How to create a city: energy grids

Introduction

This learning sheet builds practical, hands-on skills on how to develop a city in the HERA learning game. It is a step-by-step tutorial that familiarizes students and educators with the basic functionality of the HERA game, that they will need for creating more complex learning scenarios and/or for playing the game.

Creating a city simulates real-life urban design. Students and educators will be challenged to introduce installations and services that enrich quality of life, such as housing, commercial buildings, education provifders, industry, farms, health providers, cultural providers, energy providers, telephone providers, internet providers, roads, parks, and more.

This learning sheet demonstrates how to create an energy grid in a HERA city.

Context

The activity may be used as a starter kit, to get students and instructors familiarized with the HERA game functionality. It may be used as a pre-requisite, to be deployed before focusing on more complex game scenarios.

Learning goals

Upon completion of the activity students will be able to design an energy network for a functional HERA city.

Prerequisites

There are no prerequisites for this activity. It may be deployed as a first step for initiating students and instructors into the HERA problem-based learning intervention.

Audience

Engineering and economics students and instructors using the HERA game for developing problem-based learning skills.

Core concepts

- **Electricity:** Electricity is necessary for the functioning of all buildings and infrastructure of the city, including houses, offices, industry, farms, hospitals, museums, schools, commercial buildings, and a lot more.
- **Energy grids:** Energy infrastructure, 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.
- **High voltage:** High voltage electricity is produced by power plants. To be used for powering industry or residences, it needs to be transformed to medium or low voltage.
- **Medium voltage:** Medium voltage electricity is typically used to power industrial plants.
- **Low voltage:** Low voltage industry is typically used to power residences.
- **High to medium voltage transformer:** A facility that transforms energy from high to medium voltage, suitable for industrial use.
- **Medium to low voltage transformer:** A facility that transforms energy from medium to low voltage, suitable for residential use.
- **Road grids:** Road networks allow the different parts of the city to interconnect. In HERA, they are obligatory for a proper function.

Description of the activity

During the activity students design a functional energy network, including energy production facilities and power lines that transport energy to houses, commercial buildings, industry, hospitals, educational buildings, and other city infrastructure.

To ensure that the network works properly, students and educators need to follow specific guidelines described below.

Suggested class activity

1. Create a small neighborhood with houses by selecting the housing button ( ) at the bottom of the screen menu (see Figure 1 below). Each house shows through a thumbnail above it its needs for functioning properly. In this case, the house needs a road for accessing it ( ) and low voltage electricity ( ).

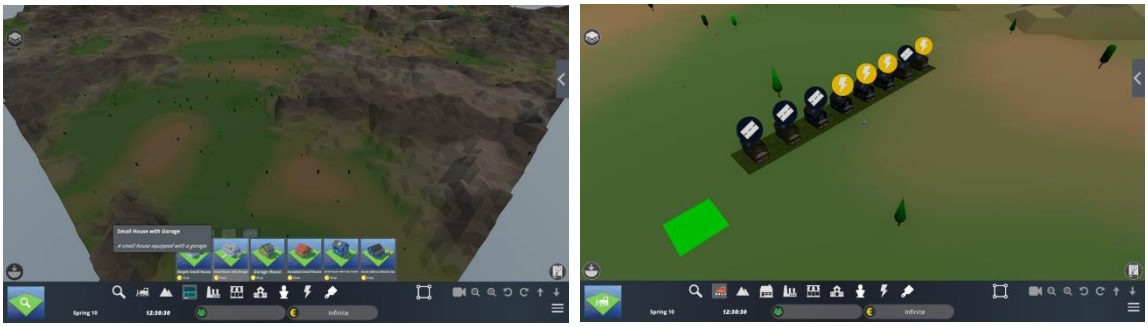

Figure 1. Create a small neighborhood with houses by selecting the housing button (left). Each house shows its needs for functioning properly, such as a road and low voltage electricity (right).

2. Build an electricity plant by selecting the infrastructure button, then the energy tab. For this example select a nuclear power plant, although any type will work. You may install the power plant at the edge of the city.

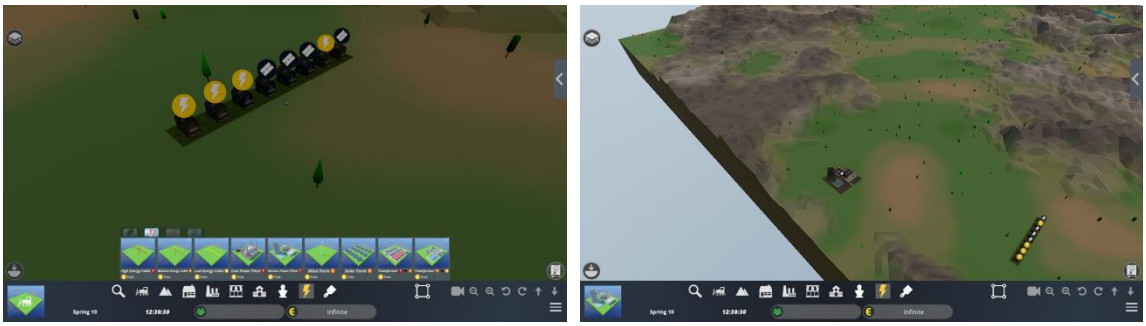

Figure 2. Build a nuclear power plant by selecting the infrastructure button, and then city energy (left). You may install the plant at the edge of the city (right).

3. Introduced energy voltage transformers next to the power plant: a) a high to medium voltage transformer and b) a medium to low voltage transformer. You may do that by clicking on the infrastructure button, then the energy tab at the

bottom of the screen menu (see Figure 3 below). Through the thumbnails at the top of each installation you can see that the power plant needs a road; the high to medium voltage transformer needs to be connected to the power plant with a high voltage cable ( ); and the medium to low voltage transformer needs to be connected to the high to medium transformer with a medium voltage cable ( ). Connect the transformers using the appropriate cables for high ( ) and medium voltage ( ) respectively using the infrastructure button and then the energy tab at the bottom of the screen menu.

4. Build a road that reaches the power plant and each of the transformers (see Figure 3 below). Now you see that the power plant and transformers work properly, as no thumbnails appear on top of the installations.

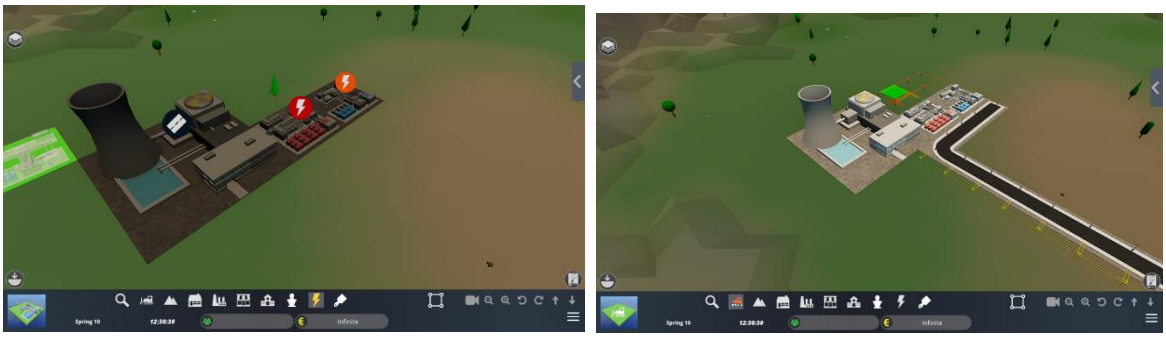

Figure 3. Build high to medium and medium to low voltage transformers next to the power plant (left). Connect them with the appropriate cables and build a road (right).

5. Make sure that the road connects the power plant with each house. Make sure that the houses are connected to the power plant with a low energy cable ( ). Select the low energy cable using the infrastructure button and then the energy tab at the bottom of the screen menu (see Figure 4 below). You will notice that the houses now function properly, as no thumbnails are highlighted over any house.

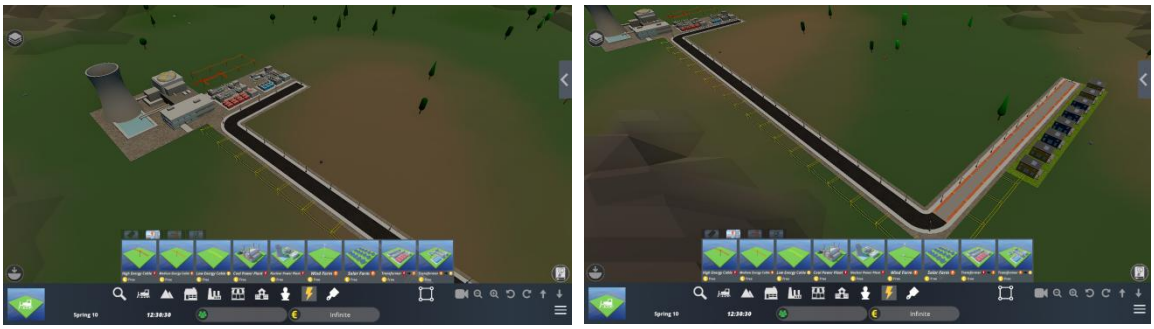

Figure 4. Make sure that the power plant is connected to the houses with a road and a low energy power cable.

6. You may also add some parks to the neighborhood. To do that, click on the public services button at the bottom of the screen menu and then select parks (see Figure 5 below). You will notice through the thumbnails appearing on top of each park that they need a road to function properly. Add a road, and your scenario is complete.

Figure 5. You may add parks to the neighborhood (left); for the parks to function properly you need to make them accessible through a road (right).

Assessment methods

This activity aims to build basic skills on the deployment of the HERA learning game. Assessment of the skills developed may be performed using authentic models, namely models that encourage students to demonstrate the newly developed knowledge hands-on. More specifically, students may be asked to demonstrate the creation of a city for the benefit of themselves, their fellow students, and the instructor. Alternatively, students may be asked to submit a video recording in which the creation of their city is demonstrated.