students will complete individual assignments (e.g., take home exam, problem sets) on their own.

Course Policy for Late Submissions and Missed Assignments for Medical Reasons

If you require accommodation for late submission of assignments or a missed midterm examination, you must inform your instructor by email within 24 hours of the due date of the assignment or missed test. In addition, you must also submit University accepted medical or other documentation, in person, to the Faculty of Forestry *within 5 calendar days* for missed assignments or midterm examination. Medical Certificates or Doctor's Notes *must* be an original U of T Student Medical Certificate (available from the Office of the Registrar's web site) and *must* include the statement "This Student was unable to write the test on date(s) for medical reasons". Documentation *must* show that the physician was consulted within *one* day of the test. A statement merely confirming a report of illness made by the student is *not* acceptable. Failure to comply with this policy will result in a grade of zero for the assignment or midterm in question. For students with a documented absence due to a medical condition or other serious event who are unable to submit an assignment within 6 days, the other assignments will be reweighted on a pro rata basis.

Late assignments

It is expected that assignments will be handed in by the dates specified on the course syllabus. Late assignments will be penalized 5% per day of lateness, to a maximum of 6 days (30%). After six days, assignments will no longer be accepted and a grade of 0 will be given.

Late assignments can be slipped under the door of office 3038 ESC after regular business hours.

Participation and group dynamics

The material in this course will represent many opportunities for interesting, lively and sometimes controversial discussions. Students are encouraged to participate actively in these discussions, and are expected to respect the opinions and ideas of other class members at all times.

Communication with instructors and TA

Students are encouraged to approach the instructor and TA with any questions, concerns or ideas they may have throughout the course. If questions are detailed, it is recommended that students visit instructor and/or the TA during office hours rather than

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via email (although we will make every effort to answer all emails promptly), as face-to-face may be a more efficient means of communication for some complex questions. If a student is unable to come to any of the specified office hours, please contact us to set up an appointment with an instructor/TA as available.