General Course Information:

ELEN E6906, Topics Course, FUTURE ENERGY: ECONOMICS, SYSTEMS, POLICIES

Instructor Information

Debasis Mitra
Senior Research Scientist and Adjunct Professor
Department of Electrical Engineering
http://www.ee.columbia.edu/debasis-mitra
email: debasismitra@columbia.edu

Course Prerequisite, Description

Students must have either taken ELEN 6767, “Internet Economics, Engineering and the Implications for Society”, or have sufficient knowledge of the course content, to be verified by instructor. In particular, incoming students will have knowledge of the following economic concepts: social welfare maximization; elasticity; competitive, oligopoly, monopoly markets; subadditivity in cost functions with large fixed cost; first and second best pricing; average cost pricing; Cournot & Bertrand pricing; Ramsey pricing; Price of Anarchy; Pigovian taxes; Coasian bargaining; externalities.

It is assumed that students will be able to read and understand on their own the first four chapters of D.S. Kirschen and G.Strabac’s “Fundamentals of Power System Economics”, 2nd edition (“Introduction”, “Basic Concepts from Economics”, “Markets for Electrical Energy”, “Participation in Markets for Electrical Energy”). The course will largely bypass electricity markets and related optimizations, which are covered well in texts and other courses.

The course will consist primarily of reading, discussing and researching contents of the papers listed below. Students will take turns at presenting papers, and leading class discussions.

Course requirements: Active participation; homework; two papers; project with oral presentation.

Grading policy:
35% active participation
15% homework
15% mid-term paper
15% project and oral presentation
20% final exam paper

Themes & Reading:

   (i) Fundamentals of Renewable Energy
   Basic characteristics of biomass, hydropower, wind, solar, geothermal energy sources; their intermittency and environmental externalities; policies for the renewable energy
transition.


(ii) Social Cost


(iii) Hidden Costs and Externalities of Energy Production


(iv) Economics of Renewable Energy


2. Connection to Climate Change


4. Regulators’ Problems

Regulators, notably in California, have the problem of setting prices and subsidies for centralized, stable grid power, which is subject to high sunk and fixed costs, and decentralized, variable power from PV/solar panels, which is further complicated by
contrasting societal impacts.


5. Future Energy Systems & Networks

(i) Implications of Significant Wind Generation Penetration


(ii) Demand Response with Intermittent Renewable Energy


(iii) Economies of Scale in Storage and Transmission for Renewable Energy Sources


(iv) Risk-Aware System Design with Stable and Variable Energy Sources


(v) Energy System Expansion Design Optimization

C. Skar, R. Egging, A. Tomasgard, “The Role of Transmission and Energy Storage for Integrating Large Shares of Renewables in Europe”, International Association for Energy Economics, Q1, 2016

6. Case Study of Design Optimization of Hybrid Wind-PV Microgrids in Bangladesh