Economics of Renewable Energy

Module 3, 2024-2025 academic year

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Course information

Course Website: my.nes.ru
Instructor's Office Hours: by appointment
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Course description

This course will familiarize the students with renewable energy resources and its economics. For decades renewable energy peacefully coexisted with traditional fossil fuel energy. The former in the laboratories and the enthusiasts' backyards, the latter - on the energy market. More recently the continued progress in technology has made certain renewable energy sources cost competitive with the incumbents.

Such cost competitiveness has the potential to change the landscape of the energy industry, with further implications on the macro side (current account surpluses/deficits, FX), politics (rent economies and non-rent economies demand different politics), geopolitics, and economics (new international division of labor in the global economy).

We will also have a brief look at "second order effects" - a number of seemingly unrelated problems where energy availability and cost have until recently been considered a bottleneck.

The students will get acquainted with the physical foundations of traditional and renewable energy, its economics, competitive landscape in the energy industry, ESG agenda, and current regulatory initiatives.

Course requirements, grading, and attendance policies

Prerequisites: Microeconomics, Corporate Finance, School level physics
Attendance: Voluntary
Grading: Homeworks (40%) / Final exam (60%)

Course contents

Economics of renewable energy technologies
- Solar (physical foundations, economics)
- Wind (physical foundations, economics)
- Storage (physical foundations, economics)
- Other sources of renewable energy

Energy markets: traditional vs. renewable
- Electricity (natural gas vs. solar/wind)
- Heat (natural gas/CHP vs. solar/wind)
- Transportation (oil vs. solar/wind)
- Renewable chemistry (oil-based top down chemistry vs. CO_2/biomass-based bottom up chemistry)

Macro/Micro/Political implications
- Corporate level (incumbents vs. new players)
- Macro level (current accounts, FX)
- Economics (Comparative advantage, Dutch disease)
- Politics (rent-economy politics vs. non-rent economy politics)
- Second order effects (water, food, construction)

Regulation/Environment
- ESG
- Climate change
- Carbon footprint

Course materials

Physical foundations of renewable energy
- [Sustainable Energy – Without The Hot Air](#) (2008). *David JC MacKay.*
  (Free online book on physical foundations of renewable energy)
- [Fundamentals of Renewable Energy Processes](#) (2012). *Aldo V. da Rosa.*
  (Advanced book on physical foundations of renewable energy)

Feasibility studies of renewable energy
- 100% Clean and Renewable Wind, Water, and Sunlight (WWS) AllSector Energy Roadmaps for 139 Countries of the World (2017). *Mark Jacobson et al.* ([graphics](#), [text](#))
- Low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes. *Mark Jacobson et al.* ([text](#))

Economics of renewable energy
- [Lazard's LCOE+ (levelized cost of Energy 15.0 / Storage 7.0 / Hydrogen 2.0)](#) (2021)
- [Lazard's LCOE+ (levelized cost of Energy 16.0 / Storage 8.0 / Hydrogen 3.0)](#) (2023)

Energy transition
- [RMI's The Renewable Revolution](#) (2023)

ESG
- [Unsettled](#) (2021). *Steven Koonin.*
- [The Strange Case of Global Warming](#) (2012). *Ivar Giaever*
- [IPCC Sixth Assessment Report (Working Group 1: The Physical Science Basis)](#) (2021)

Media/Think tanks
- [Cleantechnica](#)
- [Forbes - Energy](#)
- [Greentech Media](#)
- [Renew Economy](#)
- [Bloomberg New Energy Finance](#) (BNEF). Think tank.
- [The Solutions Project](#). Think tank / lobbyist for 100% renewable energy world.
- Vitaly Kazakov's [blog](#) on the economics of renewable energy.

People
- [Elon Musk.](#) Founder of Tesla Motors.
- [Mark Jacobson.](#) Stanford university professor. Co-founder of The Solutions Project.
- [Michael Liebreich](#). Founder of BNEF.