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Exploring Energy and Energy Sources

Teacher's Guide

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Project Partners





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CONTEXT

The scope of this teacher's guide

This teacher's guide addresses the concept of energy source and distinguishes between renewable and 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 or more students' worksheets.

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, Computer Studies, and English.

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

Summary

This professional lesson plan enables students aged 15–17 to explore the concept of energy source, distinguish between renewable and non-renewable energy sources, and evaluate their environmental and social impacts. Through collaborative research, multimedia exploration, hands-on activities, and scenario-based discussions, students will develop critical thinking skills and energy literacy 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 renewable and non-renewable energy sources, namely to:

- Define what energy sources are.
- Differentiate between renewable and non-renewable energy sources.
- Evaluate the environmental impact of various energy sources.
- Explain how energy sources work.

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

- Creativity and innovation
- Critical thinking and problem-solving
- Communication and collaboration



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- 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:** Students choose an energy source to research according to their interests.
- **STEM topic integration:** Concepts of energy, environmental science and technological applications explored.
- **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, hands-on experiments, 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.



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Theoretical background

We obtain the energy needed to power our daily lives, industries, and technological systems from energy sources. They can be broadly classified into two categories: renewable and non-renewable energy sources. Renewable energy sources, such as sun, wind, water, geothermal heat, and biomass, are replenished naturally and have lower environmental impacts. Non-renewable sources, such as coal, oil, natural gas, and uranium, are finite, and their use contributes to environmental degradation.

Understanding the advantages and limitations of each energy source is essential in creating sustainable energy strategies. For example, while fossil fuels provide high energy output and are currently integrated into global infrastructure, their extraction and combustion contribute significantly to greenhouse gas emissions. Conversely, renewable sources offer long-term sustainability but may be limited by geographic, technological, or economic constraints.

You can get more information on energy here:

<https://www.projectgreenlighteu.com/Home/ePlatform?section=definition>

You can learn about some myths on energy here

<https://www.projectgreenlighteu.com/Home/ePlatform?section=myths>

You can get more information on energy sources here:

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

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

LESSON PLANS ON ENERGY AND ENERGY SOURCES (ESx)

Time: 120 minutes (2 x 60 minutes)

Teacher's materials: 2 lesson plans, including videos

Students' materials: 6 worksheets

Lesson Plan ES1 (60 minutes)

The first lesson introduces students to the concept of energy sources, stimulates curiosity through multimedia, and engages them in collaborative classification activities.

1. **Kick-off (15 min):** Show a short, engaging video introducing energy sources available from: <https://www.youtube.com/watch?v=UrJkRr8YQo>

Ask students what comes to their mind when they think of energy.

At this stage, energy is difficult to define precisely. Emphasize examples and experiences rather than formal definitions. Allow students to share anything that comes to mind - objects, movements or natural phenomena - then guide them toward the idea that energy is what makes things happen or change.

2. **Introduction to energy sources (15 min):** Using a collaborative Canva presentation (<https://tinyurl.com/muk4p53x>), give clear definitions of *energy*, highlighting the difference between **forms of energy** (kinetic and potential), **types of energy** (e.g., thermal, electrical,



sound energy, etc.) and **energy sources** (where energy comes from, such as the sun, wind, water, or fossil fuels). Then, differentiate renewable from non-renewable energy sources and name the type of energy each one provides.

3. Application Activity (15 min): Hand out Worksheet ES1. Ask small groups of students (3 to 5 students) to answer the questions about the different renewable and non-renewable sources of energy represented in the images, the key advantages, disadvantages, and interesting facts about each energy type.
4. Reflection (10 min): Ask groups to share their answers with the others. Summarise and correct any misconceptions that may emerge.
5. Homework (5 min): Each student selects one energy source as required by Worksheet ES2, to research and answer the questions for the next class.

Alternative homework: Write the following questions on the board and ask students to copy them into their diary notebook or a piece of paper, to answer at home:

- What renewable energy sources does your home use?
- How could you include more renewable energy in your home?

Lesson Plan ES2 (60 minutes)

The second lesson focuses on applying knowledge through project-based learning and scenario problem-solving.

1. Homework Review (10 min): Students share the findings from their research on their chosen energy source. As each student/group presents, note key points on the board or a shared digital space. Facilitate a short discussion by comparing similarities, differences, and surprising findings between the renewable energy sources. Summarize the main takeaways.
2. Scenario discussion (10 min): Introduce the following scenario to the students:

A city near your place wants to reach 60% renewable energy by 2035. As an expert in energy, you are invited to help the Municipality decide which energy source or sources they should use. The task of your group is to make a proposal to be presented to the municipality. You should decide which energy sources the city should use and explain your choices.

Make sure students understand the task.

3. Problem-solving (10 minutes): Handout Worksheet ES3, which includes the scenario. Ask small groups of students to solve the problem, that is, to make a proposal to help the Municipality reach the target.
They can use information on renewable energy sources they researched in their own region, combine their findings, evaluate which local sources are feasible, and propose an energy mix with justifications.
Afterward, students should be asked to share their solutions with the class briefly. Other groups should peer assess their presentation using Worksheet ES4.
4. Brochure Creation (10 min): Ask the same groups of students to create a brochure (on a piece of paper) that persuades people in their community to conserve energy. Hand out Worksheet ES5, where they can find instructions on how to create a good brochure.



ANNEXES

Annex 1: Glossary

- **Energy:** The ability to do work or cause change.
- **Types of energy:** have to do with the different ways energy manifests itself: thermal, light, mechanical and chemical energy.
- **Forms of energy:** are broad classifications of energy which encompass kinetic energy, the energy of motion, and potential energy, due to position or state. Examples include the energy of a moving car (kinetic) and the energy of water stored in a high dam (potential).
- **Renewable Energy:** Energy derived from natural sources that are constantly replenished, such as sunlight, wind, flowing water and biomass.
- **Non-renewable Energy:** Energy obtained from sources that cannot be replenished on a human time scale, such as fossil fuels.
- **Fossil Fuels:** Energy sources formed from the remains of ancient plants and animals, including coal, oil and natural gas.
- **Solar Energy:** Energy harnessed from the sun's rays, often captured using solar panels or solar thermal systems.
- **Wind Energy:** Energy generated by converting the kinetic energy of wind into electrical power using turbines.
- **Hydroelectric energy:** Energy produced by using the flow of water to generate electricity, usually through dams or small-scale river turbines.
- **Biomass Energy:** Energy produced from organic materials such as wood, agricultural residues, or animal waste, through burning or composting processes.
- **Sustainability:** Using resources in a way that meets current needs without compromising the ability of future generations to meet theirs.
- **Energy Efficiency:** Using less energy to perform the same task, reducing waste and environmental impact.
- **Energy Saving:** Reducing overall energy consumption by changing habits, using energy-efficient technologies, or improving existing processes.



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5. Presentation & Peer Review (10 min): Each group presents its brochure briefly. Peers provide feedback using the 'Fist-to-Five' technique.
6. Reflection (5 minutes): Students complete Worksheet ES6, to reflect on how they feel about the Exploration of Energy and Energy Sources.
7. Self-assessment (5 minutes): Invite students to play the games available at <https://www.projectgreenlighteu.com/Home/ePlatform?section=energyGames>

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—**scenario solutions and brochures**—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: Influence of geographic factors on energy production.
- Economics: Cost analysis and sustainability considerations.
- Technology/Art: Use of digital tools for visual communication.

Additional Notes for Teacher

Ensure access to digital devices and reliable internet.

Encourage creativity and use of free online tools like Canva (<https://www.canva.com/design-school/>).

Maintain a balance between teacher-led instruction and student-centered exploration.

Adapt timing if groups need additional time for discussions or brochure creation (<https://www.youtube.com/watch?v=ukLIYgRloWU>)



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ADDITIONAL SUGGESTIONS

PLEASE MAKE THESE APPLICATIONS BEFORE THE FINAL EVALUATION PHASE.

Video / Activity	Planning Part	Integration Format	Outcomes
YouTube: "What is Energy?"	Lesson ES1 Kick-off (10 min)	Introducing the concept of energy. After the video, a discussion on "What is energy?"	Differentiating different forms of energy, activating students' prior knowledge.
Solar Oven STEM activity (ScienceBuddies) + YouTube + YouTube Demonstration	Lesson ES2 – Create a brochure or additional practice time	Students can build a solar oven as their own "renewable energy application." It can be included in an observation report or brochure as an example of "renewable energy at home."	Discovering the functioning of solar energy, the engineering-design process.



Annex 2: Checklist for Lesson Activities

- **Definition & Understanding:** Has the student understood and can clearly explain what this specific type of energy is (Solar/Wind/Hydroelectric/Biomass energy)?
- **Classification:** Was the correct categorization made (renewable/non-renewable) and were key characteristics of each category identified?
- **Key Concepts:** Are essential details included (method of production, technologies, current levels of use, prospects)?
- **Pros & Cons:** Are at least two advantages and two disadvantages identified for each energy source use?
- **Environmental Impacts:** Are the positive/negative impacts on the environment accurately described?
- **Real-world Examples:** Are there concrete examples from students' countries/Europe/the world showing practical application?
 - Solar: e.g., Portugal – Solar farm of Amareleja ; Greece – Chronus Kozani Solar PV Park, **Turkey – Karapınar Solar Power Plant.**
 - Wind: e.g., Wind farm in Mani offshore wind turbines (general example: North Sea); Turkey – Balıkesir Bandırma Wind Farm.
 - Hydropower: e.g., Kremasta Hydroelectric Plant small “run-of-river” facilities.
 - Biomass: e.g., Biomass units in Western Macedonia use of agricultural residues, Turkey – Konya Biomass Power Plant, using agricultural waste.
- **Collaboration:** Was there effective teamwork (role distribution, time management, conflict resolution)?
- **Creativity:** Was creativity incorporated (poster/infographic, role-play, original solutions to scenarios)?
- **Critical Thinking:** Were positions supported with evidence? Were options compared and justified?
- **Use of Digital Tools:** Were Canva/Genially/Kahoot/Google Forms effectively used for research, organization, and presentation?
- **Presentation Skills:** Were the presentations clear, well-structured, and adapted to the audience?
- **Reflection:** Was self- and peer-assessment carried out (e.g., Fist-to-Five, short reflective responses) with clear next steps for improvement?
- **Visual & Communication Clarity:** In visual work, were appropriate images/icons/layouts used to ensure readability and an engaging outcome?



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Annex 3 – Energy Source Cards

Annex to Worksheet WES1

		
Water	Coal	Sun
Your answer:	Your answer:	Your answer:
		
Oil	Wind	Biomass
Your answer:	Your answer:	Your answer:
		
Natural Gas	Sea waves	Uranium
Your answer:	Your answer:	Your answer: