

# EPS 219: Energy and the Environment

## Fall, 2021

**Instructor:** Michael Wysession, Earth and Planetary Sciences, [michael@wucore.wustl.edu](mailto:michael@wucore.wustl.edu), Rudolph Hall, Rm. 385, 5-5625 (Zoom office hours: Wednesdays, 1-2 pm)

**AI:** Forest Balemian-Spencer ([b.forest@wustl.edu](mailto:b.forest@wustl.edu)) – Zoom office hours: Wednesdays, 7 – 8:30 pm

**TA:** Josie Alexander ([jalexander@wustl.edu](mailto:jalexander@wustl.edu)) – Zoom office hours: Thursday, 4 – 5 pm

**Class Hours:** Tuesdays and Thursdays, 11:30 pm to 12:50 pm, January Hall, Rm. 110

**Course Content Description:** The course will examine the topic of energy from many human-relevant perspectives. Humans use an enormous amount of energy, at the staggering rate of 20 terawatts. Where does this energy come from? How long will it last? What are the consequences? This course will examine these questions and look at energy resources and their consumption from scientific, social, economic, and political viewpoints. The course will first examine what energy is, as well its relation to other concepts such as heat, work, and power. We will then look at the way that energy is used by society. We will examine the different sources of energy, their availabilities, the pros and cons of using them, their consequences, and their futures.

Humans are at an interesting point in time concerning energy use. About 85% of human energy consumption is from non-renewable energy sources: fossil fuels and uranium. While we will not entirely run out of these in the near future, the increasing social, environmental, and financial costs associated with finding and extracting these sources, as well as the costs of dealing with their wastes, will make them increasingly economically unattractive. And, of course, carbon dioxide and methane are powerful greenhouse gases, and fossil fuel extraction and consumption is changing regional and global climates at very high rates. At the same time, technological advances have now making the use of renewable energy sources (solar and wind) less expensive than non-renewable sources, even before taking into account health and environmental costs. Given that Earth receives more energy from the sun in one hour than all humans use in a year, opportunities for solar-based power (photovoltaic, wind, hydro, biomass) are plentiful. However, how we get to there from where we are now is not clear, and many questions remain (the role of nuclear power, the rate of transition, the role of government, the impacts of climate change, energy storage capabilities, battery vs. hydrogen fuel cell cars, etc.). This course will look at all of these topics related to all of the energy sources, including the roles they played in our past and the roles they might play in our future.

**Course Structure:** We are planning for the course to be fully in-person. Preparation for the classes will involve a combination of homework problems and pre-recorded lectures, with in-class time dedicated to a mix of short lecture, group work, problem-based learning, and guest presentations. The video lectures are from a course I made as part of the *Great Courses* video lecture series, called “The Science of Energy: Resources and Power Explained.” That video course was made after teaching this WashU course for many years. These video lectures will be posted within Canvas and are only for use within this course. It is expected that you watch the assigned videos before each Tuesday and Thursday class, and there will be a short quiz within Canvas based on each lecture, access to which will cease the moment that class starts.

**Textbook:** *Energy, Environment, and Climate*, 3<sup>rd</sup> Ed., Richard Wolfson, Norton, 2018.

**Prerequisites:** One year of high school physics or chemistry and a comfort with algebra.

**Grading and Assessments:** Assessments for the course will take several forms.

- 1) On Tuesdays and Thursdays, a short asynchronous quiz will be due before the start of class, based on the asynchronous video for that day. This will involve 5 multiple-choice questions

that are automatically graded within Canvas. The questions will be presented one at a time, without the ability to go back and change answer. In addition, each quiz will request a question from you, based on the material. I will start off each class by answering some of these questions, and you will get a 10-point bonus each time I answer one of your questions. At the end of the course, I will toss out your two lowest quiz scores.

- 2) For most weeks, a set of homework questions will be assigned, in the form of an untimed Canvas "Quiz." You are to upload your answers into the Quiz tool by the end of the day on Thursdays. Many of the homework problems will be loosely based on the textbook, but none taken directly (alas, the textbook's homework solutions are too easily obtained online). Late homework will be graded for 80% of full credit if turned in by 5 PM Friday, 60% if turned in by 5 PM Monday, and 40% before 5 PM Tuesday. Homework presented later than that will not be graded.
- 3) On some days, in-class assignments will be done during class and collected at the end of class. A major part of this is that there will be a set of 4 in-class debates carried out in the final classes of the course. Each student will be on one team for one of the debates, but will act as part of the jury for each of the other three debates. Students will have the option of choosing which team to be on. The Debate grade will be a combination of the student's own debate and their participation in evaluating the other debates.
- 4) A final project will be due during finals period. It will involve preparing a hypothetical high school-level educational activity on an energy-related topic of your choosing.

**Academic Integrity:** Copying from another student or from material published conventionally or electronically is not acceptable. You are *encouraged* to work together on homework questions, but each of you must write up your own answers after leaving any study group. Suspected infractions of the university academic integrity policy will be taken to the Academic Integrity Committee of the College of Arts & Sciences.

**Preparation for Class:** For most classes, class preparation will take two forms: the half-hour video lecture and a short reading assignment from the textbook, listed in the syllabus. There will also be occasional additional readings, sometimes before class, sometimes within class, sometimes as part of homework.

**Attendance, Participation, and Classroom Climate:** Class attendance is required, unless excused for medical reasons. Discussion and participation are a major emphasis in this course. This means that it is your responsibility to come to class ready and willing to take part in group knowledge building. Research shows that group work and discussions are an important part of building your brain's neural pathways for understanding. The lecture portions of classes will be recorded and made available through the Canvas course Kaltura Media Gallery, but these will be a minority of class time.

All classroom interactions are expected to remain civil, respectful, and supportive. For WashU's policy on Inclusive Learning, please see <https://diversity.wustl.edu/framework/advisory-best-practice-groups/inclusive-learning-environment/>.

Digital devices are allowed in class, but please keep any non-course-related activity to a bare minimum. Research (from WashU Psychology professor Julie Bugg) has shown that non-essential digital device use in class not only detracts from your own understanding but also that of a halo of students around you.

**Learning Expectations:** By the end of the course, I expect students to be able to:

- Ask questions to develop explanations about energy-related issues
- Discuss and debate current controversies related to energy
- Analyze and interpret energy-related texts
- Analyze and interpret current and future events related to energy
- Construct explanations based on energy-related data

- Use quantitative data to solve energy-related problems
- Identify reliable information related to energy
- Defend an argument on an energy-related topic
- Carry these out in a variety of formats: digital and in-person

**Grading:** The value of course assignments will be roughly weekly homework (~35%), daily online quizzes (~25%), In-Class assignments, including the Debates (~25%), and Final Project (~15%).

**Canvas:** The course materials will be based out of Canvas.

<b>Schedule:</b>		<b>Video Lecture</b>	<b>Reading (Wolfson)</b>	
Aug	31: Introduction	---	---	
Sep	2: Energy and History	1		
	7: Forms of Energy	2	Ch. 2	
	9: Work, Energy, and Power	A	Ch. 3	
	14: Heat and the Flow of Energy	3	Ch. 4	
	16: Electricity	4	Ch. 11.1	
	21: Atoms and Chemical Energy	5	Ch. 1	
	23: Energy and Coal (Guest: Beth Martin)	6	Ch. 5	
	28: Petroleum	7		
	30: Natural Gas (Guest: Elai Rettig)	8		
Oct	5: Fossil Fuel Impacts (Guest: Bret Gustafson)	9	Ch. 6	
	7: Climate Systems	10	Ch. 13	
	12: No Class (Fall Break)			
	14: Climate and Human History (Guest: Liz Hubertz)	B	Ch. 14, 15.3, 15.4	
	19: Nuclear Fission	11	Ch. 7.1-7.4	
	21: Nuclear Fuel Cycle (Guest: Sam Evans-Brown)	12	Ch. 7.5-7.8	
	26: Solar Energy – I	13	Ch. 9.1, 9.3, 12.1-12.4	
	28: Solar Energy – II	14	Ch. 9.2, 9.4, -9.7	
	Nov	2: Wind Energy (Guest: Phil Valko)	15	Ch. 10.2
		4: Hydroelectric Energy	16	Ch. 10.1
9: Biomass Energy		17	Ch. 10.3	
11: Geothermal		18	Ch. 8	
16: Energy Storage (Guest: Vijay Ramani)		19	pp. 304-307	
18: Energy and Transportation		20	---	
23: Energy Efficiency		21	Ch. 16.5	
25: No Class (Thanksgiving)				
30: Energy and Law/Economics	22	---		
Dec	2: Probable and Possible Future Energy Scenarios	23	Ch. 7.9	
	7: Energy Trends: Planning for the Near Future	24	Ch. 16.1-16.4, 16.6	
	9: Big Picture Perspectives			
	17: Final Project due (digital upload)			

## COVID-19 Health and Safety Protocols

Exceptions to course attendance policies, expectations, and requirements because of a COVID-19 diagnosis, symptoms consistent with COVID-19, or exposure to a person with a confirmed or suspected COVID-19 diagnosis that requires quarantine or isolation will be made in collaboration between the student and instructor. In these cases, please notify your instructor as soon as possible to discuss appropriate accommodations.

While on campus, it is imperative that students follow all public health guidelines established to reduce the risk of COVID-19 transmission within our community. The full set of University protocols can be found at <https://covid19.wustl.edu/health-safety/>. This includes:

- **Completing a self-screening using the [WashU COVID-19 Screening app](#) every day before coming to campus or leaving your residence hall room.** If you do not receive a green check and pass the screening, you are not permitted to come to campus or leave your residence hall room. You must contact the COVID Call Center (314-362-5056) or the Habif Health and Wellness Center (314 935-6666) immediately. **Note:** In addition to the symptoms listed in the screening tool, everyone also should pay attention to symptoms that are new or different for you, including things like headache and congestion, particularly in combination with diarrhea. These can also be signs of COVID-19. **Call the COVID Call Center or Habif to report these symptoms.**
- **Complying with universal masking.** All individuals on campus must wear disposable masks or cloth face coverings while occupying indoor public settings, including: multi-person offices, hallways, stairwells, elevators, meeting rooms, classrooms and restrooms. Extra masks are available in the classroom if you have forgotten one. This means that eating during class time is not allowed. Students with disabilities for whom masked instructors or classmates create a communication barrier are encouraged to contact Disability Resources ([www.disability.wustl.edu](http://www.disability.wustl.edu)) or talk to their instructor for assistance in determining reasonable adjustments. Adjustments may involve amplification devices, captioning, or clear masks but will not allow for the disregard of mask policies.
- **Maintaining physical distancing as needed.** While distancing requirements have been removed for vaccinated students, those who are not fully vaccinated are strongly encouraged, for their own health, to maintain a distance of 6 ft from others in the classroom. If you are not able to be vaccinated or have conditions that may put you at increased risk of failed immunity and classroom activities would bring you in frequent proximity to other students, contact your instructor to discuss alternatives.
- **Practicing healthy personal hygiene,** including frequent handwashing with soap and warm water for at least 20 seconds and/or using hand sanitizer with at least 60% alcohol. Disinfectant gel and wipes are available in the classroom.

## University-Wide Policies

### Reporting Sexual Assault or Harassment

If a student discusses or discloses an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if a faculty member otherwise observes or becomes aware of such an allegation, the faculty member will keep the information as private as possible, but as a faculty member of Washington University, they are required to immediately report it to the Department Chair, Dean, or to Ms. Cynthia Copeland, the Associate Title IX Coordinator, at (314) 935-3411, [cmcopeland@wustl.edu](mailto:cmcopeland@wustl.edu). Additionally, you can report incidents or complaints to the Office of Student

Conduct and Community Standards or by contacting WUPD at (314) 935-5555 or your local law enforcement agency. See: [Title IX](#).

### **Reasonable Accommodations for Disabled Students**

Washington University in St. Louis supports the rights of enrolled students to a full and equal educational opportunity and, in compliance with federal, state, and local requirements, is committed to reasonable accommodations for individuals with documented disabilities. Disabled students for whom accommodations may be necessary must be registered with, and provide their instructors official notification through, WUSTL's Disability Resources ([www.disability.wustl.edu](http://www.disability.wustl.edu)). Once established, responsibility for disability-related accommodations and access is shared by DR, faculty, and the student. Please contact Disability Resources at 314.935.5970 or [disabilityresources@wustl.edu](mailto:disabilityresources@wustl.edu).

### **Statement on Military Service Leave**

Washington University recognizes that students serving in the U.S. Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or [veterans@wustl.edu](mailto:veterans@wustl.edu) and their academic dean for guidance and assistance. See: <https://veterans.wustl.edu/policies/policy-for-military-students/>.

### **Preferred Names and Gender Inclusive Pronouns**

In order to affirm each person's gender identity and lived experiences, it is important that we ask and check in with others about pronouns. This simple effort can make a profound difference in a person's experience of safety, respect, and support. See: <https://students.wustl.edu/gender-pronouns-information/> , <https://registrar.wustl.edu/student-records/ssn-name-changes/preferred-name/>.

### **Emergency Preparedness**

Before an emergency, familiarize yourself with the building(s) that you frequent. Know the layout, including exit locations, stairwells and the Emergency Assembly Point (EAP). Review the "Quick Guide for Emergencies" that is found near the door in many classrooms for specific emergency information and instructions. For additional Information and EAP maps, visit [emergency.wustl.edu](http://emergency.wustl.edu). To ensure that you receive emergency notifications, make sure your information and cell phone number is updated in SIS, and/or download. The WUSTL app and enable notifications.

To report an emergency:

Danforth Campus: (314) 935-5555

School of Medicine Campus: (314) 362-4357

North/West/South and Off Campus: 911 then (314) 935-5555

### **Academic Integrity**

Effective learning, teaching and research all depend upon the ability of members of the academic community to trust one another and to trust the integrity of work that is submitted for academic credit or conducted in the wider arena of scholarly research. Such an atmosphere of mutual trust fosters the free exchange of ideas and enables all members of the community to achieve their highest potential. In all academic work, the ideas and contributions of others must be appropriately acknowledged and work that is presented as original must be, in fact, original. Faculty, students and administrative staff all share the responsibility of ensuring the honesty and fairness of the intellectual environment at Washington University in St. Louis.

For additional details on the university-wide Undergraduate Academic Integrity policy, please see: <https://wustl.edu/about/compliance-policies/academic-policies/undergraduate-student-academic-integrity-policy/>

### **Turnitin**

In taking this course, students may be expected to submit papers and assignments through Turnitin for detection of potential plagiarism and other academic integrity concerns. If students do not have an

account with Turnitin and/or do not utilize Turnitin when submitting their papers and assignments, the instructor may upload your paper or assignment to Turnitin for processing and review.

## **Resources for Students**

The syllabus can be a place for students to find support for academic and non-academic challenges that can impact their learning. Resources for students that can be highlighted in the syllabus include those listed below.

### **Disability Resources**

At Washington University we strive to make the academic experience accessible and inclusive. If you anticipate or experience barriers based on disability, please contact Disability Resources at 314.935.5970, [disabilityresources@wustl.edu](mailto:disabilityresources@wustl.edu), or visit our website for information about requesting academic accommodations. See: <https://students.wustl.edu/disability-resources/>.

### **Confidential Resources for Instances of Sexual Assault, Sex Discrimination, Sexual Harassment, Dating Violence, Domestic Violence, or Stalking**

The University is committed to offering reasonable academic accommodations (e.g. a no-contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If a student needs to explore options for medical care, protections, or reporting, or would like to receive individual counseling services, there are free, confidential support resources and professional counseling services available through the Relationship and Sexual Violence Prevention (RSVP) Center. If you need to request such accommodations, please contact RSVP to schedule an appointment with a confidential and licensed counselor. Although information shared with counselors is confidential, requests for accommodations will be coordinated with the appropriate University administrators and faculty. The RSVP Center is located in Seigle Hall, Suite 435, and can be reached at [resvpcenter@wustl.edu](mailto:resvpcenter@wustl.edu) or (314) 935-3445. For after-hours emergency response services, call (314) 935-6666 or (314) 935-5555 and ask to speak with an RSVP Counselor on call. See: [RSVP Center](#).

### **Bias Report and Support System (BRSS)**

The University has a process through which students, faculty, staff, and community members who have experienced or witnessed incidents of bias, prejudice, or discrimination against a student can report their experiences to the University's Bias Report and Support System (BRSS) team. To report an instance of bias, visit <https://students.wustl.edu/bias-report-support-system/>.

### **Mental Health Services**

Mental Health Services' professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect a student's academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety, depression, and thoughts of suicide. See: <https://students.wustl.edu/mental-health-services/> Additionally, see the mental health services offered through the RSVP Center listed above.

### **WashU Cares**

[WashU Cares](#), specializes in connecting students to mental health, medical, financial and academic resources by using supportive case management. We seek to empower students to be successful through life's challenges and to have ownership of their experiences. Our services are designed to support Danforth Campus students. If you feel concerned about a student who may need help connecting to resources, we accept referrals from all students, faculty, and staff. If you are concerned about a student, you can file a report here: <https://washucares.wustl.edu/> and a WashU Cares Case Manager will reach out to you to get more information about your concern.

### **The Writing Center**

The Writing Center offers free writing support to all Washington University undergraduate and graduate students. Staff members will work with students on any kind of writing project, including essays, writing assignments, personal statements, theses, and dissertations. They can help at any stage of the process, including brainstorming, developing and clarifying an argument, organizing evidence, or improving style. Instead of simply editing or proofreading papers, the tutors will ask questions and have a conversation with the writer about their ideas and reasoning, allowing for a higher order revision of the work. They will also spend some time looking at sentence level patterns to teach students to edit their own work. The Center is located in Mallinckrodt and open Sunday through Thursday from 11:00 am to 9:00 pm and Friday from 11:00 am to 5:00 pm. Students are seen primarily by appointment, but walk-ins will be accepted as the schedule allows. To make an appointment, go to [writingcenter.wustl.edu](mailto:writingcenter.wustl.edu). Email: [writing@wustl.edu](mailto:writing@wustl.edu).

### **Engineering Communications Center**

The Engineering Communications Center offers students in the McKelvey School of Engineering one-on-one help with oral presentations, writing assignments, and other communications projects. They are located in Urbauer Hall, Rm. 104. To schedule an appointment, please email the ECC faculty at [ecc@seas.wustl.edu](mailto:ecc@seas.wustl.edu).

### **The Learning Center**

The Learning Center of the Center for Teaching and Learning (CTL), located on the ground floor of the Mallinckrodt Center, works collaboratively with University partners to provide undergraduate students key resources, such as academic peer led team mentoring (PLTL), residential peer mentoring (RPM), and academic peer mentoring (APM) to enhance their academic progress. Contact them at <https://ctl.wustl.edu/learningcenter/> to find out what support they may offer for your classes.

### **Center for Diversity and Inclusion (CDI)**

The Center for Diversity and Inclusion (CDI) supports and advocates for undergraduate, graduate, and professional school students from underrepresented and/or marginalized populations, collaborates with campus and community partners, and promotes dialogue and social change to cultivate and foster a supportive campus climate for students of all backgrounds, cultures, and identities. Visit: <https://diversityinclusion.wustl.edu/>.

### **Gephardt Institute**

State and local elections can have direct and immediate impacts on our communities and will be happening here in St. Louis and around the country this year. Make sure you stay current on upcoming elections at all levels by registering as a voter, requesting an absentee ballot, or getting election day reminders. You can do all this at <https://wustl.turbovote.org/> for any of the 50 states and Washington D.C.. If you are ineligible to vote, you can still participate by referring your friends who are eligible to the TurboVote link and by engaging with your peers about local issues. If you have any questions about the voting process in the United States, please visit: <http://washuvotes.wustl.edu>.