

## **Career & Technical Education (CTE) Standards Revision Project**

### **Cluster: Energy**

**Pathways: Fossil Energy Extraction, Processing & Distribution, Electromechanical Generation & Maintenance, Electrical Energy Transmission & Distribution, Renewable Energy Production, Energy Efficiency & Environmental Technology**

**The standards for this cluster area a result of a compilation of Energy standards from State CTE Standards developed in Ohio and California and introductory course standards from Colorado community colleges. The attached standards for each of the pathways identify links to Colorado core content standards which have been validated by content specialists in each of the core content areas.**

**Michael Womochil, Program Director, Agriculture, Natural Resources & Energy**

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| <b>Career Cluster/Cluster Grouping:</b>  | <b>Energy</b>   |
| <b>Pathway(s):</b>   | <b>Energy Efficiency &amp; Environmental Technology</b>   |
| <b>Prepared Completer Competencies:</b><br><b>ENY 06. Understand and analyze the environmental impact of energy production and use and the effect of efficiency on energy demands</b>  |   |
| <b>High School Expectations</b>  |   |
| <b>Concepts and skills students know include:</b><br><b>ENY 06.01 Students understand energy resources and the effects of these resources and systems on the environment:</b>  |   |
| <b>Evidence Outcomes Students can:</b>   | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>  |
| <p><b>ENY 06.01 A</b> Classify various conventional energy resources by depletable, nondepletable, renewable, and nonrenewable type</p> <p>(SCI3.5a; SCI3.5b)</p> <p><b>ENY 06.01 B</b> Research the new and emerging energy resources.</p> <p>(RWC 4.11.a; RWC 4.11.b; RWC 4.11.c; RWC 4.11.d; RWC 4.11.e; RWC 4.11.f; RWC 4.11.g; RWC 4.11.h; RWC 4.11.i; RWC 4.11.j; RWC 4.11.k; RWC 4.11.l; RWC 4.11.m)</p> <p><b>ENY 06.01 C</b> Differentiate the advantages and disadvantages of energy resources in terms of their effects on the environment.</p> <p>(SCI3.5a; SCI3.5b)</p> | <p><b>Academic Content Knowledge Alignment:</b></p> <p>RWC4.11.a-Reading, Writing and Communicating, Research and Reasoning, Use quality reasoning and effective problem solving strategies. - Analyze the purpose, question at issue, information, points of view, implications and consequences, inferences, assumptions and concepts inherent in thinking.</p> <p>RWC4.11.b- Assess strengths and weaknesses of their thinking and thinking of others by using criteria including: relevance, clarity, accuracy, fairness, significance, depth, breadth, logic and precision.</p> <p>RWC4.11.c- Articulate goal and purpose</p> <p>RWC4.11.d- State the problem clearly and precisely.</p> |

RWC4.11.e- Identify the type of problem at hand.

RWC4.11.f- Determine what parts of the problem are solvable.

RWC4.11.g- Determine the information needed to solve the problem.

RWC4.11.h- Analyze and interpret information.

RWC4.11.i- Make inferences after considering information.

RWC4.11.j- Identify and evaluate options for advantages and disadvantages.

RWC4.11.k- Determine appropriate forms of action.

RWC4.11.l- Monitor the implications of actions.

RWC4.11.m- Be prepared to revise strategy if situation requires it.

SCI3.5.a-Science, Earth Science, There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources - Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources

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|  | SCI3.5.b-Science, Earth Science, - Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use |
|  | <b>Learning &amp; Behavioral Skills (Inquiry, Application in Society &amp; Technology &amp; Nature of...):</b>  |

| <b>High School Expectations</b>  |  |
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| <b>Concepts and skills students know include:</b><br><b>ENY 06.02 Students understand the environmental implications of energy conversion processes and energy transmission systems</b>  |  |
| <b>Evidence Outcomes Students can:</b>   | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>   |
| <p><b>ENY 06.02 A</b> Map energy conversion processes and energy transmission systems as they relate to activities across the environment.</p> <p>(SCI3.5a; SCI3.5b)</p> <p><b>ENY 06.02 B</b> Explore the basic terms, characteristics, and concepts of physical and chemical processes related to components and systems operations and maintenance in energy conversion and transmission systems.</p> <p><b>ENY 06.02 C</b> Identify the basic gas, electrical, and electronic terms, units, definitions, and concepts in energy conversion and transmission systems.</p> <p><b>ENY 06.02 D</b> Compare the influences of three different energy conversion processes and energy transmission systems.</p> <p><b>ENY 06.02 E</b> Identify the basic principles of energy systems: chemical, hydraulic, pneumatic, electrical, nuclear, solar, wind, and geothermal.</p> | <p><b>Academic Content Knowledge Alignment:</b></p> <p>SCI3.5.a-Science, Earth Science, There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources - Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources</p> <p>SCI3.5.b-Science, Earth Science, - Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use</p> <p><b>Learning &amp; Behavioral Skills (Inquiry, Application in Society &amp; Technology &amp; Nature of...):</b></p> |

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| <p><b>ENY 06.02 F</b> Identify basic energy production systems and components, including the main components and system flow-paths in energy conversion and transmission systems.</p> |  |
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| <b>High School Expectations</b>   |  |
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| <b>Concepts and skills students know include:</b>   |  |
| <p><b>ENY 06.03</b> Students understand the applications and environmental effects of energy extraction processes, energy conservation systems, and energy storing systems:</p>   |  |
| <b>Evidence Outcomes Students can:</b>  | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>   |
| <p><b>ENY 06.03 A</b> Know the common energy extraction processes, energy conservation systems, and energy storage systems.</p> <p>(SCI3.5a; SCI 3.5b )</p> <p><b>ENY 06.03 B</b> Understand the environmental implications of energy conservation principles related to energy extraction processes, conservation systems, and storage systems.</p> <p>(SCI3.5a; SCI 3.5b)</p> <p><b>ENY 06.03 C</b> Understand the pragmatic applications of energy extraction processes, energy conservation systems, and energy storing methods.</p> <p><b>ENY 06.03 D</b> Apply the structure of the atmosphere to Earth's weather and climate.</p> <p>(SCI 3.4a )</p> <p><b>ENY 06.03 E</b> Evaluate the causes and effects of climate change</p> | <p><b>Academic Content Knowledge Alignment:</b></p> <p>RWC1.7.a-Reading, Writing and Communicating, Oral Expression and Language Study, Deliver and apply skills in preparing a planned formal and informal oral presentations to various audiences using appropriate communication skills. - Give formal and informal talks to various audiences and for various purposes using appropriate level of formality and rhetorical devices.</p> <p>RWC1.7.b- Use verbal and nonverbal techniques to communicate information.</p> <p>RWC1.7.c- Define a position and select evidence to support that position.</p> <p>RWC1.7.d- Develop a well organized presentation to defend a position.</p> <p>RWC1.7.e- Apply persuasive rhetorical devises and techniques.</p> <p>RWC1.7.f- Use effective audience and oral</p> |

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| <p>(SCI 3.4e )</p> <p><b>ENY 06.03 F</b> Describe the types and effects of water, air, and soil pollution and how their quality affects biodiversity.</p> <p>( SCI 2.2a; SCI 3.6a)</p> <p><b>ENY 06.03 G</b> Describe ecological responses to environmental change</p> <p>( SCI 2.2a; SCI 3.6a)</p> <p><b>ENY 06.03 H</b> Discuss environmental laws, ethics, and policies</p> <p>(RWC 4.11.a; RWC 4.11.b; RWC 4.11.c; RWC 4.11.d; RWC 4.11.e; RWC 4.11.f; RWC 4.11.g; RWC 4.11.h; RWC 4.11.i; RWC 4.11.j; RWC 4.11.k; RWC 4.11.l; RWC 4.11.m; RWC 4.2.a; RWC 4.2.b RWC 4.2d; RWC 4.11.l; RWC 4.11.m; RWC 1.7.a; RWC 1.7. b; RWC 1.7.c; RWC 1.7.d; RWC 1.7.e; RWC 1.7.f; RWC 1.7.g)</p> <p><b>ENY 06.03 I</b> Relate environmental issues to population and economic growth.</p> | <p>delivery skills to convince an audience.</p> <p>RWC1.7.g- Select appropriate technical or specialized language to help the audience understand content of the presentation.</p> <p>RWC4.11.a-Reading, Writing and Communicating, Research and Reasoning, Use quality reasoning and effective problem solving strategies. - Analyze the purpose, question at issue, information, points of view, implications and consequences, inferences, assumptions and concepts inherent in thinking.</p> <p>RWC4.11.b- Assess strengths and weaknesses of their thinking and thinking of others by using criteria including: relevance, clarity, accuracy, fairness, significance, depth, breadth, logic and precision.</p> <p>RWC4.11.c- Articulate goal and purpose</p> <p>RWC4.11.d- State the problem clearly and precisely.</p> <p>RWC4.11.e- Identify the type of problem at hand.</p> <p>RWC4.11.f- Determine what parts of the problem are solvable.</p> <p>RWC4.11.g- Determine the information needed to solve the problem.</p> |
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RWC4.11.h- Analyze and interpret information.

RWC4.11.i- Make inferences after considering information.

RWC4.11.j- Identify and evaluate options for advantages and disadvantages.

RWC4.11.k- Determine appropriate forms of action.

RWC4.11.l- Monitor the implications of actions.

RWC4.11.m- Be prepared to revise strategy if situation requires it.

SCI2.2.a-Science, Life Science, The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem - Analyze and interpret data about the impact of removing keystone species from an ecosystem or introducing non-native species into an ecosystem

SCI3.4.a-Science, Earth Science, Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere - Develop, communicate, and justify an evidence-based scientific explanation that shows climate is a result of energy transfer among the atmosphere, hydrosphere, geosphere and biosphere

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|  | <p>SCI3.5.a-Science, Earth Science, There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources - Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources</p> <p>SCI3.5.b-Science, Earth Science, - Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use</p> <p>SCI3.6.a-Science, Earth Science, The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes - Develop, communicate, and justify an evidence-based scientific explanation addressing questions regarding the interaction of Earth's surface with water, air, gravity, and biological activity</p> <p><b>Learning &amp; Behavioral Skills (Inquiry, Application in Society &amp; Technology &amp; Nature of...):</b></p> |
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| <b>High School Expectations</b>  |   |
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| <b>Concepts and skills students know include:<br/>ENY 06.04 Understanding the physics of energy movement</b>   |   |
| <b>Evidence Outcomes - Students can:</b>   | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>  |
| <p><b>ENY 06.03 A</b> Define Temperature, sensible vs. latent heat, heat loss and gain</p> <p><b>ENY 06.03 B</b> Explain conduction, convection and combined conduction-convection.</p> <p><b>ENY 06.03 C</b> Discuss forced convection versus natural convection.</p> <p><b>ENY 06.03 D</b> Define radiation heat transfer.</p> <p><b>ENY 06.03 E</b> Explain the operation of heat exchangers.</p> <p><b>ENY 06.03 F</b> Discuss heat transfer as it applies to heating, ventilation, air conditioning and refrigeration (HVACR).</p> <p><b>ENY 06.03 G</b> Relate physics of heat to structural heat loss and infiltration principles</p> | <p><b>Academic Content Knowledge Alignment:</b></p> <hr/> <p><b>Learning &amp; Behavioral Skills (Inquiry, Application in Society &amp; Technology &amp; Nature of...):</b></p> |

| <b>High School Expectations</b>   |   |
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| <b>Concepts and skills students know include:<br/>ENY 06.04 Analysis and application of energy saving techniques</b>  |   |
| <b>Evidence Outcomes Students can:</b>  | <b>21<sup>st</sup> Century Skills and Readiness Competencies</b>  |
| <p><b>ENY 06.04 A</b> Apply knowledge of energy use and efficiency to real life situations.</p> <p><b>ENY 06.04 B</b> Compare different building materials and techniques to achieve the most efficient structure</p> <p><b>ENY 06.04 C</b> Analyze the impact of structural energy saving features such as windows, doors, and insulation on the overall energy use</p> <p>(RWC 4.2.a; RWC 4.2.b RWC 4.2d; RWC 4.11.i; RWC 4.11.m)</p> <p><b>ENY 06.04 D</b> Identify alternative energy applications that apply to real life situations</p> <p><b>ENY 06.04 E</b> Critique the effectiveness of Energy-saving and water-saving appliances</p> <p><b>ENY 06.04 F</b> Analyze Heating and cooling (HVAC) equipment and systems on energy efficiency</p> <p><b>ENY 06.04 G</b> Apply knowledge of energy use, conservation and efficiency to real life situations.</p> | <p><b>Academic Content Knowledge Alignment:</b></p> <p>RWC4.2.a-Reading, Writing and Communicating, Research and Reasoning, Analyze and develop a logical argument that distinguishes facts, opinions, evidence and inferences. - Synthesize information logically: distinguish among facts opinions, evidence, and inferences; identify false premises or assumptions; and detect potential bias and “loaded” language (e.g., sarcasm, personal attack, appeal to pity)</p> <p>RWC4.2.b- Summarize ideas including alternate views, rich detail, well-developed paragraphs, and logical argumentation.</p> <p>RWC4.2.d- If the presentation is or oral a visual product: Prepare notes and visuals for clarity of content and effect, grammatically correct use of language, spelling, and mechanics.</p> <p>RWC4.11.i-Reading, Writing and Communicating, Research and Reasoning, Use quality reasoning and effective problem solving strategies. - Monitor the implications of actions.</p> <p>RWC4.11.m- Be prepared to revise strategy if situation requires it.</p> |

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|  | <b>Learning &amp; Behavioral Skills (Inquiry, Application in Society &amp; Technology &amp; Nature of...):</b> |
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