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EV/PHEV – CHANGING REVENUE & PROFIT POOLS IN THE AUTOMOTIVE VALUE CHAIN REQUIRE NEW BUSINESS MODELS

Dr. Wolfgang Bernhart [1], Junyi Zhang [2], and Juri Wagenleitner [1]

[1] *Roland Berger Strategy Consultants GmbH, 80807 Munich, Germany, Wolfgang_Bernhart@de.rolandberger.com*
[2] *Roland Berger (Shanghai) Ltd., Shanghai 200040, P.R. China, Wolfgang_Bernhart@de.rolandberger.com*

Abstract

OEMs need to take action to cope with the changes brought about by the shift to the electric powertrain. As EVs gain market share, revenue pools along the value chain will change significantly. Higher battery costs, decreased fuel and energy revenues, less aftermarket potential, increased variabilization of costs, more value-added services and additional revenues from recycling are all factors affecting revenue and profit pools. To adapt to these changes, OEMs need to proactively secure their future business. They can capture value in new EV components, make leasing/service their main sales channel, leverage lower variable costs or explore recycling. There is tremendous potential for suppliers of components for the new electrified powertrain. OEMs will assume a large portion of the additional value-added especially at first, but this will decline as specialization rises. The expected growth in EV and PHEV depends heavily on driving down battery costs. Even if these costs are successfully lowered, electric vehicles will still cost significantly more than vehicles with internal combustion engines. However, not enough customers are willing to pay the difference, at least in a traditional purchase. Yet viable alternatives exist if they are marketed correctly. New and existing services can be bundled into attractive mobility-oriented packages for the customer. These packages, plus partnerships with public transit providers, mean that OEMs will be acting increasingly as general mobility providers. All these changes mean that OEMs need new business models for the growing but highly competitive EV market.

Keywords: Electric vehicles, batteries, market potential, mobility services, new business models

1. Revenue and profit pools shift with an increasing share of EVs

Electric vehicles (including plug-in hybrid electric vehicles and range extended battery electric vehicles) are likely to represent a market of 8-10 million units in 2020 and around 800,000 to 1,000,000 vehicles in 2015, assuming a significant drop in battery costs and further increasing fuel prices (fig. 1; see [1] for scenario assumptions).

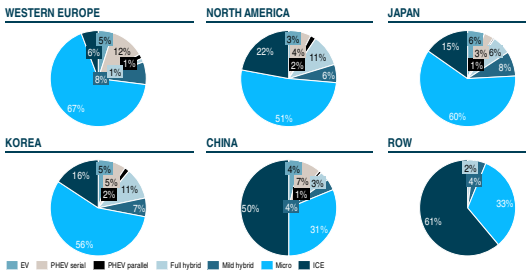
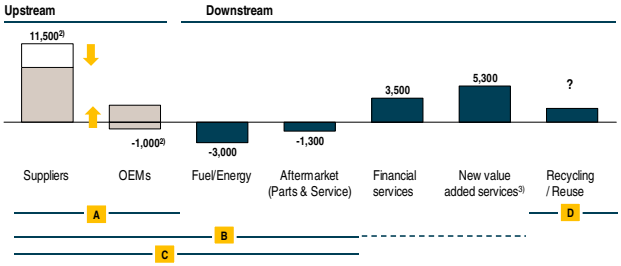


Figure 1: Share of powertrain technologies in major markets in 2020 – High scenario [1]

The shift from the internal combustion engine towards electrified powertrain results in significant changes in revenue pools along the value chain during a vehicle's lifetime.

Compared to an ICE-propelled A-segment vehicle, we expect the following for a battery EV sold in 2015 (fig. 2):

- Approx. EUR 10,500 higher upstream revenues for new car production and sales. Most of these additional revenues will be triggered by higher costs for the battery and in particular battery cells (approx. 65% of the total increase).
- A decrease of approx. EUR 3,000 in fuel and energy revenues in total, due to replacing fossil fuels with less expensive and more efficient electricity.
- A decrease of EUR 1,300 in the aftermarket revenue potential due to the lower maintenance needs of EVs.
- An increase of approx. EUR 3,500 in financial services (e.g. leasing, insurance) as a result of stronger variabilization of vehicle cost and innovative distribution models.
- An overall increase of approx. EUR 5,300 in additional value-added services specifically designed for electric vehicles.
- Additional revenues for recycling, depending on cell chemistries.



1) Assumption: A-class vehicle produced in 2015, lifetime 15 years, 12,500 km p.a., one battery change, all figures at 2015 costs (2nd battery at 2020 cost level)
2) Assumption: all new powertrain components manufactured by suppliers
3) Telematics, fast charging, etc.

Figure 2: Changes in lifecycle revenue pools per vehicle EV vs. ICE [EUR], 2015

These changes in lifecycle revenue pools result in a number of challenges and opportunities for incumbent business models. Specifically, the OEMs need to be proactive in securing the future upstream and downstream business:

A. Significant growth potential in components: OEMs need to capture value shares in new EV components. Various manufacturers therefore plan to engage in battery assembly and in-house production of electric traction machines.
B. OEMs need to switch from vehicle sales to leasing/service as their main sales channel – combining services with energy to avoid a high sticker price and make the potential total cost of ownership (TCO) advantage transparent to the customer.
C. OEMs can also leverage lower variable costs for car sharing/discount rental business models.
D. Recycling (and potentially second-life applications for batteries) creates new business – but recycling could also increase initial battery costs even further.

There will be a significant shift from a profit perspective as well: the share of upstream profit potential will increase as a result of higher vehicle costs, mainly due to the battery. However, the upstream margins of OEMs and suppliers are expected to decrease – we expect that batteries will have below-average profitability due to the high investment needed for R&D, CAPEX and competition.

2. Significant growth potential in electric powertrain components

For suppliers, the electrification of the powertrain represents the biggest growth opportunity in original equipment supply business (fig. 3).

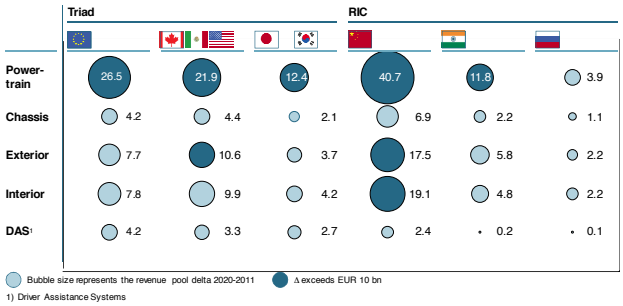


Figure 3: Additional automotive component revenue pools
(Δ 2020-2011) [EUR bn] by domain and region [2]

2.1 Market potential of new powertrain components

While the traditional powertrain components, such as engine blocks and fuel tanks, will come under significant pressure and lose revenue potential, components for hybrid and electric vehicle powertrain will see a large increase in revenue potential (fig 4).

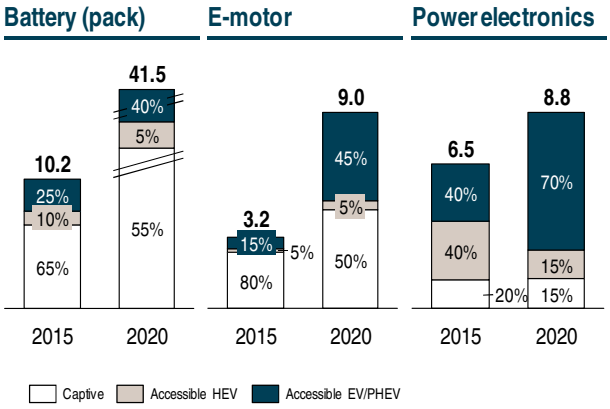


Figure 4: Estimated electric powertrain market potential development [EUR bn] – High scenario

OEMs will assume a significant share of the additional value added, especially in the initial stage, to compensate for their otherwise shrinking share in the overall revenue and profit pools and to develop the technological know-how. Nevertheless, we expect that OEMs' captive shares, particularly in traction machines and power electronics (module assembly), will gradually decrease in the second half of the decade, simply because specialized suppliers will be able to realize better economies of scale and therefore better cost levels than most OEMs.

2.2 Battery costs need to go down – improved materials are key

The expected growth in EV and PHEV relies heavily on the ability of the industry to drive down the battery costs. Current costs for Li-Ion batteries based on a ternary mix are approximately USD 550 per kWh (fig. 5).

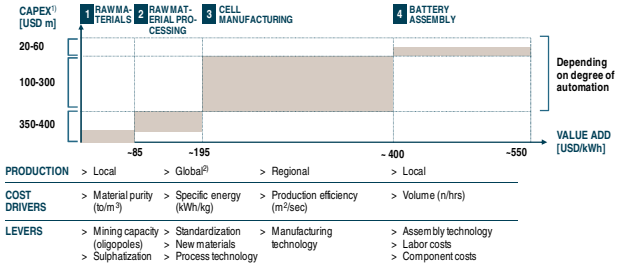


Fig. 5: Value chain EV battery (high – "Ternary mix" $LiNi_xCo_xMn_xO_2$, 2010)

The target for 2015 is to reach a cost level of USD 400 or less per kWh, and a further reduction to under USD 300 per kWh is necessary by 2020 to achieve the projected EV/PHEV penetration rates.

Cost reduction need to occur along the entire value chain. In particular a significant increase in energy density (e.g. above 200 WH/kg for TNC) through improved active materials is necessary for reaching the intended cost targets (fig. 6).

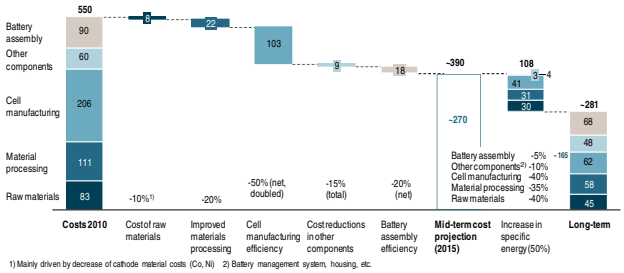


Figure 6: Cost reduction levers in the battery value chain [USD/kWh] and necessary increase of specific energy

3. From "traditional" vehicle sales to improved leasing models and mobility offerings

Even assuming that battery costs will go down to around 300 USD/kWh in 2020, electric vehicles will still see significant cost differences (more than EUR 4,000) compared to vehicles with an internal combustion engine. At the same time, only a few customers will be willing to spend a sufficient premium to cover the additional costs of an electric powertrain. Additional revenue and profit sources are therefore needed to close this gap (fig 7) [3].

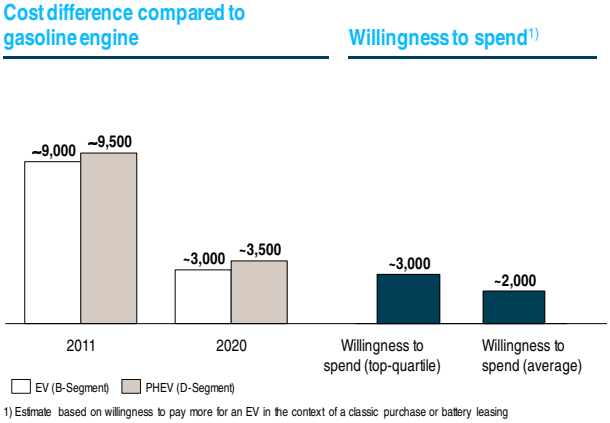


Figure 7: Cost difference vs. gasoline engines and customers' willingness to spend [EUR]

Since the cost difference is even higher for the years after that, despite taking subsidies into account, prices cannot be compared directly to those of ICE vehicles. But our research also shows that while German and French customers, for example, prefer a traditional purchase of the vehicle, alternative models will be accepted by customers if promoted in the right way (fig. 8 [3]):

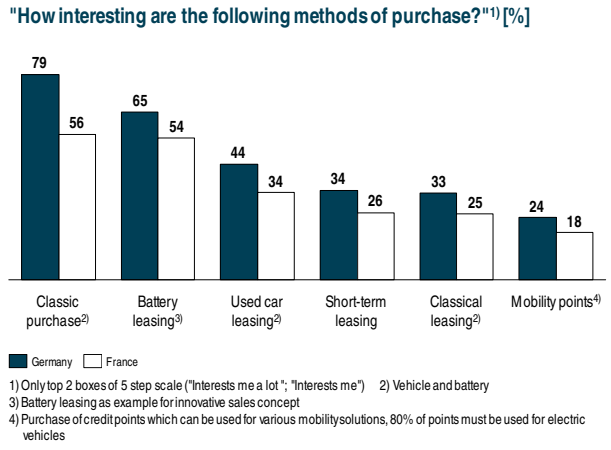


Figure 8: Attractiveness of purchase methods [3]

3.1 Value-added services can provide additional sources of revenue and profit

Several new and already existing services can be bundled to offer attractive packages for the customer (fig. 9).

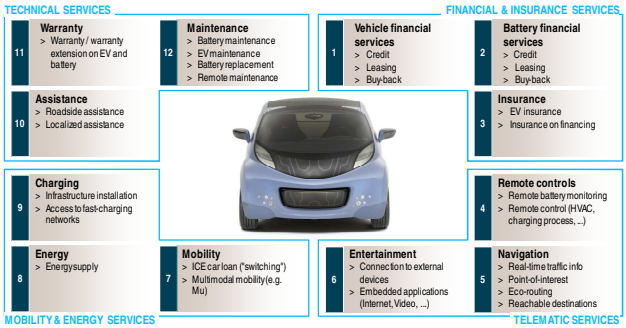


Figure 9: Services as part of a mobility-oriented offering

Bundling these services ultimately leads to OEMs acting as mobility providers. Customers also mostly associate urban mobility with EVs. Partnerships with public transit providers are particularly attractive for consumers (fig. 10).

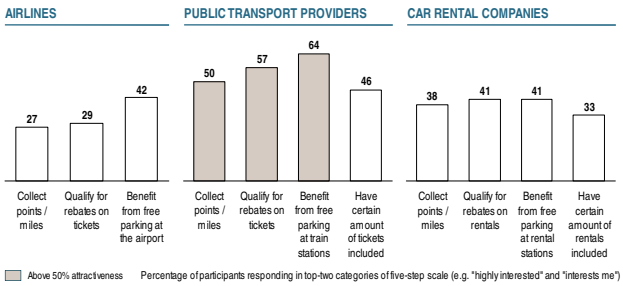


Figure 10: Attractiveness of EV partnerships [%] [3]

3.2 Changing customer values pave the way for new mobility services

With much lower operating costs, battery electric vehicles are well suited to new mobility service concepts. Especially among young customers, cars are becoming less of a status symbol and other expenses hold a higher emotional value. This trend has been observed in both Germany and Japan, for example.

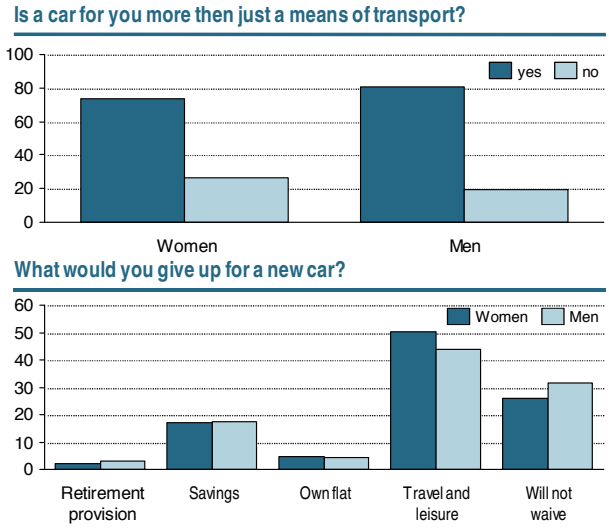
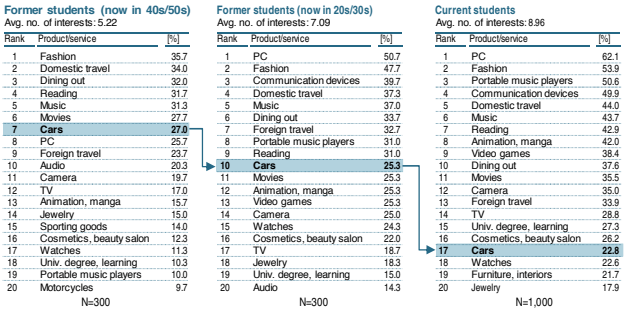


Figure 11: Survey among consumers aged 18-25 years in Germany (Source: Center of Automotive Research)

Figure 11 shows the results of a poll conducted among young Germans by the Center of Automotive Research:

- 1 in 5 young German adults has no emotional ties to cars.
- A quarter of the women see cars solely as a means of transportation.
- Nearly 30% would not give up other costly expenses, such as travel or an apartment, for a new car.

A similar study conducted by JAMA in 2008 in Japan shows similar results: Young people have much broader interests – the car is becoming less relevant (fig. 12).



Former students (now in 40s/50s)
Avg. no. of interests: 5.22

Rank	Product/service	[%]
1	Fashion	35.7
2	Domestic travel	34.0
3	Dining out	32.0
4	Reading	31.7
5	Music	31.3
6	Movies	27.7
7	**Cars**	**27.0**
8	PC	25.7
9	Foreign travel	23.7
10	Audio	20.3
11	Camera	19.7
12	TV	17.0
13	Animation, manga	15.7
14	Jewelry	15.0
15	Sporting goods	14.0
16	Cosmetics, beauty salon	12.3
17	Watches	11.3
18	Univ. degree, learning	10.3
19	Portable music players	10.0
20	Motorcycles	9.7

N=300

Former students (now in 20s/30s)
Avg. no. of interests: 7.09

Rank	Product/service	[%]
1	PC	50.7
2	Fashion	47.7
3	Communication devices	39.7
4	Domestic travel	37.3
5	Music	37.0
6	Dining out	33.7
7	Foreign travel	32.7
8	Portable music players	31.0
9	Reading	31.0
10	**Cars**	**25.3**
11	Movies	25.3
12	Animation, manga	25.3
13	Video games	25.3
14	Camera	25.0
15	Watches	24.3
16	Cosmetics, beauty salon	22.0
17	TV	18.7
18	Jewelry	18.3
19	Univ. degree, learning	15.0
20	Audio	14.3

N=300

Current students
Avg. no. of interests: 8.96

Rank	Product/service	[%]
1	PC	62.1
2	Fashion	53.9
3	Portable music players	50.6
4	Communication devices	49.9
5	Domestic travel	44.0
6	Music	43.7
7	Reading	42.9
8	Animation, manga	42.0
9	Video games	38.4
10	Dining out	37.6
11	Movies	35.5
12	Camera	35.0
13	Foreign travel	33.9
14	TV	28.8
15	Univ. degree, learning	27.3
16	Cosmetics, beauty salon	26.2
17	**Cars**	**22.8**
18	Watches	22.6
19	Furniture, interiors	21.7
20	Jewelry	17.9

N=1,000

Figure 12: Ranking of Japanese university students' interests (Source: JAMA, 2008)

In addition to sales and leasing models, other new business models that focus on usage instead of ownership are emerging: car sharing, fractional ownership and discount rental as ways to meet modern mobility demands.
Initial offerings are already on the market. Founded in 2000, ZIPCAR is today the world's largest car sharing service with 9,500 cars and over 650,000 members. It is available in more than 50 cities and 100 universities in the US, Canada and UK. The service targets private individuals and business users and charges by the hour or by the day.
As car sharing develops from an idealistic initiative to a proper business model, it is also being investigated by more and more OEMs, e.g. by Daimler with its Car2Go initiative or by Peugeot with its "Mu" concept, an innovative mobility service comparable to car sharing/flexible leasing. It integrates cars, vans, scooters and (electric) bicycles as well as travel agency services and works with a prepaid card which can be charged online. The target group is specifically non-customers of the brand, partly because they cannot afford a Peugeot product or they do not see the need to own one in order to use it. Travel agencies earn bonus points to be used for other mobility offers. "Mu" started in 4 French cities in 2010, and will be expanded in combination with EVs to other metropolitan areas.

4. Summary and conclusion: New business models are needed

The changes in the lifecycle revenue pools along the value chain require adjusting existing business models to secure and further grow the business of incumbent players.
Specifically, OEMs need to capture shares in components production to compensate for lost revenue and profit pools in ICE powertrain technologies. That goes along with the need to build up new skills and competencies, especially in engineering for electric motors, battery, energy management and power electronics. Even more importantly, they need to master the downstream business – today's car sales model will not work for EVs. OEMs need to be proactive in making EVs more attractive to customers by variabilizing the cost and directly showing the TCO advantages. They also need to offer innovative downstream services to promote EV usage before new players such as utilities and other companies will do so.
EV components will be a large, but also a highly competitive market for suppliers – captive shares of OEMs, new entrants and new alliances will put significant pressure on margins, making risk management one of the most important parts of new business models. The suppliers need to define their target product portfolio, develop required competencies and adjust the delivery structure/partnerships to better suit the new markets. If they want to be active in battery assembly, they need to establish close relationships to a strong cell manufacturer.
Because of heavy subsidies and massive investments, overcapacity on the cell manufacturer level can be expected by 2015 (fig. 13) [4].

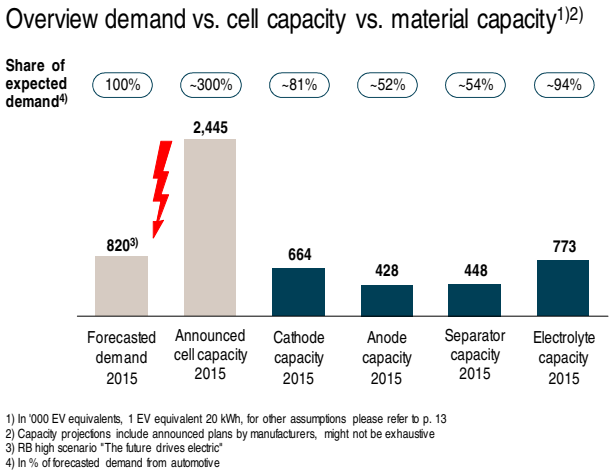


Figure 13: Estimated demand vs. announced capacity installments along the different value chain steps, in EV equivalents

Based on the announced investments (which result in an average investment of 0.5 EUR/Ah), the declared capacity in 2015 would correspond to about 300% of demand. But even with a more conservative approach, using the current ballpark figure of 1.0 EUR/Ah, the capacity is still 150% of demand. While additional industrial applications (e.g. solar) may cushion this situation, unannounced plans could further increase this threat of overcapacity. State subsidies, e.g. about USD 2 billion in the US, will stimulate investment in excess capacity, which will in turn lead to a massive consolidation that only players with a strong financial background can survive. On the other hand, the temporary overcapacity will drive down prices to the levels needed for increased EV penetration.

5. References

[1] W. Bernhart, "*Electromobility – the only way forward?*", 22nd International AVL Conference "Engine & Environment", September 9-10, 2010, Graz, Austria.

[2] Roland Berger Strategy Consultants, "*Win with the winners – Future profit pools in the global automotive component market*", Study, Munich/Stuttgart, May 2010.

[3] Roland Berger Strategy Consultants, "*Powertrain 2020: Electric vehicles – voice of the customer*", Study, Frankfurt, April 2010.

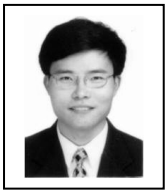
[4] Roland Berger Strategy Consultants, "*Powertrain 2020: Li-Ion batteries – the next bubble ahead?*", Study, Munich/Shanghai/Detroit, February 2010.

6. Authors

Dr. Wolfgang Bernhart
Roland Berger Strategy Consultants GmbH, Loeffelstrasse 46, 70597 Stuttgart, Germany
Tel +49 (711) 3275-7421
Fax: +49 711 1377 - 7421

E-mail: Wolfgang_Bernhart@de.rolandberger.com

Professional background
Dr. Wolfgang Bernhart has been working in the automotive industry for 17 years and has been Partner at Roland Berger Strategy Consultants GmbH since 2007. He coordinates all of Roland Berger's e-mobility activities around the world.



Junyi Zhang
Roland Berger Ltd., 1515 Nanjing West Road, Shanghai 200040, China
Tel: +86 21 52986677 - 123
Fax: +86 21 52986655
E-mail: junyi_zhang@cn.rolandberger.com

Juri Wagenleitner
Roland Berger Strategy Consultants GmbH, Mies-van-der-Rohe-Strasse 6, 80807 Munich, Germany
Tel: +49 89 9230 - 8919
E-fax: +49 89 5485 – 8919

E-mail: juri_wagenleitner@de.rolandberger.com

URL: www.rolandberger.com