

Renewable Energy, Technology, and Resource Economics

ENGR 3000 (4 credits / 60 hours)

Iceland: Renewable Energy, Technology, and Resource Economics

This syllabus is representative of a typical semester. Because courses develop and change over time to take advantage of unique learning opportunities, actual course content varies from semester to semester.

Description

This seminar takes an interdisciplinary approach to renewable energy to build a holistic understanding and develop competence in critical analysis of sustainable energy systems. Renewable energy technologies are presented in the context of their social, economic, and environmental impacts. Through lectures, experiential learning, access to experts in the field, and student-led activities, each student gains knowledge in areas of personal interest. The seminar aims to engage students intellectually in relevant renewable energy issues and give ample opportunity to exercise their knowledge with program faculty in Iceland.

Learning Outcomes

The *Renewable Energy, Technology, and Resource Economics* course comprises 60 hours of instruction (4 credits). Upon completion of the course, students will be able to:

- Demonstrate understanding of the mechanics of a variety of renewable energy technologies;
- Differentiate among types and scales of energy utilization technologies;
- Relate energy production and consumption to resource use and management;
- Analyze and compare different energy systems and account for costs and benefits of different renewable energies;
- Demonstrate knowledge and ability to work with class concepts of resource economics renewable energy, and technology.
- Assess critically positive and negative environmental impacts from various renewable energy options in Iceland and beyond.

Language of Instruction

This course is taught in English, but students will be exposed to vocabulary related to course content as well as the nuances of renewable energy, technology, resource economics, and environmental science through in-country expert lecturers and field visits to a wide range of venues and regional locales.

Course Material and Texts

A course pack including selections from the texts listed below will be provided on the class website. You are not required to purchase these textbooks; several copies are in the program

library for you upon arrival as well as large sections are available for perusal on Google books. Other course resources include the class website, which will be updated with relevant articles through the program, the SIT online resources library, and the Icelandic national subscription to academic sources online.

Boyle, G. (2004). *Renewable energy: Power for a Sustainable Future*. Oxford: Oxford University Press.

Common, M. & Stagl, S. (2005). *Ecological Economics: An Introduction*. Cambridge: Cambridge University Press.

Tester, J. W. et al. (2005). *Sustainable Energy: Choosing among Options*. Cambridge, MA: Massachusetts Institute of Technology.

Pre-Departure Required Readings

All pre-departure readings and assignments can be found on the program's Virtual Library at <http://sit.libguides.com/ice>.

Course Schedule

Students will be provided a detailed course schedule during orientation on the program. Please be aware that topics and excursions may vary to take advantage of any emerging events, to accommodate changes in our lecturers' availability, and to respect any changes that would affect student safety. Students will be notified if this occurs.

Module 1: Renewable Energy Technology

From day one of orientation, the program visits places of significance where students experience renewable energy and sustainable communities firsthand, including hot springs and geothermal power plants. At the program base in Ísafjörður, students are hosted by local families, and classes are held at the University Centre of the Westfjords. Module 1 is a core module for the program, introducing the physics of energy and major renewable technologies in use in the world today (some of which we find in Iceland). The module is designed to be accessible to those with or without engineering backgrounds.

Topics covered include:

- Energy concepts;
- Hydropower;
- Geothermal power;
- Other renewables including solar, wind, and tidal power;
- Sustainable transportation including hydrogen fuel cells, electric vehicles, and methane.

Recommended readings:

Thordarsson, T. & Höskuldsson, A. (2002). *Iceland: Classic Geology in Europe*. Edinburgh: Dunedin Academic Press.

Tester, J. W. et al. (2005). Chapter 11: Geothermal energy. In *Sustainable Energy: Choosing among Options* (453-518). Cambridge, MA: MIT.

- Friðleifsson, I. B. (2001). Geothermal energy for the benefit of the people. *Renewable and Sustainable Energy Review*, 5(3), 299-312.
- Gunnlaugsson, E. (2008). *District Heating in Reykjavík: Past – Present – Future*. Reykjavík: Orkuveita Reykjavíkur.
- Stefansson, V. & Axelsson, G. (2003). *Sustainable Utilization of Geothermal Resources*. Reykjavík: Orkuveita Reykjavíkur.
- Tester, J. W. et al. (2005). Chapter 12: Hydropower. In *Sustainable Energy: Choosing among Options (519-542)*. Cambridge, MA: MIT.
- Bosshard, P. (2003). Kárahnjúkar: A Project on Thin ice. Berkely, CA: International Rivers Network.
- Boyle, G. (2004). Chapters 2 and 3: Solar thermal energy and solar photovoltaics. In *Renewable energy: Power for a sustainable future*, 18-103.
- Tester, J. W. (2005). Chapters 15 and 18: Wind energy; Transportation services. In *Sustainable energy: Choosing among Options (613-645; 727-758)*. Cambridge, MA: MIT.
- Park, S. (2011). Iceland's hydrogen energy policy development (1998-2007) from a sociotechnical experiment viewpoint. In *International Journal of Hydrogen Energy* 36, 10443-10454.

Module 2: Energy and the Environment

Modules 2 & 3 will be held in Reykjavík. As the country's capital and largest city, Reykjavík is the center of much energy policy making and energy research. Students will have classes in environmental impacts of energy projects, resource economics, policies, and sustainability concepts. Students will also meet with experts in the field of renewable energy and leaders of industry, research, and development, and learn about Iceland's progress in exploring alternative fuels.

Module 2 is an exploration of the environmental impacts of energy production, including the environmental effects of renewable energy sources such as the hydropower and geothermal energy that are widely used in Iceland.

Topics include:

- Renewable energies and climate change
- Pollution from combustion sources of energy, including biomass;
- Environmental externalities of hydropower development;
- Pollutants from geothermal plants.
- Landscape impacts of renewable energy production

Recommended readings:

- Common, M. & Stagl, S. (2005). Chapter 3: Humans in the environment—some history. In *Ecological Economics: An introduction (66-86)*. Cambridge: Cambridge University Press.
- Common, M. & Stagl, S. (2005). Chapter 4: The economy and the environment—a conceptual framework. In *Ecological economics: An introduction (86-120)*. Cambridge: Cambridge University Press.

Iceland's energy resources and master plan with environmental and economic constraints
Sæþórsdóttir, A.D. & Saarinen, J. (2016). Challenges due to changing ideas of natural resources: tourism and power plant development in the Icelandic wilderness. *Polar Rec*: 52, 82–91.

Umhvervisstofun (Icelandic Environmental Agency). (2019). National Inventory Report. Emissions of Greenhouse Gases in Iceland from 1990 to 2017. Submitted under the United Nations Framework Convention on Climate Change and the Kyoto Protocol, 2019.

Wald, E. C. (2012). Land-use Development in South Iceland 1900 – 2010. Faculty of Biology and Environmental Science University of Iceland 2012.

Þórhallsdóttir, Þ. E. (2007). Environment and energy in Iceland: A comparative analysis of values and impacts. *Environmental Impact Assessment Review* 27: 522–544

Module 3: Renewable Energy Economics

This module looks broadly at the ecological economics of providing energy for society, including standard (neoclassical) approaches and alternative views, as well as approaches to sustainability. Policy options for a sustainable future are considered. Students produce their own hypothetical energy transition plans.

Topics include:

- Sustainability concepts and definitions;
- Energy and resource economics;
- Management of energy resources;
- Energy policy.

Each topic is related to the wider context, so students gain thorough comprehension of renewable energy in terms of sustainability.

Recommended readings:

Common, M. & Stagl, S. (2005). Chapter 11: Environmental policy instruments. In *Ecological economics: An introduction* (402-438). Cambridge: Cambridge University Press.

Jean-Baptiste, P. & Ducroux, R. (2003). Energy policy and climate change. *Energy Policy*, 31, 155-166.

Costanza, R. et al. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387, 253-260.

Brown, M. (2001). Market failures and barriers as a basis for clean energy policy. *Energy Policy*, 29, 1197-1207.

Moran, E. F. (2010). *Environmental Social Science: Human-Environment Interactions and Sustainability*. West Sussex: John Wiley & Sons.

Evaluation and Grading Criteria

Evaluation is based not only on assessment of comprehension of the course concepts listed above, but also on student engagement and initiative in course exercises and activities. Grade is determined by:

Class Assignments (30%)

These will include problem sets and other exercises based on readings, class material, and excursions. Students are encouraged to work together, but each person must submit his or her own assignment.

Module 1 Exam (35%)

An in-class exam at the end of Module I will cover key concepts and skills from that portion of the class.

Group Project (35%)

Module 2 & 3 include a group project in which students will assess an existing or design their own conceptual sustainable energy system and demonstrate mastery of key concepts in resource economics, environmental science, renewable energy, and technology, and communication skills.

Assessment:

Class Assignments	30%
Module 1 Exam	35%
Module 2 Group Project	35%

Grading Scale

94-100%	A	Excellent
90-93%	A-	
87-89%	B+	
84-86%	B	Above Average
80-83%	B-	
77-79%	C+	
74-76%	C	Average
70-73%	C-	
67-69%	D+	
64-66%	D	Below Average
below 64	F	Fail

Expectations and Policies

- Show up prepared. Be on time; have your readings completed and points in mind for discussion or clarification. This raises the level of class discussion for everyone. Frequent tardiness will count as absences.
- Have assignments completed on schedule, printed, and done accordingly to the specified requirements. This will help ensure that your assignments are returned in a timely manner.
- Ask questions in class. Engage the lecturer. These are often very busy professionals who are doing us an honor by coming to speak.

- Comply with academic integrity policies as specified in the [SIT Study Abroad Student Handbook](#).
- Respect differences of opinion (classmates, lecturers, local constituents engaged with on the visits). You are not expected to agree with everything you hear, but you are expected to listen across difference and consider other perspectives with respect.

Please note: the syllabus, course content, lecturers, and readings may be modified by the Academic Director in order to better suit the needs of the course and its participants. Should any change of class topics or lecturers be necessary, students will be promptly notified.

Academic Policies: SIT prides itself on providing students with an experientially based program; we hold ourselves, and our students, to the highest of academic standards. Students are asked to refer to the **SIT Study Abroad Handbook** for policies on academic integrity, ethics, academic warning and probation, diversity and disability, sexual harassment and the academic appeals process.

Disability Services: Students with disabilities are encouraged to contact Disability Services at disabilityservices@sit.edu for information and support in facilitating an accessible educational experience. Additional information regarding SIT Disability Services, including a link to the online request form, can be found on the Disability Services website at <http://studyabroad.sit.edu/disabilityservices>.