

## A Renovate Solution for Public Transit

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### Abstract

#### 1.The Solution

Power Battery Express Change Station (PBECS) for electric buses provides a renovate solution for the buses continue running.

#### 2.The products

Power Battery Express Change Robot (PBECR)

Battery Matrix

Battery Storage Shelf

Charge and power Supply system

Management System for PBECS

#### 3.Application of the Solution in the public transit in China.

PBECS has been used for the public bus line 31 upto 50,000KM in Lanzhou, China in 2005.And bus line 121 in Beijing, China since 2006.

The milestone is PBECS applied to public bus for Beijing Olympic Game in Beijing, China in 2008

Currently, the e-bus and battery exchange system has applied to bus line 06 in Beijing and the sanitation trucks with PBECS are also being used in Beijing.

Keyword: Electric bus, Battery Exchange, Public Transit,

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### 1 Introduction

From a commercial point of view, there are three running modules for the electric bus. The first one is the tram or/and trolley bus that has been more than 100 years. The second one is the loading battery charger, more or less like the hybrid vehicle. And the third one is full battery. The battery needs to be charged whatever 30 minutes or 3 hours and

then the bus has to be waited for charging. Essentially, the battery can be charged in the charge station not on the bus, and then exchanged when there is a need to do.

PBECS provides a solution of the continuing running for the electric public transits (buses). The battery matrix can be replaced within 5-8 minutes whenever the bus needs. This station can be used for any battery bus since the power battery group is

packed. It can be used for any kind of battery, pd-acid, Ni-MH or Lithium-ion. The function of PBECS for an electric buses/vehicles is more or less the same as the re-fill gasoline for the engine buses/vehicles in the service station.

The station has three elements. Power Battery Express Change Robot, Battery Matrix and Battery Shelf.

## 2 The PBECS system

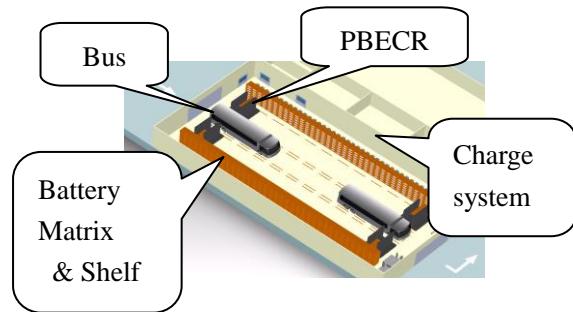


Figure 1 PBECS

### 2.1 Power Battery Express Change Robot (PBECR)

PBECR is a programmable logic controller (PLC) equipment. It under the Dianba's independent intellectual property rights and designed to load and unload up to 600kg battery matrix with repeat positioning accuracy less than 2mm.



Figure 2, PBECR

PBECR can change the battery matrixes for an electric bus in 5-8 minutes.

### 2.2 Battery Matrix

In order to change the battery, the battery must be pack in group. It is a very important step and design idea. The matrix is not a simple battery pack. The matrix has a grouped smart power connectors, temperature and smoke monitor, cooling fans and battery managing system (BMS). This BMS was designed and developed by Beijing Jiaotong University.



Figure 4 Battery matrixex in the bus

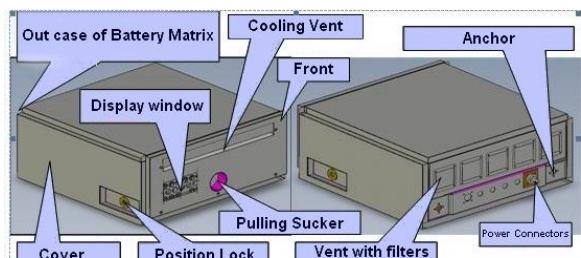


Figure 4 The functions of Battery matrix

This creative idea separates the battery matrix and vehicle and resolves the vehicle continuing running problem caused by the battery. The battery and battery group become easy maintenance and easy loading and unloading. And furthermore, this idea allows the batteries are charged during in the night (valley power) that will balance the grid and save energy. This design and development are under Dianba Technology and Beijing Institute of Technology's independent intellectual property rights and can be used for all different kind of

batteries.

### 2.3 Battery Shelf

It is also including the special designed smart connectors, temperature and smoke monitor and battery locking device.

Through Recharge Managing System (RMS), to monitor and optimise the battery matrix recharges. RMS has a special protocol to connect with vehicle's CAN and battery manage system (BMS). This RMS was designed by China Electric Power Research Institute.

By using the system, peak load shifting by charging the battery in the nighttime (Valley power) and also can be used for the electricity storage in large-scales.



Figure 5. Battery Shelf in Beijing

### 2.4 Power supply and charge

General power supply and chargers are necessary. Because of using separate battery matrix and power storage, the wind power, the solar power become an ideal energy.

### 2.5 Management System

The whole managing system of PBECS has

three important nervous systems.

BMS: Battery Managing System in each battery matrix. (Beijing Jiaotong University)

CAN: Controller Area Network in bus (Beijing Institute of Technology)

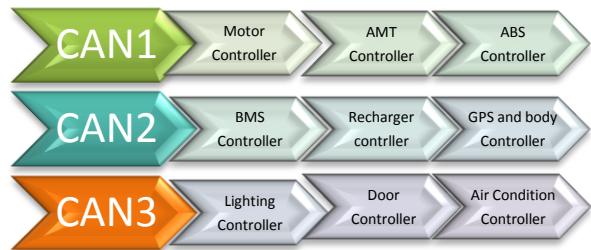


Figure 6. CAN in bus

RMS: Recharge Managing System in the station. (China Electric Power Research Institute)

The three important nervous systems of are connected by special designed communication protocol. They effectively manage the whole PBECS system and ensure PBECS working friendly and properly.

## 3 What does PBECS system bring to us?

- ✧ **Environment:** Zero emission, No urban heat island effect, Less Noise
- ✧ **The bus/vehicle can continue running.**
- ✧ **Balance of Power Grids:** By charging the battery in the night (valley power) to balance the grids
- ✧ **Saving Energy:** Using extra night power. Less being relies on Gasoline, diesel and nature Gas.
- ✧ **Save the running cost:** Current bus running at 0.8 – 1.6KWh/km.

- ✧ Bring the hope to storage energy.
- ✧ Easy to care of battery

## 4 Application of PBECS system

- ✧ The first generation e-bus, WG6110EV from Yangzi River Automotive has finished 50000km road testing in bus rout No. 31 in Lanzhou, China in 2006.
- ✧ The third generation e-bus BK6122EV1 from Beijing Jinghua Passenger Vehicle Automotive has finished 100,000km road testing in Beijing, China in 2007.
- ✧ The PBECS has been used for 50 e-buses of BK6122EV1 in 2008 Beijing Olympic Games. A battery change station has been set up in Sihuan, Beijing where closes Olympic Center Stadium, Bird's Nest. It is over 4000 times replacement has been done safely and effectively during these buses running over 133,000 KM. The battery was Lithium-ion and it supported 12meters long bus with single run between 90-190KM per charge.
- ✧ Bus line No. 06(fully e-bus) has commenced from Beijing South Station to Beitucheng in Beijing.
- ✧ Shanghai has planned to use 120 and more e-buses and 4 PBECS during Shanghai Expo 2010



Figure 7 E-bus serviced for Beijing Olympic Game



Figure 8 PBECS in Beijing

### Author:

PBECS is the technology project and developed by the Beijing Dianba Technology Ltd. PBECS is under the Dianba's own intellectual property. Either the concept and the technology commenced in 2000, the first apply in electrical vehicle. After experiment and physical running in the commercial bus line, the system successes to provide a solution of electrical vehicle for commercial market. With the co-operation of Beijing Institute of Technology and Beijing Communication University, the system has been successes to enter electrical public transit in Beijing Olympic 2008.