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Energy and Environment

Teacher's Guide

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Project Partners

CONTEXT

The scope of this teacher's guide

This teacher's guide addresses the relationship between energy and the environment and emphasizes the risks of non-renewable energy sources.

It presents two lesson plans to be used in conjunction with students' worksheets, developed to support them.

Each lesson plan was prepared for a 60-minute class and is supported by one worksheet.

The target Group is secondary school students aged 15–17 years old.

The duration of the topic is 2 classes of 60 minutes each.

Some general information, followed by the lesson plans (including information on when and how to use the students' worksheets) is provided for each lesson.

The subjects involved are Science, Technology, Geography, Economics, and English.

The keywords that describe the lessons are: renewable energy sources, non-renewable energy sources, environmental impact, eco-anxiety, sustainability, STEM, energy literacy.

Summary

This lesson plan enables students aged 15–17 to compare the **environmental advantages and disadvantages** of renewable and non-renewable energy sources, understand **Europe's evolving energy use** and discuss **eco-anxiety** constructively. Through collaborative research, multimedia exploration, debates and reflective activities, students will develop **critical thinking, media literacy and emotional awareness within a STEM framework.**

Aims of the learning sequence

By the end of the teaching and learning sequence, students are expected to show **knowledge** of the relationship between energy and the environment, namely to:

- Identify renewable and non-renewable energy sources.
- Evaluate the environmental impacts of different energy types.
- Describe the effects of eco-anxiety.
- Identify constructive coping strategies for eco-anxiety.
- Propose balanced energy mixes considering environmental, social, and economic factors.

During the sequence, students will develop **21st-century** skills in the following areas:

- Creativity and innovation
- Critical thinking and problem-solving

- Communication and collaboration
- Information, media, and technology literacy
- Initiative and self-direction

Methodological approach

The methodological approach relies on the following **strategies**:

- Collaborative learning
- Digital and visual learning
- Project-based learning
- STEM-integrated scenario work
- Media and technology skills development

The methodological approach acknowledges a **STEM orientation** by assuming:

- **Personalisation of learning:** Reflecting on eco-anxiety and proposing actions.
- **STEM topic integration:** Links between environmental science, energy technology and societal issues.
- **Formative assessment:** Continuous formative assessment through reflection and peer review.

Assessment guidelines

Assessment is continuously done based on formative practices to personalize learning and enhance the overall teaching and learning experience.

Formative assessment is embedded in the lesson activities. It should be done during class discussions, brainstorming activities, group work, project work, etc. Students' worksheets include a variety of tasks to be performed by the students that allow the teacher to observe progression on knowledge, reasoning, behavior, communication skills, social-relational skills, creativity, etc. They also allow students to express their understanding in different ways, providing evidence of how deeply they understand and can use the content. Formative assessment should consider issues like accuracy of scientific content, creativity in presentation, collaboration and teamwork, critical thinking and clarity of reasoning, communication and argumentation, and engagement with the tasks.

To strengthen active participation, both self-assessment and peer assessment play a central role. Therefore, students are asked to reflect on their learning and contribution to the group, to evaluate their group's collaboration, and the performance of the different groups, etc. In addition to teachers' questions, worksheets include questions with this aim.

Together, these assessment practices provide a holistic view of each student's progress, enabling the teacher to adapt instruction to individual needs while helping students become reflective, self-directed participants in their own education.

Theoretical background

Europe has doubled its renewable energy share since 2005, reaching approximately 25% of gross final energy consumption in 2023, with a goal of **42.5% by 2030**. While **coal** use is declining, **natural gas** and **nuclear** remain significant. Renewable energy reduces greenhouse gases, but may affect wildlife (e.g., wind turbines and birds) and require new infrastructure. Fossil fuels are **finite**, polluting, and linked to geopolitical tensions. **Eco-anxiety** - feelings of worry about environmental crises - is increasingly reported among European youth. Addressing these feelings through education and action fosters agency rather than despair.

More scientific and technical information on these issues can be found in an e-book available at: https://www.projectgreenlighteu.com/Home/ePlatform?section=relationship

https://www.projectgreenlighteu.com/Home/ePlatform?section=futurePers

https://www.projectgreenlighteu.com/Home/ePlatform?section=nonRenewable

https://www.projectgreenlighteu.com/Home/ePlatform?section=renewGlobal

Additional information available at: https://www.projectgreenlighteu.com/Home/Resources

LESSON PLANS ON ENERGY AND ENVIRONMENT (EEX)

Time: 120 minutes (2 x 60 minutes)

Teacher's materials: 2 lesson plans, including videos

Students' materials: 2 worksheets

Lesson Plan EE1 (60 minutes)

The first lesson introduces students to the advantages, disadvantages, and environmental risks of nonrenewable energy, stimulates curiosity through multimedia, and engages them in collaborative research activities.

1. Kick-off (10 min): Show two images: one of a coal power plant and another of a wind farm. See: https://www.canva.com/design/DAGziq7HYsY/7cVhY8zeG0ZsAGh9bXT3cg/edit?utm_content=DAGziq7HYsY&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton

   Promote brainstorming by asking students which one (coal power plants or wind farms) can be seen more today than 20 years ago, and why.

   Indicative Answer

   "You see wind farms more often today than 20 years ago. This is because many countries are shifting toward renewable energy to reduce greenhouse gas emissions and their effect on climate change. Advances in technology have made wind turbines more efficient and affordable, and governments often provide incentives for clean energy. At the same time, some coal power plants have closed or reduced output because coal is a major source of pollution and carbon dioxide."

2. Introduction to changes in energy use (10 min): Show a short video clip on changes in renewable and non-renewable energy use. You can use the video available from: https://www.youtube.com/watch?v=HA8-zysCxE4

   Ask students why they think about key data, like: the percentage of renewable energy in 2023 was 25%; coal use is declining, the impact/challenge of renewable energy for wildlife.

3. Fossil Fuel Detective activity (25 min): Hand out Worksheet EE1 and ask small groups of students (3 to 5 students) to conduct the Fuel Detective tasks, which require them to search for information, analyse data, and conclude about the vantages, disadvantages, and risks of using coal, oil, and natural gas.

4. Reflection (10 min): Ask groups to share their conclusions with the others. Summarise and correct any misconceptions that may emerge.

Indicative answers for question 2 of Worksheet EE1

Fossil Fuel	Where It Comes From	Advantages	Disadvantages	Environmental Risks
Coal	Mined from underground seams or surface mines; formed from ancient plant matter.	Reliable and abundant energy supply.	Produces high CO_2 emissions (climate change). Air pollution (soot, sulfur dioxide).	Acid rain, habitat destruction.
Oil	Extracted from underground reservoirs or seabeds; refined into fuels.	High energy density, easy to transport.	Non-renewable, finite resource. Price volatility and geopolitical tensions.	Oil spills damaging marine ecosystems.
Natural Gas	Found in underground rock formations, often with oil deposits; obtained through drilling or fracking.	Burns cleaner than coal or oil (lower CO_2).	Still emits greenhouse gases. Methane leaks are potent contributors to warming.	Fracking can contaminate groundwater.

Indicative answers for questions 3 and 4 of Worksheet EE1

Societies continue to use fossil fuels despite their environmental problems because they remain a reliable and energy-dense source of power, capable of meeting the constant demands of industries, homes, and transportation. Much of the existing energy infrastructure—such as power plants, pipelines, and refineries—is built around fossil fuels, making the transition to renewables expensive and complex. Economically, many regions rely on fossil fuels for jobs, government revenue, and trade, while in the short term, fossil fuels can still be cheaper and more accessible than some renewable options. Finally, shifting entirely to renewables requires significant investment in new technologies, storage solutions, and updated power grids, which takes time and careful planning."

5. Self-assessment (5 minutes): Invite students to play the games available at https://www.projectgreenlighteu.com/Home/ePlatform?section=NREGames

Lesson Plan ES2 (60 minutes)

The second lesson addresses the concept of energy mix through problem-based learning.

1. Kick off (10 min): Display a quote: "I worry about climate change every day". Ask students how they feel when they think about environmental issues.

   Let students share their feelings. Normalize feelings to prevent fear and anxiety.

2. Introduction of "eco-anxiety" (5 min): Present eco-anxiety as a common emotional response to environmental threats, a fear of suffering an environmental cataclysm. Tell students that possessing knowledge of sources of energy and their relationship with the environment promotes sustainable behaviors and reduces environmental threats and disasters.

   Alternatively, if you have time, you can use the video on eco-anxiety available from https://youtu.be/JMpkfq7o06A?si=PiTd6Qul5r022VNA-

3. Problem-solving (20 min): Handout Worksheet EE2, which asks students to play the role of European Energy Planners 2030 and suggest an Energy Mix, considering data and constraints provided.

   Ask small groups of students to solve the problem, that is, to create a balanced energy mix that meets environmental, economic, and social goals.

Sample Solution

Example Balanced 2030 Mix (Out of 100%):

- Wind: **30%**
- Solar: **20%**
- Hydro: **10%**
- Nuclear: **15%**
- Natural Gas: **15%** (as backup/transition fuel)
- Biomass/Other Renewables: **10%**

Reasoning:

- Keeps CO_2 low (only 15% fossil).
- Maintains reliability with nuclear and gas as backups.
- Uses a variety of renewables to reduce dependence on a single source.
- Considers cost and public acceptance (avoids 100% nuclear or fossil).

How Students Can Use the Data

- Calculate **% renewable vs. fossil** in their proposed mix.
- Estimate **average CO_2 emissions** for their energy mix using a weighted average.
- Consider **average cost per MWh** using a weighted calculation.
- Justify choices based on reliability and public acceptance.

4. Presentation & Peer Review (10 min): Each group presents their proposal briefly. Peers provide feedback using the 'Fist-to-Five' technique. Teacher's assessment focus:
   - Did the group use data trends?
   - Did they explain trade-offs (e.g., cost vs. emissions)?
   - Was the mix feasible given 2030 targets?

5. Reflection (10 min): Ask students to write or discuss one personal or community action to address climate change or eco-anxiety (e.g., energy-saving habits, advocacy, joining environmental clubs).

   Alternatively, show the mix of energy in your school area and discuss it with students to find out how far from the ideal one it is.

6. Self-assessment (5 minutes): Invite students to play the games available at https://www.projectgreenlighteu.com/Home/ePlatform?section=renewGames

Assessment

Assessment across both lessons is **continuous** and combines **teacher evaluation** with **student self- and peer-assessment**.

Suggested **Teacher Assessment** Strategies:

- Observe and evaluate students' participation, collaboration and comments during group work, discussions and presentations.
- Assess final outputs—Fossil Fuel Detective data collected and European Energy Planners 2030 energy mix and presentation—for content accuracy, creativity, clarity, and teamwork.

Suggested **Student's Assessment** Strategies:

- Use **one simple checklist** (for both self- and peer-assessment) after group activities to reflect on understanding, contribution, and constructive feedback.
- Apply the **Fist-to-Five** technique as a quick formative check during presentations to gauge understanding and engagement.

This streamlined approach ensures meaningful feedback without overloading class time, while encouraging reflection, collaboration, and ownership of learning.

Interdisciplinary Connections of the Topic

The lessons have connections with several subjects, as follows:

- Science: Classification and analysis of energy sources
- Geography: Geographic origin of energy sources and use.
- Economics: Cost analysis and sustainability considerations.
- Technology/Art: Use of digital tools for visual communication.

– English: Information bibliographic search

Additional Notes for Teacher

Ensure access to digital devices and reliable internet.

Encourage information search in reliable sources.

Ensure academic integrity by promoting authorship and explicit references.

ADDITIONAL SUGGESTIONS

PLEASE MAKE THESE APPLICATIONS BEFORE THE FINAL EVALUATION PHASE.

Video/Activity	Planning Part	Integration Format	Outcomes
How to Build a Solar Oven YouTube+1 Solar Oven STEM activity (ScienceBuddies)	**Lesson EE1 – After the fossil fuel detective activity (20 min)**	Building a pizza-box solar oven as a group in class, following Science Buddies instructions.	Experiencing the conversion of solar energy into heat; measuring data (temperature) and interpreting the results.
Build a Solar-Powered Model Car (Junior Solar Sprint Guide) YouTube+1	**Lesson EE2 – Problem Solving/ Capstone Project (20–30 min + competition)**	Prototyping a small-panel solar vehicle; organizing a race or performance test.	Hands-on learning of electrical→mechanical conversion of solar energy; design-test cycle.

How to Make a Mini Wind Turbine / Miniature Windmill (DIY) YouTube+1	**Lesson EE1 – Reflection / Bonus Project**	Making a mini turbine with cardboard/wood+simple motor; wind speed etc. production relationship is measured.	Examining the working principle and efficiency effects of wind energy.
Mini Waterwheel Experiment — Discover Water Power (STEM Activity) YouTube+1	**EE1 or EE2 – Extension activity/ homework**	Making a mini water wheel and observing the movement of the wheel with water flow (flow-power relationship).	Recognize the potential kinetic energy conversion that occurs with water flow and understand the role of water power in mechanical energy production.
Produce Small Batch Biogas / DIY Biogas YouTube+1	**EE2 – Before the Energy Mix discussion (short presentation)**	Model showing how biomass/biogas is produced; demonstration with attention to safety/ odor.	Understanding the energy contribution and sustainability of biomass.