

# ENGINEERING FOR ENERGY SUSTAINABILITY, CERTIFICATE

Equity and sustainability of energy resources in the face of increasing global population and economic development are key issues at the center of the public discourse today. The objective of this certificate program is to offer undergraduate students a suite of courses addressing energy sustainability. The courses span across the engineering curriculum, with firm roots in real-world design and engineering practices.

Students enrolled as degree-seeking undergraduates with a minimum GPA of 2.5 and a plan of study to fulfill the certificate requirements may enroll in the program. Applications may be submitted at any time, but students are encouraged to apply early in their undergraduate careers in order to ensure successful completion of the program; however, students may take courses that fulfill certificate requirements before submitting an application.

## HOW TO GET IN

### DECLARING THE CERTIFICATE

A student interested in completing the certificate program must contact a designated faculty member in the major department to apply. The student and faculty member must complete a Declaration of Intent and Study Plan to enter the certificate program.

Required: Declaration of Intent and Study Plan ([https://energy.wisc.edu/sites/default/files/dec\\_of\\_intent-2019.pdf](https://energy.wisc.edu/sites/default/files/dec_of_intent-2019.pdf))

See the People (<http://guide.wisc.edu/undergraduate/engineering/engineering-physics/engineering-energy-sustainability-certificate/#peopletext>) tab to find your designated faculty contact.

When the student and faculty member have filled out and signed the Declaration of Intent and Study Plan, the student must hand them in to Room 2150 Wisconsin Energy Institute.

## REQUIREMENTS

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Students must select 16 "sustainability credits" from a suite of available courses that are divided into the following categories:

- Liberal Studies and Science (Minimum of 3, maximum of 6 sustainability credits)
- Engineering (Minimum of 3, maximum of 6 sustainability credits)
- Capstone (Minimum of 3, maximum of 6 sustainability credits)
- Seminar (1 sustainability credit required)

The seminar requirement is fulfilled through the course CBE 555 Seminar-Chemical Engineering Connections, or E P 602 Special Topics in Engineering Physics (Sustainable Energy Challenges and Solutions), both of which are open to all engineering majors.

Not all courses have the same number of sustainability credits as academic credits; some courses have fewer sustainability credits depending on how closely related they are to energy and sustainability. Students should review the sustainability credits associated with each course while filling out their study plan.

### PRE-APPROVED COURSES

#### Liberal Studies and Science

Code	Title	Credits
A A E 246	Climate Change Economics and Policy <sup>3</sup> sustainability credits	3
ENVIR ST 112	Environmental Studies: Social Science Perspectives <sup>3</sup> sustainability credits	3
ENVIR ST 113	Environmental Studies: Environmental Humanities <sup>3</sup> sustainability credits	3
ENVIR ST/GEOG 139	Global Environmental Issues <sup>3</sup> sustainability credits	3
ENVIR ST/A A E 244	The Environment and the Global Economy <sup>3</sup> sustainability credits	4
ENVIR ST 250	Introduction to Sustainability Science <sup>3</sup> sustainability credits	3
ENVIR ST/GEOG 339	Environmental Conservation <sup>3</sup> sustainability credits	4
ENVIR ST/A A E/ ECON 343	Environmental Economics <sup>3</sup> sustainability credits	3-4
ENVIR ST/ GEOSCI 411	Energy Resources <sup>3</sup> sustainability credits	3
ENVIR ST/GEOG/ HISTORY 460	American Environmental History <sup>3</sup> sustainability credits	4
ENVIR ST/A A E/ CIV ENGR/ URB R PL 561	Energy Markets <sup>3</sup> sustainability credits	3

#### Engineering

Code	Title	Credits
BSE/DS/ LAND ARC 356	Sustainable Residential Construction <sup>2</sup> sustainability credits	3
BSE/ENVIR ST 367	Renewable Energy Systems <sup>3</sup> sustainability credits	3
BSE 460	Biorefining: Energy and Products from Renewable Resources <sup>3</sup> sustainability credits	3
BSE 461	Food and Bioprocessing Operations <sup>1</sup> sustainability credit	3
CBE 250	Process Synthesis <sup>1</sup> sustainability credit	3
CBE 310	Chemical Process Thermodynamics <sup>1</sup> sustainability credit	3
CBE 311	Thermodynamics of Mixtures <sup>1</sup> sustainability credit	3
CBE 326	Momentum and Heat Transfer Operations <sup>1</sup> sustainability credit	3
CBE 430	Chemical Kinetics and Reactor Design <sup>1</sup> sustainability credit	3
CBE 450	Process Design <sup>1</sup> sustainability credit	3

CBE 562	Special Topics in Chemical Engineering (Topic: Energy and Sustainability) <sup>3</sup> sustainability credits	3
CBE/M E 567	Solar Energy Technology <sup>3</sup> sustainability credits	3
CIV ENGR 320	Environmental Engineering <sup>1</sup> sustainability credit	3
CIV ENGR 370	Transportation Engineering <sup>1</sup> sustainability credit	3
CIV ENGR/G L E 421	Environmental Sustainability Engineering <sup>3</sup> sustainability credits	3
E C E 355	Electromechanical Energy Conversion <sup>1</sup> sustainability credit	3
E C E 356	Electric Power Processing for Alternative Energy Systems <sup>3</sup> sustainability credits	3
E C E 412	Power Electronic Circuits <sup>1</sup> sustainability credit	3
E C E 427	Electric Power Systems <sup>1</sup> sustainability credit	3
G L E 401	Special Topics in Geological Engineering (Topic: Wind Energy Site Design and Construction) <sup>3</sup> sustainability credits	1-4
or CIV ENGR 639	Special Topics in Geotechnical Engineering	
M E 361	Thermodynamics <sup>1</sup> sustainability credit	3
M E 370	Energy Systems Laboratory <sup>1</sup> sustainability credit	3
M E 466	Air Pollution Effects, Measurements and Control <sup>1</sup> sustainability credit	3
or CIV ENGR 423	Air Pollution Effects, Measurement and Control	
M S & E 330	Thermodynamics of Materials <sup>1</sup> sustainability credit	4
M S & E 331	Transport Phenomena in Materials <sup>1</sup> sustainability credit	3
N E 571	Economic and Environmental Aspects of Nuclear Energy <sup>3</sup> sustainability credits	3

### Capstone

Courses numbered 489, 491, 599, 601, and 699 (not exhaustive) are examples of courses that may count towards this requirement. See capstone course guidelines for more information (<https://energy.wisc.edu/education/for-students/academic-programs/certificate-energy-sustainability/capstone-guidelines>).

### Seminar

Code	Title	Credits
E P 602	Special Topics in Engineering Physics <sup>1</sup> sustainability credit	1-3
CBE 555	Seminar-Chemical Engineering Connections <sup>1</sup> sustainability credit	1

## COURSE AUTHORIZATION

Some courses may require additional approval to appear in students' DARS reports as having fulfilled part of the certificate requirements. Students who are taking a course for the capstone

requirement must fill out this DARS Authorization Form ([https://uwmadison.co1.qualtrics.com/jfe/form/SV\\_bpFYQNVcKo4UogI](https://uwmadison.co1.qualtrics.com/jfe/form/SV_bpFYQNVcKo4UogI)) to receive the proper number of sustainability credits. For more information on obtaining credits for capstone courses, see Capstone Course Guidelines (<http://energy.wisc.edu/education/energy-certificate/capstone-guidelines>).

In addition, students who wish to receive sustainability credits for courses that are not currently on the pre-approved list may also complete the DARS Authorization Form ([https://uwmadison.co1.qualtrics.com/jfe/form/SV\\_bpFYQNVcKo4UogI](https://uwmadison.co1.qualtrics.com/jfe/form/SV_bpFYQNVcKo4UogI)) and explain why the course should receive sustainability credits.

Once a form is filled out, it will be sent to the certificate faculty committee for approval. To expedite the approval process, students should submit their DARS Authorization Form ([https://uwmadison.co1.qualtrics.com/jfe/form/SV\\_bpFYQNVcKo4UogI](https://uwmadison.co1.qualtrics.com/jfe/form/SV_bpFYQNVcKo4UogI)) before or near the beginning of the semester in which they plan to take the course.

## CERTIFICATE COMPLETION REQUIREMENT

This undergraduate certificate must be completed concurrently with the student's undergraduate degree. Students cannot delay degree completion to complete the certificate.

## LEARNING OUTCOMES

1. Understand the physical properties and processes related to energy resources and the conversion technologies involved.
2. Understand how energy decisions are impacted by environmental, social, economic or political factors.
3. Synthesize knowledge of the technical/physical aspects of energy with the social/environmental factors to analyze how energy choices impact the sustainability of energy systems.
4. Apply interdisciplinary energy knowledge to analyze, design or solve a matter of real world significance related to sustainability of energy use.

## PEOPLE

The following faculty members have been designated as a point of contact for each department:

- Troy Runge (<https://energy.wisc.edu/about/energy-experts/troy-runge>), Biological Systems Engineering
- Robert G. Radwin ([http://www.engr.wisc.edu/bme/faculty/radwin\\_robert.html](http://www.engr.wisc.edu/bme/faculty/radwin_robert.html)), Biomedical Engineering
- Thatcher Root (<https://energy.wisc.edu/about/energy-experts/thatcher-root>), Chemical and Biological Engineering
- Andrea Hicks (<https://energy.wisc.edu/about/energy-experts/andrea-hicks>), Civil and Environmental Engineering
- Giri Venkataramanan (<https://energy.wisc.edu/about/energy-experts/giri-venkataramanan>), Electrical and Computer Engineering
- James Tinjum (<https://energy.wisc.edu/about/energy-experts/james-tinjum>), Geological Engineering
- Amanda Smith ([https://directory.engr.wisc.edu/ie/Faculty/Smith\\_Amanda](https://directory.engr.wisc.edu/ie/Faculty/Smith_Amanda)), Industrial and Systems Engineering

- Dane Morgan (<https://energy.wisc.edu/about/energy-experts/dane-morgan>), Materials Science and Engineering
- Sage Kokjohn (<https://energy.wisc.edu/about/energy-experts/sage-kokjohn>), Mechanical Engineering
- P ([https://directory.engr.wisc.edu/ep/Faculty/Wilson\\_Paul](https://directory.engr.wisc.edu/ep/Faculty/Wilson_Paul))aul Wilson (<https://energy.wisc.edu/about/energy-experts/paul-wilson>), Nuclear Engineering, Engineering Mechanics, and Engineering Physics

Students who are not engineering majors should contact Scott Williams (spwilliams@wisc.edu) to discuss options for completing the certificate or alternative programs.

## **ENGINEERING PHYSICS DEPARTMENT**

### **PROFESSORS**

Blanchard  
 Bonazza  
 Bronkhorst  
 Crone  
 Fonck  
 Hegna  
 Henderson  
 Lakes  
 Schmitz  
 Smith (also Mathematics)  
 Sovinec  
 Waleffe (also Mathematics)  
 Wilson (chair)

### **ASSOCIATE PROFESSOR**

Witt

### **ASSISTANT PROFESSORS**

Choy  
 Couet  
 Franck  
 Geiger  
 Notbohm  
 Thevamaran  
 Zhang

See department website (<https://directory.engr.wisc.edu/display.php/faculty/?page=ep&search=faculty>) for list.