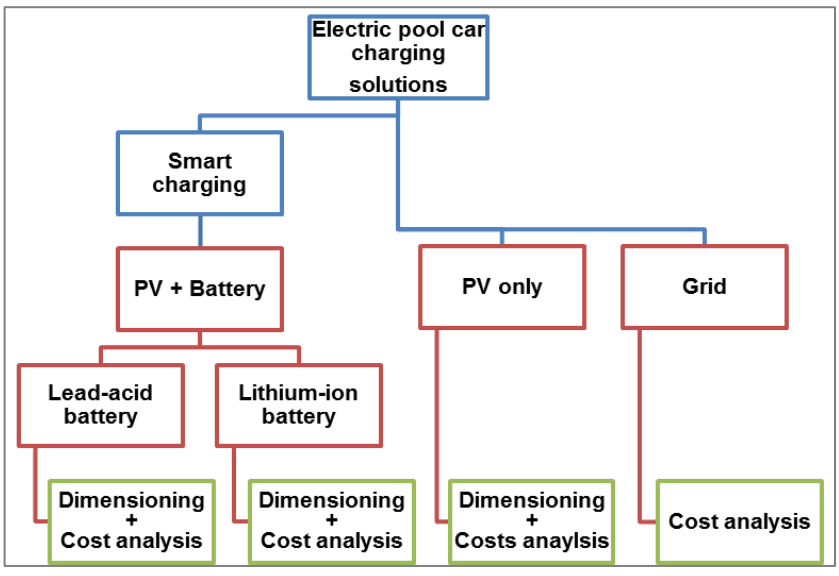
Smart Charging solutions for Electric Fleet Vehicles

Dimensioning and Cost Analysis

Electric vehicles (EVs) as an environmentally friendly alternative to petrol cars have become popular both overseas and in Australia. The practical aspects of day to day use can still present some challenges especially regarding the underdeveloped charging infrastructure. In order to counteract this, two huge but currently almost untapped Australian potentials, EVs usage and solar energy generation could be connected. EV usage charged with Victorian grid electricity produces a high amount of CO_2 emission and EV charging with solar PV energy only is not always available. Due to this EV charging solutions have to be improved in a smart way. Smart charging is adaptive to different events, improves the reliability of electricity supply, maximises the use of renewable energy and avoids CO_2 emission. The usage of a PV system in combination with batteries could be a viable smart charging solution. It could be a good alternative for a company like CSIRO, which operates a petrol passenger vehicle fleet. CSIRO in Melbourne offers good prospects to replace a petrol passenger car by an EV and to install smart charging infrastructure.



As main objective, efficiency and advantages of electric pool car smart charging with PV and lead-acid battery as well as PV and lithium-ion battery will be explored. Due to this the PV system and batteries need to be dimensioned and total system and environmental costs need to be calculated. With the aid of the Excel simulation tool SUNULATOR, which has been developed by the Alternative Technology Association, the PV system and battery can be dimensioned and the most cost efficient and environmentally friendly combination will be demonstrated. The evaluation of self-consumption can provide information about the best

dimensioning. The cost analysis is done with the help of Excel and consists of total system costs as well as environmental costs expressed in CO_2. With regard to other EV charging solutions and a hybrid scenario, it is possible to give clear indication of smart charging efficiency for electric pool cars in comparison to a petrol car. The aim should be to replace a petrol passenger car of CSIROs vehicle fleet with an EV.

Smart charging scenarios Over 20 years	Smart Charging with PV and lead-acid battery	Smart Charging with PV and lithium-ion battery
Total costs avoided	3,288 AUD	4,181 AUD
CO2 emission avoided	22.27 t CO_2	22.27 t CO_2

In a long term of 20 years the most cost effective smart charging solutions are a 3 kWp PV system and 2 kWh lead-acid battery as well as a 2.5 kWp PV system and 1.5 kWh lithium-ion battery combination. In comparison to a petrol car, smart charging avoids a high amount of CO_2 emission. After an amortisation of 13 years, it is also possible to save total system costs.

With regard to the total system costs per ton CO_2 emission, the scenario charging with PV only avoids the highest amount of total system costs per ton CO_2 emission, followed by smart charging scenarios. The most cost efficient charging solution is charging with grid electricity. For sustainability smart charging with PV and battery would be the best solution. Furthermore the usage of a hybrid car could be also a good alternative to a petrol car and an EV. In comparison to a petrol car, total system costs and CO_2 emission can be constantly avoided. Therefore it is an advantage to replace a petrol car of the CSIRO car fleet with a hybrid car or, preferably, with an EV. For the usage of an EV the best (smart-) charging solution depends on the indicator with the highest priority.

Summarized smart charging with PV and battery presents an EV charging solution which combines the advantages of charging with PV only as well as with grid electricity and exploits existing Australian renewable energy potentials. It is focused on the future, environmental sustainability as well as availability.