**ChE 90 Science and Engineering of Sustainable Energy**
Spring Semester 2013

**Course Description:** An introduction is given to the science and technologies of producing electricity and transportation fuels from renewable energy resources (biomass, geothermal, solar, wind, and wave). Students will be introduced to quantitative calculations and comparisons of energy technologies together with the economic and political factors affecting the transition from non-renewable to sustainable energy resources. Mass and energy balances will be used to analyze the conversion of energy resources.

**Course Structure:** Lectures will be presented discussing the demand for energy in the form of electricity and fuels for transportation and heating, the availability and rates of consumption of energy resources, the technological and economic challenges faced with converting renewable resources to needed forms of energy, and the social and political challenges that must be overcome in order to make the transition from non-renewable (fossil and nuclear) to renewable (biomass, geothermal, solar, wind, and wave) energy resources. Each topic presented in lecture will be illustrated with examples and discussed. To enable a quantitative analysis of alternative energy sources, basic principles of mass and energy balances and the thermodynamics of thermal energy conversion to electricity will be introduced and discussed. Lectures and discussion will be presented and led by the instructors and by guest lecturers drawn from campus and the Lawrence Berkeley National Laboratory.

**Units:** (3) Lectures Tu and Th 10-11 am (2 Evans Hall) and Discussion Section W 3-4 pm (105 Latimer Hall)

**Instructors:** Alexis T. Bell (107 Gilman Hall), 642-1536, bell@cchem.berkeley.edu); Norman Su, norman.su@berkeley.edu

**Office Hours:** Alexis T. Bell: By Appointment Only; Norman Su: Tu 11 am -12 pm Chem. Lib. Room F, Th 5 -6 pm Chem. Lib Room E

**Grading:**
60% homework (assigned and collected weekly)
40% final project (done individually or in small group teams, subject selected via discussion with instructor or from a suggested list)

**Text:** Recommended Text: Frank Kreith and Jan F. Krieder, *Principles of Sustainable Energy*, CRC Press, New York, 2011.

**References:**

David J.C. MacKay, *Sustainable Energy – Without the Hot Air*, UIT, Cambridge, England, 2009. ISBN 978-0-9544529-3-3

*Overview and Summary of America's Energy Future*, National Research Council, Washington, DC, 2010.

*Hidden Costs of Energy – Unpriced Consequences of Energy Production and Use*, National Research Council, Washington, DC, 2010.

*Liquid Transportation Fuels from Coal and Biomass – Technological Status, Costs, and Environmental Impacts*, National Research Council, Washington, DC, 2009.

*Report on the First Quadrennial Technology Review*, DOE, Washington, DC, 2011.

L. Louis Hegedus and Dorota S. Temple, *Viewing America's Energy Future in Three Dimensions*, Research Triangle Institute, Research Triangle Park, NC, 2011.

*California's Energy Future – The View to 2050*, California Council on Science and Technology, Sacramento, CA, 2011.

*2012 The Outlook for Energy to 2040*, ExxonMobil, Irving, TX, 2012.

Aldo Vierira da Rosa, *Fundamentals of Renewable Energy Processes* (2nd Ed.), Academic Press, New York, 2009. ISBN 978-0-12-374639-9

Godfrey Boyle, BobEvereet, and Janet Ramage, *Energy System and Sustainability, Oxford University* Press, Oxford, England, 2003. ISBN 0-19-926179-2

Godfrey Boyle, *Renewable Energy – Power for a Sustainable Future* (2nd Ed.), Oxford University Press, Oxford, England, 2004. ISBN 0-19-926178-4