SOFT ENERGY WILL MAKE LIGHT RAIL VEHICLE RUN IN THE STRICKEN AREA WITHOUT A CATENARY SYSTEM

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ABSTRACT

In 2011, the Tohoku district in Japan suffered serious damage from a big earthquake and tsunami. In reconstruction of the public transportation in the stricken area, we propose a new transportation system which is environmentally friendly and is effective at the time of a disaster.

Dual-mode light rail vehicle with rechargeable system runs by renewable energy. Railroad track connects seaside city area and hillside village. Usually, this system functions as people and environmentally friendly transportation system. If a disaster occurs, this system will function as evacuation system and the local power plant.

1 INTRODUCTION

On March 11, 2011, the Tohoku district in Japan suffered serious damage from a big earthquake and tsunami. Many buildings were destroyed by the earthquake. Furthermore, more than 10 thousand of people who were not able to take refuge in a hill were washed away by tsunami.

The transportation system was paralyzed and supply of electric power also stopped. Although supply of electric power was recovered immediately, public transportation has not been reconstructed completely yet.

In reconstruction of the public transportation in the stricken area, we propose a new transportation system which is environmentally friendly and is effective at the time of a disaster.

2 THE NORMAL PERIOD

The transportation system which we propose functions as an environmentally friendly transportation system ordinarily.

2.1 The Light Rail is Environmentally Friendly

Almost all of rural district of Japan is automobile dependent society. Although there are railroads in countryside, people do not use them in their daily life. It is not useful as commuter rail because the trains are very infrequent on that line. Only the students and old persons who cannot drive a car use a railroad.

When the light rails (trams, street cars) run the town and train service increases, people will use the light rails. The railroad is known as an environmentally friendly transportation system. CO_2 emission and energy consumption of rail transport is lower than that of road transport.[(2)] When the light rail can be run by soft energy, such as solar power, wind power and hydro power, it will be more environmentally friendly transportation.

The light rail is friendly not only for environment but also for people. The light rail does not divide the town like a railroad. People can cross a rail easily.

2.2 Summary of the System

We propose the rechargeable run system [(3)]. Solar cells are installed on the roof of the station and around the station. Wind turbines and water wheels are built around the station. The electric double layer capacitor (EDLC) unit is installed at the station as a charging device, and the EDLC unit is always charged from these generators.

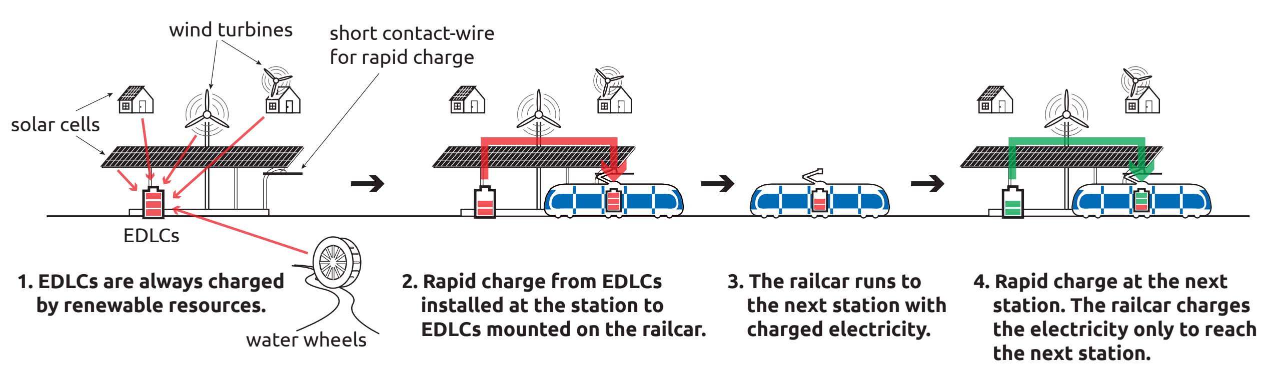

Fig. 1: Schematic diagram of power supply system [3]

There is the short contact wire for rapid charge at the station. The EDLC unit is also mounted on the railcar. When the railcar stops at the station, electricity is rapidly transmitted from the EDLC unit of the station to the EDLC unit of the railcar. The railcar charges the electric power only to reach the next station at each stop.

In this system, charging devices repeat charge and discharge. Advantages of EDLC such as long life, high input-output power, low pollution, are suitable for our system. The amount of energy stored per unit weight is lower than that of batteries. But usually distance between stations of trams is shorter than that of railways. Therefore that cannot become a disadvantage in this system.

By this method, the railcar can be run on a cloudy day or at night. Moreover, we do not need to worry about transmission loss. Fig. 1 shows the schematic diagram of this system. If about 99,000 kWh per year can be generated at all the stations, the light rail can be run only by renewable energy [3,5].

3 THE DISASTER PERIOD

If a disaster occurs, our system will function as the evacuation system and the local power plant.

3.1 Evacuation Route and Vehicle

In Japan, city areas are located in the plain along the sea, and there are small villages in mountain slopes, in general. Since young people moved to city area, rural villages have problem about aging of population. For example, when there is no hospital in the village, the elderly people need to go to city area, in order to go to the hospital. Since public transportation is poor, when a young person is not in the neighborhood, it is very hard to go to city area. Therefore, the route of the transportation system which we propose needs to connect the village to city area.

Since the railcar cannot climb a steep slope, when the altitude of the village to connect is high, it may become elevated railroad in the city area. Although it may be inconvenience ordinarily, if a disaster occurs, it will serve as an evacuation route to the hill.

Furthermore, in this system, not standard light rail vehicles but dual-mode vehicles are used. Dual-mode vehicles can run on the rails and conventional road surfaces. If a big earthquake occurs, railroad tracks will be distorted and it will become impossible to run railroads. Since it is more efficient than a rubber tire, dual-mode vehicles usually run with iron wheels, and if an earthquake occurs, vehicles will run with rubber tires.

If a disaster occurs, dual-mode light rail vehicles will serve as evacuation vehicle. Furthermore, private automobiles run on the railroad track in order to evacuate to the hill. Since automobiles run on the railroad track, even if the elevated track is exclusively for light rail, the surface of track must be shared track.

3.2 Local Power Plant

In this system, several generators such as solar panels, wind turbines and small-scale hydro powers, are installed in each station. Although this system is used for relief supplies transportation after refuge, the train service is not necessary as usual. Therefore, even if the power transmission from the electric power company stops, electric power can be supplied from each station.

Since fuel is unnecessary for generation by renewable energy, even if supply of goods stops, electric power can be supplied.

4 CONCLUSION

We hope immediate reconstruction of the Tohoku district in Japan. In order to improve their life rather than before, and in order to prepare for the disaster which is not desired to occur again, we hope our proposal to be helpful.

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