Renewable energy

Topic: renewable energy, sustainability, pollution mitigation

Introduction

Cities rely on energy distribution to be able to provide settling and development conditions for the persons, industries, services, etc. Energy distribution is normally ensured by private or public operators beyond the scope or control of the city. However, as cities can become centers of pollution due to production, even if this takes place outside the city limits, and use of that energy it is in the interest of the city inhabitants to ensure that the production of energy is as clean as possible. The city managers can also implement policies and regulations that contribute to the local clean production of energy, such as promoting the use of solar panels on the roofs, micro-wind centrals, and other technology. Also city managers can introduce policies that encourage mobility based on clean energy, therefore reducing the level of pollution. The main objective of this lesson plan is to encourage students design energy supply for the city mainly based on renewable energies.

Context

The city major was elected to a city with a lot of pollution due to the use of fossil fuel. Citizens are not happy and want a cleaner and less polluted city! The mayor must work with other stakeholders towards reducing the emissions produced through energy use.

Figure 1. A large city grid allows players to experiment with renewable energy solutions.

Following are some suggestions for roles that students may undertake:

Role 1: Energy manager

The energy manager ensures that all city inhabitants have access to energy for residential, business, and other purposes. The mayor must work with energy providers to ensure the best deals but also to guarantee that the cleanest sources of energy are used. The mayor is further responsible for creating policies related with the local micro-production of energy.

Role 2: Treasurer

The treasurer ensures that the enhancements to the city infrastructures and energy distribution networks can be implemented with the existing budget.

Role 3: The city mayor

As the head of the city, the city mayor has the final word about energy production policies, for example electric vs. fossil fuel mobility, and supporting infrastructures, such as roads, buildings, energy distribution facilities, and more. The mayor must ensure that citizens have access to clean energy taking into account fluctuations to energy demand due, for example, to changing weather conditions. The city mayor is really keen on being re-elected, so she is interested to ensure the happiness of inhabitants through the reduction of pollution.

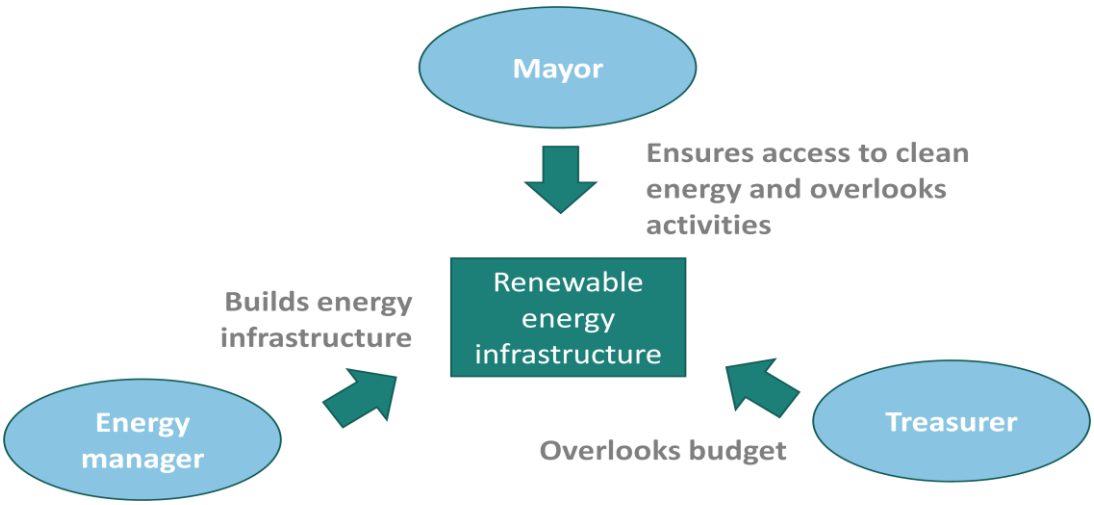

Figure 2. Roles, actions, and interactions.

Learning goals

Upon completion of the activities students will:

- Understand the connections between environmental, social, and economic aspects of everyday life.
- Have experienced how to achieve cooperation between different parties with different goals and needs.
- Built competence in taking an integrative approach in researching city management and related environmental issues.
- Create the conditions necessary for navigating the challenges modern society and environmental changes pose for the public and private sector.
- Understand the importance of the energy supply in real life.
- Understand the importance of the renewable energy and its positive and negative aspects.

Prerequisites

The activity can be introduced to students with no pre-required information. Teachers can deliver an initial briefing about sustainable energy and mobility options and strategies.

Audience

This scenario is suitable for students in all engineering and management principles. In terms of engineering, the goal scope is closer to the learning objectives of electrical engineering students, but students enrolled in other engineering programs won't have any problems in implementing the scenario.

Figure 3. The city includes rich infrastructure, such as residences, a stadium, an airport, and more that require diverse energy supply.

Core concepts

- **e-Commerce:** Economic activity that takes place over the internet.

Through e-Commerce individuals and business have the opportunity to buy and sell products and services on-line.

- **Energy grids:** Energy infrastructures, including diverse energy production plants, such as nuclear, coal-based, or renewable energy based, energy transformers from high, to medium, and low voltage, and power lines that transport energy to homes, businesses, and industry.
- **Culture:** Arts and other manifestation of human intellectual achievement. In the context of this scenario, culture refers to all activities that promote education, expression, and athletics and foster a high quality of life.
- **Internet and phone service provider:** A company that provides access to the internet for both personal and business customers. The service requires a network infrastructure, including servers and cables for connectivity and processing of information.
- **City management:** Managing the services, revenues, and expenses of a city.
- **Transversal skills:** collaboration, critical thinking, analytical thinking, innovative thinking.

Description of the scenario

Figure 4. Small and large residential buildings support the needs of city inhabitants.

The overall purpose of the scenario is to allow students to experience the conflicts of interests and the difficulty of implementing changes when a major city aspect, such as energy, has to be dramatically reconfigured with implications on the infrastructure but also on the individual way of thinking about access to energy. It demands good collaborative skills, making compromises towards achieving common goals in a team, critical thinking, and a good flair for optimizing decisions.

The scenario explores the full HERA game using the communication and planning facilities in the game. Students are encouraged to discuss, negotiate, and agree on

decisions that they can subsequently implement digitally through the scenario simulated environment.

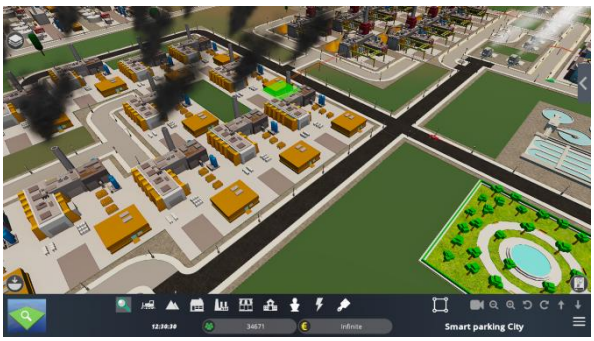

Figure 5. Industries consume energy, which would be best produced through renewable resources.

Participants can explore the consequences of their decisions and insights into what it means in real-life to work with complex decisions. The scenario is based on a city grid that is non-trivial including rich enough facilities for students to meaningfully engage in a complex discussion related to energy issue. The initial city grid, on which students will start working, has a traditional energy approach focused on fossil fuel which leads to pollution. Students are challenged to introduce interventions towards clean energy production. As an added difficulty, the city can have climatic events that raise energy demands, therefore creating peaks.

Suggested class activity

1. The teacher presents the problem to the class and introduces the scenario and game.
2. The students brainstorm to understand the problem and the parameters within which they have to work. This includes the available city budget; the city plans with the current energy schemes and the restrains on what can be built.
3. The students are encouraged to come up with as many ideas as possible through brainstorming. Techniques of design thinking could be used for promoting innovative design and the introduction of a human-centered solution that address actual needs of city citizens.
4. The students are asked to jointly decide on the ideas to implement from the pool of suggestions that they came up with taking into account restrictions, such as city plans, budget, and energy production.
5. The teacher forms groups and gives students their roles in the game.
6. The students play the game according to their roles.

7. The students discuss the game results and their roles; the teacher gives feedback.

Assessment methods

This is a collaborative, open ended activity in which not a single solution exists. Self-assessment is useful in this scenario offering students the benefit of taking responsibility of their learning. Students will discuss their roles within their group and reach a decision on whether they achieved their goal or not. Students may further present their solution to the entire class receiving evaluation from their peers. Finally, the class may decide on the more creative solutions among all teams.