The impact of second life applications of electric vehicle batteries on customer's mobility cost

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Abstract

Due to competitiveness reasons basic economics suggest that cost of electric mobility (e-mobility) have to be in the range of conventional cars. This paper analyses to which extent benefits of second life applications of electric vehicle (EV) batteries could influence future cost of e-mobility for customers. The paper focuses on the EV brands “Nissan Leaf”, “Mitsubishi i-MiEV” and “CODA Sedan” taking into account calculated Buy Out Prices achieved by “Residential Load Following” and “Electric Energy Time-shift” battery second life applications. It turns out that there exist e-mobility cost reduction possibilities leading to lower cost gaps of EVs compared to conventional cars, if technological feasibility of implemented battery second life applications is given. Furthermore, results show that it has to be considered that achievable battery Buy Out Prices could partly reduce the necessity of additional incentive mechanisms such as Federal Tax Credits. On the contrary, the case study of the CODA Sedan shows that e-mobility cost only can be equal to cost of comparable conventional cars if yearly driven distances are beyond 50,000 km (which might be quite rarely the case for EVs) and both support mechanisms – a granted Tax Credit and in addition a Buy Out Price - are applied.

Keywords

Electric vehicle batteries, second life applications, benefits and cost, battery buy out rates, customer mobility cost impacts, e-mobility policy impacts

1 Introduction

The worldwide increase of energy consumption by the transport sector due to the steady rise of vehicle numbers and their capacities will further lead to increasing CO_2 emissions (compare [1]). If climate goals are considered (see e.g. [2], [3] and [4]), an efficiency increase in the transport sector becomes essential being the main intention of a broad market integration of electric vehicles (EVs). Nevertheless, EVs may hardly achieve a high market penetration, if mobility cost cannot compete with conventional vehicles using e.g. gasoline or diesel technologies. Therefore, policy makers provide incentive programmes for customers (e.g. tax credits as described in [5]) trying to reduce initial barriers and additional cost of electric mobility (e-mobility).

This paper analyses possible cost and benefits of second life applications for EV batteries and resulting cost reduction impacts for e-mobility. Several studies and reports (compare e.g. [6], [7]) in this context conclude that certain battery applications (e.g. Residential Load Following in [8]) are economically and technically feasible as cost (e.g. for battery testing and packaging) can be lower than expected system benefits (e.g. due to postponed investments in distribution and transmission grids). Thus, if all benefits of battery second life applications are higher than overall battery system cost a corresponding positive Buy Out Price (B_{OP}) for used EV batteries could be granted for vehicle owners reducing their EV purchase prices (Net present values) besides granted Tax Credits.

On that account, section 2 of this paper describes the data used for calculation of benefits of battery second life applications, battery assembling cost as well as cost for e-mobility, which is then followed by section 3 addressing the chosen calculation methodology. In section 4 results of case study related battery Buy Out Price calculations are derived showing their impact on e-mobility cost in section 5. Finally, chapter 6 concludes this paper.

2 Data used

2.1 *Second life applications*

2.1.1 Electric Energy Time-shift

This second life application of EV batteries identifies possible benefits of buying electricity during off-peak time periods (low electricity prices) in order to sell it in peak periods (high electricity prices). As shown in Table 1 data and corresponding literature sources (see [8], [10], [11]) were collected for calculation of achievable annual benefits according to equation (1) in section 3.1.1. Furthermore, the presented battery capacity is to be interpreted as usable capacity for the analysed second life application.

Table 1 Overview of collected data for the battery second life application "Electric Energy Time-shift"

Data type	Variable name	Data description	Source
Electricity price	p	Electricity price data are used on an hourly basis (for a whole year) according to 2009 data of the Energy Exchange Austria market platform	[10]
Charging / discharging time	h	Charging times were set from 2am to 6am whereas discharging times were set between 12pm and 13pm as well as between 19pm and 20pm	assumption
Charging / discharging energy	q	Charging energy per hour is set at 1.5 kWh for the hours 2am, 3am, 4am followed by 1 kWh for 5am and 0.5 kWh for 6am; Discharging energy is equal to 1.35 kWh for all discharging hours (efficiency rate = 90%)	assumption
Available battery nominal power	$NP_{Bat,ts}$	11 kW	[8]
Useable battery capacity	BC_{ts}	6 kWh	[8]
Necessary battery modules		At a rated nominal power of 2.4 kW/module as well as 1.2 kWh/module of storable electricity the necessary number of modules calculates to 5	[8]
Exchange rate €/$	-	Calculated average exchange rate of 1.36 for 2009	[11]
Storage efficiency	η	90%	assumption

2.1.2 Residential Load Following

Residential Load Following intents to maximise the use of residentially generated electricity causing reduced imports from the grid as well as decreased grid losses. This concept can only be adopted, if storage is possible on site, i.e. residential generators can seize those benefits by buying second life EV batteries. In the chosen case study a normalised yearly residential consumption profile (at European conditions see [12]) in combination with a yearly photovoltaic generation system (PV) profile (according to Austrian conditions as in [13]) was used to calculate possible annual benefits of a residential storage unit as exemplarily illustrated in Figure 1 and Figure 2. Furthermore, it is assumed that the AC/DC converter of the PV system is able to integrate the battery system as well.

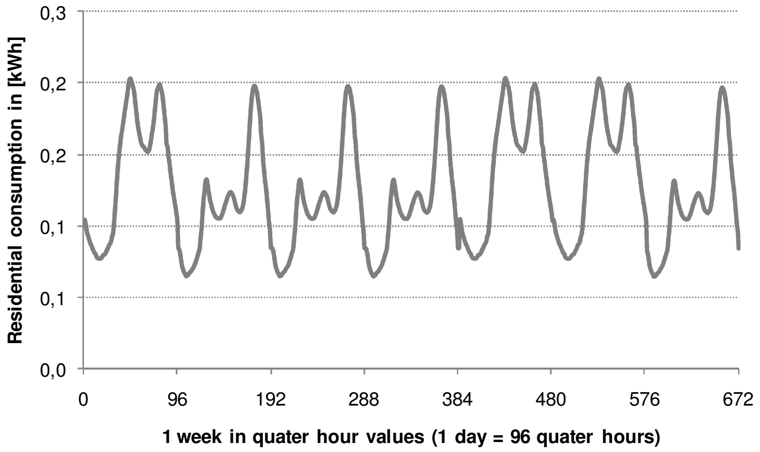

Figure 1 Overview of residential consumption profile for the first week in January (source [12])

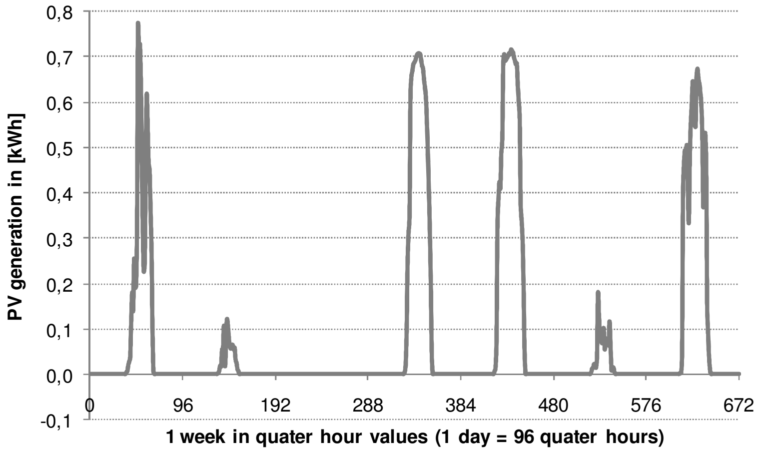

Figure 2 Overview of the implemented PV generation profile for the first week in January (source [13])

The electricity storage system will get charged if PV generation is higher than residential consumption until the battery storage capacity is reached. Discharging events will occur if generation is lower than residential demand until the battery is depleted. Furthermore an incentive mechanism (higher Feed in Tariff for residentially generated and consumed PV electricity as in [14]) as recently introduced in Germany as well as benefits regarding reduced grid losses (due to distributed generation and use of electricity as in [15]) will be taken into account besides other parameters as shown in Table 2. Section 3.1.2 describes how these parameters will be used to derive monetary benefits of this residential load following approach.

Table 2 Overview of collected data for the battery second life application "Residential Load Following"

Data type	Variable name	Data description	Source
Discharged electricity	q	The total amount of electricity discharged is calculated the following way: The battery is charged if demand is lower than generation and a discharged if demand is higher than generation; adequate load and generation profiles are used implementing quarter hourly data	[12], [13]
Value of discharged electricity	h	The value of discharged electricity is calculated by an average retail electricity price of 0.2 €/kWh and an extra 0.08 €/kWh is added representing the Feed In Tariff incentive for residentially generated PV electricity	[14]
Value of yearly grid loss reduction	q	Project results derive average benefits of 20 €/kW*yr for Distributed Generation enabling grid loss reduction	[15]
Available battery nominal power	$NP_{Bat,ts}$	11 kW	[8]
Useable battery capacity	BC_{ts}	6 kWh	[8]
Necessary battery modules		At a rated nominal power of 2.4 kW/module as well as 1.2 kWh/module of useable electricity the necessary number of modules calculates to 5	[8]
Exchange rate €/$	-	Calculated average exchange rate of 1.334 for 2010	[11]
Storage efficiency	η	90%	assumption

2.2 Battery assembling cost

Regarding battery assembling cost for testing, packaging, transportation and installation of used EV batteries outcomes of the report "Technical and Economic Feasibility of Applying Used EV Batteries in Stationary Applications" (see [8]) were collected transforming them to 2010 cost values (conversion factor of 1.22 (from 2001 values to 2010 values) as derived from [23]). Data as described in Table 4 where then used to calculate battery Buy Out Prices for the analysed battery second life applications (compare section 2.1.1 to 2.1.4) according to equations (5) to (8) of section 3.2. The lifetimes of each battery application were adjusted to expected annual energy throughput taking into account chapter 5.4.2 of [8] (analysing whether the calendar life and cycle life of the batteries becomes applicable) resulting in battery life times of approximately 4 years for Electric Energy Time-shift and Residential Load following. In addition to that, Total Balance of System (BOS) cost as indicated in equation (6) reflects the sum of BOS1 to BOS3 categories in Table 4 (see again [8]). Balance of System cost therefore summarise overall cost for battery accessories (e.g. cables), necessary facilities where the assembled battery will be placed, transportation and installation cost as well as cost for controlling equipment including communication needs.

Table 4 Overview of collected data for the battery assembling cost of second life applications (source [8])

Data type	Unit	Electric Energy Time-shift	Residential Load Following
Battery life	yr	3.9	3.9
Project duration	yr	20	20
Battery purchases	-	6	6
Interest rate	%	6	6
Battery testing and packaging	$/module	96	96
BOS1: Accessories, facilities, transportation	$/kWh	included	included
BOS2: Interface equipment, controls	$/kW	122	122
BOS3: Installation & startup	$/kWh	included	included
Operation and maintenance	$/kW	124	124

2.3 E-mobility cost data

This paper analyses cost impacts of different battery Buy Out Prices on customer's e-mobility cost for the EV brands "Nissan Leaf", "Mitsubishi I-MiEV" and "Coda Sedan". Therefore, the following EV cost data (see Table 5) were collected together with cost components of conventional gasoline cars (middle and compact class as in Table 6). However, as cost for insurance and maintenance were assumed to be the same for conventional cars and EVs they were not considered in the mobility cost calculation as can be seen in equation (9) of section 3.3.

Table 5 Overview of collected cost data for different electric vehicles

Data type	Variable name	Nissan Leaf (compact class)	Mitsubishi I-MiEV (compact class)	CODA Sedan (middle class)	Sources
Purchase price	EV_{cc}	32,780 $	42,160 $ (price in Japan)	44,900 $	[17], [18], [20]
Federal Tax Credit	TC	7,500 $	7,500 $	7,500 $	[5]
EV resale value	RV-	5,000 $	5,000 $	7,000 $	assumption
Interest rate	r	6%	6%	6%	assumption
EV battery capacity	EV_{Cap}	24 kWh	16 kWh	33.8 kWh	[17], [19], [21]
Vehicle range per charge	-	160 km	130 km	160 km	[17], [19], [21]
Year of car return	V_c	6	6	6	assumption
Fuel cost of EV	RC_{EV}	0.015 $/km	0.012 $/km	0.021 $/km	Calculated at an electricity price of 0.1 $/kWh

Table 6 Overview of collected cost data for different electric vehicles

Data type	Variable name	Gasoline compact class car	Gasoline middle class car	Source
Purchase price	EV_{cc}	14,800	25,000	[22]
EV resale value	RV-	5,000 $	7,000 $	assumption
Interest rate	r	6%	6%	assumption
Fuel consumption per 100 km	-	6 litre	7.5 litre	[22]
Year of car return	V_c	6	6	assumption
Fuel cost of EV	RC_{EV}	0.044 $/km	0.055 $/km	Calculated at an average fuel price of 0.73 $/litre

3 Methodology

As mentioned in the introduction cost and benefits of second life applications of EV batteries and possible cost reduction impacts for e-mobility at customer level are analysed in this paper. Therefore, Figure 3 provides an overview of performed calculation steps. Starting from both, calculation of battery second life application benefits and battery assembling cost, possible battery Buy Out Prices will be derived which then are taken into account in e-mobility cost calculations. The following sections provide a general description of performed calculations per application case based on the data of section 2.

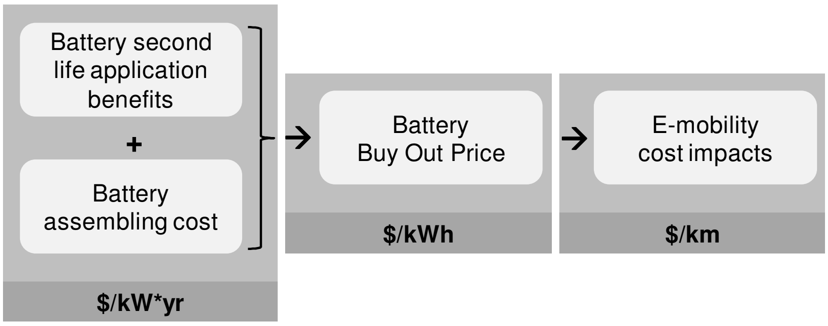

Figure 3 Overview of chosen steps to derive E-mobility cost impacts of battery second life applications

3.1 Battery second life application benefits

3.1.1 Electric Energy Time-shift

For an Electric Energy Time-shift battery application case the yearly benefits B_{Ts} calculate to

$$B_{Ts} = -\frac{C_{ch} - R_D}{NP_{Bat,Ts}} = -\frac{\sum_{d=1}^{365}\sum_{h=2}^{6} p_{d,h} * q_{d,h} - \eta * \left(\sum_{d=1}^{365}\sum_{h=12}^{13} p_{d,h} * q_{d,h} + \sum_{d=1}^{365}\sum_{h=19}^{20} p_{d,h} * q_{d,h}\right)}{NP_{Bat,Ts}} \quad (1)$$

with

B_{Ts} Yearly benefits of Electric Energy Time-Shift [$/kW*yr]

C_{Ch} Yearly charging cost [$/yr]

R_D Yearly discharging revenues [$/yr]

$NP_{Bat,Ts}$ Nominal power of battery storage for Time-shift application [kW]

p electricity price [€/kWh]

q quantity of sold or purchased electricity [kWh]

d day of the year [1/yr]

η storage efficiency [%]

h hour of the day [1/d].

3.1.2 Residential Load Following

Yearly benefits of Residential Load Following applications including payments from the grid operator for reduced grid losses (L_r) are calculated by

$$B_{RLF} = \frac{R_{rg}}{NP_{Bat,LF}} + L_r = \frac{\eta * \sum_{i=1}^{n} q_i * IT}{NP_{Bat,LF}} + L_r \qquad (2)$$

with

B_{RLF} Yearly benefits of Residential Load Following [$/kW*yr]

R_{rg} Revenues for residentially generated and used electricity [$/yr]

L_r Grid loss reduction due to local energy storage [$/kW*yr]

q Quantity of stored and later used electricity [kWh]

IT Incentive tariff for own electricity use [$/kWh]

i Number of discharging event [1]

$NP_{Bat,LF}$ Nominal power of battery storage for load following application [kW].

As described in [14] there is a higher Feed In Tariff for residentially generated PV electricity, which is taken into account in equation (3) in the following way

$$IT = RP + (FT_R - FT_G) \qquad (3)$$

whereas

RP Retail electricity price [$/kWh]

FT_R Feed in Tariff for electricity directly used at customer site [$/kWh]

FT_G Feed in Tariff for electricity fed to the grid [$/kWh]

3.2 Battery assembling cost and Buy Out Price

Used EV batteries will last for certain periods (e.g. 4 years) of time depending on their frequency of use and annual energy throughput. Thus battery repurchases become necessary (e.g. 2 times). This is why, battery purchases in the future have to be referred to current values of money taking into account case study related project lifetimes (e.g. 10 years). For a given number of modules m, a dedicated project lifetime of P_{lt} and a specific battery pack lifetime (depending on yearly usage) the following Net Present Value of the battery storage system can be calculated (including reinvestments for depleted battery packs) by

$$NPV_{Bat} = \left(C_{t\&p} + C_{pack}\right) * \left(\frac{1}{(1+r)^0} + \frac{1}{(1+r)^a} + \frac{1}{(1+r)^b} + \dots + \frac{1}{(1+r)^z}\right) = \left(C_{t\&p} + C_{pack}\right) * Rf_{Bat} \quad (5)$$

with

NPV_{Bat} Net Present Value of Battery [$]

$C_{t\&p}$ Total cost of battery testing and packaging [$]

C_{pack} Total cost of necessary battery packs (used to calculate battery Buy Out Price – see equation (8)) [$]

a,b, ... z Year of battery replacement [1]

r Interest rate [%]

Rf_{Bat} Repurchase factor for battery system [1].

In order to calculate overall battery system cost (B_{SC}) the following equation has to be considered

$$B_{SC} = \frac{(NPV_{Bat} + BOS_{Bat}) * \alpha + C_{O\&M,Bat}}{NP_{Bat}} = \frac{\left(\left(C_{t\&p} + C_{pack}\right) * Rf_{Bat} + BOS_{Bat}\right) * \alpha_{BS} + C_{O\&M,Bat}}{NP_{Bat}} \quad (6)$$

with

B_{SC} Overall battery system cost [$/kW*yr]

BOS_{Bat} Balance of System cost for battery storage system [$]

α_{BS} Annuity factor for battery system [1/yr]

$C_{O\&M,Bat}$ Overall battery system Operation and Maintenance cost [$/yr]

NP_{Bat} Nominal power of battery storage system [kW]

Out of equation (6) and a given overall battery system cost, which in the case of this paper are represented by the overall benefits of battery second life applications (B_{Ts}, B_{RLF} compare section 2), the cost for the battery pack (solely the used battery modules out of EVs) are given by

$$C_{pack} = \frac{(B_{SC} * NP_{Bat} - C_{O\&M,Bat}) - \alpha_{BS} * BOS_{Bat}}{\alpha * Rf_{Bat}} - C_{t\&p} \quad (7)$$

As a consequence, the Buy Out Price referred to the battery system capacity (in kWh) is then represented by

$$B_{OP} = \frac{C_{pack}}{S_{Cap}} \quad (8)$$

with

B_{OP} Buy Out Price for electric vehicles batteries [$/kWh]

S_{Cap} Total battery storage capacity [kWh]

Those achievable Buy Out Prices per application case are then considered in the following section as an additional cost reducing parameter for e-mobility of different EV types (compare section 2.3).

3.3 E-mobility cost impacts

Customer's EV related mobility cost taking into account case specific Buy Out Prices are given by

$$MC = \frac{\alpha_{EV} * \left(EV_{cc} - TC - \frac{RV}{(1+r)^{Vc}} - \frac{(EV_{Cap} * B_{OP})}{(1+r)^{Vc}} \right)}{D_d} + RC_{EV} \tag{9}$$

whereas

MC Cost of electric mobility for customers [$/km]

α_{EV} Annuity factor for electric vehicle [1/yr]

EV_{cc} Electric vehicle purchase price [$]

TC Total tax credit for EV [$]

RV Rest value of vehicle when returned to dealer after V_c years [$]

r Interest rate [%]

V_c Year in which car is returned to car dealer and batteries first circle ends

EV_{Cap} Electricity storage capacity of EV battery [kWh]

RC_{EV} Running cost for fuel of electric vehicle [$/km]

D_d Distance driven per year [km/yr]

4 Battery Buy Out Price results

4.1 Electric Energy Time-shift

Taking into account data of section 2.1.1 as well as the calculation methodology in section 3 the cumulated cost for electricity purchases within the Electric Energy Time-shift battery application calculate to 63 $/yr. Correspondingly, yearly revenues for electricity sales are 136 $/yr based on the chosen data of 2009 (compare Figure 4). Thus, overall benefits (B_{Ts}) of solely 5.4 $/kW*yr are derived according to equation (1).

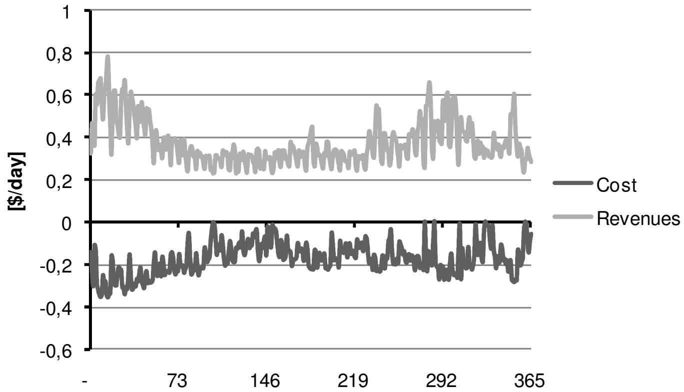

Figure 4 Overview of daily cost and revenue calculation results for the Electric Energy Time-shift application

On the contrary, as the yearly cost for battery assembling are ~50$/kW (adopted values of [8]) and hence, much higher than calculated benefits, no positive Buy Out Price can be achieved. Therefore, no e-mobility cost impacts can be derived within section 5 for this battery second life application.

4.2 Residential Load Following

As shown in Figure 5 (on a weekly basis) the Residential Load Following application in general reduces grid imports due to storage of residentially generated electricity. Within the chosen case the nominal power of a photovoltaic generation unit accounts to 4 kW leading to a yearly generation of 4.8 MWh which is slightly higher than an implemented yearly residential consumption of approximately 3.6 MWh. The chosen storage application reduces grid imports by about 1.331 kWh/yr, which qualifies the customer for an increased Feed In Tariff as described in section 2.1.2. Thus, overall benefits of the Residential load following (B_{Rlf}) application (compare equation (2)) calculate to 76.4 $/kW*yr.

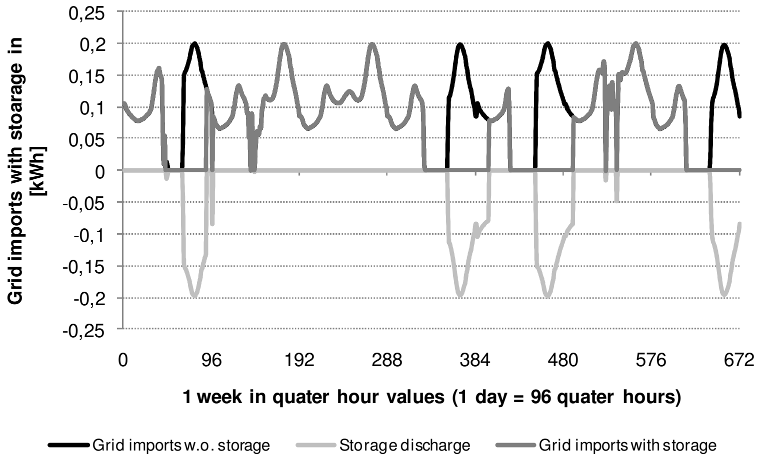

Figure 5 Grid imports and storage discharging profile for the Residential Load Following application in one week

Accordingly, a battery Buy Out Price (B_{OP}) of approximately 180 $/kWh can be derived for the Residential Load Following application according to equations (7) and (8). Section 5 will then address the achievable mobility cost impacts.

5 Impacts on customer's mobility cost

5.1 Nissan Leaf

After calculating achievable battery second life application benefits in section 4 corresponding battery Buy Out Prices are influencing e-mobility cost developments of the Nissan Leaf according to Figure 6. By comparing those cost to cost of a conventional middle class car depending on yearly driven kilometres it can be seen that e-mobility cost after Tax Credits (no Buy Out prices) are significantly higher.

If the battery Buy Out Price of the Residential Load Following is considered it can be seen that the cost difference decreases but still is higher for the EV even if Tax Credits are considered. This gap reduced the higher the yearly driven distance is as e.g. the $/km gap reduces to about 5 c$/km if 20.000 km/yr are applicable.

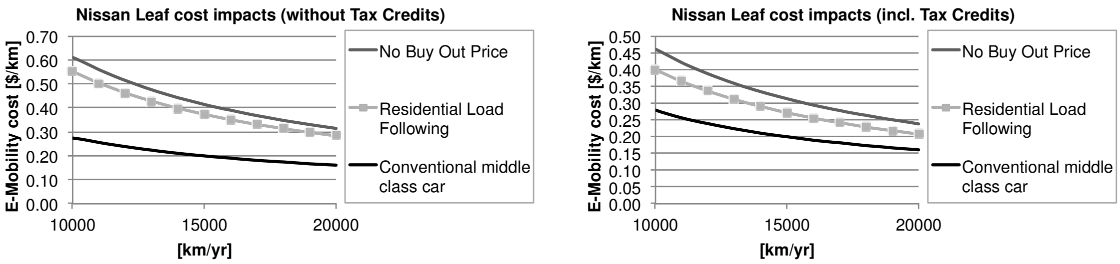

Figure 6 Overview of mobility cost of the Nissan Leaf compared to a conventional middle class vehicle; the impacts of battery Buy Out Prices are illustrated including a Federal Tax Credit (left) and without Federal Tax Credit (right)

5.2 Mitsubishi i-MiEV

For the Mitsubishi i-MiEV two cost settings were analysed in order to derive mobility cost impacts. On the one hand EV purchase cost of 42 k$ were considered according to [18] followed by significantly lower cost of 30 k$ (expected at US market introduction price according to [18]) on the other hand. Consequently, Figure 7 and Figure 8 illustrate EV cost impacts compared to a conventional car.

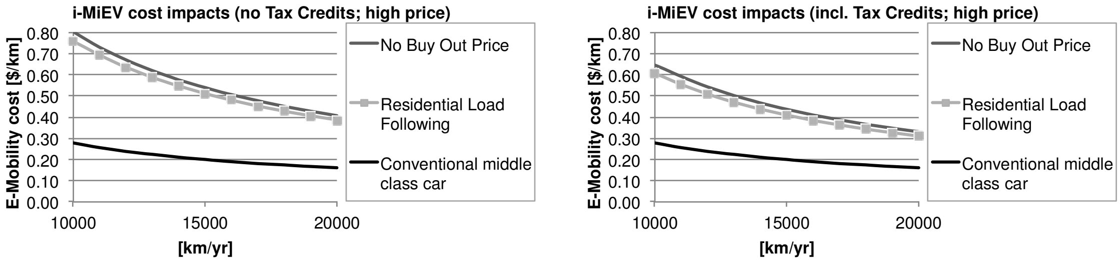

Figure 7 Overview of mobility cost of the i-MiEV (purchase price = 42 k$) compared to a conventional vehicle; the impacts of battery Buy Out Prices are illustrated including a Federal Tax Credit (left) and without Federal Tax Credit (right)

If the purchase price is modelled at 42 k$ conventional middle class cars are by far cheaper than the i-MiEV regardless of the achievable battery Buy Out Price. Battery second life applications in this context can have positive impacts on e-mobility cost but could currently not achieve economically feasible cost of EVs compared to conventional car solutions.

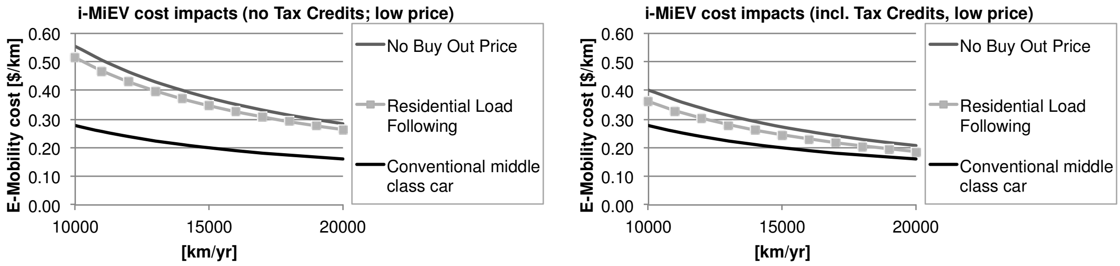

Figure 8 Overview of mobility cost of the i-MiEV (purchase price = 30 k$) compared to a conventional middle class vehicle; the impacts of battery Buy Out Prices are illustrated including a Federal Tax Credit (left) and without Federal Tax Credit (right)

The situation improves significantly, if a purchase price of 30 k$ for the i-MiEV is considered. In this case mobility cost are comparable to a conventional middle class car, if benefits of the Residential Load Following can be achieved at 20.000 km/yr and grated Tax Credits. On contrary, cost for EVs are still higher compared to conventional solutions, if Tax Credits are not included in the calculations.

5.3 Coda Sedan

As a third vehicle the CODA Sedan was analysed as can be seen in Figure 9. If Tax Credits are granted, mobility cost for a conventional compact class car are close to the CODA cost at Buy Out Prices achieved within the Residential Load Following application cases as well as granted Tax Credits. They become equal at about 50.000 km of yearly usage as can be seen in Figure 10.

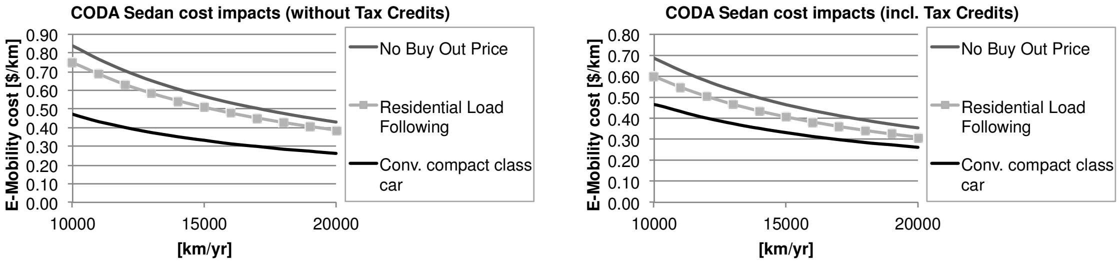

Figure 9 Overview of mobility cost of the CODA Sedan compared to a conventional compact class vehicle; the impacts of battery Buy Out Prices are illustrated including a Federal Tax Credit (left) and without Federal Tax Credit (right)

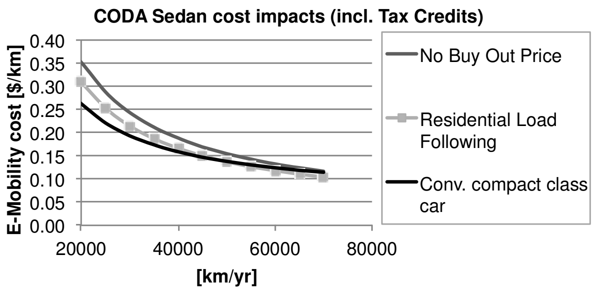

Figure 10 Overview of mobility cost of the CODA Sedan compared to a conventional compact class vehicle at high yearly driven distances

6 Conclusion

The paper departed from the research question: To which extent can benefits of EV batteries second life applications influence the cost of e-mobility for customers?

Collected data for testing, packaging and installing used EV batteries are combined with achievable case study related benefits of second life applications such as Residential Load Following or DC Fast Charging in order to calculate application-specific battery Buy Out Prices. Those Buy Out Prices were then analysed regarding their impact on e-mobility cost per yearly driven kilometre for the EV types “Nissan Leaf”, “Mitsubishi i-MiEV” and “CODA Sedan”. Furthermore, mobility costs are compared to conventional compact and middle class car mobility cost to evaluate whether chosen EV and battery application solutions are economically feasible.

Results show, that a battery second life application towards Electric Energy Time-shifting is not feasible from an economic point of view as yearly benefits are lower than expected battery assembling cost and hence, no positive Buy Out Price can be achieved. On the other hand, promising applications such as Residential Load Following (storage of residentially generated renewable electricity for later used) may derive overall benefits of 76.4 $ per kilowatt storage capacity and year. Corresponding battery Buy Out Prices calculate then to approximately 180 $/kWh. However, it still needs to be tested by demonstration projects, how performance and technology problems (e.g. battery degradation, achievable charging cycles) can be overcome for second life EV battery applications. Nevertheless, those values were chosen in this paper to analyse the extent of achievable e-mobility cost impact on customer level addressing the possibility of reduced incentives such as Tax Credits.

Consequently calculations show that mobility cost of the Nissan Leaf, Mitsubishi i-MiEV and CODA Sedan vehicles can be reduced significantly by allocating battery Buy Out Prices of Residential Load Following to EV customers. In general, mobility cost of EVs are still higher than cost for comparable conventional gasoline cars due to currently high initial purchase prices, even if granted Tax Credits are considered. This situation changes, the higher the yearly driven kilometres are.

To summarise, it is clear that this paper is just limited to provide snapshots of performed case studies towards possible battery second life applications, their benefits and calculated impacts for chosen EV types. However, lessons learnt highlight e-mobility cost reduction possibilities at battery Buy Out Prices of 180 $/kWh leading to improved competitiveness of EVs compared to conventional cars. In addition, it has to be considered that at very high yearly usage rates the necessity of additional incentive mechanisms such as Federal Tax Credits could be reduced. On the contrary, the case study of the CODA Sedan shows that e-mobility cost only can be equal to a comparable conventional car if yearly driven distances are beyond 50,000 km (which might be quite rarely the case for a EV) and both support mechanisms – a granted Tax Credit and in addition a Buy Out Price - are applied.

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