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Swappable Batteries for light electric vehicles – the new GreenPack standard battery-system

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Summary

Light electric vehicles (LEV) can also be "recharged" by exchanging their batteries manually. GreenPack developed a swappable battery system for light electric vehicles (LEV). One GreenPack battery weighs 9 kg and has an energy storage capacity of 1.4 kWh. Several of these 48 volt batteries can be used in parallel although they do not have the same state of charge. This system can also be used in vehicle-to-grid-applications as the swapping stations are connected 24 h per day with the electric grid. The batteries can be charged when there is too much power in the grid and they can feed the grid when there is not enough power.

Keywords: battery, energy storage, light vehicles, smart grid, v2g

1 Vision

Creation of a new, global battery standard for the storage of renewable energies and providing energy supply for light electric vehicles (LEV), boats, and larger electric devices.

Establishment and operation of an infrastructure for GreenPack battery storages in private households and battery swapping stations installed in public areas.

Development and distribution of GreenPack battery modules and GreenPack products.

Figure 1: GreenPack swappable 48volt-battery

2 Need for light electric vehicles (LEV)

All over the world our cities suffer from air pollution and growing traffic density. A trend against this development is electric mobility by small, low-weight vehicles, so called Light Electric Vehicles, LEVs. By switching batteries manually, “refueling“ is much more comfortable and quicker than charging LEVs at charging stations. The world market lacks a standard battery for LEVs and larger electric devices.

In cities, LEV mobility is welcome to reduce energy and space consumption of the moving and resting traffic. In the urban logistic, delivery services and companies offering LEV sharing, e. g. for e-scooters, have a special demand “on the last mile“.

In contrast to manufacturers of heavy electric vehicles (HEVs), many LEV manufacturers would appreciate battery standardization, as they have no share in an added value from batteries.

The economic risk of owners of LEV decreases as the lifetime of batteries no longer limits the lifetime of the vehicle.

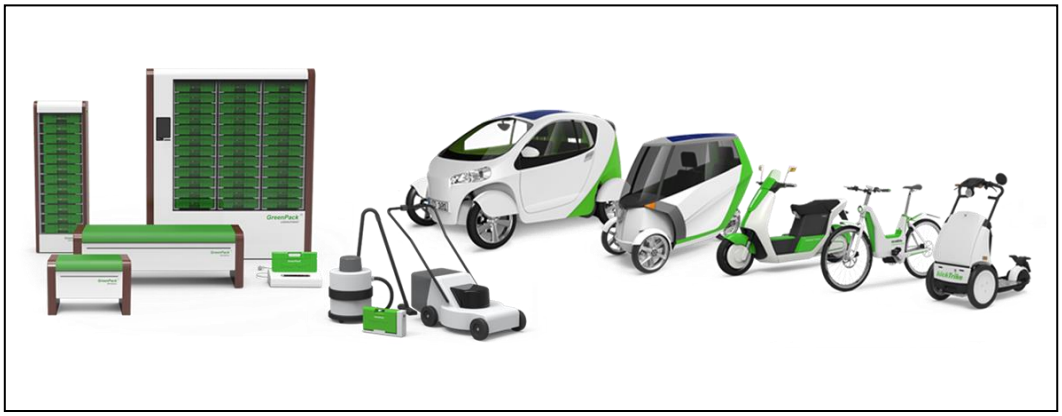

Figure 2: GreenPack appliances categories, swapping stations, devices, vehicles

In fig. 2 different vehicle categories are shown (right to left): KickTrike, Pedelecs and E-Bikes, E-Scooters, and small passenger cars. At the left: different charging and swapping devices for homes or office, work and public areas.

3 New battery technologies

The big advantage for the owner of light electric vehicles is that they get new battery-technologies immediately. If one day a GreenPack-battery will have an increased capacity of e.g. 2.5 kWh, they will be soon available at the swapping stations.

Figure 3: Different sizes of swapping stations for GreenPack batteries

4 Demand for electric energy storage

Due to the increasing use of solar and wind energy, there is a great demand for establishing a battery storage infrastructure. The multi-use capability offered by GreenPack increases the incentive for private users to buy battery storage systems.

Consumers and local communities approve of a battery standard since it improves the intrinsic value and sustainability of battery-powered products. Apart from that, a public infrastructure with battery swapping stations makes sense only with a standard battery for different LEV types and other electric applications. Furthermore, battery storages are used by power grid operators as swarm storages for the stabilization of their electric networks.

Figure 4: GP Battery bench for small flats in cities and houses with solar systems

5 Solution

The unique, patented features of the GreenPack battery and its implementation, separately or in a cluster, in very different applications (multi-use capability) make GreenPack predestined for the creation of a new standard.

The Cluster management system (CMS) provides for the compatibility of different types of chemical storages technologies, different charging conditions and different GP manufacturers within the cluster.

The sustainability of GP applications and of a GP infrastructure for battery exchange is ensured by the GreenPack licensing strategy.

GreenPack-Features

1. Easy to handle, manually replaceable, weight max. 9 kg
2. Dimensions appropriate for integration into a large variety of vehicles and devices
3. Nothing to break, compact design, no loose parts such as hinged handle or cable
4. Splash-proof according to German standard IP 65
5. Mechanical fixation of batteries only by the sturdy plug which also allows the use of thinner, lighter GreenPacks
6. Lateral contact cavities protected against water and dirt
7. Robust plug-and-socket system with twin contacts
8. Prepared for the use of thicker and longer round cells (21700) in the future instead of 18650 round cells being used at the moment
9. Separation of the electric inside construction and the exterior shell allowing the use of metall shells for heat dissipation in the case of high performance GreenPacks
10. Mechanical construction suitable for automized manufacturing
11. Outer dimensions adapted to logistic requirements (suitable for Euro-pallets)
12. Volt free contacts for a safe transport
13. Standard nominal voltage of 48 V (harmless low voltage)
14. Standard CAN interface
15. Cluster capability even with different types of battery chemistry accomplished by the GreenPack CMS (Cluster-Management-System)
16. The system allows for storage chemistry to come in the future
17. Proprietary battery management system (BMS)
18. Cryptosystem against forgery
19. No dependence on property rights of third parties, especially concerning the plug system
20. Licensable by different manufacturers

Figure 5: plug-and-socket-system with double contacts for each pole and 8 data contacts

6 Swapping stations as a basis for vehicle-to-grid

While there are no business cases up to now to motivate drivers of EV to drive to charging stations to feed in a part of their battery capacity into the electric grid, swapping stations for battery packs are always connected to the electric grid. So the batteries can be charged when there is too much energy and the machine can buffer the electric grid from energy from the batteries when there is need for.

7 Prototype vehicles

Together TU Berlin (Institute for vocational training IBBA) and Constin/GreenPack have transformed a Govecs electric scooter to be used with 1 to 3 GreenPack-batteries.

A pedelec for 1 GreenPack battery is finished also KickTrike, different cargo bikes and vehicles for last mile.

Small passenger cars that are under construction may need up to 12 batteries (108 kg, 16,8 kWh).

Many manufacturers of light electric vehicles (LEV) welcome a standardization of the batteries because they do not participate in the value added of the battery.

Figure 6: electric scooter with 3-5 GP modules

Figure 7: Different light electric vehicles on the market which can be powered by GreenPack-batteries

8 Food&Energy

With the concept food&energy people are invited to buy not only their food at the supermarket but also their stored energy at e.g. a GreenPack-accumulator swapping station.

The first GreenPack-swapping stations for supermarkets will be installed in late 2017 in Berlin.

Figure 8: GreenPack swapping station at a supermarket

Authors

Andreas Manthey studied vehicle engineering at Technical University of Berlin, was awarded with the European Solar Prize 1994 of the European Commission and is working on the topics of electric vehicles and renewable energies since 1985. Since 1992 he was responsible for the German part of the charging station network “Park&Charge”.

Today he teaches electric energy at the Technical University of Berlin, Institute for vocational studies. He works especially on electric (lightweight) vehicles, renewable energies and charging infrastructure.

Hans Constien, born 1956, graduate degree in mechanical engineering, designer, inventor, founder, manager, owner of Constin GmbH and kickTrike GmbH and GreenPack GmbH.

Since 1983 Hans Constin runs his own service company - Constin GmbH - focusing mainly on design-relevant products.

1993 invention of the Nokia Communicator, 2006 invention of kickTrike, since 2011 invention of the GreenPack accumulator and comprehensive development of the relevant industrial property round of the GreenPack.

Idea development of the GreenPack-System as a new kind of infrastructure (accumulator net) for storage of ecological electricity and for energy supply of lightweight electric vehicles LEV.

In April 2017 he was awarded with the “Golden Prize Transportation” of the European Product Design Award for kickTrike and the GreenPack-System.