This course has two motivations. The first is that the West does not currently appear to be living sustainably. This leads to questions about social and technological changes that must happen in order for human society as we know it to have a future. The second is that everyone, no matter what their background, is capable of making rigorous arguments about physics. These two subjects are linked, because the world is going to make hard decisions in your lifetimes, and everyone will be expected to participate in those decisions at some level.

Aims of the course: (1) Explore the extent to which ideas about the environment and sustainability are supported by present-day engineering capabilities or limited by constraints coming from fundamental physical laws. (2) Develop strategies and skills for making estimates and arguments in the face of enormous uncertainties, or when problems are ill-posed (as all important problems are). (3) Learn some principles in fundamental physics. (4) Practice reading, writing, and generating original arguments in scientific and quantitative topics. This course is also part of the On Being Human collection of First-Year Seminars.

Readings: Much of the reading for this course will be decided based on the subjects that individual students are interested in. We will chose it from internet, scientific-journal, and newspaper sources. However, we will start off by reading sections of David J. C. MacKay, Sustainable Energy—without the hot air, https://www.withouthotair.com/.

Research and writing: Each student will do some writing every week. Each student will choose some areas of specialization and do more intensive reading and research in that area. Each student will produce a short written piece of original research by the end of the semester. This research might be a criticism of current thinking about sustainability, a proposal for policy or study, a criticism of existing policy or activity, or an exploration of more futuristic ideas.

Schedule: Each week, there will be reading, in-class discussion, a take-home problem or problem set, and some writing.

Week 1–2 Consumption: How much energy, water, and other resources does humanity consume? We will break these down by industry or category.

Week 3–4 Theoretical limits: What are the zeroth-order limits on how much energy is available to humanity? How does that flow down to other kinds of resources like water, transportation, and agriculture?
Week 5–6 **Pragmatic considerations**: What are the current technologies for generating resources and how far are they from theoretical limits? Are there other kinds of theoretical limits we have missed in previous weeks, for example related to dissipation or entropy? In these two weeks, students will propose specializations that specialize their research for subsequent weeks.

Week 7–8 **The far future**: We will look at conceivable long-term activity by humanity like building at Solar-System scale or interstellar travel. How are these activities limited theoretically? Also in this period, students will workshop possible research projects as a group, generating research and writing plans for each individual student.

Week 9–10 **Individualized quantitative work**: Students will have reading, problem-solving, and writing on their individual projects. We will discuss these as a group. Although work has become individual by this point, there will still be problem work assigned each week.

Week 11–12 **Writing workshop**: In small groups, students will read and critique each other's work. This critique will not just be of the presentation, but also of the quantitative and problem-solving approaches used in the work.

Week 13–14 **Reports and discussion**: Students will give short presentations summarizing their key findings, and they will hand in final written work.