



ENERGY RESOURCES, ECONOMICS AND ENVIRONMENT

PROF. RANGAN BANERJEE

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INTENDED AUDIENCE : Masters students of Energy Systems Engineering. UG students of Mech, Elec, Chemical interested in Energy

COURSE OUTLINE :

This course will equip students with the tools necessary for economic analysis and quantification of impacts of energy systems. We will review the availability of energy resources and study methods for quantification of resource depletion and scarcity. The course will cover basic concepts in economics and their application to energy systems. Tools and techniques for project economics for an individual/company perspective and macro-decision making for society will be introduced. We will discuss basic concepts of welfare economics and environmental economics that are necessary for energy systems analysis and their environmental impacts.

ABOUT INSTRUCTOR :

Prof. Rangan Banerjee is currently the Director, IIT Delhi. From February 2022 he is on lien from IIT Bombay where he served as the Forbes Marshall Chair Professor in the Department of Energy Science and Engineering - a Department that he helped start in 2007. His areas of interest include energy management, modelling of energy systems, energy planning and policy, hydrogen energy and fuel cells.

Prof. Rangan Banerjee currently serves on the editorial board of International Journal of Sustainable Energy, International Journal of Sustainable Engineering, International Journal of Thermodynamics, Solar Energy Advances, Global Transitions (Energy Transitions). He has been involved in setting up a megawatt scale Solar Thermal Power Testing, Simulation, Research Facility sponsored by the Ministry of New and Renewable Energy (MNRE) and is the faculty advisor of Team Shunya- India's first student team in the Solar Decathlon Europe finals. He has been involved in advising the city, state regulatory commission and energy agency, Niti Aayog, MNRE on energy issues and worked with several Indian and international industries.

Prof. Banerjee has been the Dean (R&D) and received the Excellence in Teaching Award from IIT Bombay and is a Fellow of the Indian National Academy of Engineering. Prof. Banerjee is also an Adjunct faculty (Honorary) in the Department of Engineering & Public Policy, Carnegie Mellon University.

COURSE PLAN :

Week 1: Energy Flow Diagram ,Global Trends in Energy Use, India and World- Disaggregation by supply, end use, Energy and Environment, The Kaya Identity, Emission Factor

Week 2: Energy and Quality of Life, Energy Inequality, Energy Security, Introduction to Country Energy Balance assignment

Week 3: Energy Economics - Simple Payback Period, Time Value of Money- discount rate, Criteria for Assessing Energy Projects –(Net Present Value (NPV), Benefit/Cost Ratio (B/C), Inflation, Internal Rate of Return (IRR)

Week 4: Resources & Reserves Growth Rates in Consumption, Estimates of Duration of Fossil Fuels, McKelvey Diagram, Peak oil, Hubbert's model

Week 5: Materials used in renewable energy (Kuznet's Curve, Betting on the planet, Simon's Change), Non Renewable Energy Economics (Hotelling's Rule)

Week 6: Preferences and Utility, Utility and Social Choice

Week 7: Public and private goods / bads, Demand curves , Externalities

Week 8: Financing Energy – Debt/ Equity- Sources of funds, innovative financing models

Week 9: Input Output Analysis

Week 10: Primary Energy Analysis, Net Energy Analysis, Examples, Energy Cost of Energy, Life Cycle Analysis of Bioenergy

Week 11: Net Energy Examples, Energy Policy

Week 12: Energy Policy Examples, Practice problems solution