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| Activity plan | | | |
| ACTIVITY PLAN | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 1. Environmental Awareness and Conservation | * 1. Climate Change and Renewable Energy | Biomass - renewable source of energy |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | Deepen student’s understanding of biomass as a renewable energy source and how environmental waste can be used to produce thermal energy. The activities will initiate students to think and discuss the pros and cons of biomass as a source of energy and investigate which waste from their environment can be economically and energetically most suitable for biomass, thus developing a critical opinion, independently making decisions and feel useful to society with their work. |
| **SETTING** | Classroom |

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| Materials Needed |
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| **Materials Needed** | Computer (phone or tablet can be used to collect information), video presentation equipment, flip charts, markers |

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| **Learning Outcomes** | * Understanding the ways in which biomass can be converted into thermal energy * Initiating a discussion about the pros and cons of biomass as an energy source * Researching which waste from their environment can be economically and energetically most suitable for biomass * Developing a critical opinion, independent decision-making and developing a sense of responsibility towards society. * Recognizing the environmental impact of traditional energy sources and the need for sustainable alternatives. |  |
| **Activity Contents** | **ACTIVITY 1 (40minutes): Pros and cons of using biomass as an energy source**  ***Theoretical part 1*** *(10minutes)*  The teacher explains the ways in which biomass is converted into thermal energy (burning, briquetting, rotting, fermentation). Video material about the processes of converting biomass into energy is attached:  Video: **“Journey to the heart od energy – How a biomass power plant works”**  <https://www.youtube.com/watch?v=40ztd8uoU9Q> (duration 2minutes 06 seconds)  Overview: An educational video designet to discover how a biomass power plant works. In a biomass power plant, electricity is generated using the heat produced by the combustion of organic materials, such as plant residues, household waste and the biogas.  Video: **“Biomass pyrolysis process”**  <https://www.youtube.com/watch?v=3K1zWAYDvMA> (duration 3minutes 58 seconds)  Overview: An educational video about biomass pyrolysis process. Wooden or agricultural biomass is treated with high temperature. That process results in quick concentration of elemental carbon and disappearance of the fibrous structure improving its grindability. In order to maximize efficiency of pyrolysis process flue gases cooled down in the heat exchanger.  *Task 1 (10 minutes)*  The students comment on the advantages and disadvantages of each method from an economic and environmental point of view.Through conversation and individual statements, studentsexchange knowledge and opinions.  *Task 2 (20min)*   * Students divide into 4 groups and discuss the pros and cons of using biomass as an energy source. They write down the common views on flip charts, separating the pros and cons in two columns.Students can research information about the topic using digital resources. * After that, one student from each group reads the notes from flip charts previously placed in visible places in the classroom.   **ACTIVITY 2 (60minutes): Researching which waste can be economically and energetically most suitable for biomass**  ***Theoretical part 1*** *(10min)*  The teacher explains to the students that the main disadvantages of biomass are the large amount of moisture it contains and the low energy value per unit mass, which is why biomass is processed to obtain a suitable form for transport and storage.  Video: **“Biomass drying containers”**  <https://www.youtube.com/watch?v=VnkeFps8VlA> (duration 2min 29s)  Overview: An educational video about the process of drying the biomass, which means the reduction of the moisture content in the combustion material in biomass boilers  *Task 1 (30min)*   * Each student is given the task to individually analyze and compare two types of biomass that can be found in the students' environment: grape stalks as waste from pruning vineyards on an area of ​​2250ha andwaste from an area under corn on an area of ​​1500ha. * Data on the technical potential and thermal power of each of the biomasses as well as the energy efficiency formula are given in the study sheet (Appendix 1). * Students calculate the cost of transporting an appropriate amount of biomass for a 100km distribution (to a potential plant for converting biomass into thermal energy)   *Task 2 (20 min)*  The correct calculations that the students should have got are given on the smart board, students compare them with their own calculations and self-evaluate. Students discuss and come to a conclusion whether a plant with a drive to convert biomass into heat energy should be built in the surroundings of their city, also which would be energetically and economically more profitable. |  |
| **Assessments** | Verbal feedback during class;  Conversation with/among students;  Monitoring of students during group work;  Evaluation of the thoroughness and accuracu of individual work;  Each student self-assesses his contribution to the work; |  |
| **Key Competences** | * Cognitive competence * Creativity competence * Communication competence * Social, emotional and healthy living competences * Digital competence |  |
| **Connections with Eco STEAM** | **Eco**- Biomass is a renewable energy source, and in addition, by converting waste materials into energy, biomass helps reduce landfill use and methane emissions.  **S**cience: Fuels, renewable energy sources and their conversion into thermal energy.  **T**echnology: Students will learn how biomass combustion plants work.  **E**ngineering: Students can design biomass burning plants and waste recycling devices.  **A**rt: Students can draw the types of biomass and the process of converting it into energy.  **M**ath: Students perform various mathematical calculations to find out the energy efficiencyand transport costs of different types of biomass. |  |
| **References** | * Physics textbook for high school education in the Republic of Nort Macedonia * Dr. Ilija J.Petrovski, B.Sc. M.Sc., STEAM BOILERS 2004, Education Skopje * Dr. Emil Zaev, Bipmasa 2017, UKIM Skopje * <https://www.ea.gov.mk/chesto-postavuvani-prasha%D1%9Aa/za-obnovlivi-izvori-na-energi%D1%98a/> |  |
| **Notes** | •Students can apply the knowledge of biomass to energy conversion and the research they have done to propose solutions for waste management and energy production, specifically to propose a location for plants in which biomass from their environment will be converted to energy.  • Developing strategies to optimize the use of biomass while minimizing the impact on the environment.  • Different types of biomass can be chosen from those prposed for calculations and analysis depending on what type of waste (biomass) is most prevalent in your environment. |  |

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| Appendix 1. STUDENT'S ACTIVITY SHEET |
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| BIOMASS DATA | | | | |
| Type of biomass | **Area** | **Annual income per hectare** | **Technical potential** | **Thermal power (Tm )** |
| Grape stalks as waste from pruning vineyards | **2250 ha** | **3t** | **60%** | **11500 kJ/kg** |
| Waste from an area under corn | **1500 ha** | **10t** | **20%** | **16500 kJ/kg** |
| Research Aspects | | | **Answers for grape stalks biomass** | **Answers for corn waste** |
| 1.Energy efficiency ?  Calculate energy efficiency according to the formula : En=m\*Tm | | |  |  |
| 2.Sustainability ?  Is this type of biomass obtained in a way that is sustainable and does not lead to the destruction of natural resources ? | | |  |  |
| 3.Technological aspects ?  Which type of technology is most suitable for the utilization of both biomasse ? | | |  |  |
| 4.Transportation aspects ?  Calculate the transport costs for the corresponding quantities of biomass for a distance of 100 km . | | |  |  |
| Student’s name and surname : | | | | |
| You can use internet research to answer the questions ! | | | | | |

**Assessment Table for individual work:**

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| Assessment Criteria | Points | Comments |
| Energy efficiency calculations of biomass types | \_\_/10 |  |
| Transport costs calculations | \_\_/10 |  |
| Data analysis and critical thinking | \_\_/5 |  |
| Quality of Notes and Comments | \_\_/5 |  |
| Internet research skills | \_\_/5 |  |
| Skills in making conclusions and decisions | \_\_/5 |  |

**Assessment Table for group work:**

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| Assessment Criteria | Points | Comments |
| Understandingthe ways in which biomass is converted into thermal energy | \_\_/5 |  |
| Determination the pros and cons of using biomass as an energy source | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |
| Ecological Interpretations and Insights | \_\_/5 |  |
| Teamwork and Collaboration | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |