

**Insider's Guide to Energy Business and Finance (EBF) at
Penn State University, AY 2022-23**

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1 About EBF and the Insider's Guide

The Energy Business and Finance degree program, offered through the John and Willie Leone Family Department of Energy and Mineral Engineering at Penn State, is a unique degree program designed to train students for careers in energy or related industries. The General Option provides students with broad training in business and economics as relevant to energy production, consumption and delivery. Students are expected to supplement this training with an approved minor, concurrent major, or term abroad experience, depending on their personal and career interests.

While the EBF General Option covers many of the essentials that students will find in conventional economics or business programs, our requirements are much more difficult than either. In particular, the EBF program expects a level of comfort with mathematical, statistical and quantitative thinking that is higher than expectations in economics or business.

This EBF Insider's Guide is designed to provide students in the General Option of the Energy Business and Finance program at Penn State with detailed information on program requirements, courses available to students in the major, and pathways to graduation. It expands upon information available through two online resources:

- The EBF General Option program description available through the University Bulletin (<http://undergraduate.bulletins.psu.edu/undergraduate/colleges/earth-mineral-sciences/energy-business-finance-bs/>);
- The Recommended Academic Plans for the EBF General Option (<http://undergraduate.bulletins.psu.edu/undergraduate/colleges/earth-mineral-sciences/energy-business-finance-bs/#suggestedacademicplantext>).

The EBF major has a number of aspects that some students find complicated. The Insider's Guide is designed to provide a clear explanation of program requirements and the courses that make up the EBF major. To minimize pain and confusion, all EBF General Option students are urged to read this document carefully and to take two additional steps:

1.1 Get to Know Your Advisor!

We encourage students to know their advisors. Meeting with your assigned advisor regularly can save you lots of trouble. If you do not know who your assigned advisor is, check in your LionPATH Student Center or, if you do not have an advisor listed there, email Molly Nulty at mkn6@psu.edu to request to be assigned to one. If there is a question your advisor cannot answer, please contact the program chair, Dr. Lei. But do not contact the program chair first with an issue your advisor can handle. You will simply be directed to talk to your advisor.

You should talk with your advisor about:

- Scheduling courses
- Reviewing degree audits and progress towards your degree
- Signing course substitution petitions
- Career or internship questions

For the following issues, you should talk with the program chair directly:

- Approval of concurrent majors
- Approval for minors not already on the approved list at the end of this document
- Approval of study abroad options used to satisfy EBF General Option requirements (if you are studying abroad just because you want to and not to satisfy any program requirement, then you don't need to talk to the program chair)
- Approval for electives not already on the approved list contained in this document or on your degree audit

Ms. Nulty is the dedicated academic advisor for the EBF program and is available to answer questions. Please see <https://www.eme.psu.edu/undergraduate/undergraduate-advising/who-contact-advising-questions> for information about which advising topics to discuss with your faculty advisor or Ms. Nulty.

1.2 Schedule Classes Early!

Demand for many EBF courses exceeds capacity, and demand for many of the courses that EBF students take through the Smeal College of Business also exceeds capacity. It is therefore imperative that students schedule courses as early as possible. If you don't know when your scheduling date is, you can find out in your LionPATH Student Center.

We suggest scheduling courses literally as soon as you can – at 12:01 am on the earliest day that you are allowed to schedule. There is very little that the faculty or advisors can do to help you if you delay scheduling, even by one day!

If you aren't able to schedule the classes that you need on your registration day, it is imperative that you contact Molly Nulty or your academic advisor as soon as possible. Some courses have more than one section, so if you aren't admitted into the section of a course that you originally chose, make sure you look to see if there is another open section at a different time.

2 What is New This Year?

2.1 EBF 301

Residence EBF 301 is only offered in Fall 2022 this year.

An online EBF 301 is offered in Summer 2023.

2.2 EBF 401

EBF 401 is only offered once per year, in the spring.

The EBF program will allow FIN 305 offered by Smeal to substitute for EBF 401, but EBF students should realize that they can enter the class only during the summer, and they will need to have all of the prerequisites (especially a statistics class). Corporate finance courses offered at other Universities may also substitute for EBF 401 if they are listed in the transferring credits tool as equivalent to PSU's FIN 305.

The EBF program NO LONGER allows FIN 301 offered by Smeal to substitute for EBF 401, given the material FIN 301 currently covers.

2.3 EBF 473

Residence EBF 473 is only offered once per year, in the Fall.

An online EBF 473 might be offered in Summer 2023 if the enrollment is sufficient.

2.4 EBF 497

One EBF 497 (special topics) course is offered in Spring 2023, titled "The Great Transition: Law, Economics, and the New Frontiers of Energy" and taught by Drs. Kleit and Wiseman.

It may substitute for EBF 304W.

2.5 EME 450 (Energy Crisis Leadership)

EME 450 is the official course number for the Energy Crisis Leadership course, taught by Dr. Kleit. It can be used in place of the 400-level elective, but NOT for your WAC requirement.

2.6 PNG 397

PNG 397 is a data analytics course newly offered by EME. It can be used to substitute STAT 401.

2.7. EMSC 297 (Geopolitics of Energy)

EMSC 297 is a new course offered by Dr. Lo Prete, in Fall 2022. It can be used for GS requirement.

3 EBF Courses for Academic Year 2022/23

3.1 Prerequisites for EBF Courses

Prerequisites for EBF courses have been changed. The new prerequisites have become effective starting from Spring 2021.

Students will need to plan very carefully to get EBF 200, EBF 301 and statistics completed as early in their careers as possible. Note that MATH 141 is a prerequisite for STAT 401, so make sure that you take MATH 141 or an equivalent early enough (you should not delay taking MATH 141 anyway, since it is a requirement for entry to the major).

EBF 200

Old Prerequisites: ECON 102 and MATH 022 or equivalent

New Prerequisites: ECON 102 and (MATH 22 or MATH 26 or MATH 40 or MATH 41 or MATH 140 or placement beyond MATH 22)

EBF 304

Old Prerequisites: EBF200

New Prerequisites: EBF 200 and EME 460 and (STAT 401 or EBF 472 or ECON 306)

EBF 401

Old Prerequisites: EBF 200 and EBF 301 and EME 460; E B F 472 or STAT 200 or STAT 301 or STAT 401 (Junior or Senior standing)

New Prerequisites: EBF 200 and EBF 301 and EME 460 and (EBF 472 or STAT 200 or STAT 401 or ECON 106 or SCM 200)

EBF 402

Old Prerequisites: BLAW243

New Prerequisites: BLAW 243 or BA 242 or BA 243

EBF 473

Old Prerequisites: MATH 140; (ECON 102 and MATH 230) or (EBF 200 and EBF 301); (EBF 472 or STAT 301 or STAT 401)

New Prerequisites: EBF 200 and (MATH 111 or MATH 141) and (EBF 472 or STAT 200 or STAT 401 or ECON 106 or SCM 200)

EBF 483

Old Prerequisites: MATH 140; and (EBF 200 and EBF 301) or (ECON 102 and MATH 230); and (EBF 472 or STAT 200 or STAT 301 or STAT 401)

New Prerequisites: EBF 200 and MATH 140 and EBF 301 and (EBF 472 or STAT 200 or STAT 401 or ECON 106 or SCM 200)

EBF 484

Old Prerequisites: (ECON 102 and MATH 230) or (EBF 200 and EBF 301); and (MATH 110 or MATH 140); and (EBF 472 OR STAT 200 OR STAT 301 OR STAT 401)

New Prerequisites: (MATH 110 or MATH 140) and EBF 200 and EBF 301 and (ECON 302 or MATH 250 or MATH 251)

3.2 EBF Course Offerings for Academic Year 2022/23

Students should note the EBF course offerings and controls for AY 2022/23.

EBF Courses, Fall 2022

Course	Instructor	Controls
EBF 200	Landry, Joel	
EBF 301	He, Zhongyang	
EBF 304 (WAC)	He, Zhongyang	EBF students only
EBF 473	Kleit, Andrew	
EBF 483 (web)	He, Zhongyang	
EME 460	King, Gregory	Fourth semester standing
PNG 397	Morgan	
EMSC 297	Lo Prete	

EBF Courses, Spring 2023 (tentative)

Course	Instructor	Prerequisites/Controls
EBF 200	Lei, Zhen	
EBF 401	Lei, Zhen	
EBF 484	Landry, Joel	
EBF 497 (WAC): The Great Transition: Law, Economics, and the New Frontiers of Energy	Kleit, Andrew & Wiseman, Hannah	
EME 460: Energy Crisis Leadership	Kleit, Andrew	
EME 460	Wang	Fourth semester standing
PNG 397	Obringer	

Note: WAC = Writing Across the Curriculum (the “W” class for the EBF major)

Besides the course schedule, students should note the following:

- Students should expect that enforcement of the prerequisites will be strict, and that students should have completed prerequisites before taking a class that requires prerequisites (i.e., prerequisites cannot be taken concurrently). If you have questions about course prerequisites, please contact the instructor, not your advisor or the program chair. Students may be dropped from classes for not meeting all listed prerequisites.
- There is one section of EBF 497 (special topics) planned for AY 2022/23. It may substitute for EBF 304 W.

3.3 Course Repeat Policy

Penn State policy is that students may not attempt a Penn State class more than two times, regardless of the campus at which the course is taken (University Park, Commonwealth Campuses or World Campus). An “attempt” is defined as receiving a grade or late dropping the course. Courses taken in a semester when a student withdraws from the University or Penn State equivalent courses taken at other universities are not counted as “attempts.”

If you are in a situation where you have attempted a required class (such as ECON 302) two times without passing, then you basically have a few options:

- You may petition to take the class a third time. The process of petitioning starts with a visit to the EME or EMS advisors (Molly Nulty or the Ryan Family Student Center). **Do not see your faculty advisor to ask about petitions for exceptions to the Three-Attempt policy.** Students must meet certain criteria to have a petition approved; it is not automatic.
- You may take an equivalent class at another university and have the credits transfer to Penn State.
- Third attempt requests must be submitted at least 10 university business days prior to the first day of classes of the semester for which the student wants to enroll.
- You may look for alternative majors besides EBF.

4 Requirements for the EBF General Option

This section details the requirements for the EBF General Option. It largely repeats material available from the University Bulletin, but with some additional information.

4.1 Entry to the Major

Students who started at Penn State as freshmen (at any campus) must complete *all* of the following requirements to enter the EBF major:

- Completion of between 40 and 70 credits of Penn State coursework (no entry to the EBF major will be permitted once a student accumulates more than 70 credits of Penn State coursework);
- Cumulative GPA of 2.8 or higher if you entered Penn State prior to summer 2020,
Cumulative GPA of 2.6 or higher if you entered Penn State summer 2020 or later;
- Completion of ECON 102, MATH 140, and MATH 141 with a grade of C or higher in each if you entered Penn State prior to summer 2022,
Completion of ECON 102 and MATH 140 with a grade of C or higher in each if you entered Penn State summer 2022 or later.

If a student applies for EBF while enrolled in their last entrance-to-major course(s) and meets the credit window and GPA requirements, the student will be conditionally accepted to the EBF major. The grade from the in-progress entrance-to-major course(s) will be checked at the end of the semester, and the student must have earned a C or above or otherwise will be removed from the major. The

student's cumulative GPA must also meet the criteria at the end of the semester for the student to remain in the EBF major.

Students who transfer to Penn State from another University go through a somewhat different process.

- Transfer students who meet the College of Earth and Mineral Sciences transfer admissions criteria can enter the College in pre-major status and apply for EBF when they meet the entrance-to-major requirements for transfer students described below.
- Transfer students must apply to officially enter the EBF major when they have completed between 14 and 26 Penn State credits. At the time that transfer students apply for the major, they must meet the following requirements:
 - Penn State cumulative GPA of at least 2.6.
 - Completion of Econ 102, Math 140, and Math 141 with a C or higher in each class (or transfer credit for direct equivalents of these courses) if you entered Penn State prior to summer 2022.
Completion of ECON 102 and MATH 140 with a grade of C or higher in both classes (or transfer credit for direct equivalents of these courses) if you entered Penn State summer 2022 or later.

If a student applies for EBF while enrolled in their last entrance-to-major course(s) and meets the credit window and GPA requirements, the student will be conditionally accepted to the EBF major. The grade from the in-progress entrance-to-major course(s) will be checked at the end of the semester, and the student must have earned a C or above or otherwise will be removed from the major. The cumulative GPA must also still be a 2.6 or above at the end of the semester for the student to remain in the EBF major.

4.2 Overview of EBF General Option Requirements

The EBF General Option requirements consist of a set of coursework and supplementary training aimed at complementing the major coursework.

4.2.1 Coursework Requirements

We divide coursework for the EBF General Option into core EBF courses, required supporting courses, and electives.

Core EBF Courses: EBF 200, EBF 301, EBF 304, EBF 401, EME 460, EBF 483 or 484, and EBF 473. These courses provide the business and economics foundation for

careers in the energy industries. A grade of C or higher is required for all core EBF courses with the exception of EBF 473.

Required Supporting Courses:

Mathematics: MATH 140 and 141. A grade of C or higher is required for both MATH 140 and 141. The EBF program takes this requirement very seriously. We will not accept MATH 110/111 in place of MATH 140/141. Even if you have taken higher-level math, you still need to pass MATH 140/141 with a grade of C or higher in each.

Statistics: STAT 401. A grade of C or higher is required.

Computer Programming: CMPSC 101, CMPSC 200, CMPSC 201, or CMPSC 202.

Economics: ECON 102, ECON 104, ECON 302. A grade of C or higher is required for ECON 102 and ECON 302.

Business: ACCTG 211, BLAW 243 (or BA 241 and BA 242) or ERM 411, IB 303, RM 302. A grade of C or higher is required for RM 302.

English: ENGL 15 or ENGL 30, ENGL 202C or ENGL 202D.

Electives

- 6-7 credits of introductory electives (200-level or lower) from an approved list.
- 3 credits of advanced electives (400-level) from an approved list.

The approved electives lists can be found in the PSU Bulletin:

<http://undergraduate.bulletins.psu.edu/undergraduate/colleges/earth-mineral-sciences/energy-business-finance-bs/#programrequirements>

Some course substitutions are possible, and the EBF program will accept a wider range of electives than what is on the approved list. Common substitutions are discussed in Section 3.4 of this document. Electives that the EBF program will accept are found in Section 5, which also provides detailed course descriptions.

4.2.2 Supplementary Training and Experience

In addition to the coursework requirements, all EBF General Option students are required to attain one of the following:

- A minor from an approved list, available at <http://undergraduate.bulletins.psu.edu/undergraduate/colleges/earth-mineral-sciences/energy-business-finance-bs/#programrequirements>.

Additional information on approved minors is also provided in Section 5 of this Insider's Guide.

- A concurrent major in any subject;
- A 15-credit term abroad or study away program approved by the program chair for EBF

Students wishing to fill this requirement using a minor should be aware of four things.

1. **It is the student's responsibility, not the responsibility of the EME Department or advisors, to ensure that minor requirements have been met prior to graduation.** Before students are certified for graduation, the EBF program chair and EME staff will check degree audits to ensure that minors have been completed. The department will not certify students to graduate if minor requirements have not been completed.
2. Any student wanting to take a minor not on the approved list should consult with the EBF program chair well in advance of starting to take coursework in the minor. **It is the program chair's responsibility, not the responsibility of individual faculty or academic advisors, to approve minors that are not already on the approved list.** The program chair will not approve minors just because all of the requirements for the minor have been fulfilled! In particular, **students should be aware that a minor in Economics or Business Administration cannot be used to fill this EBF requirement.**
3. It is important to note that EME advisors do not advise for minors not in EME and that all students doing such minors should contact the appropriate advising office for them. An advising contact for each minor is listed in the minor's page in the Bulletin.
4. The Smeal College allows EBF students to earn the Certificate in Business Fundamentals. **This certificate program may not be used to meet EBF General Option requirements, and there is limited overlap between the certificate program and EBF requirements.** Students interested in the Certificate in Business Fundamentals should look at the guidance document posted online:
https://www.eme.psu.edu/sites/www.eme.psu.edu/files/documents/undergraduate/ebf_and_smeal_certificate.pdf
5. Some of the minors approved to satisfy EBF major requirements are becoming over-subscribed and seats in classes are very limited. **The minor requirement will not be waived because students are unable to get seats in classes of the minor of their choice.** Students are thus urged to speak with the professor in charge of their chosen minor early on to discuss their plans and get a sense of whether seats in classes may be restricted. This applies particularly to the minor in Spanish and the New Ventures Cluster of the Entrepreneurship and Innovation Minor (this minor offers a number of other good cluster options besides New Ventures, so EBF students are especially encouraged to choose one of those other cluster options).

Students wishing to take a concurrent major should be aware that the process for enrolling in a concurrent major is somewhat complicated. In addition to adding the second major through Update Academics in LionPATH, students need written approval from both departments before the concurrent major will show up on the transcript and degree audit. EBF students wishing to add a concurrent major should contact the EBF Program Chair to discuss their plans, and the Program Chair will signal approval with a written note in the student's records.

Students considering using a term abroad experience to fill this requirement should read **the EBF Study Abroad Guide** (posted on the EBF web site), which has a list of qualifying programs and course requirements for each qualifying program. Courses taken during the term abroad experience may be able to cover specific program requirements. For example, a student who takes the equivalent of Intermediate Microeconomics (ECON 302) during a term abroad program would not be required to take ECON 302 at Penn State.

1. EBF now has a list of qualifying study abroad programs that are listed in the Study Abroad Guide. You need to discuss your study abroad plan with and get approval from the EBF program chair before you apply for a study abroad program. While abroad, you must stick with the approved plan and in cases where agreed-on courses are not available and you need to make necessary changes, you must contact the EBF program chair in advance to get approval.
2. Each qualifying study abroad program now has a list of courses for students to take while abroad. Students can still use study abroad classes to substitute for major requirements in some cases, but there is now much less overlap between study abroad classes and major requirements.
3. Penn State has started to offer "study away" opportunities in Pittsburgh and (eventually) Philadelphia. The EBF program will allow these study away programs to meet EBF major requirements instead of study abroad.
4. The GREEN program may NOT be used as a study abroad to fulfill this requirement.

Note: If you are planning on studying abroad just for the experience and not to meet major requirements, then you can choose whatever program you would like.

4.3 An Important Note on Math Requirements

The EBF General Option requires completion of both MATH 140 and MATH 141, with a grade of C or higher in each.

The EBF program takes the math requirement very seriously. Our experience has been that a student's grade in calculus is one of the best predictors of success in the

EBF major. We urge students to fulfill the mathematics requirement as early in their careers as possible, particularly since MATH 140 and 141 are both required for entry to major. **The mathematics requirements for the major will not be waived!** This means that students in the EBF General Option need to take MATH 140 and 141 (or a direct equivalent from another institution) and to earn a grade of C or higher in both courses. In particular, the program will not accept MATH 110/111 in place of MATH 140/141 for entrance to major under any circumstances.

4.4 Common Course Substitutions

Many EBF students fill some of their program requirements with courses taken at other institutions, or in some cases with other Penn State courses besides those listed in the curriculum. There is a three-step process for approving course substitutions:

1. Have the substitution approved in writing by your faculty advisor and the program chair.
2. Once you have received a grade for the course (if you took it at Penn State) or the course shows up on your Penn State transcript (if you took it at another college or university), fill out a petition form (available in 115 Hosler) and bring it to your advisor to sign. Please make sure that you are using the EMS College form, not a form that you may have downloaded from the internet.
3. Place the completed petition form with supporting documentation (written approvals for the substitution and transcripts from other institutions where appropriate) in Dr. Lei's mailbox in 113 Hosler. You don't need to make an appointment or come to Dr. Lei's office to have petition forms signed.

If you take a course at another university that Penn State recognizes as a direct equivalent to one of its own courses (you can find out whether this is the case through Transferring Credit Tool on the Admissions website at <http://admissions.psu.edu/info/future/transfer/credit/>), then you don't need to go through the course substitution approval process but you do need to make sure that the transcript is sent to the Penn State Admissions Office.

Here are some of the more common course substitutions used by EBF students:

- EBF requires 6 credits of introductory "Natural Science" electives. An extensive list of courses is available on the degree audit or through the Bulletin. Any GN course taught through Earth and Mineral Sciences may be used to fulfill this requirement. In addition, CHEM 110, CHEM 112, PHYS 211, PHYS 212, PHYS 250 and PHYS 251 may also be used to fulfill this requirement.
- Either EBF 483 or EBF 484 may count to meet core EBF requirements. If a student takes (and passes) both, one may be used to fill the advanced elective requirement. *Students are encouraged to take both EBF 483 and 484 but are not required to.*

- Virtually any introductory accounting course from a community college or other university may be used to meet the ACCTG 211 requirement. Many introductory accounting courses at other universities are 3-credit courses, whereas ACCTG 211 is a 4-credit course. We will waive the extra credit of the ACCTG 211 requirement for students transferring in 3-credit introductory accounting courses from other universities, though students will still need to meet the requirement of 120 credits for graduation.
- BA 241 and BA 242 may be taken in place of BLAW 243 or BA 243.
- Students may meet the mathematics requirements through direct equivalents to MATH 140 and 141 taken at another institution.
- Students may meet the statistics requirement using a course taken at a community college or another university. EBF requires a **calculus-based** statistics course, and this requirement extends to any substitute statistics course. **The program chair will not approve any substitute statistics course that does not have calculus as a pre-requisite.**
- Equivalent courses for ECON 102, ECON 104 and ECON 302 can be found at many other universities.
- Students may elect to take a computer science course from another university or one at Penn State other than those listed in the degree requirements. EBF requires a course in a programming language (e.g., C++, Python, Matlab). Courses in word processing or spreadsheet management (e.g., Excel) or courses in web design (HTML), for example, do not meet this requirement.
- Students in ROTC may use three credits of their ROTC coursework towards the Environmental Courses requirement for EBF (these are the 400-level electives) and three credits towards GHW general education requirements.

4.5 Credit for Summer Internships

Some students wish to get credit for summer internships. Advanced students in the general option (rising juniors or higher) can meet their 3-credit advanced elective requirement using a qualified internship. Students wishing to take this option must meet the following requirements:

1. Entrance to the major prior to the start of the internship;
2. Completion of at least four semesters of university coursework prior to the start of the internship;
3. Completion of EBF 200 and EBF 301 prior to the start of the internship, with grades of C or higher in each.

There is a four-step process for getting internship credit:

1. The internship must clearly build upon and complement the EBF curriculum (just working for an energy company is not sufficient – qualifying internships will utilize industry or analytic skills developed through coursework or will build upon a student's analytic tools in a meaningful way);

2. You must get the permission of your faculty advisor by June 1 of the relevant year (much earlier if possible, since many faculty travel a lot over the summer);
3. You need to sign up for a section of ENNEC 496 in the fall term (your advisor can help with this);
4. You need to write a 20-page paper describing your internship, to be evaluated by your advisor.

4.6 Summer Coursework

A number of EBF General Option requirements can be met by taking summer courses, either at University Park, online or through other institutions. Some EBF core courses, such as EBF 200, EBF 301, EBF 483, EBF 483 and EME 460, might be offered online in summer, if the enrollment is sufficient.

More information on summertime course availability is available at <https://www.eme.psu.edu/undergraduate/academics/undergraduate-programs/energy-business-and-finance>. The guide to summertime courses for EBF students is updated in January or February of each year.

4.7 Honors Coursework

We strongly encourage students with GPAs greater than 3.7 and at least an A- in EBF 200 who have not yet entered their junior year to apply to the Schreyer Honors College. More information on the “sophomore gateway” is available from the Honors College at <https://www.shc.psu.edu/admissions/apply/gateway.cfm>.

If you wish to apply to the Honors College at the end of your freshman year, please contact Dr. Lei about getting into EBF 200 if you have not yet scheduled it.

Students wishing to write an EBF honors thesis are expected to take additional coursework in statistics beyond what is required for the EBF General Option – specifically, either ECON 306 or STAT 462. The EBF program will allow this additional statistics work to count as the 3 required advanced elective credits.

For students with strong quantitative and analytical skills, the Honors College provides an excellent pathway to get involved in EBF faculty research. If you have any interest in research-based graduate study someday (see Section 5), getting research experience as an undergraduate is extremely beneficial. Many EBF honors theses wind up getting published!

5 Considering Graduate School?

The EBF General Option positions students very well for graduate study in a number of areas, including economics, finance, law and public policy. A number of our

alumni have gone on to graduate study, either directly from Penn State or after a stint in the workplace.

Students with an interest in graduate study should consider taking additional coursework that complements the EBF General Option and will strengthen their applications. How best to do this depends on the type of graduate study – professional degrees (e.g. a law degree or MBA) or research-based graduate study (e.g. the M.S. or Ph.D.). Students with an interest in graduate study are encouraged to discuss the type of program of interest with faculty advisors or with the EBF program chair.

Students interested in M.S. or Ph.D. programs in economics, finance or in some cases public policy should plan to take as much mathematics and statistics as possible. Minor in math, physics or statistics (or double-majoring) is very strongly encouraged as preparation before pursuing admission to an M.S. or Ph.D. program in one of these fields. Students interested in most areas of professional graduate study are advised to take coursework that develops written communication skills (such as history). An exception might be quantitative MBA programs, where mathematical skills are more highly valued.

5.1 The IUG Program in Energy and Mineral Engineering

The EME Department has an IUG program which allows successful students to graduate in five years with both the B.S. in EBF and the M.S. in Energy and Mineral Engineering. EBF General Option students who wish to be considered for this program need to have a GPA of 3.5 or better. Students interested in the IUG option should discuss this interest with faculty advisors or the EBF program chair as soon as possible.

More information on the IUG program is available at <https://bulletins.psu.edu/graduate/programs/majors/energy-mineral-engineering/#integratedundergradgradprogramstext>

5.2 The Intercollege Graduate Degree Program in Energy, Environmental and Food Economics

Penn State has recently approved an M.S. and Ph.D. program in Energy, Environmental and Food Economics that is offered jointly by EMS and the College of Agricultural Sciences. EBF students interested in a research-based graduate program with high GPAs, excellent recommendations from faculty and sufficient mathematics training would be competitive applicants for this program. Please talk with your faculty advisor if you think you would be interested in applying.

6 Detailed Course Descriptions

This section contains detailed descriptions of courses that can be used to meet EBF requirements (Sections 6.1 through 6.3), as well as a list of minors that will satisfy General Option requirements (Section 6.4). Course descriptions are largely from the University Bulletin, with some commentary. Prerequisites are strictly enforced across the University, so it is always best to check with the instructor or department offering the course if you have questions about prerequisites!

6.1 EBF General Option Core and Required Courses

ECON 102 (GS) INTRODUCTORY MICROECONOMIC ANALYSIS AND POLICY (3) Methods of economic analysis and their use; price determination; theory of the firm; distribution. *A grade of C or better is required.*

Students should take this as early as possible (it is required for entrance into the major). It is offered in the summer at most PSU campuses, and equivalents are offered in the summer at most universities.

ECON 302 (GS) INTERMEDIATE MICROECONOMIC ANALYSIS (3) Allocation of resources and distribution of income within various market structures, with emphasis on analytical tools. *A grade of C or better is required.*

This should be taken immediately after students take ECON 102. It can be taken in the summer at several campuses, and equivalents can be taken at many universities.

EBF 200 (GS) INTRODUCTION TO ENERGY AND EARTH SCIENCES ECONOMICS (3) Resource use decisions and their effect on local, national, and global development. *A grade of C or better is required.*

This is the introductory course to the major and a prerequisite for advanced EBF courses.

EBF 301 GLOBAL FINANCE FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES (3) The aim of this course is to introduce fundamental concepts of financial management and illustrate their global applications. *A grade of C or better is required.*

EBF 301 focuses on commodity markets. Students should take this course early in their EBF career, but not before taking ECON 102.

EBF 304 GLOBAL MANAGEMENT FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES (3) This class is designed to introduce students to modern management and organization strategies for resource businesses. *A grade of C or better is required.*

EBF 304 focuses on risk analysis and making decisions in the face of uncertainty, during both semesters. Since EBF 304 is the writing-intensive course for the EBF program, seats are limited and the course can be hard to get in to. Students taking a concurrent major can have the class with the writing attribute required for their other major count in place of EBF 304. The EBF program has started offering multiple special topics courses (EBF 497) that can substitute for EBF 304.

EBF 401 STRATEGIC CORPORATE FINANCE FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES (3) Financial decisions corporations in the earth science area make and the tools and analyses used to make these decisions. *A grade of C or better is required.*

The EBF program allows FIN 305 offered by Smeal to substitute for EBF 401, but EBF students should realize that they can enter the Smeal course only during the summer, and they will need to have all of the prerequisites (especially a statistics class). Corporate finance courses offered at other Universities may substitute for EBF 401 if they are listed in the transferring credits tool as equivalent to PSU's FIN 305.

EBF 473 RISK MANAGEMENT IN ENERGY INDUSTRIES (3) Analysis of strategies for mitigating business risk from market, atmospheric, geophysical uncertainties including the use of energy/mineral commodity futures/options, weather derivatives, and insurance.

This is the most challenging course in the major and is one of the most relevant to employment opportunities. Less than fully motivated students taking this course senior year should beware – you can fail this class, even if you work at it!

Alternatives for this class are difficult to find. It may be helpful to take EBF 401 previously or concurrently.

EBF 483 Introduction to Electricity Markets (3) This course will introduce students to the structure of regulated and deregulated electricity markets; emerging environmental regulations shaping the electricity industry; and the potential impacts of the "smart grid" on electricity generation, transmission and utilization. *A grade of C or better is required.*

Students are required to take either EBF 483 or EBF 484. If you complete both, one of the classes can count for the 400-level elective course. EBF 483 is offered only in the fall term and is offered online during the summer. EBF 483 provides excellent preparation for a career in the electric power sector.

EBF 484 ENERGY ECONOMICS (3) Economics of energy demand, production, storage, and pricing; advanced energy policy issues including regulation, climate change, new energy technology. *A grade of C or better is required.*

EBF 484 focuses on the economics of the oil and natural gas industries and is offered only in the spring semester. Students are required to take either EBF 483 or EBF 484. If you complete both, one of the classes can count for the 400-level elective course.

ENGL 202C (GWS) Effective Writing: Technical Writing (3) Writing for students in scientific and technical disciplines. (A student may take only one course for credit from ENGL 202A, 202B, 202C, and 202D.)

Or

ENGL 202D (GWS) Effective Writing: Business Writing (3) Writing reports and other common forms of business communication. (A student may take only one course for credit from ENGL 202A, 202B, 202C, and 202D.)

IB 303 (IL) INTERNATIONAL BUSINESS OPERATIONS (3) A survey of the major aspects of international business environment and operations with an emphasis on the cultural dimension.

This class does not appear to be taught at other PSU campuses but may be offered during the summer at University Park.

RM 302 RISK AND INSURANCE (3) Introduction to the principles and methods of handling business and personal risks; emphasis on insurance techniques. *A grade of C or better is required.*

EBF students should plan to take this class in the fall, when there are many more seats offered than during the spring. There is no good substitute for this class at Penn State, and substitutes at other universities are difficult to find.

EMSC 100 (GWS) Earth and Mineral Sciences First-Year Seminar (3) Writing, speaking, and critical thinking skills applied to topics of general interest in Environmental and Materials Science. This is only for first-year students in the EMS College.

Or

CAS 100 (GWS) Effective Speech (3) Introduction to speech communication: formal speaking, group discussion, analysis and evaluation of messages.

If you entered the EMS College as a freshman, you should have taken EMSC 100. If you entered EMS after your freshman year, you need to take CAS 100 and a freshman seminar. You probably already took the freshman seminar from another college. If you are a transfer student, you do not have to take the freshman seminar, and you will need CAS 100 in place of EMSC 100.

ACCTG 211 FINANCIAL AND MANAGERIAL ACCOUNTING FOR DECISION

MAKING (4) Introduction to the role of accounting numbers in the process of managing a business and in investor decision making.

This is the standard accounting course, taught at almost every university in the country. Most UP sections are now offered as hybrid resident-online courses. Unfortunately, the Smeal College has made it difficult for EBF students to take this course in the fall term, so it is usually taken in the spring semester by EBF students. In the summer, you may wish to take it online through the World Campus.

Substitutes for this class can be taken at almost all universities. If you take an accounting course at another university that is only worth 3 credits, Penn State will not recognize it as “ACCTG 211”, but merely “Accounting.” The EBF program will recognize 3-credit accounting courses as satisfying our accounting requirement as long as the material is similar to ACCTG 211. (But students should be aware that Smeal will not accept 3-credit accounting courses as equivalent to ACCTG 211, which means that if you want to take certain Smeal courses then you need to take Penn State’s version of ACCTG 211.) Courses in personal finance are **not** considered an appropriate substitute for ACCTG 211.

CMPSC 101 (GQ) INTRODUCTION TO ALGORITHMIC PROCESSES (3) Properties of algorithms, languages, and notations for describing algorithms, applications of a procedure-oriented language to problem solving. A student may receive credit for only one of the following courses: CMPSC 101, 200, 201, 202, 121.

Or

CMPSC 121 (GQ) Introduction to Programming Techniques (3) Design and implementation of algorithms. Structured programming. Problem solving techniques. Introduction to a high-level language, including arrays, procedures, and recursion.

Or

CMPSC 200 (GQ) PROGRAMMING FOR ENGINEERS WITH MATLAB (3) Development and implementation of algorithms in a MATLAB environment, with emphasis on numerical methods for engineering problems. Students can receive credit for only one of the following: CMPSC 101, 200, 201, 202, 121.

Or

CMPSC 201 (GQ) PROGRAMMING FOR ENGINEERS WITH C++ (3) Development and implementation of algorithms in a procedure-oriented language, with emphasis on numerical methods for engineering problems. Students can receive credit for only one of the following: CMPSC 101, 200, 201, 202, 121.

Or

CMPSC 202 (GQ) Programming for Engineers with FORTRAN (3) Development and implementation of algorithms in a procedure-oriented language, with emphasis on numerical methods for engineering problems. A student may receive credit for only one of the following courses: CMPSC 101, 102, 200, 201, or 202.

The idea here is that we want you to take a programming class. Lots of alternatives are available at other universities.

MATH 140 (GQ) CALCULUS WITH ANALYTIC GEOMETRY I (4) Functions, limits; analytic geometry; derivatives, differentials, applications; integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, 140B, and 140H. *A grade of C or better is required.*

These classes, or their equivalents, are offered in a large number of places and times. We emphasize again that students need to earn a C or higher in this course and in MATH 141. Frankly, if you got a D in calculus, you are probably in the wrong major.

MATH 141 (GQ) Calculus with Analytic Geometry II (4) Derivatives, integrals, applications; sequences and series; analytic geometry; polar coordinates. Students may take only one course for credit from MATH 141, 141B, and 141H. *A grade of C or better is required.*

BLAW 243 LEGAL ENVIRONMENT OF BUSINESS (3) Social control through law: courts, basic policies underlying individual and contractual rights in everyday society. May not be used to satisfy Smeal College baccalaureate degree requirements.

Or

ERM 411 LEGAL ASPECTS OF RESOURCE MANAGEMENT (3) Legal systems and lawmaking processes; property rights in land, water, and wildlife resources; jurisdictional problems in planning resource use.

BLAW 243 is offered in the summer at various PSU campuses. There may be alternatives available in the summer at other universities. ERM 411 is offered fall term. You can take ERM 411 in place of BLAW 243 or as a 400-level elective, but not both. You can also take BA 241 and BA 242 (together 4 credits) for this requirement (at UP, you have to be in DUS or the Smeal College to take BA 241 and BA 242, while

there may have no such controls at other campuses). These classes are described below.

Or

BA 241 Legal Environment of Business (2) Examines the legal system's role and impact regarding business transactions, liability issues, and ownership of intellectual property. Students earning credit for BA 241 may not earn credit toward Smeal College baccalaureate degrees for BLAW 243 and/or BA 243.

And (if you take this route)

BA 242 Social and Ethical Environment of Business (2) Explores the social and ethical environment of business and ethical decision making in a business context.

ECON 104 (GS) INTRODUCTORY MACROECONOMIC ANALYSIS AND POLICY (3) National income measurement; aggregate economic models; money and income; policy problems.

ECON 104 is not a prerequisite to anything in the EBF curriculum, and so there is no need to take it at a particular time. ECON 104 is offered in the summer at most PSU campuses, and equivalents are offered in the summer at most universities.

STAT 401 EXPERIMENTAL METHODS (3) Random variables; probability density functions; estimation; statistical tests, t-tests; correlation; simple linear regression; one-way analysis of variance; randomized blocks.

A grade of C or better is required to fill this requirement. Some students come into the EBF program already having taken STAT 200; they still have to take STAT 401.

The EBF program requires a statistics class with a calculus prerequisite, if students take it at other universities. Some students may have AP Statistics credit from high school, but that is not an acceptable substitute for the EBF statistics requirement.

EME 460 GEO-RESOURCE EVALUATION AND INVESTMENT ANALYSIS (3) Application of present worth and rate-of-return analysis; reserve calculations; decline curve analysis; uncertainty and risk analysis to engineering project design and evaluation.

This class is offered in both the fall and the spring terms. It is often (but not always) offered on-line over the summer. IE 302 is a potential substitute for this class, but talk to the instructor first. IE 302 has a MATH 141 prerequisite, and the IE department often has enrollment controls on their courses.

6.2 Introductory Electives

There are a large number of potential classes here, not all of which are listed on the degree audit or in the University Bulletin. Basically, the program will accept any GN class offered by the College of Earth and Mineral Sciences. Below is a discussion of a few classes that we particularly encourage students to take.

EGEE 101 (GN) (MATSE) **ENERGY AND THE ENVIRONMENT** (3) Energy utilization and technological development, energy resources, conversion and consequences on the local and global environment, and future energy alternatives.

This is an excellent introduction to energy engineering issues and is taught by popular instructors. It is also offered online.

EGEE 102 (GN) **ENERGY CONSERVATION FOR ENVIRONMENTAL PROTECTION** (3) Exposure to energy efficiency in day-to-day life to save money and energy, and thereby protect the environment.

This is an excellent introduction to energy conservation issues and is again taught by popular instructors and offered online.

EGEE 120 (GS;US;IL) **OIL: INTERNATIONAL EVOLUTION** (3) Survey of the commercial development of the world petroleum industry from various international, historical, business, and cultural perspectives.

This course investigates historical issues relevant to the major and is therefore a good choice for GS, US, and IL requirements (but note that it does not satisfy GN requirements). It is only offered online.

METEO 4 (GN) **Weather and Risk** (3) Non-technical introduction to the science and historical development of meteorology, and the role of weather forecasting as a tool for risk management by individuals, businesses, and societies.

This is a very nice non-technical elective that discusses many risk management issues. While it isn't on the list of approved electives on the EBF degree audit, this course may be used to partially fulfill the 6-credit introductory elective requirement.

6.3 Advanced Electives from Other Programs

There are a number of choices here, and not all will be discussed. If students desire to concentrate in areas relevant to the major with courses not listed here, they should contact the EBF program chair in advance.

ECON 306 Introduction to Econometrics (3) The implementation of statistical techniques to analyze data and address economic questions. Econometric results are produced and assessed.

ECON 402 Decision Making and Strategy in Economics (3) Development and application of the tools for decision making under uncertainty and for game theoretic analysis of economic problems.

ECON 415 The Economics of Global Climate Change (3) Evidence on climate change; economic models of the environment and market failure; cost-benefit analysis of policy options; carbon markets.

ECON 444 Economics of the Corporation (3) Coordination and incentive issues within a corporation. Topics include employment contracts, performance incentives and pricing of financial assets.

EGEE 437 Design of Solar Energy Conversion Systems (3) A review of fundamental concepts in solar energy conversion including photovoltaic (PV) and solar thermal conversion systems.

EGEE 438 Wind and Hydropower Energy Conversion (3) Principles of sustainability and renewable energy conversion with emphasis on wind and hydrokinetic energy resources.

EGEE 439 Alternative Fuels from Biomass Sources (3) This course will examine the chemistry of technologies of bio-based sources for power generation and transportation fuels.

EME 301 Thermodynamics in Energy and Mineral Engineering (3) Treatment of classical thermodynamics targeted to the needs of students in the Department of Energy and Mineral Engineering.

EME 407 Electrochemical Energy Storage (3) Electrochemical concepts in energy storage devices, cell construction and materials involved in batteries and capacitors, electrochemical testing methods and applications.

EME 432 (GEOG 432) Energy Policy (3) Analysis, formulation, implementation, and impacts of energy-related policies, regulations, and initiatives.

This course is offered online periodically (check the Penn State scheduling web site or contact the Dutton e-Education Institute).

EME 450 Energy Crisis Leadership (3) Energy Crisis Leadership prepares students to lead in high-pressure, high-stakes environments. This is an

interactive class that utilizes case studies to help students solve open-ended and complex problems. The case studies are from rare, but significant events with challenges that students are likely to experience someday in the energy and natural resource industries. In addition to the case studies, we will have guest speakers from the energy industry discuss their experiences with various operational upsets and their roles in addressing them. The culmination of the class is a competition where teams of students must formulate a plan to deal with a major crisis.

FIN 406 Security Analysis and Portfolio Management (3) Advanced valuation theory; fundamentals of security analysis; portfolio construction and management.

This class has historically only been available to EBF students during the summer.

FIN 408 Financial Markets and Institutions (3) Functional analysis of major credit institutions; sources and uses of funds; impact of government regulation.

This class has historically only been only available to EBF students during the summer.

FIN 410 Derivative Markets (3) Functions, techniques, and impact of speculation conducted through forward markets; the nature of speculative transactions, pricing, and methods of trading.

GEOSC 450 RISK ANALYSIS IN THE EARTH SCIENCES (3) An introduction to concepts and methods of quantitative risk analysis with focus on water, climate, and energy related risks.

There will be a lot of math in this class.

GEOSC 454 GEOLOGY OF OIL AND GAS (3) Properties, origin, migration, and occurrence of oil and gas. This course has one or more required field trips for which a fee is charged to the student.

This is a challenging yet highly relevant class. Speak to the instructor before you sign up for it, particularly if you have struggled with other Geosciences courses.

METEO 460 Weather Risk and Financial Markets (3) This course will introduce the role that weather plays as a source of financial and operational risk for businesses, market and other institutions.

METEO 473 APPLICATION OF COMPUTERS TO METEOROLOGY (3) Application of statistical and numerical methods to practical problems in meteorology.

This is a challenging class. If you are not also a meteorology major or minor, speak with the instructor before signing up to ensure that the class will be appropriate for you.

GEOG 430 HUMAN USE OF ENVIRONMENT (3) The human use of resources and ecosystems and social causes and consequences of environmental degradation in different parts of the world; development of environmental policy and management strategies.

GEOG 424 (US;IL) GEOGRAPHY OF THE GLOBAL ECONOMY (3) Focus on industrial location theory, factors in industrial location, studies of selected industries and problems of industrial development.

GEOG 431 GEOGRAPHY OF WATER RESOURCES (3) Perspectives on water as a resource and hazard for human society; water resource issues in environmental and regional planning.

GEOG 444 AFRICAN RESOURCES AND DEVELOPMENT (3) Ecological and cultural factors in the geography of Africa; natural resources and development.

CED 404 (AGEC) METHODS IN NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS (3) Students will learn empirical research methodology in the areas of environmental and natural resource economics.

CED 409 LAND USE PLANNING AND PROCEDURE (3) General land use planning laws and procedures.

CED 429 (AGEC) NATURAL RESOURCE ECONOMICS (3) Optimal management of resources; roles of markets and other institutions; resources and economic development; public policy.

CED 431W (AGEC) ECONOMIC ANALYSIS OF ENVIRONMENTAL AND RESOURCE POLICIES (3) Economic analysis of environmental and natural resource policies, benefit-cost analysis, non-market valuation techniques; resource damage assessment.

CED 450 (IL) INTERNATIONAL DEVELOPMENT, RENEWABLE RESOURCES, AND THE ENVIRONMENT (3) Theories of agricultural and economic development, with particular attention to interactions between development, renewable resources, and the environment.

FOR 440 Forest Economics and Finance (3) The application of economic theory to forest resources systems, with emphasis on production and investment analyses.

PLSC 490 POLICY MAKING AND EVALUATION (3) Advanced analysis of public policy, emphasizing policy evaluation and the factors that determine policy success and failure.

PNG 301 Introduction to Petroleum and Natural Gas Engineering (3) The course first introduces the design and implementation of the systems used in the extraction of oil and gas and then presents the various key disciplines in petroleum and natural gas engineering in the chronological order of how the disciplines interact.

6.4 Approved Minors for the EBF General Option

This section provides a list of approved minors.

Approved minors are chosen to complement the EBF program and include technical engineering or earth science minors, as well as foreign language minors. Students wishing to use a minor not on the approved list to satisfy the EBF requirement will need to get approval from Dr. Lei, preferably before beginning coursework for the minor.

The following minors are approved to satisfy the requirements of the EBF General Option.

- Any minor offered by the College of Earth and Mineral Sciences except the EBF minor or the Environmental Inquiry minor (a full list is available at <http://www.ems.psu.edu/academics/find-program-study#degree.isotope-instance-program=.minors>)
- Environmental Resource Management
- Sustainability Leadership
- Watersheds and Water Resources
- Mathematics
- Statistics
- Civic and Community Engagement
- Entrepreneurship and Innovation
- Any foreign language

Also, most hard science or engineering minors will be approved, but check with the EBF program chair in advance to confirm that a specific hard science or engineering minor you are considering will be accepted