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

Funded by the European Union

PRACTICAL ACTIVITY 4 - Part 2 (Wood sector)

Title	○ Energy losses of the train braking process, their solution
Part of the training course referred to in this lesson	○ Part 1 □ General information about sustainability and CE Part 2 Specific Information about: X Wood sector □ Plastic sector □ Agrifood sector
Duration	7 days
Location	X Outside X Inside
Specific location requirement	Compliance with the requirements for the premises of the Kėdainiai railway station's train control panel
Equipment needed	Travel route indicators, city coats of arms, material for the stand "How good/bad that trains run and rush through Kėdainiai", textbooks of physics
General Learning objective(s) according to the Bloom Taxonomy https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/	X **Create** Produce new or original work (design, assemble, construct, investigate, formulate) X **Evaluate** Justify a stand or decision (appraise, argue, defend, critique, select, support) X **Analyze** Draw connections among ideas (differentiate, organize, relate, compare, distinguish, test, experiment) X **Apply** Use information in new situations (execute, implement, solve, use, demonstrate, operate) X **Understand** Explain ideas or concepts (classify, discuss, describe, identify, locate, translate) □ **Remember** Recall facts and basic concepts (define, duplicate, list, memorize, repeat)
Specific learning objective(s)	• *To get acquainted with the operation of train locomotives.* • *To collect data for calculations.* • *To calculate the energy losses when braking the vehicle.* • *To prepare recommendations for reducing thermal losses.*
Cognitive,	**SDG 7 Affordable and Clean Energy**

socioemotional and behavioural outcomes based on https://www.unesco.de/sites/default/files/2018-08/unesco_education_for_sustainable_development_goals.pdf	Cognitive learning objectives: ● The learner knows about different energy resources – renewable and non-renewable – and their respective advantages and disadvantages 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 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 assess and understand the need for affordable, reliable, sustainable and clean energy of other people/other countries or regions. 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. **SDG 9 Industry, Innovation and Infrastructure** Cognitive learning objectives: ● The learner understands the local, national and global challenges and conflicts in achieving sustainability in infrastructure and industrialization. ● The learner can define the term resilience in the context of infrastructure and spatial planning, understanding key concepts such as modularity and diversity, and apply it to their local community and nationwide. ● The learner is aware of new opportunities and markets for sustainability innovation, resilient infrastructure and industrial development. Socio-emotional learning objectives: ● The learner is able to argue for sustainable, resilient and inclusive infrastructure in their local area. ● The learner is able to recognize and reflect on their own personal demands on the local infrastructure such as their carbon and water footprints and food miles. Behavioural learning objectives: ● The learner is able to evaluate various forms of industrialization and compare their resilience. **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 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 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. <u>Socio-emotional learning objectives:</u> • 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. <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.
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 □ Waste management X Environmental auditing □ Ecosystem management □ Other_____
Step by step instructions to implement the activity	**1. Preparation.** To get acquainted with the structure of the locomotive, calculate braking possibilities at the railway station, students should collect data for calculations, conclusions. According to the data given, calculate the fuel consumption, collect the material for the stand that will be put at school.. **2. Activities.** Calculation of the fuel loss when braking the truck and the train. Compare the calculation. Calculations of the truck SCANIA with a mass of 12t, moving from a place for 500 m on a road, reaches a speed of 72 km/h. The coefficient of friction between the road surface and the tires is 0,4. a) What work is done on the acceleration path of the car? b) How much diesel fuel will this vehicle consume if the engine efficiency is 35%?

	The heat of combustion of diesel fuel is 42·106 J/kg. Calculations of a train with a mass of 4000 t, moving from a place, develops a speed of 90 km/h on a 1400 m road. The coefficient of friction between the rails and the wheels is 0.005. a) What work is done on the acceleration path of the train? b) How much diesel fuel will this vehicle consume if the engine efficiency is 35%? The heat of combustion of diesel fuel is 42·106 J/kg. = **3. Problem solving.** New control system that enables the electric machine in electric traction locomotives to operate in engine and generator modes. Depending on the speed during braking, the energy is returned to the storage batteries. Fuel consumption can be reduced by 25-30% using non- conventional electric train kinetic energy management systems.
Assessment tool / methodology	• Accuracy of calculations, formulation of conclusions. • Relevance of the stand material, quality of decoration.
Additional resources	//
Source	https://en.wikipedia.org/wiki/Train https://www.bmk.gv.at/en/topics/mobility/transportation/international_eu/publications/rail-freight-corridors.html