SREB | High Schools That Work

Advanced Career

# Energy and Power Curriculum


## College or Career?...Why Not Both?

# *Advanced Career combines college-ready academics with authentic, hands-on projects.*


Schools are under pressure to better prepare students for a wide array of postsecondary options. The workforce of today and tomorrow demands a higher level of skill — people who grasp complex problems, understand technology and troubleshoot problems.

Advanced Career (AC) answers both of these needs. By fusing a rigorous academic core with challenging project work and advanced technology in a career pathway program of study, AC courses give students a greater depth of knowledge and skills and prepare them for more options after high school.

## Advanced Career provides:

- ready-to-implement AC course work for students
- comprehensive training for teachers
- access to tools and technology for project-based learning
- end-of-course assessments
- opportunity for industry certification and/or dual credit

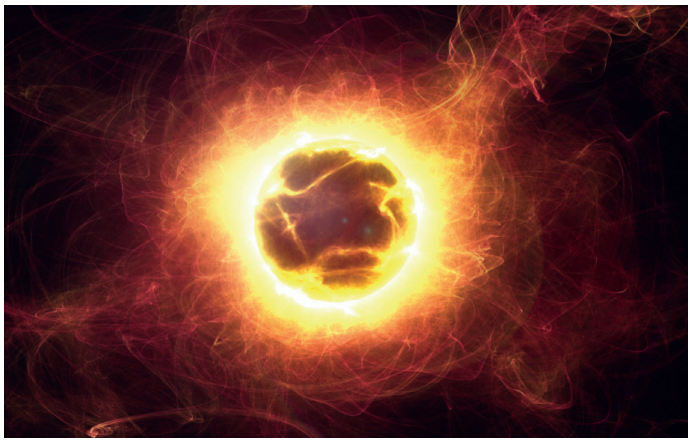
## Energy and Power

The Energy and Power curriculum will introduce students to the many career and educational opportunities that exist in the energy and power industry. Through the four courses that form the Energy and Power pathway, students will research, design and build a series of authentic, hands-on projects that will enable them to understand the interplay of the generation, distribution and use of energy. Systems thinking is used as an approach to teach how things work by understanding how the parts influence the entire system and how the system impacts the parts.

This program is designed, through authentic projects, to prepare students to: a) understand the five types of energy — mechanical, heat, chemical, electromagnetic and nuclear — as well as the knowledge to measure and control energy systems; b) learn about the various means of power generation and distribution with topics that include turbines, motor/generator sets, renewable and non-renewable energy generation, and electrochemical systems such as batteries; c) gain knowledge and skills about single- and multiple-phase generation and distribution systems, transformers, and high voltage AC and DC systems; d) work with mechanical, fluid and electrical systems; and e) understand power generation and environmental issues.

Projects will emphasize the integration of engineered systems and the control systems needed to meet design results.

Students completing the program may become an NI Certified LabVIEW Associate Developer (CLAD) and may be prepared for earning other relevant industry certifications.



*Energy and Power was developed by SREB and West Virginia as a part of a multi-state consortium to improve career and technical education in this country.*

For more information about other Advanced Career curricula, visit sreb.org/AC.

# Advanced Career
# Energy and Power Curriculum

Energy and Power is for students who have an interest in energy careers and are willing to learn and apply their math and science knowledge and technical skills as needed to complete real-world assignments in preparation for postsecondary education and the workplace.

## Course 1:
### Energy and Power Foundations

This course engages students in a variety of hands-on, authentic projects to learn about energy and power methods through the design and construction of motors, pumps, heat exchangers, hydraulics and pipeline systems. These are the technologies used in large power plant systems to run and maintain processes in energy generation plants. Through contextual projects, students will learn and apply physics, chemistry, fluid mechanics, thermodynamics, algebra and statistics in learning how these systems interact in the energy and power arena. Students will learn how engineers and technicians use these systems in the real world to optimize efficiency.

## Course 2:
### Energy Transmission and Distribution

This course focuses on energy transmission and consumer usage. Through projects, students will be introduced to AC and DC power, transformers, the electrical grid and Smart Grid, and consumer load on the electrical system. To complete projects, students will use Ohm's law, Joule's law of heating, root mean square, Pythagorean Theorem and trigonometric principles to understand how energy travels along power lines and is converted from direct current to alternating current to end up, ultimately, in homes and businesses. Students will gain an understanding of how power companies move power — stepping it up and down to meet the needs of the end-user — by designing working transformers, capacitors, inverters and a power supply.

## Course 3:
### Electronics and Control Systems

In this course, students will build on the knowledge and experience gained in the first two foundational courses. Through projects, students will apply their knowledge to more advanced systems and learn how to program and use National Instrument's LabVIEW software and the myDAQ data acquisition device to work as engineers in making and analyzing countless scientific measurements. Students will study advanced topics in energy and power such as smart-home automation, plant-level process control, natural gas pipeline monitoring, energy storage and wind power. Each project presents students with a design problem that will require them to not only design and build a prototype, but also develop the software program that will test the prototype and gather measurable, quantifiable data.

## Course 4:
### Advanced Science and Engineered Systems

Through well-developed projects in this advanced course, students will assume the roles of building technicians, design engineers, recreational engineers, electrical technicians and CEOs, while learning about real-world energy and power issues. Students will work with industry mentors to independently tackle real-world scenarios in the energy and power field. The projects in this course scaffold to allow students more choice in determining the final product for each project. This course incorporates knowledge of multiple sources of energy, engineered systems, societal impact and "the business of energy" as students engage in projects involving maglev trains, advanced concepts in steam energy, carbon sequestration and coal, hydraulic fracturing, alternative forms of fuel in transportation and environmental compliance.

# Key Features of Advanced Career

## Fully Developed Pathway Programs

Advanced Career encompasses a coherent sequence of four ready-to-implement AC courses; comprehensive training for teachers; access to tools and technology for project-based learning; and end-of-course assessments. To ensure fidelity from site to site, each course has a syllabus that includes instructional philosophy, instructional delivery and support systems, assessment and a recommended grading system.

## Advanced Career (AC) Programs of Study

Each Advanced Career program of study (POS) is a progression of non-duplicative courses joined with a college-ready academic core and aligned from high school to postsecondary studies. The integration of academic and technical content in the POS prepares students for more options after high school graduation, offers opportunity for dual credit and leads to an industry-recognized credential, advanced training, or an associate's or bachelor's degree. The high-skill, high-wage career fields represented among the AC programs of study are important to the economy.

## Project-Based Learning

Each course is designed around project-based units — featuring essential questions, project descriptions, authentic roles and tasks that require students to utilize an industry-recognized decision-making process. Assignments in AC courses encompass essential elements of good project-based learning to engage students in an extended process of asking questions, using resources and developing answers. Students collaborate and work in teams and develop important 21st-century skills.

## Blended Learning Experiences

Advanced Career course work creates rigorous blended learning experiences for all students. Students apply their academic and technical skills to real-world projects in ways that advance their literacy, math, science and technical knowledge and skills, and that strengthen their habits of behavior and mind for success.

## Technology and Software

Students employ industry-standard data acquisition hardware and software systems to complete authentic tasks simulating the work of professionals in the field.

## Assessments

Each project unit includes formative and summative assessments. Each course has an end-of-course assessment that measures both academic and technical achievement with the performance level needed for jobs, advanced training and postsecondary credit-bearing courses. In addition, students and teachers complete surveys about what works or does not work in the AC course. This serves to inform continuous improvement of the AC program.

## Counseling for Careers

Student and parent orientation to the AC program of study highlights the career field, including requirements for jobs and postsecondary study in the career field. Each AC course has a career and education exploratory component. Counselors trained to support the AC program will assist students in developing a career and education plan aligned with students' goals and aspirations.

## Teacher Selection, Professional Development and Support

Teachers are selected who have strong math skills and experience in the pathway career field. Staff development is essential and includes an intensive two-week summer institute for teachers to prepare them to teach each course and to use a project-based approach. They will perform students' assignments and use the tools developed by national industry partners. A support team including the principal, counselor and academic teachers in literacy, math and science learn how to support AC teachers and students in course implementation.

## Dual Credit and Industry Certification

Courses three and four in the AC program offer the potential for dual credit when a state or district has an established process for approving such courses. The AC program of study also offers opportunities for industry certification for students who complete the program.

## Collaboration and Partnerships

Ongoing relationships among education, business and other stakeholders are central to AC pathway programs. Representatives from industry and postsecondary institutions have helped shape the curriculum design and technical content. Serving as an expert panel, they have collaborated with secondary educators and state education agency staff to identify authentic learning experiences for students that can lead to additional opportunities after high school. Organizations represented in the development of the Advanced Career Energy and Power Pathway Program include:

American Electric Power
Appalachian Energy
Bethany College
Bridgemont Community and Technical College
Center for Economic Options
Chesapeake Energy
EnerVest
First Energy
Hocking College
Kanawha Valley Community and Technical College
Longview Power
Marshall University
Mountaineer Gas Company
National Alternative Fuels Training Consortium
National Energy Education Development Project
National Instruments
Ohio Department of Education
Ohio Oil and Gas Association
Pennsylvania College of Technology
Pierpont Community and Technical College
Sinclair Community and Technical College
Southern Regional Education Board
West Virginia Department of Education
West Virginia University – Parkersburg
West Virginia University Institute of Technology