Net Zero Emissions: Why and How

Course Syllabus

Week 1. The IPCC October, 2018 Special Report on Global Warming of 1.5 ºC provides the basis for the understanding of why the world must come to net zero emissions by 2050. It authoritatively describes the impact of global warming even at this level of temperature rise to all aspects of the environment and human society. The IPCC has been criticized by some as being alarmist and by others by being conservative in its projections. Which evaluation is more justified?

Week 2. The Paris Agreement of December, 2015 is the international framework by which governments declare their goals and policies toward climate change through nationally determined contributions (NDCs). The Agreement provided for continued negotiations through annual conferences of the Conference of the Parties, since Paris in Marrakesh, in Bonn, in Katowice, and most recently in Madrid. Has the international community made progress in efforts to address climate change?

Week 3. China with 27% of global GHG emissions and the United States with 15% account for 42% of global GHG emissions. But GDP per capita in China is only 15% of that in the United States. The actions of both countries will have a major impact on global emissions reduction. This issue will be an important component in our upcoming national elections. The Green New Deal and Democratic candidates Climate Change Plans are worthy of discussion. Would they be sufficient?

Week 4. In the United States the three fossil fuels, coal, oil, and natural gas, provide for 60% of our electrical generation, 92% of our transportation, 88% of our industry, 58% of residential and 48% of commercial energy use. Obviously, net zero emissions by 2050 will require the dramatic disruption of the fossil fuel industry. Can this transformation be made without devastating economic dislocation?

Week 5. Two plentiful sources of renewable energy, wind and solar, have experienced near exponential growth in the past decades and now provide in the United States 3% of total primary energy (8% of electricity generation). Intermittency and variability of these resources require either a dispatchable resource or energy storage. What is a possible mix of wind, solar, storage, and dispatchable resources, given technological and economic considerations?

Week 6. The transition to net zero emissions may be too slow to limit global warming to an acceptable level. Warming would subside if greenhouse gases could be removed from the atmosphere. A handful of technologies have been identified, all of which require implementation on a massive scale. Do negative emissions have a role in producing net zero emissions?

Week 7. Suppose neither emissions reduction nor negative emissions are implemented effectively and in a timely fashion. Should management of solar radiation or other geoengineering technologies be considered? Should research and pilot projects be pursued in the near term?

Week 8. Fossil fuel resources are not renewable, and their use will eventually end. In human history there have been other energy transitions, but none with this urgency. Along with energy there must be a transition for water resources and food production. What will be "The Future That We Will Not See?"