# V2G-Strategies: Electric Vehicles and System Analysis of different Charging Strategies

**Rusbeh Rezania (TU Wien), Daniel Burnier De Castro (AIT), Markus Litzlbauer (TU Wien), Wolfgang Prüggler (TU Wien)**

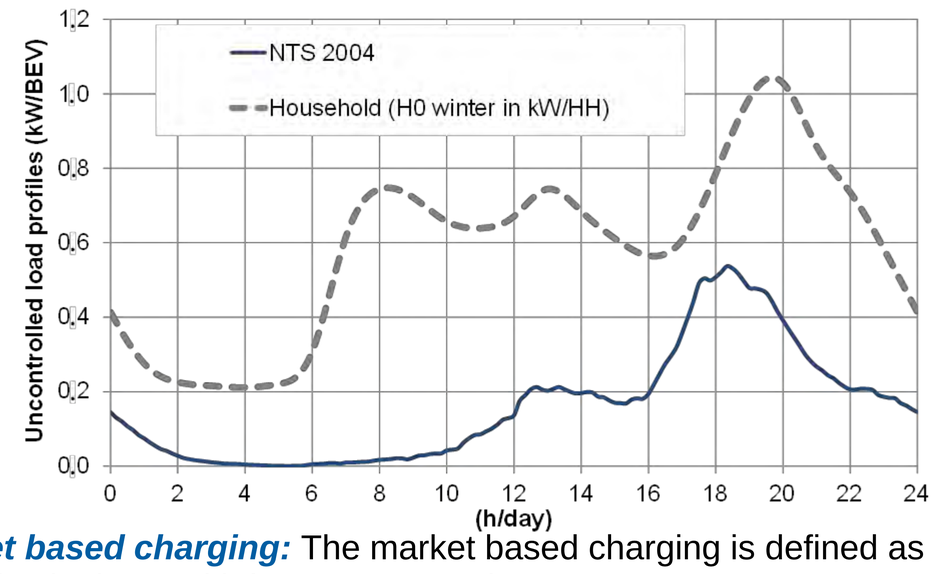
## Main goals of the project

- Influence of different charging strategies on selected low voltage grids
- Analysis of various business models: participation in control energy market and the reuse of batteries after their automotive retirement

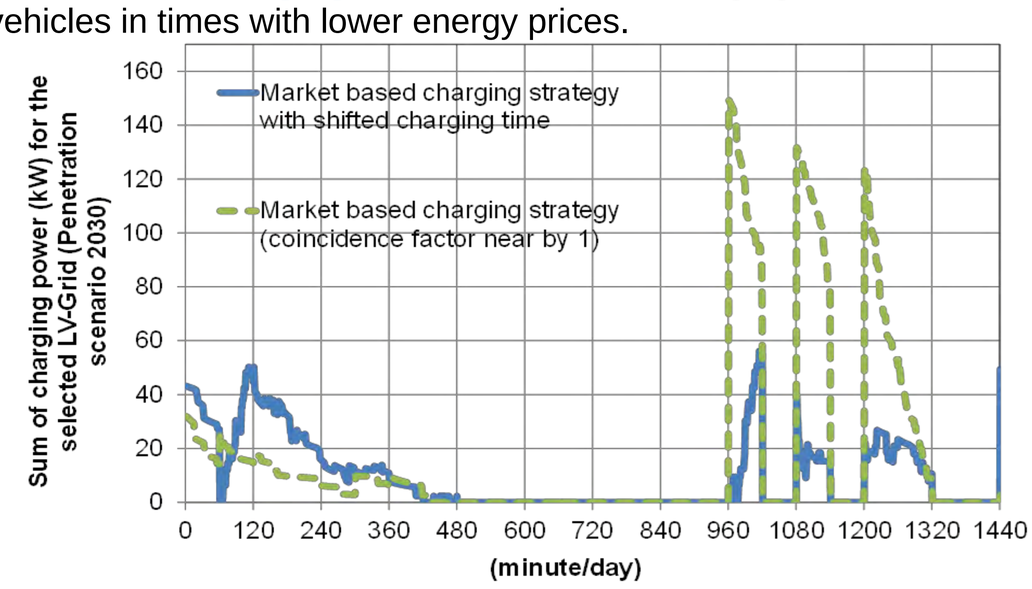
## Charging strategies

The aim of this part is to create charging strategies for Battery electric vehicles (BEV) and Plug-In hybrid electric vehicles (PHEV) which are integrated in selected low voltage grids (LV- Grids).

***A) Uncontrolled charging:*** The uncontrolled charging means, that the charging of the vehicle battery starts immediately after reaching a defined location (home) equipped with a charging infrastructure.




***B) Market based charging:*** The market based charging is defined as charging the vehicles in times with lower energy prices.

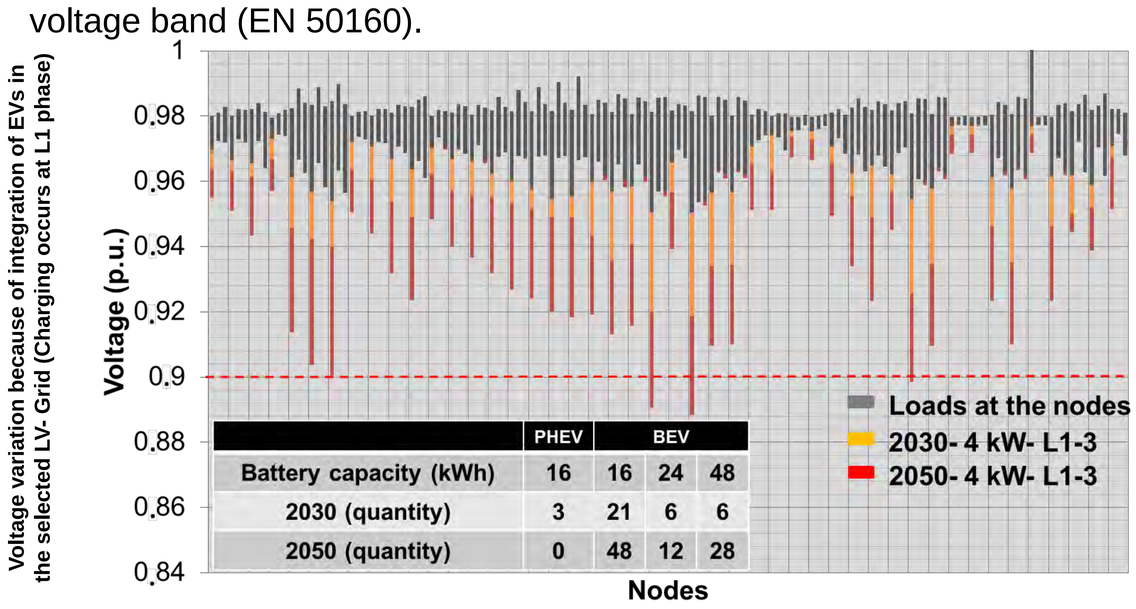



**Source:** Litzlbauer, M.: Grid integration of electric vehicles considering the mobility needs, paper for EVS26, Los Angeles, May 2012; Rezania, R.: Integration von Elektrofahrzeugen in das österreichische Energiesystem unter Analyse der Auswirkungen auf ausgewählte Mittel- und Niederspannungsnetze; Paper, 2. PHD-Workshop "Energieinformatik", Karlsruhe; Oktober 2011

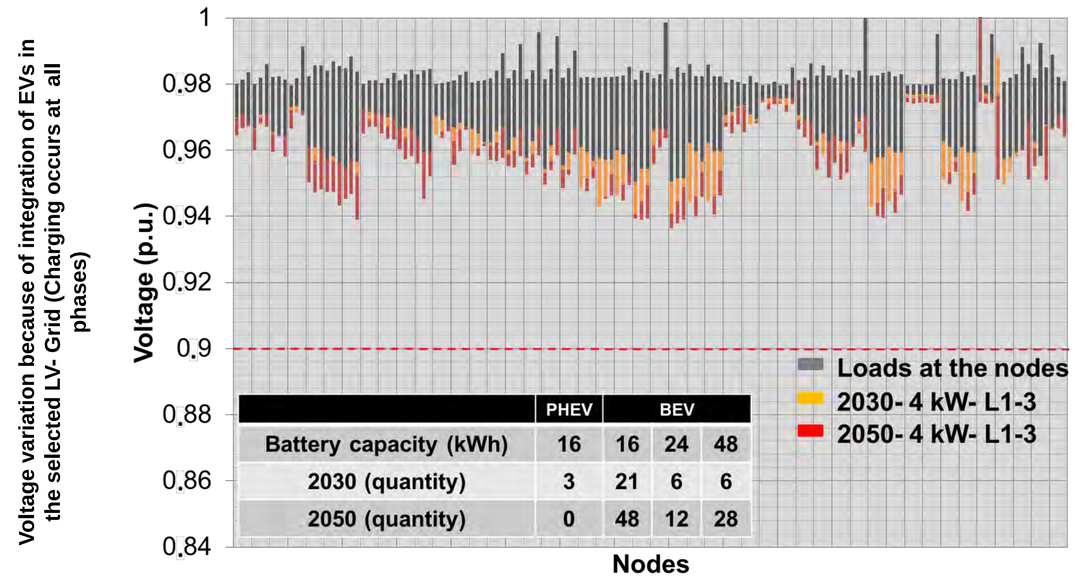
## The impact of charging strategies on the selected low voltage grids

The focus of this part is on the analysis of the impact of different penetration levels of BEVs with associated charging strategies in a selected LV-Grid in rural area.

- The single-phase charging whilst all the vehicles are connected to the same phase within a LV-Grid causes most voltage problems and consumes a wide voltage band (EN 50160).




- On the other hand, the even distribution of BEVs between all phases has been recommended in this case. In addition enough voltage band will be available for integration of other loads into the LV-Grids.



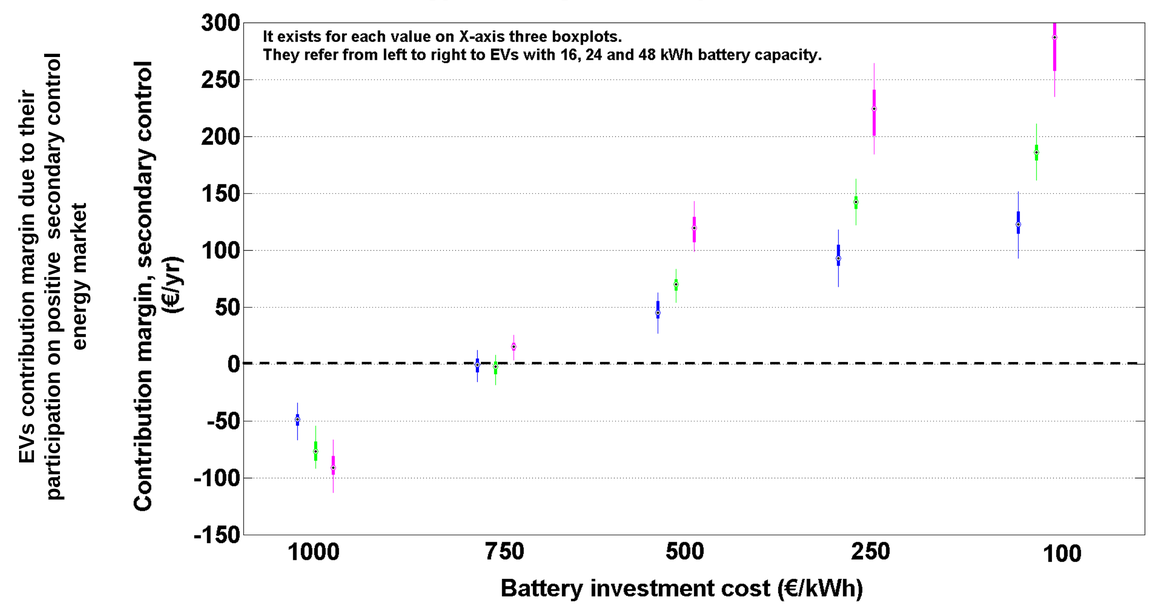

- The market based charging strategy results in an increased number of violation of normed conditions.
- A shifting of the beginning of each BEV's charging time is recommended in both strategies to decrease the associated coincidence factor and total maximum charging power of all vehicles.

**Source:** Burnier De Castro, D., Rezania,, R., Litzlbauer, M.: Auswirkung verschiedener Elektromobilitätsszenarien auf die Spannungsqualität von Niederspannungsnetzen unter Betrachtung der Phasenunsymmetrie, Paper, 12. Symposium EnInnovation, Graz, February 2012.

## Economic analysis V2G and second life usage concepts

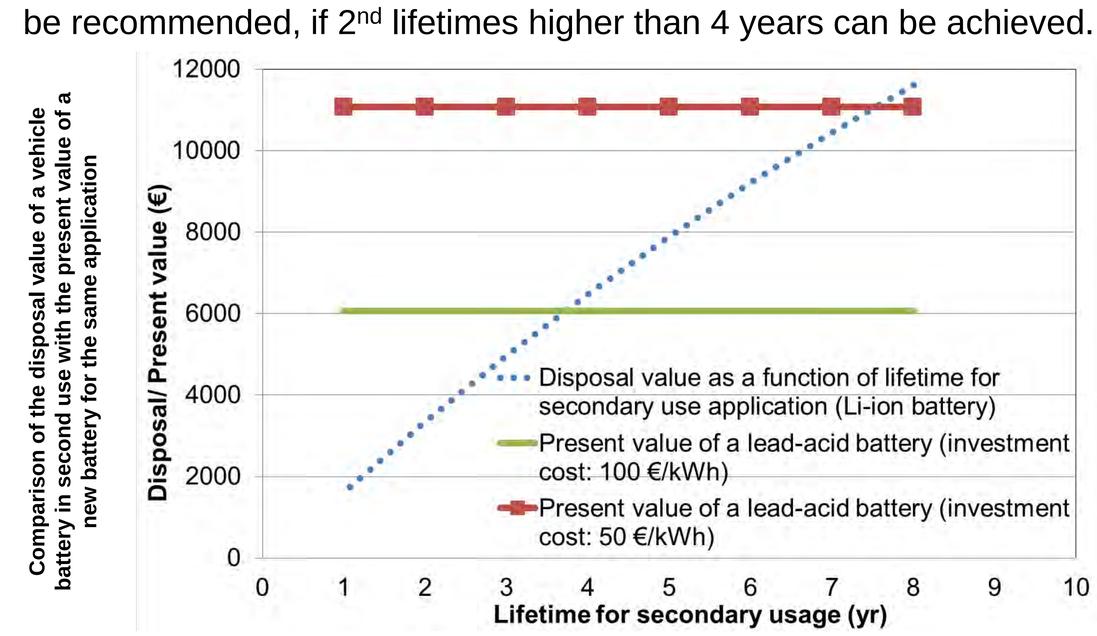
***A) EVs participation in positive secondary control energy market in the APG- control area***

- Positive margins can be achieved at battery investment cost lower or equal to 500 €/kWh due to lower battery degradation costs.
- Positive margins must be able to cover the costs for communication system, V2G-Inverter and the energy management system.




***B) Second life usage:*** The application realizes a combined storage contribution to the energy exchange and secondary control energy market.

- A reuse of EV batteries after their automotive lifetime for this application can be recommended, if 2nd lifetimes higher than 4 years can be achieved.




**Source:** Rezania, R., Prüggler, W.: Business models for the integration of electric vehicles into the Austrian energy system, 9th international conference on European Energy Market, Florence, Italy, May 2012

## Outlook

- Economical and technical analysis of PV based charging strategies due to high penetration of EVs in typical rural LV-Grids

powered by klima+ energie fonds The work is supported by the "Austrian Climate and Energy fund" and is part of the programme "NEUE ENERGIEN 2020".

SMARTGRIDS Modellregion Salzburg | TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology | Salzburg Netz | AIT AUSTRIAN INSTITUTE OF TECHNOLOGY