GREENLIGHT

Energy Efficiency and Energy Saving

Teacher's Guide

September, 2025

The scope of this teacher's guide

This teacher's guide addresses the issue of how we should behave towards energy to protect the environment.

It presents two lesson plans to be used in conjunction with a student's worksheet, developed to support a 60-minute class.

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

Some general information, followed by the lesson plan, is provided for the lesson.

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

The keywords that describe the lessons are: energy efficiency, energy saving, renewable energy, sustainability, STEM, and environmental protection

Summary

Students will explore how energy efficiency and conservation protect both the environment and the economy. Through interactive games, small-group problem-solving, real-life examples, and creative project work, students will analyze their own energy habits and propose realistic solutions.

Aims of the lessons

By the end of the teaching and learning sequence, students are expected to show **knowledge** of energy efficiency and energy saving, namely to:

- Define energy efficiency.
- Explain the environmental and economic benefits of the efficient use of energy.
- Identify everyday behaviors and technologies that save energy.
- Compare renewable and non-renewable energy use in terms of efficiency.
- Propose actionable strategies to reduce energy waste at home, school, and in their community.

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

- Creativity and innovation
- Critical thinking and problem-solving
- Communication and collaboration
- STEM Literacy:
- Information literacy

Methodological approach

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

- Collaborative learning (group challenges)

- Inquiry-based and problem-based learning

- Visual/digital learning (infographics, short videos)

- Gamification (energy challenge game)

- Formative assessment (observations, group feedback)

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

- **Personalisation of learning:** reflection on energy saving.

- **STEM topic integration:** Links between energy use, environmental conditions, and economic 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, group work, role-playing, 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

Energy efficiency means using less energy to get the same job done. Being energy efficient means minimizing energy waste to perform a task or provide a service, lowering energy bills, and reducing pollution and greenhouse gas emissions. Many devices, homes, and buildings use more energy than they actually need because of inefficiencies and energy waste. Using energy-efficient light bulbs and insulating a house are examples of energy efficiency measures. There are energy

efficiency codes for electronic devices, which rate products on a scale from A (most efficient) to G (least efficient) to help consumers make informed choices.

Energy Saving refers to the practice of reducing overall energy consumption by changing habits, using energy-efficient technologies, or improving existing processes. While energy efficiency is the ability to obtain the best results by using the least amount of energy resources possible in an activity, energy saving, by contrast, is the ability to reduce the expenditure by promoting limited energy consumption. The primary goal of energy saving is to minimize the use of finite natural resources and fossil fuels, thereby reducing costs, preserving the environment by lowering pollution and carbon footprint, and promoting a more sustainable future for generations to come. One can save energy at home by, for example, making the most of sunlight, that is, opening the curtains or blinds during the day, so sunlight comes in and naturally heats the room, and closing them at night to prevent heat loss; hanging out clothes in the sun or outdoors instead of using the dryer.

More scientific and technical information on these issues can be found at:

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

and in an e-book available at:

https://www.projectgreenlighteu.com/Home/Resources

LESSON PLANS ON ENERGY EFFICIENCY AND ENERGY SAVING (EES)

Time: 120 minutes (2 x 60 minutes)

Teacher's materials: 2 lesson plans

Students' materials: 1 worksheet

Lesson Plan EES1 (60 minutes)

This lesson introduces students to the energy efficiency concept.

1. Brainstorming activity (10 min): Ask your students: *"In your house or school, list three things you think waste the most energy."* Students write privately, then share in pairs, then in class. The idea is to build interest in the topic.

   Possible answers (not a single one)

   - Leaving lights on in empty rooms

   - Old refrigerators or appliances

   - Leaky windows or doors letting heat escape

   - Computers on standby overnight

   - Overusing air conditioning or heating

2. <u>Introduction to energy efficiency (10 min):</u> Show students a short video (2–3 min) about energy efficiency success stories. You can use the video available at https://www.youtube.com/watch?v=mBJysE4EDgY . Ask students what surprised them. Their answers can focus on different issues, and you should acknowledge all of them.

Indicative students' answers

1. **Scale of the Problem**
"I was surprised that the energy sector in Pakistan is expected to contribute 64% of all greenhouse gas emissions by 2050. I didn't realize energy use alone could have such a huge impact."

2. **Impact of Simple Changes**
"It was surprising that simply switching to LED lighting can significantly reduce energy consumption and emissions. Small changes really can make a big difference."

3. **Large Financial Investment**
"I didn't expect that a project like this would cost US$7.4 million. I was surprised by how much investment is needed to make a real difference."

4. **Diverse Application**
"I was amazed that the project isn't just for homes—it also includes commercial, industrial, and outdoor lighting. It shows that efficiency can be applied everywhere."

5. **University Library Example**
"I didn't expect that even a single building, like a library, could be retrofitted with LED lighting and make a measurable impact on energy savings."

6. **Global Support & Collaboration**
"I was surprised that the Global Environment Facility helped fund the project. It shows that international collaboration is important for tackling energy and climate issues."

7. **Speed and Feasibility**
"I was surprised by how quickly LED retrofits can be implemented and the immediate energy savings they produce. It makes efficiency feel achievable."

3. <u>Energy efficiency in Europe Activity (20 min):</u> Ask small groups of 3 to 5 students to carry out the tasks in the <u>Worksheet EES1</u> and share what stands out, and surprising numbers. Afterwards, promote a class discussion of the groups' answers.

Indicative picks

"EU buildings use 40% of total energy → means buildings are key for savings."
"Switching to LEDs can cut lighting energy use by 75% → easy first step."
"Portugal's renewables already exceed 60% of electricity → shows change is possible.".

4. <u>Design a "Be Energy Smart" Poster (10 min):</u> Ask small groups (3 to 5) of students to design a poster (could be digital or paper) with the top 3 actionable tips for saving energy in school/home, using data from the worksheet. It must include at least one renewable-oriented tip.

5. <u>Gallery Walk + Reflection (10 min):</u> Display students' posters. Ask students to walk around, note 2 tips from others they like. Exit ticket: "One thing I'll change in my home/school to save energy & why."

Lesson Plan EES2 (60 minutes)

This lesson introduces students to the energy-saving concept.

1. <u>Warm-Up Quiz (10 min):</u> Ask students to play a True/False quiz (see bank below). Use the corners of the room, one for True and another for False statements. Explain the false statements.

Quiz, answer and explanation

#	Statement	Answer	Explanation
1	Standby power can use up to 10% of household electricity.	True	Phantom/vampire loads add up.
2	LED bulbs last about 25 times longer than incandescent bulbs.	True	LEDs can last ~25,000 hours.
3	Leaving a laptop plugged in overnight uses almost no power.	False	It still draws power, even when charged.
4	Lowering your thermostat by 1°C can cut heating bills by ~5–10%.	True	Small changes save significant energy.
5	Heating water is the largest single use of home energy in Europe.	False	Space heating is usually the largest.
6	A fully loaded dishwasher uses less water and energy than hand washing.	True	Modern dishwashers are efficient.
7	Keeping fridge doors open briefly has little effect on energy use.	False	It forces the compressor to work harder.
8	Solar panels only work in very sunny countries.	False	They generate power even in cloudy Europe.
9	Insulating your attic can reduce heating energy by up to 25%.	True	Insulation prevents heat loss.
10	Unplugging chargers when not in use doesn't matter.	False	Chargers draw small amounts continuously.
11	Switching to public transport or carpooling reduces CO_2 emissions.	True	Fewer vehicles → lower emissions.
12	Washing clothes in cold water saves energy without affecting cleaning.	True	Detergents today work well at low temps.
13	Turning off Wi-Fi routers overnight damages the device.	False	It's safe and saves energy.
14	Large-screen TVs always use less energy than smaller ones.	False	Larger screens usually consume more.
15	Using curtains strategically can improve home energy efficiency.	True	Curtains keep heat in winter and block sun in summer.

2. <u>School Energy Audit Challenge (15 min):</u> Ask small groups of students to "audit" a classroom/school area (or imagine one) to spot 3 inefficiencies and suggest fixes.
Ask students to share the result with the class.

Possible inefficiencies and solutions

Area	Inefficiency	Suggested Fix
Lighting	Old bulbs, lights left on	Replace with LEDs, motion sensors
Heating/Cooling	Thermostat too high/low, windows open	Adjust thermostat, close windows, smart thermostats
Electronics	Devices on standby	Auto-shutdown, smart power strips
Insulation	Drafty windows/doors	Seal gaps, insulating film
Water Heating	Excessive heating	Timers, fix leaks
Outdoor Lighting	Lights on during day	Timers, light sensors

3. <u>Role-Play: Community Energy Council (10 min):</u> **Ask small** groups (3 to 5) students to act as councils proposing 3 energy-saving policies or behaviors for their community. Must include a renewable-related tip and cost/benefit idea.

Indicative answer

Policy / Behavior	Renewable-Related?	Cost / Benefit Idea	Explanation
1. Install solar panels on community buildings (schools, libraries, sports centers)	✅ Yes	High upfront cost (~5,000–10,000 per building) but long-term savings on electricity bills; reduces CO_2 emissions	Students can argue that solar panels provide clean energy, reduce utility costs, and serve as a visible community example.
2. Switch all street and public lighting to LED	✅ Optional (indirect)	Medium cost; saves up to 60–70% of electricity for lighting, low maintenance	LED retrofit reduces energy demand, cuts municipal energy expenses, and lowers emissions.
3. Promote carpooling, biking, and public transport	❌	Minimal cost; reduces fuel use, congestion, and emissions	Encourages behavioral change that complements renewable energy investments.
4. Implement an energy-efficiency awareness campaign	❌	Low cost; benefits include energy savings at home and school, increased community engagement	Posters, social media, and workshops educate residents on energy-saving habits.
5. Provide subsidies or rebates for home insulation and efficient appliances	✅ Indirect	Moderate cost for government; households save 20–50% on heating/cooling bills	Encourages private investment in energy efficiency and reduces overall energy demand.

4. <u>Action Plan + Slogan Competition (15 min):</u> Ask small groups (3to 5 students) to draft an action plan and a catchy slogan.

They should present in 1-minute pitches and vote on "Best Slogan" or "Most Practical Plan."

As a teacher, you should:
- • Use a timer to keep pitches at 1 minute.
- • Encourage all group members to speak briefly.
- • Create a simple voting system: sticky notes, show of hands, or digital poll.
- • Celebrate creativity in slogans and practicality in plans.

What to Expect From Students

1. **Action Plans**
   - 3 energy-saving actions, usually combining:
     - . **Behavioral changes** (turning off lights, unplugging devices, promoting biking/public transport)
     - . **Technological fixes** (LED retrofits, smart thermostats, insulation)
     - . **Renewable energy measures** (solar panels, small-scale wind, solar water heaters)
   - Plans may include **simple cost/benefit logic**: e.g., "LED bulbs cost 5 euros each but save 20 euros/year in electricity."

2. **Slogans**
   - Short, catchy, easy to remember.
   - Often rhyming or using wordplay.
   - Examples:
     - . "Turn it Off, Lighten the Load!"
     - . "Bright Ideas, Less Energy!"
     - . "Solar Today, Save Tomorrow!"
     - . "Share the Ride, Save the Planet!"

3. **Pitch Presentations**
   - 1–minute maximum → concise explanation of actions + slogan.
   - Can include **visuals or sketches** of their ideas.
   - Encourage **enthusiasm and teamwork**.

5. <u>Wrap-Up & Energy Pledges (10 min):</u> Ask each student to select and share one concrete energy-saving pledge for the next month. They can focus on home, school, traveling etc. When they share their pledges, summarize their big ideas.

The next table shows possible pledges associated with some students' most used places.

Afterwards, you can find a possible summary of the big ideas that emerge from students' pledges.

Students' possible pledges

Place	Pledge
At Home	• "I will switch all my bedroom lights to LED bulbs." • "I will unplug my phone charger and other electronics when not in use." • "I will reduce my shower time by 2–3 minutes to save hot water." • "I will wash my clothes in cold water instead of warm or hot water." • "I will turn off the TV and computer when I leave the room."
At School	• "I will remind my classmates to switch off lights and projectors when we leave the classroom." • "I will participate in a campaign to replace old bulbs with LEDs in our school." • "I will encourage teachers to close windows when the heater is on."
Community / Travel	• "I will try to walk, bike, or carpool instead of using my car." • "I will encourage my family to install solar panels or use renewable energy where possible."
General / Behavioral	• "I will keep my phone and laptop on airplane mode or turn them off when not in use." • "I will track my home energy usage this month and try to reduce it by 10%." • "I will make a chart at home to remind everyone to turn off lights and appliances."

Big ideas

Many small actions collectively make a big difference.

Behavioral changes (turning off lights, unplugging devices) are easy to implement.

Investing in energy-efficient technologies (LEDs, smart plugs, insulation) saves energy long-term.

Renewable energy adoption (solar panels, clean energy contracts) has both environmental and economic benefits.

Awareness and community engagement multiply the effect of individual actions.

Assessment

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

Suggested **Teacher Assessment** Strategies:

- Participation in quizzes and activities
- Ability to interpret simple data charts
- Creativity in role-play and slogan design
- Compromise evidenced by the pledge

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: energy efficiency and savings

– Economics: energy costs

– Technology/Art: Use of digital tools for visual communication.

– English: analysis of infographics

PLEASE MAKE THESE APPLICATIONS BEFORE THE FINAL EVALUATION PHASE.

Video/Activity	Planning Part	Integration Format	Outcomes
Short: "Everyday Energy Saving Tips"	EES1 Course – Introduction to Energy Efficiency (8 min)	It can be used in the "Successful energy efficiency examples" section.	Günlük yaşamda enerji verimliliği bilgisi.
Short: "LED vs Incandescent Bulb Test"	EES2 Lesson – Warm-Up Test or Audit Challenge	It can be cited as an example of energy saving of LED technology.	Organic products, energy components, and recyclable materials are learned through an engineering product, and the increase in sustainability is understood. Design conservation (observe → design → try → develop) is implemented.
Energy saving in school / Energy policy	EES2 – Role Playing Game (Community Energy Co ncil)	Examples of social energy policies to be implemented in schools and as an example video for energy policy discussions	Analysing the contribution of renewable energy investments to society.
"Energy-Efficient School Project"	EES2 – Action Plan + Slogan Competition	Can be used as an inspirational example.	Designing school-based energy efficiency plans.
Engineering for Energy Efficiency	EES2 Design and Prototype development	Can be used as an inspirational example.	Students understand the importance of energy efficiency and recyclable materials; the design cycle (observe → design → try)