TREE
Micro- and project-based learning programme for Teaching ciRcular Economy and Ecological awareness in VET

Funded by the European Union

R2. A1.2 PRACTICAL ACTIVITY TEMPLATE

Title	○ **Practical work "Energy efficiency is a gift for all"**
Part of the training course referred to in this lesson	○ Part 1 X General information about sustainability and CE
Duration	4 days
Location	X Inside
Specific location requirement	None
Equipment needed	2 cardboard shoe boxes, 2 ceramic tiles, 2 thermometers, knife, scissors, plasticine, transparent paper, aluminum foil, 4 rubber bands, foam, oven, and clock.
General Learning objective(s) according to the Bloom Taxonomy https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/	□ **Create** □ Produce new or original work (design, assemble, construct, investigate, formulate) □ **Evaluate** □ Justify a stand or decision (appraise, argue, defend, critique, select, support) □ **Analyze** □ Draw connections among ideas (differentiate, organize, relate, compare, distinguish, test, experiment) □ **Apply** □ Use information in new situations (execute, implement, solve, use, demonstrate, operate) □ **Understand** □ Explain ideas or concepts (classify, discuss, describe, identify, locate, translate) X **Remember** □ Recall facts and basic concepts (define, duplicate, list, memorize, repeat)
Specific learning objective(s)	• To get to know the boiler, its operation; • To collect data for calculations; • To calculate the efficiency factor of an ecological object; • To determine the temperature changes of the insulated and uninsulated house model.
Cognitive, socioemotional and behavioural outcomes	**SDG 7 | Affordable and Clean Energy** Cognitive learning objectives: • The learner knows about different energy resources – renewable and non-renewable – and their respective advantages and disadvantages

based on https://www.unesco.de/sites/default/files/2018-08/unesco_education_for_sustainable_development_goals.pdf	including environmental impacts,health issues, usage, safety and energy security, and their share in the energy mix at the local, national and global level. ● The learner understands the concept of energy efficiency and sufficiency and knows socio-technical strategies and policies to achieve efficiency and sufficiency. ● The learner understands how policies can influence the development of energy production, supply, demand and usage. ● The learner knows about harmful impacts of unsustainable energy production,understands how renewable energy technologies can help to drive sustainable development and understands the need for new and innovative technologies and especially technology transfer in collaborations between countries. Socio-emotional learning objectives: ● The learner is able to communicate the need for energy efficiency and sufficiency. ● The learner is able to clarify personal norms and values related to energy production and usage as well as to reflect and evaluate their own energy usage in terms of efficiency and sufficiency. ● The learner is able to develop a vision of a reliable, sustainable energy production, supply and usage in their country. Behavioural learning objectives: ● The learner is able to apply and evaluate measures in order to increase energy efficiency and sufficiency in their personal sphere and to increase the share of renewable energy in their local energy mix. ● The learner is able to apply basic principles to determine the most appropriate renewable energy strategy in a given situation. ● The learner is able to analyse the impact and long-term effects of big energy projects (e.g. constructing an off-shore wind park) and energy related policies on different stakeholder groups (including nature). **SDG 13| Climate Action** Cognitive learning objectives: ● The learner understands the greenhouse effect as a natural phenomenon caused by an insulating layer of greenhouse gases. ● The learner understands the current climate change as an anthropogenic phenomenon resulting from the increased greenhouse gas emissions. ● The learner knows which human activities – on a global, national, local and individual level – contribute most to climate change. ● The learner knows about the main ecological, social, cultural and economic ● consequences of climate change locally, nationally and globally and understands how these can themselves become catalysing, reinforcing factors for climate change. ● The learner knows about prevention, mitigation and adaptation strategies at different levels (global to individual) and for different contexts and their connections with disaster response and disaster risk reduction. Socio-emotional learning objectives:

	• The learner is able to explain ecosystem dynamics and the environmental, social, economic and ethical impact of climate change. • The learner is able to encourage others to protect the climate. • The learner is able to collaborate with others and to develop commonly agreed-upon strategies to deal with climate change. • The learner is able to understand their personal impact on the world's climate, from a local to a global perspective. <u>Behavioural learning objectives</u> • The learner is able to evaluate whether their private and job activities are climate friendly and – where not – to revise them. • The learner is able to act in favour of people threatened by climate change. • The learner is able to promote climate-protecting public policies. • The learner is able to support climate-friendly economic activities.
Green skill(s) addressed	X Creative problem-solving □ Forward-thinking □ Monitoring skills □ Analytical skills X Lean production □ Maintenance and repair skills X Pollution prevention □ Eco-design □ Management skills □ Impact quantification □ Life-cycle management □ Science skills X Waste management X Environmental auditing □ Ecosystem management □ Other_____
Step by step instructions to implement the activity	<u>First assignment:</u> Ecological boiler rooms energy production efficiency calculation: The information obtained during the boiler room excursion was also found in the handbooks; formulas: A=29MWh (The work done by the boiler room per day, we learn about it from the boiler room workers) qš=16.5MJ/kg (Heat of combustion of straw fuel - we found it in the physics reference book) 1Wh=3600J (switching to basic units - joule J basic work and energy unit) 1cal=4.2J (conversion to basic units) mš= 430kg (We learned the weight of one straw from the employees) Nsp(r) =20 (The number of actually used spuds per day - we learned from workers)

	Δt=11oC (Change between supply and return water temperatures - was shown by thermometers in the boiler room) cv=4200□/(□□·□) (Specific heat of water - we found it in the physics reference book) Wanted sizes: msh; etc. V; η mš - mass of straw Nsp - number of straw spikes Nsp η- efficiency factor Qš= qš·mš (The formula for the amount of heat given off by straw - from the physics textbook) A= Qš= qš·mš mš=A/qš = (29·3600□□)/(16.5 □□/□□)= 6327.3kg (Required mass of straw) mš≈6.3□ Nsp=□_š/□_□□ = 14.7 (Such number of stoves should be burned per day if there were no thermal losses) Qv=qš· Nsp(r)· msp (Real consumed amount of heat) η=□/□_□ =(29·3600□□)/(16.5 □□/□□·20·430□□)=0.735 η= 73.5% (We found the efficiency factor of the boilers, i.e. what part of the burned fuel is usefully used) Calculation of boiler fuel costs using straw: The boiler house buys straw for the year 1800t= 18 ·"105kg"; It is 4000 pcs. The price of one lever is €30; The price of all the keys is €120,000 Costs if the boiler room had used fuel oil: qm=40 · 106J/kg (Combustion heat of fuel oil - from the physics handbook) Qm=Qš= 18·105·16,5·106 =300·1011J (The amount of heat that must be provided by the fuel oil for heating the boiler water) mm=Qm/qm = ("300·1011" □)/("40 " ·" 106J/kg")= 75·104kg (So much fuel oil must be burned to obtain the required amount of heat. The price of 1 kg of fuel oil is €0.3; €225,000 will be spent to buy fuel oil Determining causes of heat losses in energy generation. Draw conclusions. <u>Second assignment:</u> It is used in the construction of eco-housing: special materials that constructs such house structures that match the basics of an ecological house characteristics: environmentally friendly materials, economical and efficient

design, balanced indoor microclimate.

Materials needed for building an eco-house: 2 cardboard shoe boxes, 2 ceramic tiles, 2 thermometers, knife, scissors, plasticine, translucent paper, aluminium foil, 4 rubber bands, strips, foam, oven, clock.

Stages for building an uninsulated house: Cut a hole - a window in the lid, cover it with paper; Cut a hole in the wall, insert the thermometer; Secure the box with rubber bands.

Stages for building an insulated house: Make the same house, just insulate it; Line the box and its lid with foil; Put on the rubber bands; Place ceramic tiles in an oven heated to 50 oC, and ready-made models on them; Record the thermometer readings every 5 minutes.

Record the readings of the thermometer in the table

House	Temperature, t C°						
	measurement beginning	after 5 min	after 10 min	after 15 min	after 20 min	after 25 min	after 30 min
Insulated							
Uninsulated							

Draw conclusions.

Assessment tool / methodology	1. Boiler efficiency coefficient calculation, conclusions. 2. Construction of sustainable house models, filling in table data.
Additional resources	
Source	Gutauskaitė J., Kynienė A., Kovaliūnienė Ž., Lozda P., Rozga R. (2009). Spektras 9. Fizikos vadovėlis 9 kl., I d. https://www.knygos.lt/lt/knygos/spektras-9--fizikos-vadovelis-9-kl---i-d-/ Межрегиональная энергосберегающая компания. (2019) Энергоэффективность. https://mec-energo.ru/energoeffektivnost-predpriyatij