Balance between power generation and consumption

NaRiKa Corporation

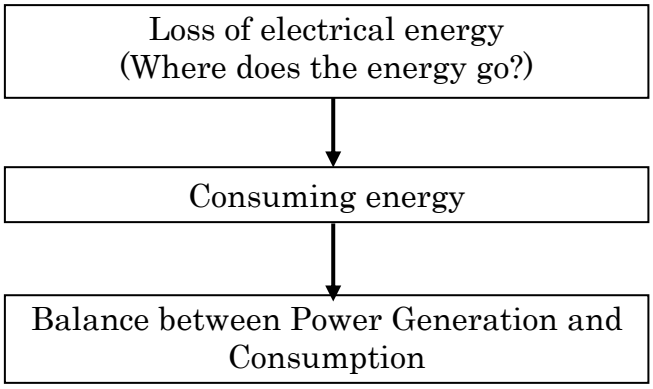
1. Learning Outcome

As a supplementary curriculum, in this unit, teachers help students understand how electricity is transferred from power stations to the towns/homes while some of the power is consumed (lost) on the way and not all of the generated power can reach to us due to the energy conversion from electricity to heat.

Based on this understanding, students learn basic concept like "Power consumption" and "Amount of Power Consumption" through the experiment to realize that a equipment of larger energy consumption requires more electric power. Also, students will know various type of fuel (source of energy) is needed to generate electric power.

Finally, students will go through the experiment to understand the balance between power generation amount and power consumption. Students to know blackout may happens in case power consumption surpasses the amount of power generation.

2. Overall Learning Scheme



3. Preparation for Experiment

In this unit, use the instrument as follows.

- P70-0395-10 Miniature Bulb and Socket (holder) with Leads & Clips: 10
- B10-2632-W0 GENECON DUE: 1
- B10-2634-W0 GENECON V3: 2
- Wooden Basement for Experiment 1

1. Miniature Bulb and Socket with Leads & Clips (P70-0395-10)

A miniature bulb is embedded in a socket (with a lead and electrical clips). Even early elementary grade students can connect it to dry-cell battery holder and electrical circuit.
Also, suitable for the experiment to light a miniature bulb with

electrical energy stored by using B10-2632 GENECON DUE.

2. GENECON DUE & V3 (B10-2632-W0, B10-2634-W0)

GENECON is a user-friendly hand-held DC (Direct Current) generator extremely useful for the power generation to be used for experiments of energy conversion and electrolysis of water. GENECON DUE produces (up to) approx. 12V DC only by turning the handle. GENECON V3 produces (up to) approx. 3V DC only by turning the handle. GENECON is a power generator specialized for the educational use to self-produce electricity.

GENECON is quite simply designed with the built-in motor inside that works to generate power. Students may realize the structural interaction of embedded motor, gears, shafts and handle through the transparent body. Teachers may easily instruct the students about the identical/interchangeable correlation between “motor” and “generator”.

GENECON V3 (DC3V Type)

GENECON DUE (DC12V Type)

	GENECON V3	GENECON DUE
Available generating voltage	approx. 3V	approx. 12V
Most suitable bulb	2.5V Type	6.3V Type

[Note] Specifications differ between GENECON V3 and GENECON DUE. In case lighting a miniature bulb 6.3V type, use GENECON DUE instead of GENECON V3. If you light 2.5V type with GENECON DUE, the bulb would be shortly broken.

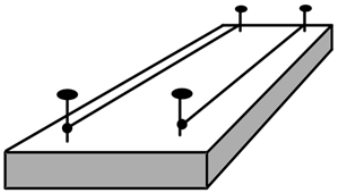
3. Wooden Basement for Experiment

This is a “Wooden Basement for Experiment” for the connections of multiple miniature bulbs. Note that this is not-for-sales product to be prepared by schools.

- Size: approx. 75 x 180 x 10 mm

- Nails or screws: x4, Total length: around 20 mm,
- Wires: x2

Fix four nails or screws on a rectangle-shaped wooden piece, and then connect wires as shown in the right-hand figure.



4. Balance between amount of power generation and consumption

We have been going through various experiments of lighting miniature bulbs using Genecon V3. We found out it become tougher in the heaviness (workload) of turning GENECON's handle when lighting 4 bulbs than we did when lighting 1 bulb. Now we know this happened because more electricity was needed to light 4 bulbs than 1 bulb. This means the Genecon V3 used made the power generation in accordance with the power demand equivalent to the power consumption. Thus, so as to use our home electric appliances without concerning about any overload, electrical power (i.e. power generation amount, or, power supplied amount) of which amount is equivalent to the power consumption of the appliances to be used. Also, in case the more appliances are used simultaneously, the more the generator would be loaded.

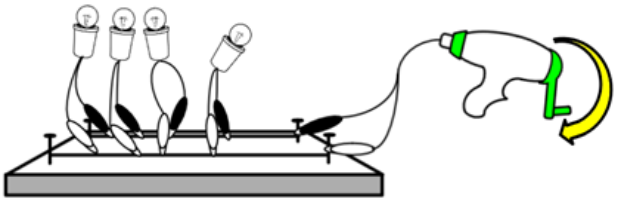
Power generation amount = Power consumption amount

5. [Experiment] Two generators in combination with multiple miniature bulbs

1. Experiment procedure

1. Connect four bulbs with two GENECON V3 on a circuit.

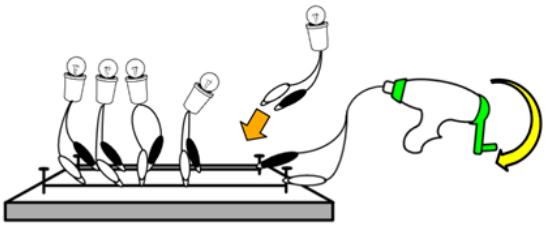
2. Check if the circuit properly works by turning the handles of the GENECON to light the bulbs.



3. Connect the 5th bulb and turn the handle of Genecon V3 as a "generator".

4. Check if all the bulbs are lit.

5. Keep increasing the number of bulbs being connected adding the 6th, 7th, and 8th, … and see if they are lit.



6. Once the total number of connected bulbs reaches to 8, keep going with two GENECONs as "generators" after adding another one. Make sure turn the handle of both GENECONs in the same direction.

7. Record the experiment result.

*Pay attention to the "apparent direction" of two Genecon V3. It should be aligned.

2. Questions for the experiment result

Q1. Up to how many bulbs were you able to light using one Genecon V3?

You may light up to ten miniature bulbs with one Genecon V3, however, they would be quite dark.

Q2. How did the brightness of the bulbs changed by the number of bulbs connected?

As the number of the miniature bulbs connected to a circuit is increased, each of the bulbs becomes darker and, the handle becomes heavier.

Q3. How the brightness of the bulbs changed after adding another Genecon v3?

All of the connected bulbs lighted quite bright because they were sufficiently provided with power with two Genecon V3.

Some students might turn the handles of the paired Genecon to different direction. In such a case, all the bulbs get darker or extinct as the current was generated to adverse direction.

Q4. Describe, based on the experiment result, what would happen if whole amount of the electrical energy consumption of a town exceeds the amount of power generation capacity that a power station can produce.

Even if not confirmed during the experiment, a whole town may black out power when excessive amount of energy is consumed compared to the capability of the power station's power generation mount.

Q5. Describe some measures to avoid the state mentioned in the Q4.

In order t prevent black out; we should

1)Set higher capability of the power station's power generation mount,

2)Have another power station,

3)Save power consumption,

4)Minimize the loss of power transmission,

5)Use electric appliances of higher efficiency in power consumption,

6)Not to use electric appliances and/or

7)Control energy consumption with circuit breaker.

Availability of these options are, for sure, depending on the circumstances of each region/country.

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