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REPIC Project

Market launch of Lithium batteries for electric vehicles in Nepal

Development of the Project and Results

Final workshop
Markus Eisenring, Switzerland

January 3, 2019

Content of the presentation

- Development of the Project
- Results



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Executive Summary

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- The **electric vehicles in Nepal** (called Safa Tempos) **depended on lead-acid batteries**
- **The Nepalese electric vehicle industry wished to equip vehicles with better batteries**
- This demand was exacerbated by the **scarcity of fossil fuels** that existed in the country for a long time
- **Towards end of 2015 some Nepalese stakeholder approached Markus Eisenring to assist in introducing better batteries in Nepal**
- **An early analysis showed that the lifetime costs of Lithium batteries are far better than those of lead-acid batteries**



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Executive Summary

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- **We decided to introduce the LiFePo₄ type of Lithium batteries in Nepal**
- **Although the procurement costs for Lithium batteries are higher than for lead batteries, the operating costs for Lithium batteries are much lower than for lead-acid batteries**
- **A project with the aim of launching Lithium batteries in Nepal by installing a Lithium battery system in 10 Safa Tempos was initiated. REPIC, was approached to finance part of the cost**
- **REPIC is an interdepartmental platform of 4 Swiss Federal Government Departments**



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Executive Summary

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- The REPIC platform's primary objective is summarized as follows:
Transfer of knowledge and technology to develop renewable energy, energy and resource efficiency in developing and transition countries
- **The objective of this project is to demonstrate that energy efficiency can be increased and that service life costs are reduced by the installation of Lithium batteries in 10 vehicles**
- This should also help to ensure that existing electric vehicles can survive, that they are not replaced by conventional vehicles and that other electric vehicles are placed on the market at a later date

Executive Summary

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- In **spring 2016, REPIC decided** to support and thus to facilitate the "**Project Market launch of Lithium batteries for electric vehicles in Nepal**"
- This should be **demonstrated** in a pilot project **on 10 Safa Tempos** by early adaptors
- All these **10 vehicles are successfully in operation**, three since December 2016 and seven more since January 2018
- **15 more vehicles are running with the same system**
- **Other Lithium battery systems have also come up** and the installation of Lithium batteries in many more vehicles is planned



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Project Development

> Implementing Organizations

From Switzerland

- **Eisenring Engineering** / Markus Eisenring
- Partner Office: **Kuster Engineering** / Thomas Kuster

From Nepal

- **EVAN (Electric vehicle Association of Nepal)**, President Umesh Shrestha
- Partner organisation: the **Clean Multipurpose Cooperative Society Ltd.** (known as Clean Cooperative)



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Project Development

> Project Goal and Objectives

The aim of the project is to demonstrate the following advantages:

- **Improvement of the Nepalese market for electric vehicles**
- **Creating more income to the participants**
- **Saving of energy**
- Achieving optimum operating efficiency
- **Replication and implementation in other vehicles**
- Prevent existing electric vehicles from being replaced by vehicles with internal combustion engines
- **Improvement of the workplace situation of people involved with Safa Tempos**
- **Provide a clean means of transportation to the public**

Project Development

> Project Target Groups, Beneficiaries

- **Safa Tempo self-driving owners**
- **Safa Tempo owners with employed drivers**
- **Owners of the charging stations**



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Project Development

- > Project Activities, significance of intervention and implementation strategy

The project was subdivided into two phases

Phase 1

- This phase included the **engineering**, the **purchase** of the batteries, the battery management systems (BMS) and the chargers, **benchmark tests** and the **installation** of the batteries in 10 Safa Tempos

Phase 2

- The second phase included the **testing**, **operation** and **monitoring** of the batteries in the vehicles, training of persons involved, maintenance, the **activities for replicating** the use of Lithium batteries and the finishing work



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Project Development

> Timeframe

- **Originally it was planned** to complete the project in **2 years**
- and that the first 10 vehicles should be running and monitored for 1 year
- This has been done now
- We managed now to **complete the project in 2 years and 9 months**

Content of the presentation

- Development of the Project
- **Results**



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Results

> Vehicles in operation

- **All 10 Safa Tempos are in operation now, equipped with Lithium batteries, the battery management system (BMS), the chargers and further devices**
- **Three of them since January 2017**
- These vehicles meet expectations well
- Apart from the larger capacity and extended range, a set of Lithium batteries is much lighter than a set of lead batteries
- The service life is extended from 15 months for lead batteries to an estimated 6 -7 years for Lithium batteries



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Results

> Vehicles in operation

- In some cases, we can follow the daily journeys on the Internet, as some vehicles are equipped with GPS.
They travel 2,600 km to 3,200 km per month
- **Since mid-January 2018, seven more Safa Tempos are in operation**
- **In the meantime, 15 more vehicles have already been converted to Lithium batteries.** These were converted completely without further support of the REPIC project
- **10 of them are running since April/May 2018 and 5 of them since August 2018**
- **The last five were converted by another group of business people around Shrawan Prasad Chaulagain of Fast Track International Pvt.**



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Results

> Vehicles in operation

- **The project has left a very good, positive impression on all those involved and on people from outside**
- Word has got around that the vehicles prove themselves very well in operation
- In addition, many other owners want to use the new batteries
- Now several groups of investors and interested people want to convert more vehicles to Lithium batteries
- **Till now a total of 25 vehicles are running with this systems**
- Many additional owners of Safa Tempos now also want to switch to Lithium batteries
- The equipment to install Lithium Systems for 25 more vehicles has been already ordered
- **And many more are going to be converted with this system**



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Results

> Vehicles in operation

- **This project has promoted the use of Lithium batteries**
- **Another group** of people around Meelan K. Paudel, **NEK Energy solution**, has introduced a **Lithium system for SafaTempos from Korea by LG**. Currently there are 3 vehicles in operation and more are planned.
They are working on equipping 100 to 300 Safa Tempos with this system.
- **And there are plans to import other Lithium battery systems from other manufacturers:**
 - **With other capacities for the Safa Tempos**
 - **For other cars**
 - **For electric scooters**
 - **For E-rickshaws**



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Results

> Findings of the project

The project has proved the following for Lithium batteries

- Lithium batteries are an alternative battery solution to lead acid batteries
- Lithium ferrous phosphate (LiFePO₄) technology used is safe and cheap among the Lithium technologies
- Technology is well proven
- 1 set of Lithium batteries replaces 2 sets of lead acid batteries
- With 300 Ah batteries the vehicles can run whole day @ 80% DOD
- No battery change at noon --> no trip to charging station necessary --> saves energy
- Batteries can be fast charged (< 1 hour) (fast charger required)



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Results

> Findings of the project

The project has proved the following for Lithium batteries (2)

- Less workers required for battery management in charging stations
- No watering in battery → no cost for water and less labour cost
- Less total weight of vehicle, equivalent 2 to 3 persons
- Less wear of tires
- Less maintenance cost, stress and tear on chassis, suspension and rims
- Less energy cost, because of driving and charging
- Charger on board --> can be charged anywhere where electricity and plugs are available



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Results

> Findings of the project

The project has proved the following for Lithium batteries (2)

- Average number of loops increased
- Battery Management System (BMS) ensures safe and proper charging and discharging of batteries and guarantees a long cycle life
- Longer battery lifetime than lead acid batteries (6 to 7 years expected)
- Smaller lifetime cost
- Battery cost will decrease in future
- Thus the cost are lower and the income is higher
- Although the initial investment is higher than with lead batteries, the lifetime costs are much lower with Lithium batteries



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Results

> Findings of the project

Advantages of lead acid batteries

- Technology well know and established in Nepal
- Lifetime of batteries known
- Less initial cost
- No Battery Management System (BMS) is needed



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Results

> Findings of the project

Economic Feasibility of Safa Tempos with Lithium Batteries

Participation in this project is economically worthwhile for all groups involved

- **SAFA Tempo Owner with employed tempo driver**
- **SAFA Tempo owner with driving them-self (Self-employed Tempo Owner)**
- **Charging centre business**

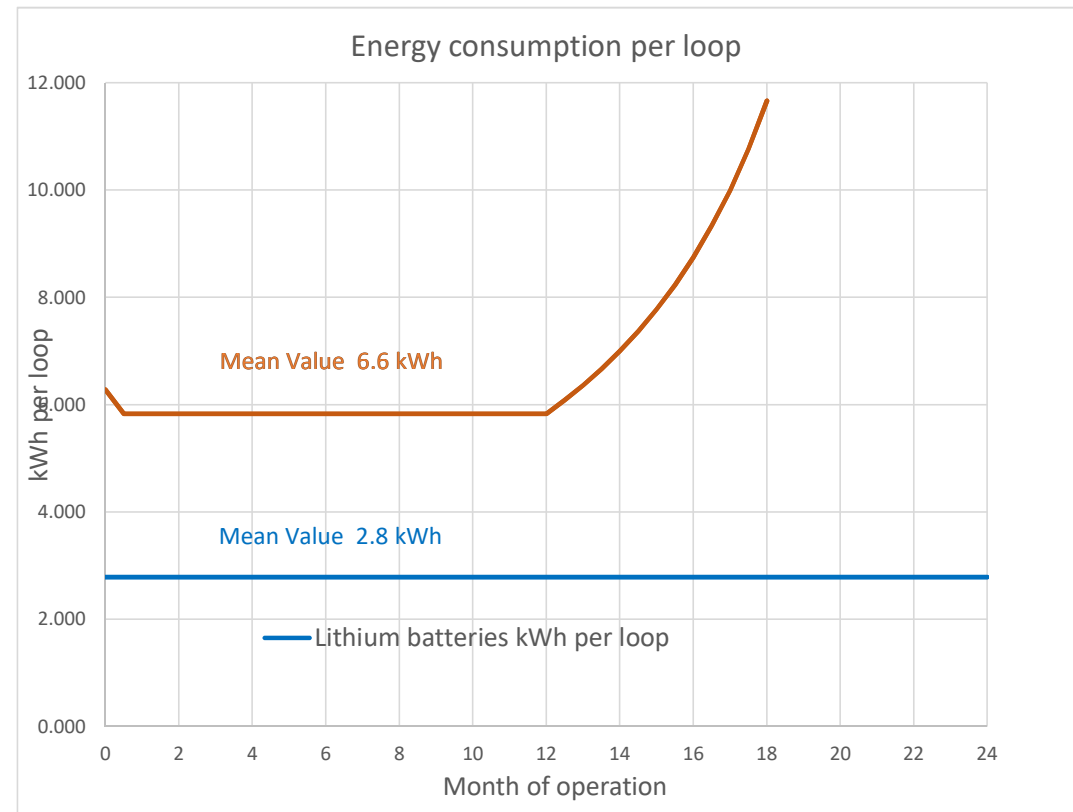


Results

> Energy saving

A lot of energy is saved with Lithium Batteries: We were expecting that with the Lithium vehicles, approx. 25% of energy can be saved

- **A survey conducted by CEN showed that our expectations were exceeded**
- **The energy saving is more than 50 %**
- **The average energy consumption was reduced from 6.6 kWh/loop to 2.8 kWh/loop**





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Results

> Side benefits

New drive systems

The use of AC drives was also triggered:

- **BLDC motors and controllers**, which are synchronous AC drive systems, were imported by Prakash Thapa and Prithvi Dhoj Ddangi
- **Asynchronous AC drive system** were introduced by Shravan and Ram Hari which are running successfully since Dec 2018
- **There are plans to import other drive systems**



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Results

> Side benefits

Some ready made vehicles with Lithium batteries were introduced in Nepal

For instance:

- New Reva car by Agni Group
- BYD

There are plans to introduce new vehicles:

- EV's
- Electric buses



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Results

> Side benefits

There was also an increased search for other battery solutions:

For instance:

- Lead carbon
- Other new types of **lead batteries**

From our point of view the project is very successful:

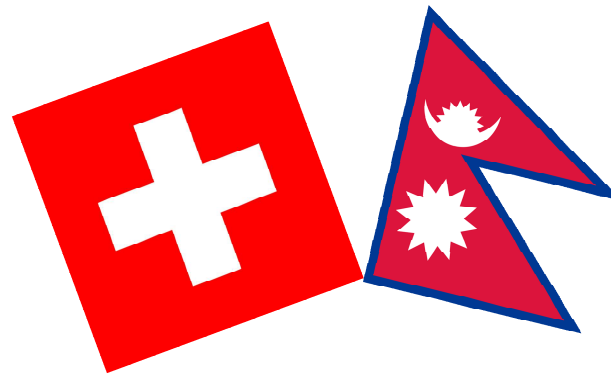
Replication happens

The Nepalese people understand now more from the Lithium battery technology.

After this we shall of course continue to support you also in future for any issues concerning EV's, be it Lithium batteries, AC drive systems, EV's, layout systems for EV's, calculations and others, as per our possibilities

January 3, 2019

Thank you for your attention



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January 3, 2019