



FLORES

Offshore Renewable Energies
partnership in the Pact for Skills

Educational Materials for the Offshore Renewable Energies

Secondary School Guidebook

Lesson 3: Solar energy

3



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About this guidebook

Forward Looking at the Offshore Renewables (FLORES) will promote the core activity of the Large-scale partnership launching the Pact for Skills in the Offshore Renewable Energies (ORE) sector. FLORES will support the most committed stakeholders in the ORE, underpinning the success of the offshore renewable energy strategy with the stimulation of dedicated training offers. The partnership will promote the skilling process for the new jobs expected in the sector, estimated to account for between 20,000 and 54,000 new workers in the following five years and contribute to improve upskilling opportunities in the field of the actual ORE workforce.

FLORES prepared a set of educational materials for secondary school teacher presenting six topics:

- 1) introduction to offshore renewables;
- 2) wind energy;
- 3) solar energy;
- 4) ocean currents energy;
- 5) wave energy;
- 6) tidal energy.

For every lesson there is a guidebook and additional sources as well as a PowerPoint presentation aimed at developing practical Science, Technology, Engineering and Mathematics (STEM) experiences for secondary school students.

The objective of these educational materials is to empower teachers to introduce offshore renewable energy as a new topic and seamlessly integrate ocean literacy into their lessons. It is a «teach the teacher» resource that equips educators with the methodology required to independently craft lesson plans, while also providing them with a curated selection of existing resources.

This guidebook is aimed at students in secondary school, and the content can be adapted to younger and older students ranging from 12-18.

Project duration: January 2023 – December 2024 (24 months)

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Guidebook



Offshore renewable energies: solar energy

This document is intended for secondary school teachers and serves as a guide for lessons introducing solar energy as an energy source.



Duration: approx. 45 minutes

Lesson time can be extended with the use of additional materials provided under the scenario.



Target group: secondary school pupils



Learning objectives:

- ▶ To introduce to students to the concept of offshore solar energy.
- ▶ To enrich the knowledge about the use of solar energy for electricity production.
- ▶ To familiarise with methods of harnessing solar energy at sea and its potential.
- ▶ To develop knowledge and awareness of the benefits associated with the use of solar energy and the potential of offshore energy as an alternative to traditional energy sources.

Competencies and skills to be developed:

- ▶ Ability to understand concepts related to offshore solar energy.
- ▶ Ability to find and analyze information about offshore solar energy.
- ▶ Ability to organize and present collected data in an accessible manner.
- ▶ Development of critical thinking skills and drawing conclusions based on the information obtained.

Proposals for evaluating learning outcomes (elective):

- ▶ Assessment of students based on their participation in discussions and group tasks.
- ▶ A short quiz to test the students' understanding of offshore solar energy.
- ▶ A homework assignment that requires students to create a short essay on the significance of offshore solar energy in the context of global energy challenges.

Including diversity and inclusive aspects in teaching:

- ▶ During the lesson, the teacher should pay attention to the different perspectives and approaches of the students towards renewable energy sources.
- ▶ Encourage open discussion and respect for different points of view.
- ▶ Enable students to conduct their own research and experiments to explore a topic according to their individual interests.
- ▶ Sensitivity to the needs of students with different religious beliefs, gender, disabilities, ensuring that they have equal opportunities to be included in the learning process.
- ▶ Recognize that your classroom may include students whose parents/family/close relatives/family friends work in the fossil fuels industry. It's vital to create a safe and inclusive space where they can freely learn, ask questions, and share their perspectives on renewable energies, fostering a richer and more holistic dialogue for all.

Lesson scenario:**Offshore renewable energies – solar energy****Lesson objectives:**

- ▶ To familiarise students with the definition of offshore solar energy.
- ▶ To understand the use of solar energy for electricity production.
- ▶ To develop awareness of the benefits associated with the use of solar energy and the potential of offshore energy as an alternative to traditional energy sources.

**Working methods:**

- ▶ Lecture
- ▶ Discussion
- ▶ Presentation

**Work format:**

- ▶ Individual
- ▶ Group work

**Teaching tools:**

- ▶ Multimedia projector
- ▶ Multimedia presentation
- ▶ A4/A3/A2 paper sheets and markers/permanent markers

Course of the lesson:**I. Introduction (10 minutes)**

- 1 Welcome students and introduces the topic of the lesson.
- 2 Introduces students to the topic - a few words about the history of solar energy.
- 3 The teacher asks the students to list associations with “solar energy”. He/she records the pupils’ answers on the board.
- 4 The teacher explains how offshore solar energy works using a sample diagram.
- 5 Then presents the benefits of offshore solar energy.
- 6 Shows a video on solar energy.

II. Group Task (30 minutes)

- 1 Divide students into groups of 4-5 people. Each group receives a set of markers and a sheet of paper.
- 2 The task of each group will be to design a simple poster informing about offshore solar energy.
- 3 Each group presents their project to the rest of the class

III. Summary and conclusion (5 minutes)

- 1 Summarises the task, emphasizing the importance of offshore solar energy as a renewable energy source and encouraging students to further research and interest in this topic. Mentions the importance of creative thinking and developing solutions related to solar energy.
- 2 Thanks the students for participating in the lesson.

Information, concepts, definitions

Offshore solar energy refers to the generation of solar power through the use of photovoltaic (PV) systems installed in bodies of water, such as oceans, seas, lakes, or reservoirs. It involves placing large arrays of solar panels on floating platforms or structures that are installed offshore, away from land. These platforms harness solar energy and convert it into electricity, which can be fed into the power grid or used for various applications. Offshore solar energy is a renewable and sustainable source of power with the potential to provide clean energy solutions and reduce dependence on traditional fossil fuels.

Comments on the slides

Slide 2 - Introduction

Offshore solar energy – like other offshore energies - can provide jobs, boost local economies, generate revenue, stabilize energy prices, reduce import dependence, drive innovation, and attract tourists.

Solar power is a type of energy that comes from the sun. It is the fastest growing source of energy in the world. Solar power is good for the environment because it does not create pollution. In Europe, solar power is becoming very popular. In 2022, Europe broke its own record for installing solar panels. They installed over 40 GW of solar power, which is the most ever in Europe. One reason why solar power is becoming so popular is because it is getting cheaper. In the past few years, the cost of solar energy has gone down by 90%. This means that more people can afford to use solar power in their homes and businesses. Experts say that by the year 2050, solar power will be the main source of energy in Europe. This is because it is getting cheaper, and more people are using it. Solar power is a great way to help the environment and save money. It is a clean source of energy that can be used by everyone.

Solar photovoltaic energy is a type of energy that uses sunlight to make electricity. It has three important parts: photovoltaic modules, which change sunlight into electricity; inverters, which change the electricity from the panels into a type of energy we can use; and transformers, which make the electricity stronger, so it doesn't get lost. The photovoltaic inverter is in charge of changing the electricity from the panels into energy we can use in our homes. It does this by using specialized items (called transistors and capacitors) to make the electricity flow like waves.

In the past, solar panel systems were usually situated on the ground or on roofs in places with lots of sunlight. But we realized that there are other places where we can use solar panels too, like marshes, reservoirs, and even the ocean! That's why we created floating photovoltaics. They put solar panels on top of water spaces to make electricity.

Slide 3 - Amazing solar facts

- ▶ Today, solar energy could provide power to the entire world using only a tiny 0.16% of the Earth's land surface.
- ▶ Since 2009, the cost of solar energy has decreased by a whopping 90%. This is the biggest cost reduction ever seen in any type of energy technology.
- ▶ Compared to coal, solar energy produces a staggering 96% less carbon emissions. In addition, it emits 93% less greenhouse gas emissions than gas does.

Slide 4 - What do you associate with “solar energy”?

Offshore solar energy refers to the process of harnessing solar power from photovoltaic (PV) panels installed in bodies of water, such as oceans. These panels are designed to float on the surface and absorb sunlight to generate electricity.

In simple terms, offshore solar energy involves placing solar panels on water to produce clean and renewable energy. It is similar to how regular solar panels on rooftops or fields convert sunlight into usable electricity, but in this case, they are set up on water bodies instead. By utilizing these floating solar panels, we can take advantage of large water surfaces that might not be utilised for other purposes, while still benefiting from the sun's energy to generate power.

Slide 5 - How does solar work?

Solar energy is a type of energy that comes from the sun. We can use special panels called photovoltaic panels to convert this energy into electricity.

When the sun shines on these panels, components known as PV cells inside them absorb the sunlight's energy. This energy makes electrical charges move in the cells, which creates electricity.

The electricity that is made is called direct current (DC) electricity. But we need a special device called an inverter to change it into the type of electricity we can use, which is called alternating current (AC) electricity.

This AC electricity can be used to power our homes, our cars, or it can be sent to the electricity grid so that others can use it too.

Slide 6 - How does offshore solar work?

Offshore solar uses similar technology to land-based solar technology. However, the solar panels and equipment are mounted on floating structures in the ocean and are anchored to the seabed with ropes and anchors. The electricity produced is then sent to land through underwater cables.

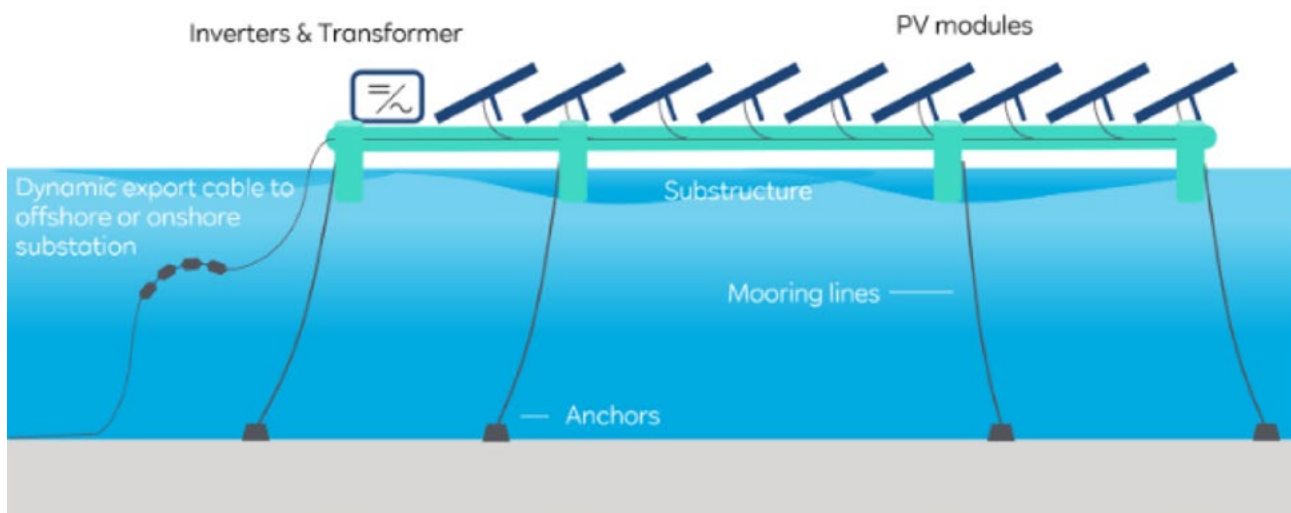


Figure 1.

Putting solar panels in the ocean requires structures that can handle big waves, strong winds, and saltwater.

This technology opens up new opportunities for solar projects in places where there isn't much wind but lots of sunlight in the ocean. It also allows for combined wind and solar projects in areas where there's not much space but where there is good wind and sunlight.

Floating solar, also called photovoltaics or floating photovoltaic, means having solar panels that float on water. These solar panels are attached to floating structures so that they stay on top of the water. Using floating solar is a green way of generating electricity because it combines marine and renewable energy technology. The electricity produced by this floating system is sent through underwater cables to a transmission tower.

Slide 7 - Advantages of floating solar**1 You don't lose valuable land space**

Lots of solar panels on the ground take up valuable land because they need a certain amount of space to be installed properly. Because solar panels work by absorbing sunlight and converting it into electricity, they require sunlight to hit them directly. So, if we place too many solar panels together, they might cast shadows on each other and not work as efficiently as possible. That's why we need to install them with a proper distance between each panel, and this takes up valuable land. But we do it because it helps us produce clean energy and protect the environment!

With floating solar panels, you don't need land. Instead, you can put them on water in places like water treatment plants, drinking water lakes, or dams. In this way, you can use the land for something else instead of covering it with solar panels. Plus, putting solar panels on water means you don't have to cut down trees.

2 Helping the environment

Floating solar panels are good for the environment. The water itself helps to cool down the solar panels. This also stops the water from evaporating, which is important in dry areas.

Moreover, having the solar panels floating on the water prevents the excessive growth of algae in freshwater. Algae can be harmful if it gets into drinking water. It can also harm animals and plants in the water.

Floating solar panels produce clean energy. Using renewable energy helps us rely less on electricity made from fossil fuels. This means there is less pollution in the air.

3 Better solar performance

Even though solar panels work well in hot weather, they can become less efficient over time. Solar panels perform best under moderate temperatures, as higher or lower temperatures can reduce efficiency. However, if you set up PV modules on water, the water cools them down and makes them work better.

Slide 8 - Benefits

There are several potential economic benefits associated with offshore solar energy:

- 1 Offshore solar energy can create many jobs in different industries like engineering, construction, manufacturing, and maintenance.
- 2 Offshore solar projects can help local businesses grow by creating new supply chains and support services.
- 3 Offshore solar projects can make money by selling electricity, which can benefit the local community through taxes and economic development funds.
- 4 Offshore solar energy can help keep energy prices stable by using different sources and reducing reliance on fossil fuels.
- 5 Offshore solar projects can reduce a country's need to import energy, especially fossil fuels, making energy more secure and reducing the trade deficit.
- 6 Offshore solar projects can drive technological advancements and innovations that can have benefits in other areas too.
- 7 Offshore solar installations can attract tourists who are interested in sustainable energy and nature.

In summary, offshore solar energy – like other kinds of offshore energy - can provide jobs, boost local economies, generate revenue, stabilize energy prices, reduce import dependence, drive innovation, and attract tourists.

The purpose of using floating platforms for offshore solar energy installations is to harness solar energy in areas where land is limited or unsuitable for conventional solar panel deployment. The use of floating platforms allows for the installation of solar panels on water bodies such as lakes, reservoirs, and oceans.

Floating solar platforms provide several advantages. Firstly, they utilize unoccupied water surfaces, enabling the efficient use of under-utilized resources. Secondly, these platforms can be deployed in proximity to populated coastal areas with high electricity demand, reducing transmission losses and improving grid integration. Thirdly, the cooling effect of water can enhance the performance and longevity of solar panels, ultimately increasing their efficiency.

Furthermore, offshore solar installations have a lower environmental impact compared to land-based ones. They do not require land clearing or displacement of ecosystems, and they have minimal impact on agriculture or other land activities. By utilizing water bodies, these platforms can also help reduce evaporation rates, mitigate algae growth, and potentially improve water quality.

Ultimately, floating platforms for offshore solar energy installations offer an innovative and sustainable solution to maximize the deployment of solar panels, tapping into the vast potential of water surfaces for renewable energy generation.

Slide 9

<https://www.youtube.com/watch?v=OVODBZUJAYE&t=25s>

Sources:

- ▶ Floating Solar Panels
<https://www.dynamicslr.com/floating-solar-panels/>
- ▶ Floating Photovoltaic Solar Energy
<https://www.iberdrola.com/innovation/floating-photovoltaic>
- ▶ Discover Offshore Solar Energy
<https://www.rwe.com/en/research-and-development/solar-energy-projects/offshore-solar/>

QUIZ: Solar energy

Guidelines: Adapt the quiz to your needs. You can use available apps, such as Kahoot, to create an online version or print and hand out to pupils.

Task 1: Single-choice test. Mark the correct answer**1. What is offshore solar energy?**

- ☐ a. Solar panels installed on rooftops of buildings near the coast.
- ☐ b. Solar panels installed on floating platforms in the ocean.
- ☐ c. Solar panels installed in deserts far away from populated areas.
- ☐ d. Solar panels installed on mountains overlooking the seaside

Correct answer: b

2. Which of the following is an advantage of offshore solar energy?

- ☐ a. High initial installation costs.
- ☐ b. Limited space availability.
- ☐ c. Less exposure to sunlight.
- ☐ d. Less visual impact on land.

Correct answer: d

3. What is the purpose of using floating platforms for offshore solar energy installations?

- ☐ a. To provide shade to marine life.
- ☐ b. To harness wave energy along with solar energy.
- ☐ c. To make it easier to move the solar panels to different locations.
- ☐ d. To allow the solar panels to track the sun's movement.

Correct answer: d

4. Which country has pioneered the development of offshore solar energy?

- ☐ a. United States.
- ☐ b. China.
- ☐ c. Germany.
- ☐ d. Japan.

Correct answer: c

5. How does offshore solar energy contribute to reducing greenhouse gas emissions?

- ☐ a. By converting solar power into wind energy.
- ☐ b. By replacing conventional fossil fuel-based power plants.
- ☐ c. By using floating platforms made from recycled materials.
- ☐ d. By minimizing the use of land for solar panel installations.

Correct answer: b

6. What is the main reason for utilizing offshore solar energy instead of onshore solar energy?

- ☐ a. Offshore solar panels are more efficient at converting sunlight into electricity.
- ☐ b. Offshore solar energy is cheaper to implement and maintain.
- ☐ c. Offshore areas have a higher population density requiring additional electricity.
- ☐ d. Onshore areas lack suitable space for solar panel installations.

Correct answer: d

7. Which factors contribute to the high initial installation costs of offshore solar energy systems?

- ☐ a. Use of specialized materials designed to withstand ocean environments.
- ☐ b. Limited availability of competent technicians for offshore maintenance.
- ☐ c. Higher taxes imposed on renewable energy projects.
- ☐ d. Lower demand for offshore solar energy compared to onshore. Correct answer: a

8. How are offshore solar installations connected to the grid?

- ☐ a. Through underground cables laid on the ocean floor.
- ☐ b. By transmitting electricity wirelessly to onshore stations.
- ☐ c. Via hybrid connections combining solar and wind energy.
- ☐ d. By using subsea transformers and cables. Correct answer: d

9. What is the primary motivation for countries to invest in offshore solar energy projects?

- ☐ a. Reducing the reliance on imported fossil fuels.
- ☐ b. Exporting excess renewable energy to neighboring countries.
- ☐ c. Enhancing the aesthetics of coastal areas with floating solar panels.
- ☐ d. Increasing revenue through government subsidies for solar energy. Correct answer: a

10. What are the potential economic benefits associated with offshore solar energy projects?

- ☐ a. Job creation in industries related to offshore construction and maintenance.
- ☐ b. Decreased tourism revenues due to the visual impact of floating platforms.
- ☐ c. Reduced income for traditional fishing communities in coastal areas.
- ☐ d. Increased dependency on foreign countries for technology and equipment. Correct answer: a

Additional sources



Reports

- ▶ IRENA (2020), Innovation outlook: Ocean energy technologies, International Renewable Energy Agency, Abu Dhabi.
<https://www.irena.org/publications/2020/Dec/Innovation-Outlook-Ocean-Energy-Technologies>

Links to educational content

- ▶ [Hollandse Kust Noord ONE – 0.5 MW in offshore windfarm](#)
- ▶ [NORTH SEA THREE – 3 MW in Belgium waters](#)
- ▶ [NORTH SEA TWO – 1 MW](#)
- ▶ [NORTH SEA 1 – surviving almost two years on the North Sea!](#)
- ▶ [DNV clears Oceans of Energy's offshore solar design for North Sea conditions](#)
- ▶ [HelioRec installs floating solar unit in French port](#)
- ▶ [SeaVolt launches first of a kind offshore solar platform](#)
- ▶ [Floating solar in Portugal could exceed national target for solar energy of 7GW, new research finds](#)
- ▶ [SolarDuck sets up Norwegian floating solar base](#)

Articles

- ▶ Offshore Renewable Energy Strategy - Key Technologies
https://ec.europa.eu/commission/presscorner/detail/en/fs_20_2098
- ▶ Floating Solar Panels
<https://www.dynamicslr.com/floating-solar-panels/>
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- ▶ Discover Offshore Solar Energy
<https://www.rwe.com/en/research-and-development/solar-energy-projects/offshore-solar/>

Films

- ▶ Are floating solar farms the future of clean energy?
<https://youtu.be/IZXV2p73vcE?feature=shared>
- ▶ Visit a solar farm - take a virtual tour!
<https://youtu.be/BmCJooBIKPI?feature=shared>



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