Electricity: How could our needs meet with responsible uses

Electrical energy and climate change: Making connections

Type of pedagogical project, activity, action, accompanying	Pedagogical project on the generation and use of electricity and their impacts on the climate.
Key words of relevant disciplines/ Pedagogical content	Electricity, fossil fuels, lignite, carbon footprint, greenhouse effect
Problematic	How is electrical energy connected to our everyday life and climate change?
Thematic	General: The greenhouse effect Causes/Human activities: Electricity generation and consumption Mitigation: Responsible energy consumption, energy saving, renewable sources
Disciplines (sciences, geography)	Physics, Chemistry, Biology, Home economics, ICT
Pedagogical Objectives/New targeted skills	**The students will be able to:** - improve their knowledge, skills and attitudes related to: • the use of electricity in everyday life • the sources used for generating electricity in Greece • the carbon footprint of electricity generation in Mediterranean regions • the impact of their own decisions with regards to electrical energy use in climate change • the need to adapt their energy behaviour and communicate on relative messages
Public target(s) (age, requested skills…)	11- 15years old

Description (step by step)	**Step 1). My life and Earths' life** **Objective:** *To reflect on how their everyday life may affect climate* The teacher addresses to students the following question as a starting point and as a way to investigate their existing ideas on the topic: - *How may you affect the climate of the planet through your everyday life activities*? The teacher writes down the ideas of students that may be visualised in the form of a word cloud. **Step 2) Living indoors. Energy consumption in the building sector** **Objective:** *To be aware of how much time and energy we spend indoors* Students are asked to guess the percentage of daytime which European people spend indoors. A figure on the total energy consumption by sector in Europe is shown. Students are asked to match each of the mentioned sectors (i.e. Buildings, Services, Transport, Industries) with the respective percentage in the figure in order to realize that Building sector (including Households and Services) accounts for a large share of total final energy consumption. Source: Final Energy Consumption by Sector EU-28, 2017, Eurostat (p. 13). Available on the website: https://ec.europa.eu/eurostat/statistics-explained/pdfscache/29046.pdf **Step 3) Energy needs in everyday life** **Objective:** *To connect the satisfaction of energy needs to electricity uses* Students are asked to recall the time periods of their typical day and work on a worksheet choosing the energy needs, among listed options, in different building types (House, School, Leisure Activities Centre). Finally, they conclude that their needs are mainly satisfied by electrical energy/electricity. **Step 4) Your electricity bill informs you** **Objective:** *To define the energy resources used for electricity generation (fossil fuels or renewable sources)* The teacher asks the question: - *Which information do you need to have about the electricity use?* Students share their ideas and read the information provided in a copy of an electricity bill. They are particularly prompted to critically read and draw information related to electricity generation in Greece. Based on the information provided they are asked to conclude whether the renewable or non-renewable energy resources are dominant in the country's electricity

	production. In a plenary discussion, students distinguish between renewable and non-renewable sources (i.e. fossil fuels) and the possible relevant impacts caused by the different type of resources. At this point, teacher could inform students about the climate and energy targets of EU by 2030 related to the increase of the share of renewable energy resources. **Step 5) Energy chain** **Objective:** *To describe the different phases of electricity (generation, transfer and use).* A set of 6 images are distributed to each group who should put them in such an order to show the successive phases of the "journey" of electrical power. In a spatial frame, this goes from the students' living spaces (house, school etc.) and ends up in the lignite mines and electric power stations located in Western Macedonia. A related video is shown as a feedback about the process of power generation from lignite. Source: *The journey of electrical energy* (video). School of Education and the Department of Fine &Applied Arts, University of Western Macedonia, Greece. Available on the website :https://www.youtube.com/watch?v=-ZBNNcczmDM **Step 6) Coal Power Plants** **Objective:** *To be aware of the impacts of Coal power stations at a local level.* After watching the short video "*Western Macedonia: destroying itself by powering Greece"* students define and write the key concepts. They organize them in a proposed semi-structured concept map related to the impacts of the operation of lignite power stations on the environment, the society and the economy at local level. The key concepts may be: *Air pollution, Pubic Health Deterioration, Relocation, Cancer/other diseases, Lignite mines expansion, Downgrading*. Additionally, the students working in groups classify the concepts about impacts into a Venn diagram (https://www.canva.com/graphs/venn-diagrams/) the three overlapped circles represent the following sectors: Environment, Society and Economy. After the presentation of groups' work, the teacher conducts a discussion so that students realize the complexity of the issues. Furthermore, the teacher asks about students' ideas about other effects of gases emissions (i.e. greenhouse gases and climate change) through a question such as: - *Are there other impacts caused by the gas emissions of lignite power stations?*

	Source: *Western Macedonia: destroying itself by powering Greece* (video). Available on the website: https://www.youtube.com/watch?v=KihwAXe54_w **Step 7) Carbon emissions of coal power plants** On a digital interactive map, students are encouraged to define and compare CO_2 emissions of different countries-members of EU. Furthermore, they classify the Mediterranean countries with their carbon footprint as a criterion (carbon dioxide emissions). Afterwards, in a plenary discussion they reflect on the phrase: "coal is a climate problem" which is mentioned on the website of map. Source: *All of Europe's existing and planned coal power plants. Digital map* *https://www.carbonbrief.org/mapped-worlds-coal-power-plants* *Rising Global Temperatures and CO2* *https://www.climatecentral.org/gallery/graphics/co2-and-rising-global-temperatures* **Step 8) CO_2: a greenhouse effect gas** **Objective:** *To identify the correlation between CO_2 and global temperature.* The teacher presents figures depicting the intertemporal correlation between CO_2 concentration and the global temperature increase. Students read the figures, share their ideas and draw conclusions. A text extract and a complementary illustration about greenhouse effect taken from the Greek Biology students' textbook are provided. Students should match the sub-processes presented in the form of short statements with the appropriate part of the illustration depicting the phenomenon. Alternatively, students can search for the relevant information on the internet or in other sources (books, articles etc.). For example, these statements may be: 1) *Solar radiation passes through the atmosphere and reaches the surface of the Earth*, 2) *Part of the incoming solar radiation is absorbed by the surface of our planet and the rest is reflected*, 3) *Radiation reflected by the earth surface escapes into space, except for a part of it, which is held by a layer of gases in the atmosphere and 4) As a consequence, there is an increase of the air*

	temperature near the surface of the Earth. Afterwards, students should sketch the changes about which they found out and transformed a beneficial effect of the planet phenomenon into a problem for Earth' s climate (you can see the Tutorial). At this point, the teacher could inform students about the climate and energy targets of EU by 2030 related to cutting CO2 emissions. *Rising Global Temperatures and CO2* *https://www.climatecentral.org/gallery/graphics/co2-and-rising-global-temperatures* **Step 9) Organizing an event to communicate the climate-friendly energy behaviour** **Objective:** *To take action and communicate on the message of behavioural change to address climate change* Taking into account the energy needs in buildings as they are examined in some previous steps (2 & 3), students brainstorm ways about climate friendly use of electricity and write associated messages. They also propose ways to spread the messages to make the school community and the public aware of the importance of taking control over energy consumption. Additionally, students can design and conduct a School Energy Survey or/and Home Energy Survey. Finally, they are encouraged to organize an event to communicate about their whole work to the school community (as well as in the local community) to raise awareness of the impact of energy use on the climate. For this purpose, they can organize a campaign promoting the results of their survey and their messages relevant to the mitigation of climate change. Examples of School Energy Survey or/and Home Energy Survey (in Greek). http://www.kpea.gr/files/energeia/varometro_kpe.pdf *http://www.kpea.gr/files/energeia/varometro_kpe.pdf*
Place (meeting room, outside space, …)	Classroom. School
Individual and / or collective actions	For the implementation of the project it is proposed to students to work in groups of 5-6 persons. Throughout their team working they collaborate, arguing with each other, to complete the activities. They present the outcomes of their work in plenary sessions and participate in the reflective discussions to

	deepen their understanding.
Material needed	Computer, projector, Internet access, Worksheets, classroom board, cards - images (6th step), post-it, coloured pencils or markers
Duration of pedagogical project or activity	
Evaluation of the new acquired skills	The initial question "*How may you affect the climate of the planet through your everyday life activities*?" is suggested to be used as a way to introduce the final evaluation by the completion of the project. Students could present their ideas and concepts by completing and enriching the initial word cloud. Additionally, the evaluation of the acquired knowledge and skills can be supported by the presentation of students' work as well as the completed activities and other supplementary material created by students (e.g. posters, article) for awareness raising event (9th step) .
Eco-citizen adaptation, knowledge enhancement and links to other topics	**Link to:** **Name of the activity/Project/knowledge sheets** **Activities** • **Experiment about CO2 impacts on earth temperature** • **Experiment about the creation of electricity with a solar panel** • **Design of an ecological house model adapted to regional constraints and available local resources** **Projects** • **Adaptation to global change problems by creating an ecological house model** • **Creating a communication campaign made by students for students and the general public** **Knowledge** • **Carbon cycle** • **Greenhouse effect** **----------Organise the links in the different language in this setting-------** **Croatian:** • https://www.fpz.unizg.hr/prom/?p=8734

	Greek: • Green energy (in Greek) http://www.edutv.gr/index.php/perivalon-2/prasini-energeia • School & Home Energy Survey (in Greek) http://www.kpea.gr/files/energeia/varometro_kpe.pdf http://www.kpea.gr/files/energeia/varometro_kpe.pdf **Italian:** • About energy consumptions in Italy (in ITA): https://www.gse.it/documenti_site/Documenti%20GSE/Rapporti%20statistici/Rapporto%20Statistico%20FER%202017.pdf http://www.efficienzaenergetica.enea.it/allegati/Alcuni%20dati%20sui%20consumi%20energetici%20in%20Italia.%20per%20insegnanti%20e%20studenti%20di%20scuole%20secondarie%20.pdf • About electrical energy consumption in Italy (ITA): https://www.terna.it/it-it/sistemaelettrico/statisticheeprevisioni/datistatistici.aspx • How to read tags with information on energy efficiency (ITA): http://www.efficienzaenergetica.enea.it/Cittadino/formazione/opuscolo-etichetta-energetica **French:** • Production européenne d'électricité avec rejet en CO2 : Map of the european production of electricity with CO2 impact (MULTILANGUAGE) https://www.electricitymap.org/?page=map&solar=false&remote=true&wind=false • Calculette pour la consummation électrique d'un foyer Calculate the electric consumption of your house https://calculettes.energie-info.fr/calculettes/estimation
Observations	This project, as a whole, has been created for the needs and purposes of the project Click for Schools (Intellectual Production: O2). However, some activities-steps have already been introduced in the educational program of Argyroupolis Centre of Environmental Education (Attica, Greece) with the title *Saving Energy at school, at home and in the city*

	(http://www.kpea.gr/energeia.php - in Greek) with positive learning outcomes. You can see pictures of the implementation of the project, during a pilot phase, in the tutorial sheet with the same title or in the thematically relevant video.