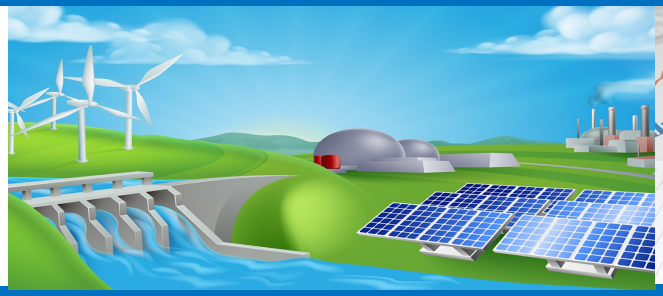



ECONOMICS OF MODERN POWER SYSTEMS

Course Overview and Introductions

Prof. Luana Medeiros Marangon Lima, Ph.D.

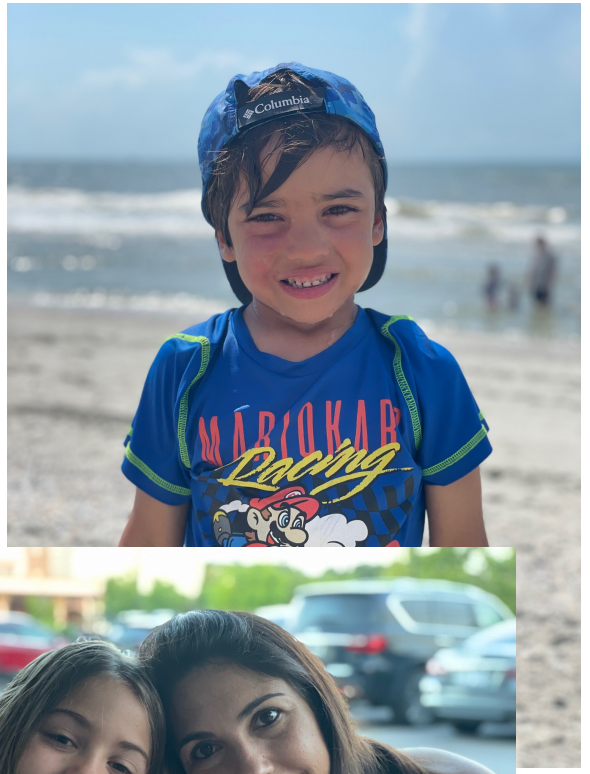
Agenda

- Instructor Introduction
- Students Introduction
- Course Description, Objectives
- Motivation
- Course Topics
- Course Format and Grading
  - Homework Assignments, Journal
  - Final Project
- Proposed Class Schedule

Instructor Introductions

A Little About Myself

- Born in Rio de Janeiro, Brazil
- Lived most of life in Itajubá, MG



- Got married in 2008 to Anderson de Queiroz a professor at NCSU

- We have two teaching assistants: Clara (11 yrs) and Lucas (7 yrs)

And before you ask…

Yes! We love soccer…

My Education

- Bachelor of Science, Electrical Engineering

  FEDERAL UNIVERSITY OF ITAJUBÁ, Brazil, 2005

  Electrical Power Systems

- Master of Science, Electrical Engineering

  FEDERAL UNIVERSITY OF ITAJUBÁ, Brazil, 2007

  Invested Cost Related Price for Transmission Use: Drawbacks and Improvements in Brazil

- Ph.D., Operations Research and Industrial Engineering

  UNIVERSITY OF TEXAS, Austin, TX, 2011

  Modeling and Forecast of Brazilian Reservoir Inflows via Dynamic Linear Models under Climate Change Scenarios

My Work Experience

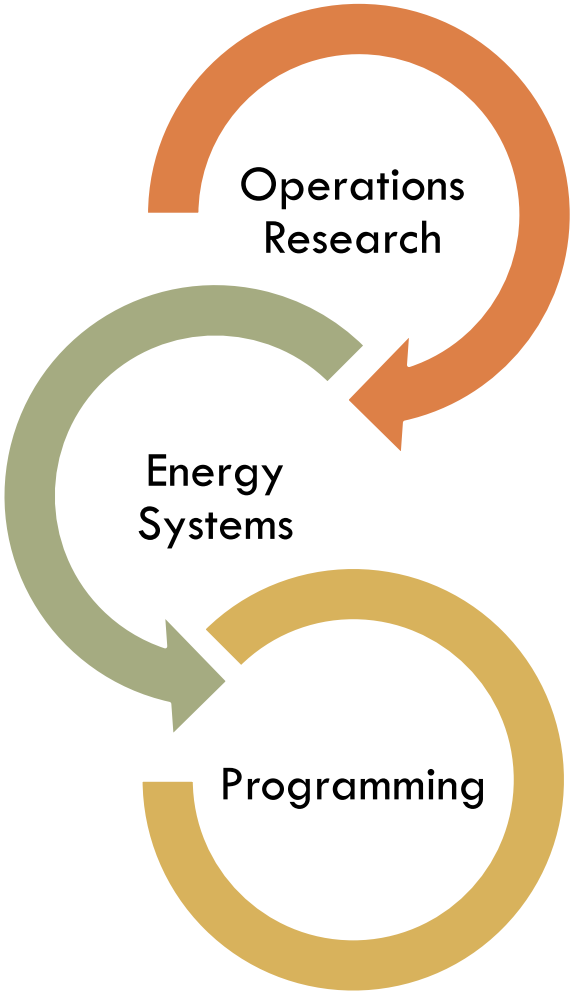
- Marangon Consulting and Engineering
  2006-Present
  Associate Researcher

- Federal University of Itajubá
  Institute of Electrical And Energy Systems
  2013-2016
  Assistant Professor
  Systems Engineering Research Group Leader (2014-2015)

- Duke University since 2018
  Visiting Assistant Professor at Nicholas School of the Environment
  Associate Director for Educational Programs at the Energy Initiative
  Director of Energy Studies at Pratt School of Engineering

My Background

- **Electricity Prices**
- **Renewable Energy**
- **Hydro-thermal Scheduling**
- Electric Power System Wheeling Charges
- Transmission and Distribution Planning in Power Systems



- **Data Analysis**
- **Time Series Modeling and Forecast**
- Mathematical Programming
- Stochastic Optimization
- Decision Making

- **R, Python**, Matlab
- GAMS
- C++, Fortran

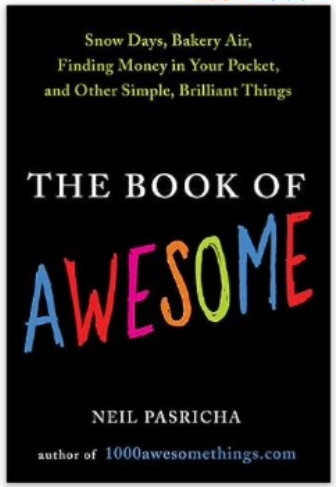
TA introduction

Marcio Ribeiro

Students Introduction

Students Intro + Activity

The Book of Awesome by Neil Pasricha is filled with simple, everyday pleasures that bring joy and positivity to our lives

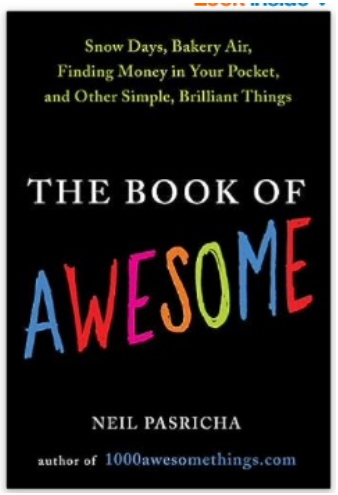


- Popping bubble wrap
- The smell of rain on a hot sidewalk
- The other side of the pillow
- Hitting a bunch of green lights in a row
- Waking up and realizing it's Saturday
- When the cashier opens a new lane at the grocery store
- The moment at a concert after the lights go out and before the band comes on stage
- When you're really tired and about to fall asleep and someone throws a blanket on you
- Finding an old mix tape
- High-fiving babies
- Snow days

Students Intro + Activity

- Activity:

"Discovering Common Awesome Moments"



- In small groups (2-3) introduce yourselves and identify one or more common awesome moments you have experienced

- Groups introduce themselves to the rest of the class and one representative from each small group will share the common awesome moments their group discovered

Course Description

Course Description

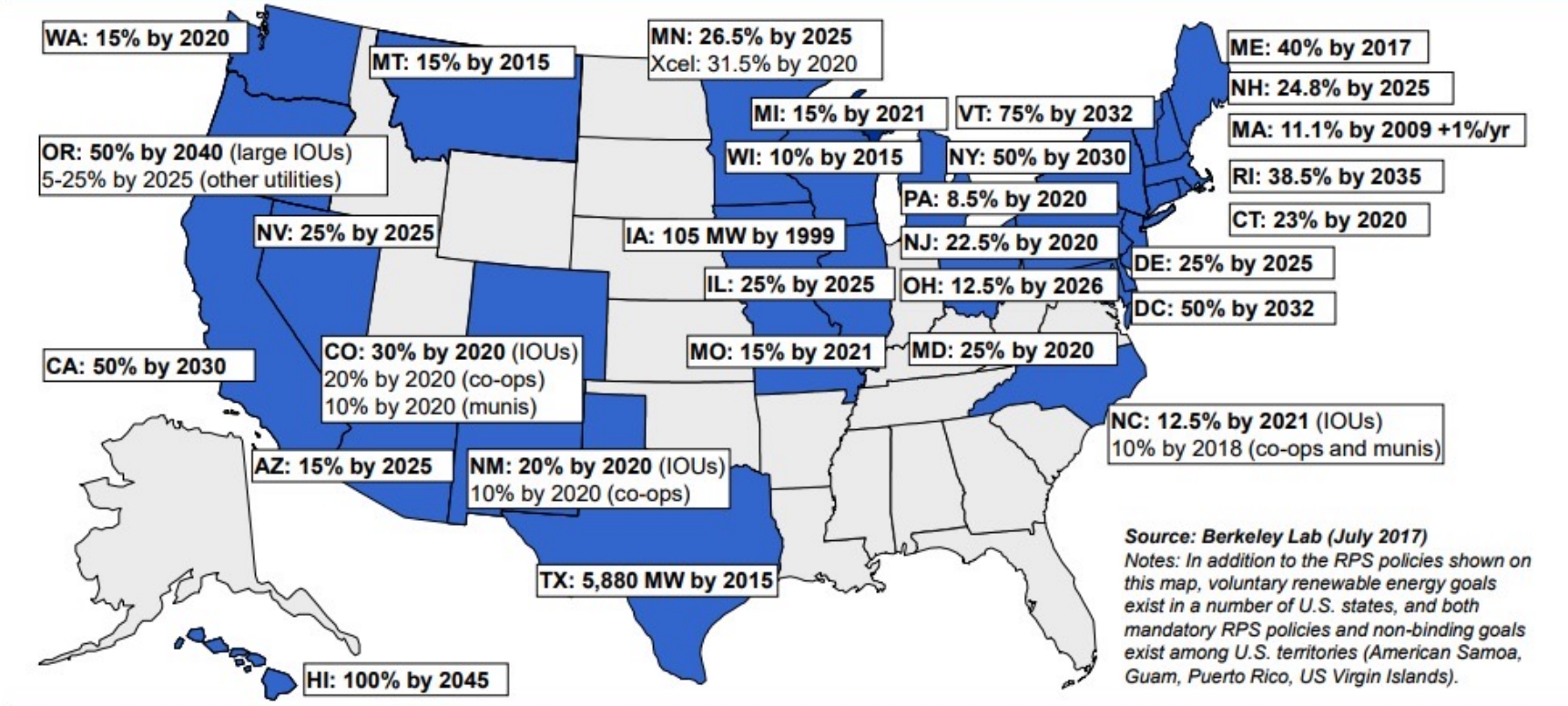
- Electric power grid is undergoing two major transformations or what some call a “revolution”

Supply Mix

Decentralization

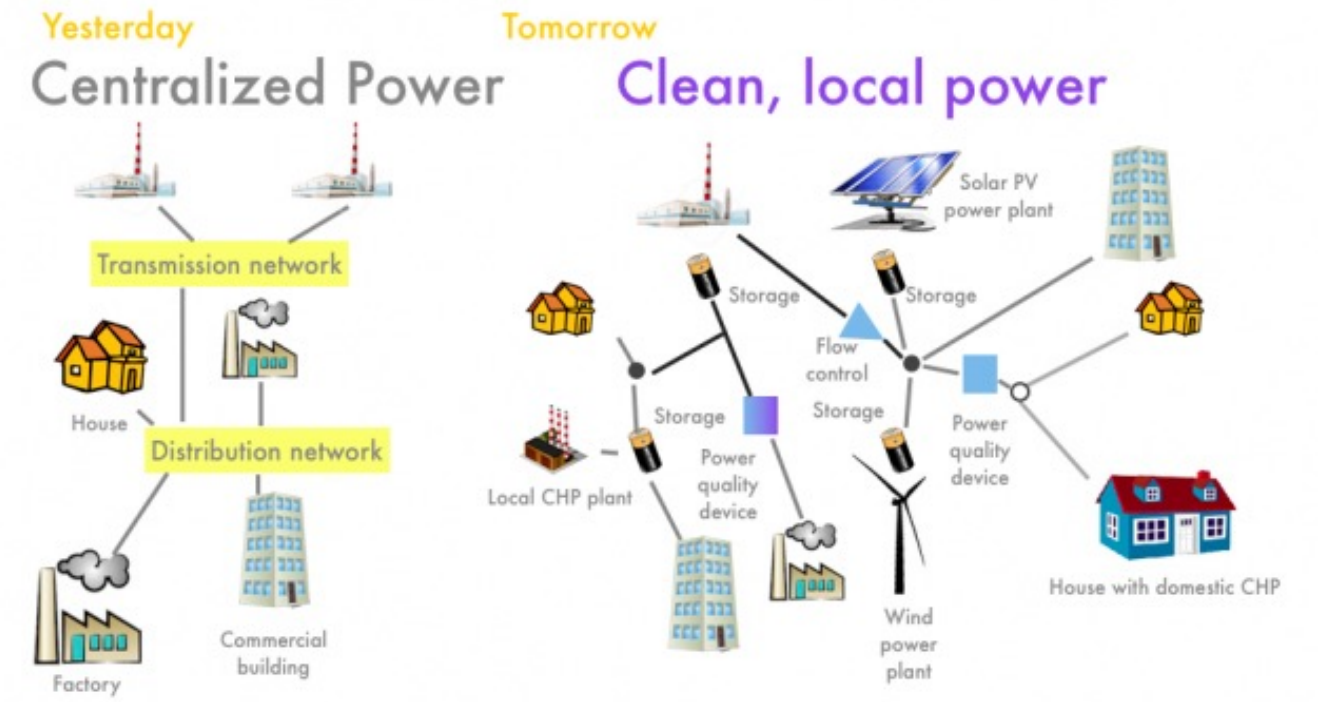
Supply Mix

- Transition away from **fossil fuels to renewables**, eventually to "100%" renewable energy



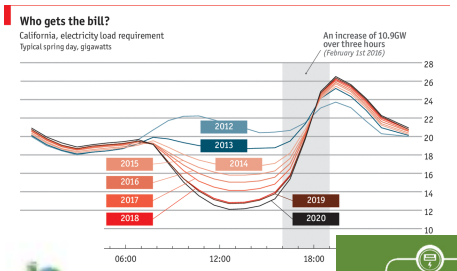
Decentralization

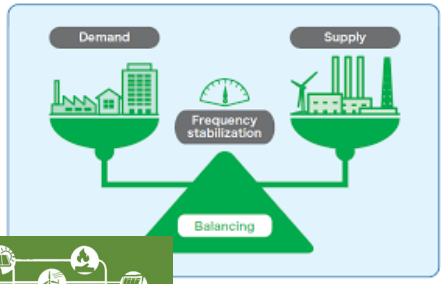
- Proliferation of diverse, small-scale, distribution-connected resources (DER)
- Community microgrids for resilience of critical services
- Electrification of transportation, building etc..

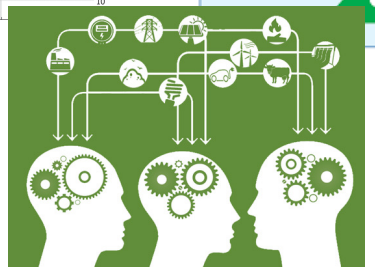


Reshaping all aspects of the industry

- Electricity demand
- Grid operations
- Planning
- Markets
- Business Models
- Utility regulation
- Capital Investment







Quantifying the Financial Impact of Distributed Energy Resources on Utility Rates and Profitability

Impacts of Retail Rate Design and Net Metering on PV Economics

EE Business Models Analysis and Technical Assistance

Solar Valuation at High Penetration

Future Electric Utility Regulation: Concept papers

Course Objectives

- We will talk about economics of modern power grids to facilitate integration of new agents/technology
  - Ex. Balancing supply and demand
  - Ex. Distribution network pricing mechanism
- In parallel with supply mix transition & decentralization is **digitalization**, upon competition of the course students will understand how

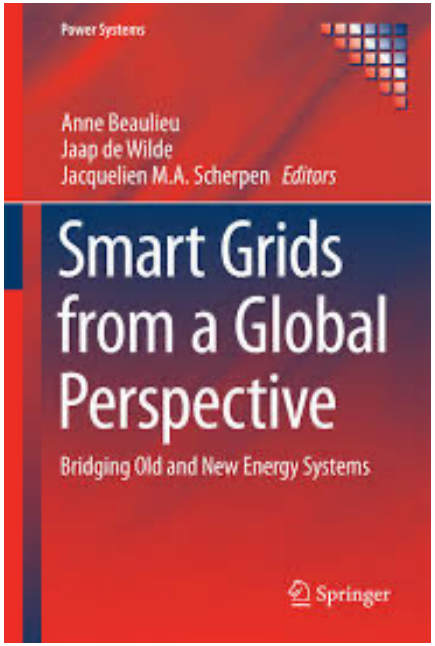
Information and communication technology will be incorporated into electricity generation, delivery and consumption to minimize environmental impact and improve reliability and efficiency.

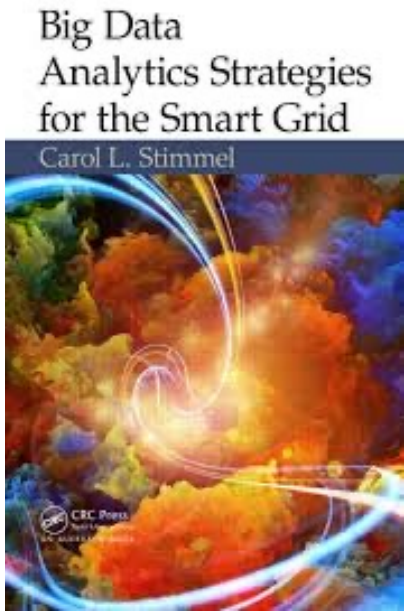
Course Topics & Proposed Schedule

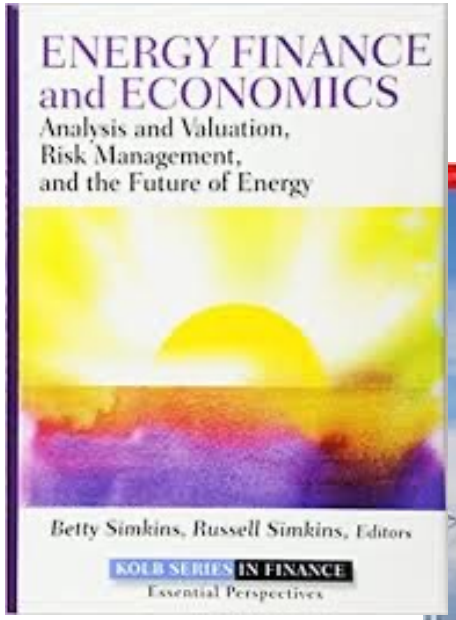
- Please check the course website

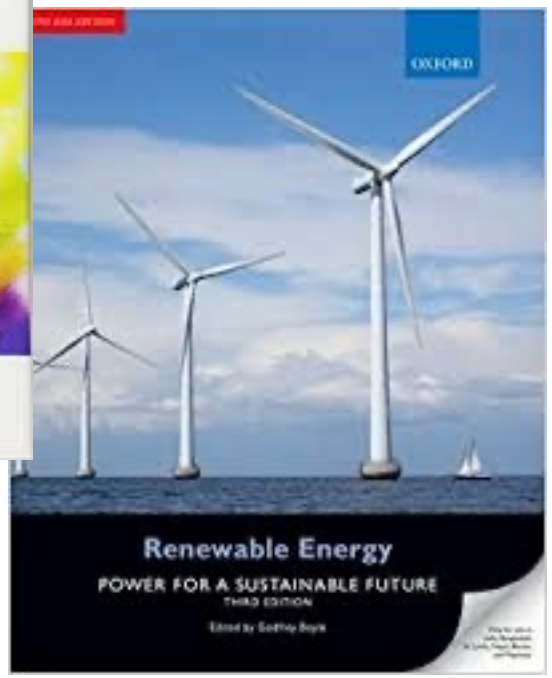
  env590.github.io

Bibliography









Collection of papers assigned throughout the course

We might use some podcasts as well for the assignments

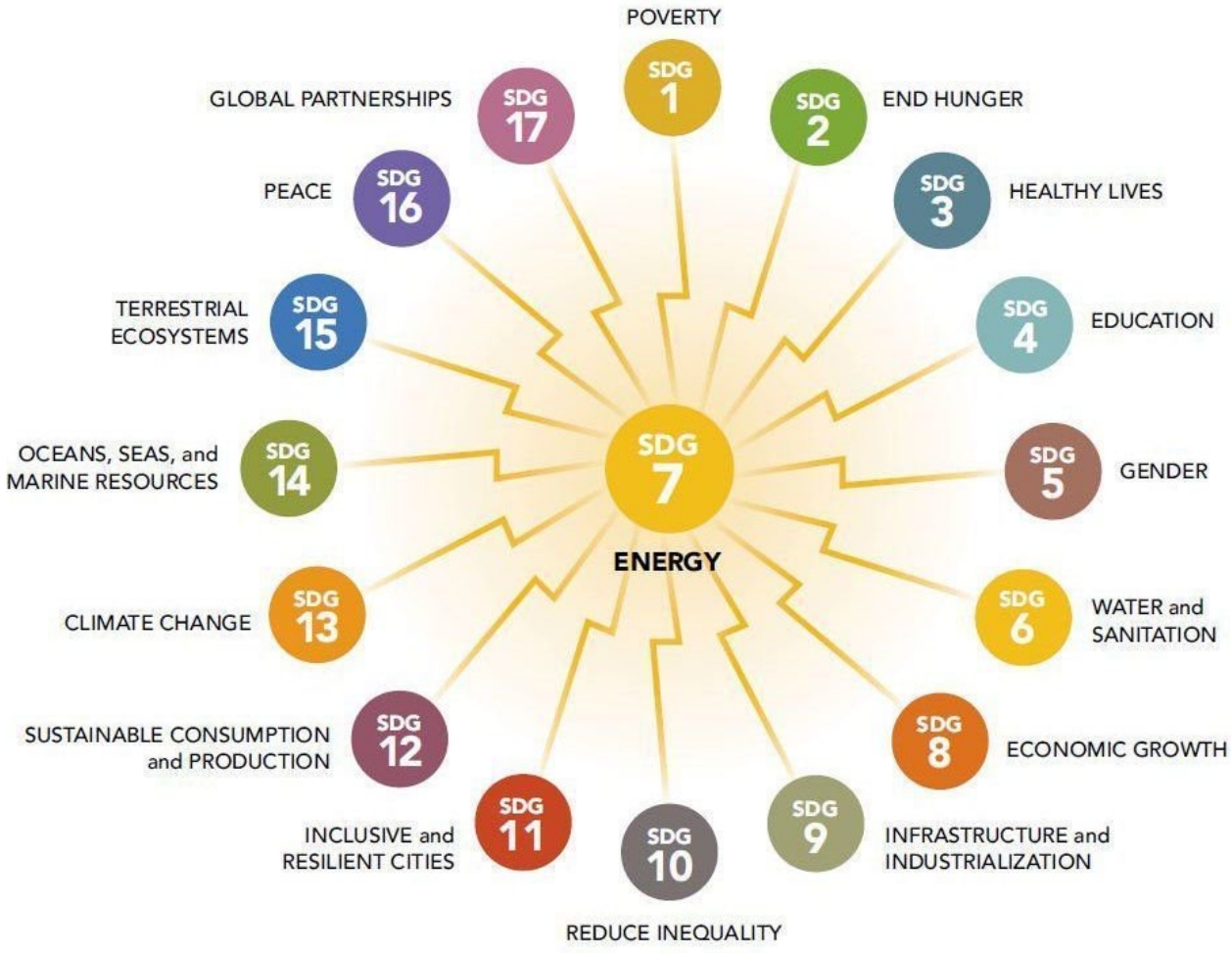
Motivation

Why should you take this course?

- Many of the **challenges facing humankind**, such as climate change, water scarcity, inequality and hunger, can only be resolved at a global level and by **promoting sustainable development**
- Sustainable development is one of the main **goals of modern society**

Sustainable Development Goals

One common aspect



Energy is essential to achieving **EVERY** Sustainable Development Goal

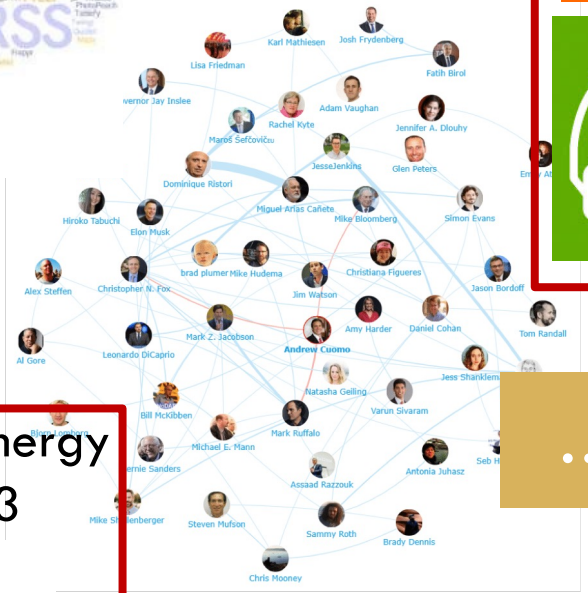
Therefore…

- **Energy lies at the heart** of
  - 2030 Agenda for Sustainable Development
  - Paris Agreement on Climate Change

- Aggressive goals to
  - Increase renewable participation (**Renewable Portfolio Standards – RPS**)
  - And **electrify the energy market**

Future of energy…

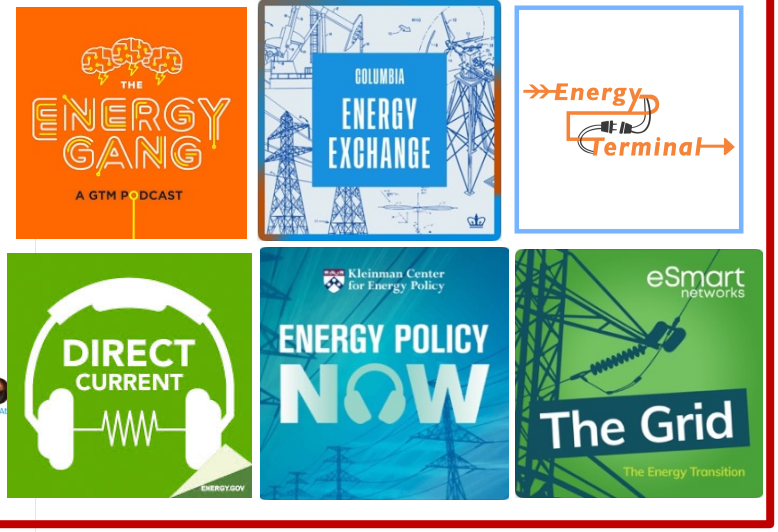
… invades media …



+1100 TED talks on energy as of August/2023

TED Ideas worth spreading

Podcast channels



… and also the job market

So the question really is…

Why wouldn't you take this course?

If you want to be a part of this, bring your energy and let's shape the future!

Logistics

Course format and Grading

- Mode: in-person class
- Weekly office hours: in-person and online options

40% **Assignments**

30% **Journal**

30% **Final Project**

Class Journal

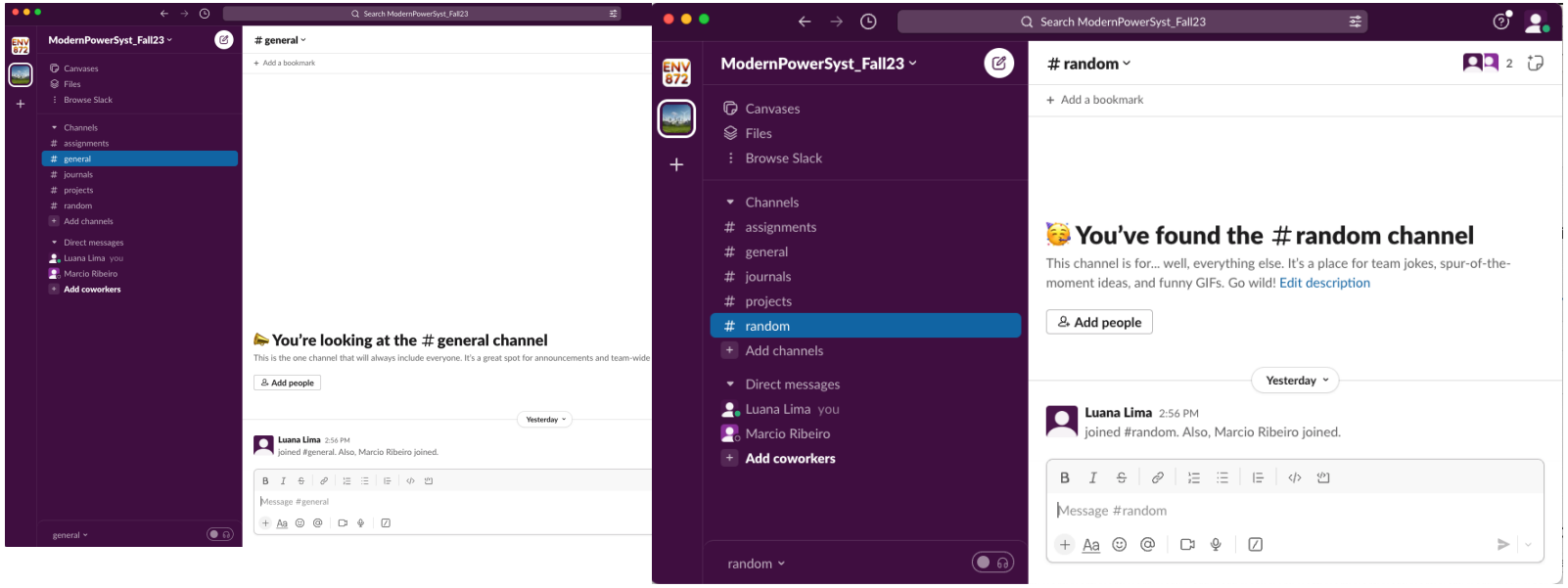
- We will use Sakai forum
- On a journal week your group will either do a blog **entry** about what you've learned in class (or other related information) or **comment** on another group post
  - If your group has an odd number you will do a journal entry
  - If your group has an even number you will do a comment on another group entry
  - Entries are due on Tuesdays by 11:59 pm and comments Fridays by 11:59pm

- Why? -Reflection
  - Process your thoughts, feeling and opinions about the topics we discussed

Note: There is no right and wrong for the entries. Everyone will get FULL credit as long as they submit on time

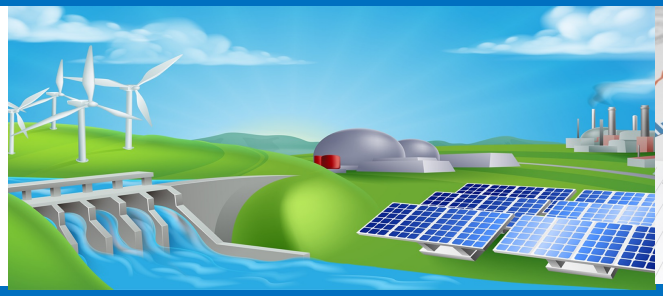
Communication

- E-mail for general announcements from instructor and TA
- Slack workspace for students interaction and any course related questions



Final Remarks

- Regardless of your background, with discipline and dedication you will successfully complete this course
- Pay close attention to course objectives, requirements, and deadlines
- Do not hesitate to ask questions, we are all here to learn!




THANK YOU !

luana.marangon.lima@duke.edu