

Hong Kong Student Science Project Competition 2023

Extended Abstract (Invention Design Proposal)

(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SCPE028

Project Title: GreenPower Oasis

Project Type: Invention Design Proposal

To our best knowledge, there are / are no * similar works in the market; (if there are,) related product links are as below:

Gear-powered generator:

<https://www.youtube.com/watch?v=a9Y59nOSLzs>

<https://phys.org/news/2011-11-speed-bump-device-traffic-energy-electricity.html>

Piezo-electric generator:

<https://www.youtube.com/watch?v=VD15-2Uriyc>

The enhancement our project proposed / the difference with related products are:

1. The enhance the capability and widen the scope of converting wasted energy
2. Implementing the model to bus stop to increase effectiveness

**Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.*

I. Background

We noticed when buses decelerate at the bus stop, the kinetic energy generated is typically wasted as heat. Our design captures this energy by converting that energy into useful electrical energy which can then be used to power electrical appliances at the bus stop.

In America, a speed-bump device was implemented in car parks which can convert a car's kinetic energy into electrical energy (Owano, 2011). After inspiration from this, a more environmentally friendly bus stop was designed in our project.

II. Objective(s)

We aim to use the wasted energy in our daily life. We discovered that there are many untapped energy reserves in bus stops. So, we have developed some power generation systems, such as piezoelectric plates, hydroelectric generators, and solar panels, installed in bus stations, hoping to fully utilize the energy resources in bus stations.

III. Methodology

Gear-powered generator: The generator is made up of Lego Technic pieces, springs, AC electricity generator, light bulb. A motorized Lego bus stop was made to simulate a real-life bus stop. A Lego Spike application was used to code instructions to make the bus model travel across it. This model can simulate a real bus stop, but a gear-powered generator is added under the “road”.

Solar Panel: Our model consists of Lego Technic pieces and a solar panel. The Lego Spike application to make custom code, allowing the solar panel to achieve a 90-degree turn. We tested it and this allows the solar panel to always be pointing at the sun, maximizing the amount of sunlight we can harness every day.

Hydro-electric generator: The generator is built with Lego Technic pieces, AC electricity generator and a light bulb. Water was poured over the flaps in the model to simulate raining over a bus stop. A light bulb was installed to indicate whether electricity was produced or not. Potential energy stored in the rain was converted to electrical energy at the bus stop.

Piezo-electric generator: The model is made from 4 Piezo-electric plates, a circuit board, 2 acrylic boards and foam blocks. Our teammates walked multiple times over the plate. Then, we recorded the amount of current generated every time to prove that people walking by the sidewalks of bus stops can passively generate energy for society with little effort.

IV. Design of Invention

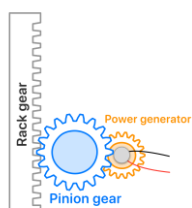


Figure 2

Gear-powered generator:

Referring to figure 1 on the right, the bus road generator is put underground. When a bus passes on top of the generator. The KE it carries and the weight of it pushes the steel plates downwards. Activating the gear mechanism in Figure 2. The rack gear causes the pinion gear to rotate, turning the gears in the power generator and generating electricity.

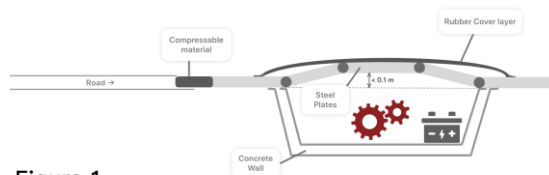
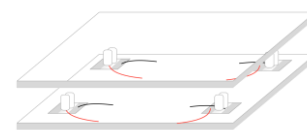


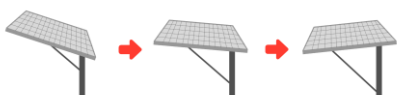
Figure 1

All the mechanism is covered in steel plates, which have a layer of rubber on top. The rubber assists the bus to slow down and brake. It also protects everything below from weathering. We also added a compressible material at the end of the steel plate to counteract the fact that the plate pushes along the road when pushed downward.

Piezoelectric plates: Two layers of plastic placed on top of one another are used to pave the pavement at bus stops, with four piezos and thin foam placed between the two sheets. When pedestrians walk over them, the sheets sink slightly, and the piezo-electric plate is compressed. An electric current is released and transferred to the battery. Foam blocks are used to minimize contact damage on the thin piezo-electric plate.



*Follow the sun from the East to the West



Solar panels: The solar installation is equipped with an electrically driven, rotating mechanism that controls the angle of the solar panel, ensuring that it is always pointed toward the sun to maximize electricity generation.

Hydropower installations: Rainwater is funneled into a water pipe which is fitted with a hydroelectric system with an impeller at the bottom of the pipe. The impeller rotates as the rainwater flows down, driving the motor and generating electricity.

V. Application / Market Need

Application and Function: We will apply the invention at bus stops, collecting the remaining kinetic energy of buses which otherwise would be wasted by braking. The KE will be converted to electricity. This not only avoids the need for additional energy to slow down the bus when braking but also converts the bus's remaining kinetic energy into electrical energy, as well as the gravitational potential energy generated by people, solar energy, and rainwater, which can be stored in a battery.

Market demand and impact: There is currently no other product like ours on the market. With millions of passenger trips made in Hong Kong daily, there is a massive untapped market for our innovative bus stop design. In 2021 alone, there were 10.6 million passenger trips made in Hong Kong every day, with a massive portion of those trips being on buses. Our design incorporates a range of green power generation technologies, making it the most eco-friendly option available.

Limitation of related work: The limitation of speed-bump device created in the US is its model design. Their model's height must be high to generate a compatible amount of energy. But our model can safely be within the range of the height regulation of speedbumps in Hong Kong. Our model can be lowered into the ground to create enough displacement for electricity generation.

The limitation of Piezo-electric generators is the place they put the device on. The road used doesn't get as much traffic as a bus stop in Hong Kong. Greatly increasing our capability to generate energy.

VI. If your team will compete for the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. (*Word limit: 300 words*)

Our project is made to be green and convert wasted energy into sustainable sources. The raised power generator on the road can help the bus slow down and convert the KE and weight of the bus into electrical energy at the same time. In addition, the solar panels and hydroelectric generators installed on the top of the bus stop can make full use of the advantages of no shelter and empty space on the top of the bus stop to generate electricity, which shows that our bus station is self-sufficient and does not need to rely on external power sources to power the bus station, such as the display screen that shows the arrival time of the bus, to continuously generate clean and environmentally friendly energy. Therefore, we are confident that this bus stop will be able to compete for this award.

VII. If your team will compete for the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. (*Word limit: 300 words*)

When society pays the most attention to environmental protection, greenhouse gases are emitted when generating energy such as burning fossil fuels. This solution can convert the kinetic energy generated at bus stops into electricity as much as possible, thus leading us to take a big step towards generating electricity with every breath in the future and achieving zero-pollution power generation at bus stops to slow down the speed of global warming. Our project also creates a foundation for plans to improve our experience of waiting for buses. This allows the addition of electric appliances such as fans, lights and charging stations to the bus stop. Creating a comforting stop on our journey. Therefore, we are confident this proposal will compete for this award.

VIII. Conclusion

Building GreenPower Oasis is believed to effectively save wasted energy, as it contains 4 promising parts. They are gear-power generator, solar power, hydro-electric power, and piezoelectric power. It is up to us to take advantage of these resources and build a more sustainable future for generations to come.