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## Lecture 1: Introduction to energy systems & sustainability, overview

### 1.1: What is energy?

- In this course, energy can refer to **electricity** (aka power) and/or **heat**.
- While energy isn't matter, later in the course we'll see that the fuels used to produce energy are matter but are often referred to as 'primary energy'.

### 1.2: What is 'conventional' energy?

- Conventional energy refers to types of energy production in **widespread use** today.
- **Fossil fuels, nuclear power, hydropower** and **traditional biomass** are conventional energy.

### 1.3: What is 'sustainable' energy?

- Sustainable energy is energy whose **source is not depleted by its use**.
- Sustainable energy sources are infinite or **renewable**.
  - Caveat: Some forms of renewable energy are sustainable only if used with **sustainable intent and practice**.
- Fossil fuels are **finite** and therefore not sustainable.
  - Is **nuclear** energy sustainable?

### 1.4: What is a system?

- Nearly everything is part of a system! Systems are the **natural form of organization**. (ecosystems, food webs, etc.,.)
- Systems have **components** (aka elements, sources and sinks) that are connected by **flows** (or relationships).
- Systems can be complex and tend to develop their own behavior.
  - They can be **emergent**: having properties as a whole that are more complex than the properties of the individual components.
- Systems have **feedback loops** that can amplify or dial down flows and relationships between components.

### 1.5: Why is systems thinking important?

- Systems thinking is important because **the world is a series of interconnected systems**.
- This course compares our complex and global conventional **energy system** with a sustainable energy system.
  - And considers how **change** from conventional to sustainable could be accomplished
- If change doesn't consider the system, its complexities and interactions it is likely to **fail** and to have **unintended consequences**.
- Energy cycles are **business cycles** which also exhibit systems behavior