

## OEM's Electric Vehicle Strategies: Risk Assessment

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### Abstract

In order to analyze the approach of the main automotive players regarding the electrification path each one is following, this report assesses those aspects required for a consistent corporate product strategy. As distinctive differences are found in terms of the scope of products, some boundaries are defined based on the mobility concept, establishing the differentiation of the current automotive business into two separated industries. After analyzing each of the industries, the report focuses on four automotive OEMs and the way they are coping with the competition for profit in each scenario. The paper also analyses and assesses both each OEM strategic choice and business model.

*Keywords: hybrid, electric, positioning, business model, strategy.*

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### 1 Scenario. How have we got here?

In recent decades, the automotive industry has been pointed out largely responsible for the production of greenhouse gases. Data from the European Environment Agency show that the **CO<sub>2</sub> emissions from the transport industry present a regular increase** since the nineties, while other sectors have a decreasing trend.

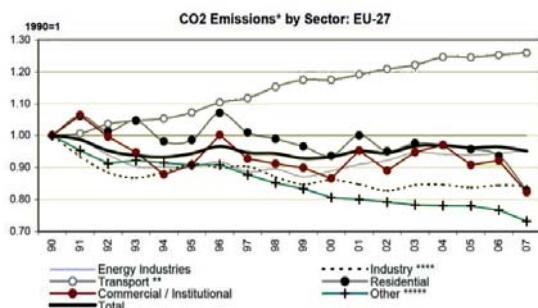


Figure 1.1: CO<sub>2</sub> emissions by sector

Public institutions, with the acquiescence of the car manufacturers, have introduced **restrictive regulations** in CO<sub>2</sub>, NO<sub>x</sub>, particles and other emissions. The European Unit for example, has imposed from 25 to 50% emissions reductions every four years. For some certain gases, the Euro VI, to come into effect in 2016, proposes 0% reduction rates over current levels, since there is no real possibility for further reduction in these cases.

The effort required by each car manufacturer varies depending on the starting emissions' level and the technological development each one can assume. The lack of fulfillment of the rules will result in **penalties**.

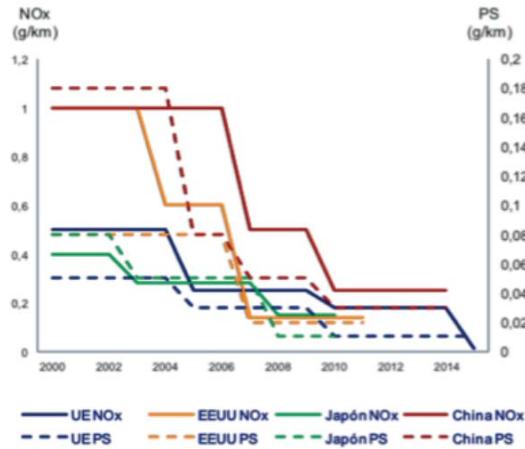


Figure 1.2: NO<sub>x</sub> and PS emission reduction by region

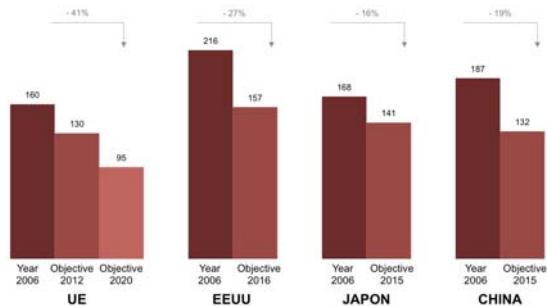


Figure 1.3: CO<sub>2</sub> emission regulation objectives by region

Apart from the restrictive regulations, the **oil dependence** on politically unstable countries has led to high volatility in oil prices. Furthermore, the **depletion** of oil reserves has worsened the *status-quo*.

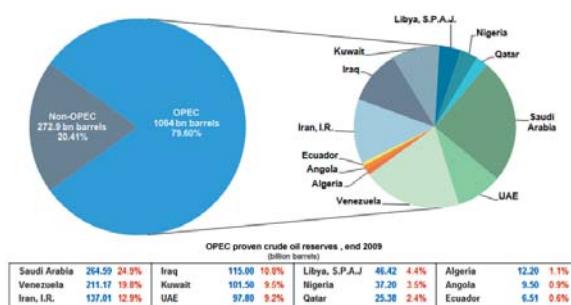


Figure 1.4: OPEC Share of World Crude Oil Reserves 2009

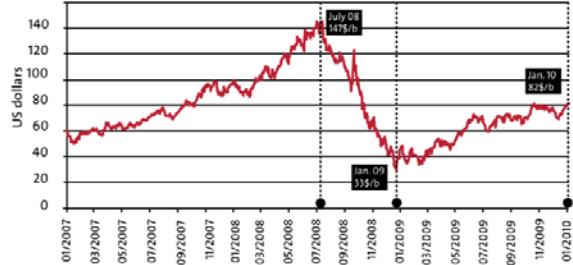


Figure 1.5: Oil price volatility 2007-2010

The **financial crisis** initiated in 2008 has deeply affected the automotive industry. The sales have decreased in all mature markets that have stagnated, and only **China** has witnessed an important increase during the last years. For the specific cases of North America and Europe, it could take from five to ten years to re-establish the pre-crisis sales volumes.

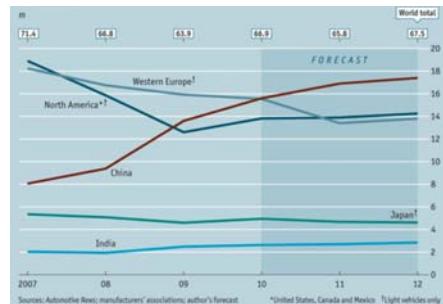


Figure 1.6: Vehicle sales' trends by region

The **public administrations** got involved in most of the mature markets; public funds and even partial nationalization of important OEMs have been part of a general strategic reassessment involving major manufacturer as well as small and medium industries involved with the sector. The main goal has been to establish more solid **positioning** required to face the economic recession outlook. The most visible examples of these initiatives have been the **acquisitions and mergers** among the OEMs and among Tier companies.



Figure 1.7: Leading manufacturers redefine their position

Most of the **player's commitment**, regarding the development of the electric vehicle, must be understood in this context.

This new scenario becomes visible when observing the **product portfolio** of most of the big **OEMs**; most of them, are proposing green technologies among their core segments' models. In parallel, **small car manufacturers** are proposing niche products that, as first-movers, can become rivals for the classical car manufacturers.



Figure 1.8: OEMs' offering regarding the hybrid and electric vehicles

## 2 Defining the relevant industry: What are we talking about?

The definition of the industry in which competition really takes place is important not only to properly analyze it but also to **define** the good **strategies** and set-up the business unit **boundaries**. Difference among products customers and geographic regions can be obscured if the industry is described too broadly, but a narrow analysis can also overlook some commonalities and linkages among related products or markets. Mistaking the relevant industry can affect positioning, competitive advantage and profitability.

As mentioned in Chapter 1, most of the player's commitment regarding the development of the EV must be understood as a response to a **business opportunity**. However, the approach of the multiple OEMs to this new scenario is diverse and must be analyzed from multiple points of view.

While **the full EV** seems to be the mid-term solution that can satisfy the requirements in consumption and emissions from the authorities, the **important drawbacks** that it presents have

catalyzed the development of **several technical alternatives** (hybridization, range extenders) that can provide attractive and affordable price-performance trade-offs.

In order to understand the strategic movements of the main car manufacturers, it is crucial to clearly set whether the pure electric vehicles and ICE equipped vehicles belong to the **same industry or not**.

The following figure represents the advantages and drawbacks of the multiple current technical solutions.

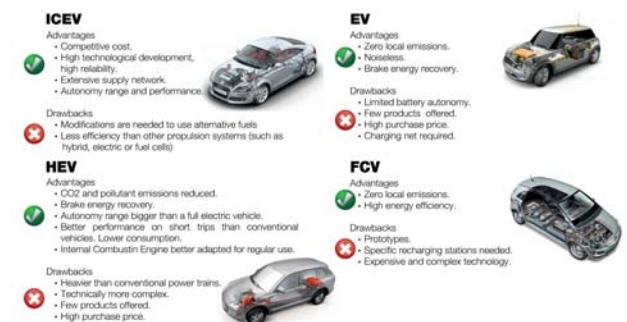


Figure 2.1: Current technical solutions' advantages and drawbacks

### 2.1 The early adopters and the importance of the mobility model

In 1908, Henry Ford changed the course of the automotive industry with Ford's for-the-great-magnitude Model T. The customer value proposition included new aspects that the industry had ignored up to that date: its product was **for everyday use, reliable and durable, easy to use and fix, and affordable for the majority of citizens** that replaced their traditional horse carriage for a reasonable price. This strategic move created a leap in value for the users and the company itself, but overall established the basis of a **mobility model** that has lasted for decades.

The exercise of replacing the classical ICE vehicles for EV reveals important drawbacks that represent a **boundary for both products and geographic scope**.

A **survey** from Ernst & Young published in 2010 [1] exposes that the factors that will make people more **hesitant to choose an EV** as their next new vehicle are the **access to charging stations, the battery driving range and the price**.

The first two concerns are closely related because the limited range (125-275 km) of the current **battery systems** imposes the perception of needing a well deployed **recharging net**. However, most of the potential users declare that they do not drive, per day, more miles than those considered acceptable as autonomy range.

Regarding the price, the same survey shows that the **fuel saving factor** is considered, by far, as the most influent in order to **consider the purchase of an EV**. This factor is undermined by the important over cost currently associated to this kind of products. The major product drawbacks that the survey reveals, contradict the pillars of the mainstream mobility model: the EV it is neither for a transversal everyday use nor easy to use and it is not for everybody but for a selected minority. But, who belongs to this minority?

Based on its propensity to adopt a specific innovation, the population can be broken down into five different segments: **innovators, early adopters, early majorities, late majorities and laggards**. The innovators are visionary people that invest great time, energy and creativity on developing new ideas and products. No change program can thrive without their energy and commitment and it make sense to integrate them in the project providing support and publicity to their innovations. The role of the **early adopters** is the **key for an innovative product to succeed**. This group is ready to make connections between clever innovation and their personal needs once the benefits start to become apparent. With a fashion conscious – trendsetter profile, what the economically successful early adopters say about an innovation, determines its success. They do not need much persuasion to become an independent test bed in which the product will be reinvented to become easier, simpler, cheaper and more advantageous to suit mainstream needs. The result of this process determines whether the product will overcome the chasm between the early adopters and the early majority, much more cost sensitive and risk averse. If the words “value for money” and “user-friendly” fit with the product, it may eventually reach majority audiences.

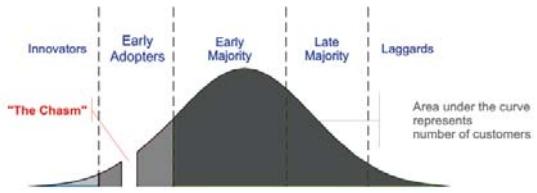


Figure 2.2: Technology adoption life cycle. Diffusion of Innovation

As presented in multiple surveys [1][2], the **potential early adopters** for the electric vehicles tend more toward females who are in their 30s or are younger. In addition, early adopters are much more likely to have an advanced college degree and their **median household income is slightly higher** than that of majority and laggards. This profile is also characterized by the fact that **urban living is more common** than for the other groups, they are more sensitive to the environmental impact but underline the fuel saving factor as the main trigger for the change. Moderates (early and late majority), on the other hand, are more likely to be in their 40s and 50s and rural living is more common.

Two first conclusions can be drawn at this point: the mobility model for the **EV** is right now **suited for an urban use** and the potential customer is limited to the **early adopters** with a high willingness to pay for socially respected product.

Compared with the other available technical solutions, the potential buyer profile is quite different. Regular combustion engines powered vehicles are attractive for people that see a **high risk in adopting an unproved product** with a limited use; pragmatism and established standards are the drivers of the **late majority and laggards** profiles.

The **hybrid and plug-in hybrid** technologies aim another potential customer. The technology introduced by Toyota in 1998, has become quite **familiar in all mature markets** and few emergent ones (75% of US consumers [1]) and its purchase can be considered by the **early majority profile** once these technologies have reached the category of industry standards and they represent a better way of doing what the customers already do.

The **range extended** vehicles are in an **intermediate position**; although its transversal use, the technology is far from being popular and the product will be offered in mature markets aiming early-adopting profiles.

## 2.2 The technology suppliers or the high entry barriers

Among the multiple issues that hinder the fitting of the EV with the classical mobility model, technology implications and limitations are of most importance. **The power train** not only conditions several vehicle functions, but also currently **defines the kind of use suitable for the EV**.

Traditional OEMs have been investing important sums in R&D related to the optimization of the classical power trains; as presented in Chapter 1, the regulations have imposed restrictive emission limits that have promoted the development of technologies aimed to satisfy the demanding goals. Being this know-how the technical core of the car manufacturers, the replacement of the internal combustion engines by electric power trains, represents an **important switch in the value chain**. As the **electric motors and the batteries become the components with the highest added value**, the influence of the suppliers over the OEM increases up to the point that the car manufacturer could become an integrator of Tier1's products or, even worst, observe a forward integration from the suppliers that could become themselves a car producer.

Stated the high power of suppliers, the main traditional **OEMs** have established **partnerships with battery manufacturers** not only to guarantee its self provision but also to have an influence on the development of the technology. Without these agreements, battery development represents a too high barrier for potential new comers.

Stages	Vehicle Development	Manufacturing	Commercialization
Activities	<ul style="list-style-type: none"> <li>Strategy</li> <li>Systems Engineering</li> <li>Specifications</li> <li>Prototypes</li> <li>Tests &amp; integration</li> <li>Standardization</li> </ul>	<ul style="list-style-type: none"> <li>Parts &amp; subsystems (suppliers)</li> <li>Manufacturing of the "base" vehicle</li> <li>Battery systems: cells and management systems</li> <li>Electronic systems</li> <li>Vehicle final assembly</li> </ul>	<ul style="list-style-type: none"> <li>Logistics</li> <li>Direct sales</li> <li>Renting and leasing</li> <li>Packs (vehicle, energy, etc.)</li> <li>Insurances</li> <li>Loans</li> </ul>
Agents	<ul style="list-style-type: none"> <li>OEM : BMW, Renault, PSA, Toyota, etc.</li> <li>Batteries Tier 1: Saft, Degussa, Sion, Varta, Johnson Matthey &amp; Co, Chinese Shama, etc.</li> <li>Other specific Tier 1 (electric and hybrid): Bosch, Valeo, Siemens, Denso, etc.</li> </ul>	<ul style="list-style-type: none"> <li>OEM : BMW, Renault, PSA, Toyota, etc.</li> <li>Batteries Tier 1: Saft, Degussa, Sion, Varta, Johnson Matthey &amp; Co, Chinese Shama, etc.</li> <li>Other specific Tier 1 (electric and hybrid): Bosch, Valeo, Siemens, Denso, Continental, etc.</li> </ul>	<ul style="list-style-type: none"> <li>OEMs' dealers network</li> <li>OEMs' financial agencies</li> <li>Renting and leasing companies</li> <li>Banks</li> <li>Insurances</li> <li>New mobility companies (Better Place, NiceCar, etc.)</li> </ul>
Comments	<ul style="list-style-type: none"> <li>Technology improvements not needed, the OEMs are already developing them. The business model presents from proliferation (autonomy and battery cost)</li> </ul>	<ul style="list-style-type: none"> <li>High level of implication from several suppliers, mainly focused on the hybrid vehicles' needs</li> </ul>	<ul style="list-style-type: none"> <li>The main risk is to develop an specific dealing network</li> <li>The property model could change due to the high cost of the basic vehicle</li> </ul>

Infrastructure and Power Distribution	After-sales services	Used cars sale	End of live
<ul style="list-style-type: none"> <li>Power supply</li> <li>Connexion</li> <li>Packages</li> <li>Pricing</li> </ul>	<ul style="list-style-type: none"> <li>Maintenance</li> <li>Technical control (legal)</li> <li>Packages (maintenance contracts)</li> </ul>	<ul style="list-style-type: none"> <li>Used cars sales</li> <li>Rent and spare batteries</li> </ul>	<ul style="list-style-type: none"> <li>Batteries, motors and electronics life cycle management</li> </ul>
<ul style="list-style-type: none"> <li>Electricity distribution: Iberdrola, EDF, etc.</li> <li>Distribution of fuels (hybrids) Oil companies, high consumption</li> </ul>	<ul style="list-style-type: none"> <li>OEMs' sales network</li> <li>Advanced workshops (Speedy, Norauto, etc.)</li> <li>Technical control companies (Dekra, Auto-bilan, etc.)</li> <li>Diagnostic tools manufacturers: Actia</li> </ul>	<ul style="list-style-type: none"> <li>Companies selling used cars</li> </ul>	<ul style="list-style-type: none"> <li>Agents specialized in the recycling of these components</li> </ul>
<ul style="list-style-type: none"> <li>Installed base shortage except for some pilot products</li> </ul>	<ul style="list-style-type: none"> <li>Source of problems in the first electric vehicle series</li> </ul>	<ul style="list-style-type: none"> <li>Need to subsidize the sale of used cars, before sufficient volume to generate an independent market</li> <li>Sales values probably very volatile in the first generations of products</li> </ul>	<ul style="list-style-type: none"> <li>All major battery manufacturers are designing recycling systems along with the batteries themselves</li> <li>Batteries may be reused as storage systems at peak times</li> </ul>

Figure 2.3: Changes and opportunities in the value chain

Regarding the other technical options, the influence of the technology suppliers is not so crucial. The **development of ICE-powered cars** is not depending on external technology as the pure EV, mainly because the technology is well mastered **in-house** and several players offer their capabilities ad-hoc. The **hybrid technologies** have developed an internal knowledge in which the **interdependence among the two types of power trains** is much **more important than the features of the batteries**. The range extender vehicles are in between: the battery range is also crucial, but the recharging combustion engine reduces its dependence.

## 2.3 Industry's structure by region

In order to successfully deploy the EV, OEMs, utilities and public administrations must be aligned and offer a customer value proposition interesting for the market. Taking into account the reduced range of the current batteries and the need of reassuring expressed by the potential customers, an extensive and accessible recharging net (street recharging points, parking areas...) seems to be compulsory. **Both public administrations and utilities** will need to **adapt the infrastructures and public spaces** as a first initiative. On the other hand, **government funds** will be needed in order to subsidize the purchase of an EV, at least during the first stages of its popularization.

The **possibility of renting the batteries** could also be a factor decreasing the final price of the product. OEMs must also offer those technical solutions that can ease the deployment: multiple recharging systems (slow, fast, contactless), battery drop possibility...

The validation and acceptance of the mobility model that the current EV represents, requires the concentration of the different elements mentioned.

Urban environments represent a platform that easily integrates all players while permitting parallel initiatives that can contribute to the assessment of the customer value proposition that the **EV** represents (fleets, car sharing...). Several **cities in mature markets** have reached agreements with both utilities and OEMs. They should present the **first assessments** of the deployment campaign shortly.

The level of commitment required from the public administrations and the utilities for the validation of hybrid technologies is quite different. Traditionally this kind of vehicles has been **validated without a specific aid** from these two players but it is obvious that the plug-in versions can profit from an extensive recharging net as well as from any fund that the administration can assign in order to reduce the final cost of the product. The same analysis can be applied to the range extender technologies.

To sum up, for the **current EV industry**, the **validation in an urban environment** is for the moment **compulsory**. For other technologies, the products can be tested and approved without specific requirements.

According with the arguments presented above, the figure 2.4 identifies the differences in use, customer profiles, technical suppliers and regional industry structure for every kind of technology. As it can be observed, the **EV has several specificities that suggest the need of considering it as a separate industry**. Consequently, the profitability analysis presented in Chapter 3 will study both structures (EV, Hybrids-classical) independently.

	ICE	Mild-Hybrid	HEV	PHEV	RE	EV
Use	Urban	Quite unefficient	Better than nothing	Specially suitable for corporate fleets or taxis	Suitable because limited range and infrastructure	
	Metropolitan			Reduced "pure electric" use	Suitable but ICE assistance needed	Limited by range
	Long distance	Natural habit		Electric drive is useless	Suitable but ICE assistance needed	Impossible
Users	Eco-friendly	Mainly focused on consumption		Good compromise needs convictions		High identification
	Economy-savers	Multiple options, low cost	Affordable	Expensive. Medium and high segments		Expensive, even low segments versions
Suppliers		Traditional players		Engine, battery and motor suppliers are important		Battery and motor suppliers fundamental
Entry barriers	Low entry barriers	Accessible technology	High internal technical development required, but available	High powertrain R&D necessary		High battery R&D required
Industry structure by regions	Global industry with specificities	Emergent markets start to integrate it		Emergent and mature market		Only mature markets full & fast deployment
OTHER FACTORS:	ICE	Mild-Hybrid	HEV	PHEV	RE	EV
PRICE RANGE	Transversal	Low-cost excluded		From 30.000 €	From 40.000 €	From 16.000-25.000 €
SEGMENTS	All segments covered	Not common among entry segments	Not all segments. Core products covered		Medium-high segments	Mainly low segments
FEATURES	All	All	Expanding performances and ranges		Reduced range without ICE	Battery range limited
OEMs	All	Majority	Well established OEMs. Few emergent players		Few OEMs	Few OEMs and new players

Figure 2.4: Scope of products

### 3 The profitability of the industry

In 1979, Harvard Business Review published *How Competitive Forces Shape Strategy* by Michael E. Porter, starting a revolution in the strategy field that has shaped a generation of academic research and business practice. The goal of the Porter's article was to propose a methodology aimed to identify the roots of an industry's profitability: how the value is retained by companies, how it is bargained away from customers or suppliers, how it is limited by substitutes or how it is constrained by potential new entrants. In sum: **why profitability is what it is?** From this analysis, strategists should have a complete picture that may permit them to size up company's strengths and weaknesses against other players, as well as initiate strategic actions in order to anticipate, exploit or cope with suppliers, customers, new entrants, substitutes and competitors.

#### 3.1 The profitability of the EV industry

The appearance of a new player in a specific industry usually implies a higher pressure in prices, costs and rate of investment. Apart from the desire of gaining market, new comers that come from other industries can leverage existing capabilities and cash flows to alter competition in their profit. In sum, the **threat of new entrants**, not whether actually occurs, puts a cap on the potential profit of an industry. The magnitude of this force depends on the height of the entry barriers and on the reaction entrants can expect from incumbents.

The slow growth of the EV industry implies that market share only can be gained by taking it from incumbents. This suggests that current **players may fight back a new entrant** and for example clout with distribution channels and customers. Apart from this potential retaliation, the **important capital requirement** and the **incumbency advantage that technical knowledge represents**, stand out as the major entry barriers for potential newcomers. In addition, as the technology of the EV is not already fixed, once in the industry, the **cost of switching suppliers** may become important for any player.

Suppliers can squeeze profitability if the industry is unable to pass on cost increases, into its own prices. Charging higher prices as well as limiting quality or services and shifting costs, are the usual vectors that are leveraged in order to capture more value and increase **the power of suppliers**. Specifically for the EV industry, **suppliers could concentrate** in case that a specific battery technology reaches a level of performance (range, security, costs, weight...) unequalled by other alternatives. The suppliers with the biggest added value of the EV industry **do not depend exclusively on the automotive sector**. The volumes of batteries and electric motors that the car manufactures are purchasing right now, do not represent the suppliers' business core. An important factor that increases the power of suppliers is the fact that it would **not be difficult for them to integrate forward into the industry** and become an OEM, especially if a disruptive technical solution is developed by one supplier.

Other threats are that once a product is developed, **changing suppliers may be quite costly**, and that **there is no substitute** for what the supplier groups provides (batteries or batteries).

Customers can capture part of the product value by forcing down prices, demanding better quality and generally playing participants off against one another. The **power of buyers** is at expense of industry profitability, especially if **they are price sensitive**, which it might be the case because, although their willingness to pay, the purchase of an EV represents a significant fraction of the procurement budget for most of the citizens. In addition, the **reduced number of customers**

could easily generate a price war between the different manufacturers.

A substitute product must be able to perform the same or similar functions but by different means. The growth potential and the profitability can suffer if the industry's product is not able to distance itself from substitutes through performances, brand image, marketing... Potential substitutes might be easy to overlook because they may appear to be very different from the industry's product. The **threat of substitutes** that products like the **Segway** ® or the **electric bikes** represent for the early-adopters profiles, cannot be discarded because they offer an **attractive and cheap price-performance trade-off**.

The **rivalry among competitors** can happen under several forms such as improved services, price discounts, marketing campaigns or launching of new products. The rivalry intensity in the EV industry is high, mainly because of the **important exit barriers** that the R&D investments required represent. No less important is the fact that the **slow industry growth** will precipitate a fight for market share that also come from the fact that the **players are approaching and competing differently** within the same industry. Under this unstable scenario, some rivals are **highly committed to the business and aim lead** some niche markets in front of the big classical OEMs. Apart from the intensity of the rivalry, it makes sense to analyze the dimensions in which this competition takes place. The recently **war price** initiated by some OEMs reflects the need to **profit from the positive atmosphere** created around the EV before it starts to decay. In some cases **similar EV products** can also promote this price rivalry.

Competition in other dimensions also arises: **features, services, and brand image** will play similar roles as for the combustion engine powered vehicles' industry.

### 3.1.1 Assessment and conclusions

Among the identified forces, the **power of suppliers** seems to be the most influential. As long as the most convenient technologies are not already fixed, Tiers have a bearing on the future evolution of this industry. The **rivalry among competitors** could rank second, mainly due to the important investments required to play a role in this sector. The **power of buyers** will probably reinforce the price war generated by the need of selling the first units immediately. **The threat of**

**substitutes** is relative: it is difficult to figure whether a cheap non-car product can become a substitute for an early-adopter profile. As most OEMs have already presented their strategies regarding the EV industry, it can be said that **the threat of new entrants is already residual**. Retaliation issues are probably not yet a priority due to the several unknowns still existing.

The following table summarizes the five forces analysis presented.



Figure 3.1: The 5 five competitive forces for the EV industry.

### 3.2 The profitability of the *classical* automotive industry

The classical products of the automotive industry are progressively adopting those technical solutions that, **optimizing the existing technologies**, allow them to satisfy the **restrictive emission regulations**. *Start & stop* and mild-hybridization devices, will prolong the life of pure combustion engines. In line with this evolution, the hybrid power trains and range extenders will integrate batteries with higher performances until its range becomes satisfactory enough to dispense with their auxiliary combustion engines. This scenario can be considered transversal for most of the international OEMs.

The **high entry barriers** that characterize the automotive industry reduce the **threat of new entrants**. It seems quite difficult that a new generalist OEM can rival with the traditional ones at a global level. Even in emergent markets, supply and demand-side economies of scale, capital requirements, brand identity and proprietary technology represent insurmountable fences for a new comer in order to fight under equal conditions. **Restrictive government policies** can hinder or aid new entry directly, as well as amplify or nullify other entry barriers. In growing and big markets it is usual that this entry barrier alters the natural *status-quo* of the industry.

The suppliers of the classical automotive industry have inherited several R&D responsibilities from the OEMs; although the high percentage of externally supplied parts is high, core technologies are still developed internally. For example, power train competences are, among others, still part of the added value knowledge that the big car manufacturers want to keep. For the specific case of hybrid engines, the technical pad leaded by TOYOTA since 1998 has inspired the OEMs' development that has been internal in some cases, external in others or even have signed supply agreements with the TOYOTA itself. In sum, **the power of suppliers does not seem to represent a threat for an OEM aiming to offer hybrid products**. Regarding the range extender systems, the level of development of the auxiliary combustion engine does not represent a challenge for any current group. In addition, due to the limited battery range for this special hybridization, the biggest added value lies on the combined performance of both systems, and thus, retained by the OEM.

Cars' customers are usually price sensitive: the purchased item represents a significant and exceptional sum in average family budgets. **the power of buyers** can be considered **high** and exerted via **playing off the brands one against the other**. This influence is reinforced by the fact that for most of the segments, **products are undifferentiated** and the **costs of switching vendors are low**.

The kind of use to which a product is focused determines its potential substitutes. As combustion engine and hybrid vehicles are present in all segments and for transversal uses, **it is difficult to determine a generic substitute**. Consequently, the **threat of substitutes** can be considered **low**.

The **rivalry among existing competitors** is **extremely high** and at all levels: price wars, new products, services improvements and aggressive marketing campaigns. The **competitors are numerous and several are roughly equal in size and power**, the **industry growth is slow** as corresponds to a mature one and the **exit barriers are high** due to the **important and historic investments required**.

The **rivalry is evident on price**; with **similar products and services**, **high fixed costs** and **high investments required** in order to profit from a bigger capacity, the profitability goes to the

customers to the detriment of product features. Less generalist manufacturers differentiate precisely in features aiming to support higher prices or brand reputation in order to raise higher barriers against new entrants.

### 3.2.1 Assessment and conclusions

Among the identified forces, **the rivalry among existing competitors** seems to be the most influential. Mature products in mature markets squeeze the profitability of a well-mastered industry. **The high power of buyers** is a consequence of this status quo. **The threat of new entrants** can also represent a problem for well-established car manufacturers; in emergent markets, government policies force partnerships with local manufactures in order to permit the entry of foreign ones. Some other countries have established protectionist regulations that have been beneficial for country's OEMs at a global level.

The following table summarizes the five forces analysis presented.

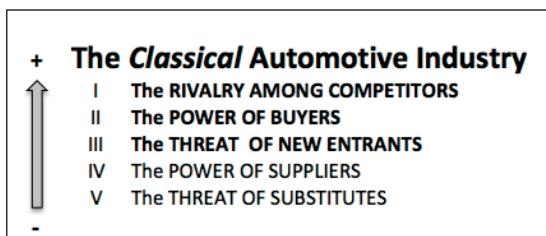


Figure 3.2: The 5 five competitive forces for the *classical* automotive industry.

### 3.3 Comparison of the forces that shape both industries.

For the **EV industry**, **the power of suppliers** is key: the knowledge with the highest added value can be developed externally reducing the OEM to a merely assembler. For the combustion engine powered/assisted cars industry, the core technologies are usually internally mastered.

The **rivalry among competitors** will follow the **same rules for both industries**, differing just in the volume of the offer and the demand.

The **power of customers** can be considered a **consequence of the rivalry in each industry**: similar products, services or brand image can easily lead to a war price.

Finally, the **threat of new entrants** seems to be **more important for the regular vehicles**. Not only technical mastering is *easy* to reach, but also the emergent markets are promoting the appearance of new local OEMs. The EV industry seems to be unattractive for these newcomers.

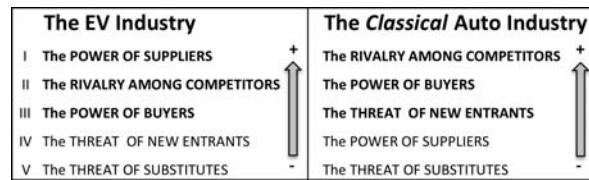


Figure 3.3: The 5 five competitive forces comparison.

## 4 Four significant OEMs. How are they doing it?

Once defined the forces that shape both industries, it makes sense to assess how four significant OEMs are sizing up company's strengths and weaknesses in order to cope with competition for profit.

### 4.1 Toyota Motor Corporation

Toyota Motor Corporation (TMC) is a **Japan-based multinational** automaker. Kiichiro Toyoda founded TMC in 1937 and now the company is headquartered in Toyota, Aichi, Japan. The company is mainly engaged in the automobile business and financial business. The brands of the company are Toyota, Lexus, Daihatsu, Scion and Hino (heavy trucks).

#### 4.1.1 Core segments, core markets and power train portfolio

The Toyota Motor Corporation is a generalist group attending all light vehicle segments with its **brands Daihatsu, Lexus, Scion and Toyota**. The forecasted production for 2011 was 7.354.738 units (ranked #3).

The core segments at 2011 are **Segment C (21,3%)** of the forecasted production, **+79,47% evolution 2005-2020**, **Segment J (18,7%, +74,49%)**, **Segment M (14,5%, + 13,12%)**, **Segment E (12,9%, +27,39%)** and **Segment B (12,1%, +85,91%)**.

The products of the Toyota group are mainly sold in **Eastern Asia (34% of group sales, -8,9% evolution 2005-2010)**, **Nafta (30%, -19,8%)**, **China (13%, +425,6%)** and **Western Europe (9%, -14%)**.

The distribution of sales by segments is presented in the figure 4.1.

Segments	NAFTA		China		Eastern Asia		Western Europe	
	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010
Segment C	33,1%	-18,5%	17,1%	278,1%	32,0%	85,8%	7,3%	-49,6%
Segment J	50,3%	15,9%	21,4%	18625(+1)	8,1%	0,2%	6,2%	-52,6%
Segment M	14,0%	-41,7%	4,9%	447%*	67,1%	-3,3%	3,5%	37,8%
Segment E	51,1%	-32,6%	29,8%	524,3%	13,8%	-39,7%	0,1%	-97,3%
Segment B	12,9%	8,0%	5,9%	211,2%	48,9%	-19,7%	27,8%	-19,7%

\*from 2009 to 2010  
(1) In 2005: 10.216 units; In 2010: 200.456 units [Sales China, Segment J]

Figure 4.1: Toyota's sales distribution by segments

The actual power train portfolio of Toyota includes alternative internal combustion engines (both Otto and Diesel) and hybrid engines. The internal combustion engines' portfolio ranges from 998 cc (69 CV, 96 Nm) to 4.969 cc (423 CV, 515 Nm) for Otto engines, and from 1.364 cc (90 CV, 209 Nm) to 4.461 cc (286 CV, 663 Nm) for Diesel. Concerning the hybrid technologies, Toyota proposes the following combinations:

- I. Otto, 1.797 cc, 4 cylinders (98 CV, 147 Nm). Electric motor permanent magnet AC synchronous (88 CV, 206 Nm). ECVT transmission.
- II. Otto, 2.362 cc (150 CV, 187 Nm). Electric motor permanent magnet AC synchronous (143 CV, 270 Nm). ECVT transmission.
- III. Otto, 3.456 cc, V6 (296 CV, 368 Nm). Electric motor permanent magnet AC synchronous (150 -200 CV, 275 Nm). ECVT transmission.
- IV. Otto, 4.968 cc, V8 (395 CV, 520 Nm). Electric motor permanent magnet AC synchronous (224 CV, 300 Nm). ECVT transmission.

Although Toyota has announced the electric version of its SUV model RAV4 for 2012, and has also unveiled an electric concept car for the A segment, this technology is not already available at Toyota.

#### 4.1.2 Green technologies portfolio

Toyota has a vast portfolio of low emission models that covers all the segments except Pick-Up and commercial vehicles. The group offers more than one model (under different brands) for the segments with highest production figures or growing potential. Hybrid power trains are offered in all segments except segment A, in which a pure electric vehicle is planned. This technology is also offered in segment J.

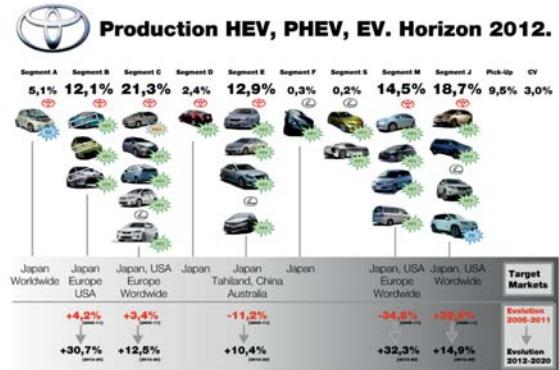


Figure 4.2: Toyota's green technology portfolio

##### 4.1.2.1 Toyota's coping with the EV industry

Toyota's eco car development is not limited to the hybrid technology. Back in 1997, Toyota tested a fleet of full electric powered RAV4 in Japan and in California. These validation programs were considered counterproductive, stating that hybrids could work much better. Also in 1997, Toyota built a fuel-cell hybrid vehicle on the basis of the Highlander and six units were tested in the US and Japan. This preliminary R&D diversification has permitted Toyota to be updated and not in a disadvantaged position with respect to the other competitors, mainly when the EV has started to be considered as a viable option from other competitors.

For 2012, Toyota has planned to introduce an EV based on the two-seat IQ model in Japan, Europe and in the U.S. (major markets of Toyota). Although segment A represents just a 5,1% of the group's production, the aim is to sell several thousand per year. One new electric model in the J segment (18,7% of group's production, 74,49% expected evolution 2005-2020) is also expected, the RAV4 EV. Additionally, it is rumored that the partnership between FAW's Tianjin subsidiary and Toyota is working on a self-developed electric car for the Chinese market, which will be based on segment B. Nevertheless, Toyota has refused to comment or deny this plan.

Regarding fuel cell vehicles, it is expected that a reasonable product price is achievable in 2015, when we expect that the hydrogen supply infrastructure will be in place.

As mentioned in previous chapters, the **power of suppliers** for the EV industry is very important. The background of Toyota in hybrid technologies provides it with a vast experience in battery

technologies that represents an important asset when defining the minimum performances of pure electric. Primearth EV, the 80-20% partnership between Toyota and Panasonic Corporation has permitted the OEM to become battery supplier of several hybrid car manufacturers, assuring advanced knowledge and capacity for the development and manufacturing of batteries with an extended range. Complementary to this agreement, Toyota Motor Corporation has invested \$50 million in Tesla Motor Inc. The purchase of a minor stake of the Californian firm has two main purposes: develop the versions for the RAV4 and the hybrid Lexus RX (\$60 million budget) and get access to Tesla's specific battery knowledge. In exchange, Tesla Motor Inc. has acquired (\$42 million) the assembly plant that Toyota has in Fremont, California. The models mentioned above will be manufactured in this site.

Toyota will have to **rival competitors** under similar conditions to the conventional automotive industry. The sums invested in offering these specific pure electric products prevent Toyota from abandoning the industry; its participation in Tesla's capital indicates **Toyota's commitment in leading** this technology next step. The well-founded reputation of Toyota hybrid products generates an interesting synergy with the top performance image associated to Tesla's products. **Features and brand image** are the main assets Toyota presents in order to cope with this force. The reduced EV offer can represent a serious drawback.

Related to the rivalry among competitors, **the involvement of the public administrations** and utilities is fundamental in order to develop a competitive advantage for Toyota's EV products. With this goal, Toyota requires from both players, the realization of a new power grid developed from the vehicle user's perspective in which power supply can be managed via ITs. The project is called **Toyota Smart Center** and it is conceived to **connect EV (of course, also PHEV) with Home Energy Management System (HEMS)** equipped houses, to control home electricity supply/demand, the electricity supplied by the power company, as well as the electricity generated by the houses, thus making external control possible. There are various projects along this line in Toyota City (JP), Boulder Colorado (U.S.A), and Strasbourg (FR). Several agreements with utilities (TEPCO,

ENDESA, EDF...) deploy the recharging nets in other cities.

Although the EV industry is incipient, the **power of customers** conditions product strategies. For A segment products, Toyota will compete with an important number of well-established OEMs (p.e. Renault's Twizy) as well as other new players that also offer urban EV (REVA, Think, Bolloré...). If the electric version of the Toyota's IQ is not able to differentiate from the other options, it will be difficult to avoid a **war price promoted by the customer**. The situation can be considered different regarding the J segment product that Toyota is offering; just Mitsubishi is offering an EV SUV, so the risk of starting a war price is insignificant.

The **threat of new entrants** and the **threat of substitutes** can be considered forces of least importance. The technical knowledge and the capital required in order to become a challenging player within the EV industry keeps minor car manufacturers out. On the other hand, new small players can arise offering niche products. Regarding the substitutes, only for a very specific uses (urban, leisure) substitutes can represent a threat.

The following table summarizes and assesses Toyota's EV positioning.

Threat of new entrants	5	Not relevant for major OEMs in mainstream segments
Power of suppliers	5	Key strong partnerships with Panasonic & Tesla
Power of buyers	3,5	Similar products and low demand can start a war price
Threat of substitutes	4,5	No clear potential substitute
Rivalry among competitors	3,5	Low demand, therefore fierce competition Features and brand image, main assets

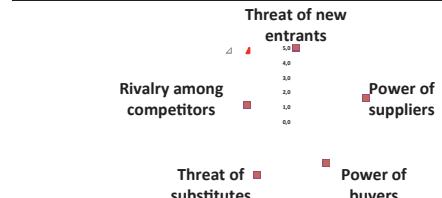


Figure 4.3: Toyota's coping assessment with the EV industry

#### 4.1.2.2 Toyota's coping with the classic and hybrid industry

After fifteen years in the market, hybrid technologies are well expanded among the major OEMs worldwide. As **first mover**, Toyota benefits from the learning and experience acquired as a

result of being first in the marketplace forcing the other players to follow. This is the main asset of Toyota against the **rivalry among competitors**: the **technical knowledge** permits offering **outstanding features** and provides Toyota with an **image** of technological reference in this field. This is confirmed by the fact that OEMs such as Ford or Mazda have agreements for the supply of hybrid technologies with Toyota. This competitive advantage is reinforced by the **agreements that Toyota is reaching with public administrations and utilities** in order to deploy the recharging net. Although the EV is the product that mainly requires this infrastructure, the PHEV will profit from it. However, some **recent events** have affected Toyota's excellence reputation. From the last quarter of 2009 through the first quarter of 2010, more than eight million of vehicles have been withdrawn due to **quality and safety issues**. In February 2010, Toyota announced a **recall** in markets including Japan, North America and Europe related to the braking control system in certain vehicle models including the hybrid Toyota Prius. The recalls and other safety measures have led to a number of claims, lawsuits and government investigations against Toyota in the United States of America.

Partly due to those recall scandals that made headlines across the globe, Toyota's **market share has crumbled** to just 4.0 % in Europe in 2011 from a peak of 5.8% in 2007, according to data from the European auto industry body ACEA.

Some sources also affirm that Toyota has put too much management attention on hybrids and has **lost out in combustion engines**. This can affect on its sales in Europe, where Diesel cars enjoy ever rising popularity thanks to affordability and solid fuel savings. In terms of solving this weakness Toyota has struck a deal to procure Diesel engines from BMW's range of combustion engines from 2014, handing over access to precious battery technology in exchange.

Although not a strategic issue, the Great East Japan **earthquake** and the recent **floods** in Thailand have seriously affected the manufacturing performance of Toyota. After the earthquake's occurrence on March 11, 2011, Toyota temporarily suspended operations at all of its domestic factories due to damage to social

infrastructure including energy supply, transportation systems, gas, water and communication systems caused by the earthquake, shortages of parts from suppliers, and damage sustained by some subsidiaries of Toyota in regions adjacent to the disaster zone. Later, the same year, Thailand's worst floods in 50 years have cut off the supply of about 100 components for Toyota, Thailand's top automaker with a production capacity of 650,000 vehicles a year at its three factories there. Due to these supply problems profits at Toyota have fallen and the company has withdrawn its profit and vehicles sales forecasts for the period 2011-2012.

Since 1997, hybrid products have progressively appeared in the product portfolio of the main car manufacturers. With a multiplied and similar offer, in most of the segments, **customers** can leverage their **power** and promote a **price war** against brands playing off vendors one against the other.

Last but not least, emerging countries, such as China and India, still experiencing economic growth, and developed countries, including those in North America and Europe, are expected to observe a gradual economic recovery in fiscal 2012: the automotive markets worldwide are expected to grow over the medium to long term. Regarding China, Toyota's sales have increased 178% from 2006 to 2010. The conventional combustion engine powered car will become inadequate in order to meet the stringent emission targets set by the Chinese government. The automotive industry will have to rely heavily on fuel-efficient cars such as hybrids to comply with the legislation.

The **encouraging from the public administration**, along with the **technical knowledge** and the strong brand image built on it, represent important assets in order to become a **reference new player** in the hybrid Chinese market, **profiting the existing infrastructure** that Toyota already has in the country through its partnership with FAW that guarantees **supply and demand-side economies of scale**.

Regarding the European market, **joint ventures with PSA**, a French motoring company, has provided various opportunities for the company to produce cars in France. In addition, the **opening up of imports in the European market** is also a great opportunity for Toyota, enabling a premium positioning of its **luxury brand** Lexus in BMW

and Mercedes Benz original markets.

The strategic movements in both the European and the Chinese markets are well aligned with the global strategy Toyota presented in March 2011: the company expects a \$15 billion profit from the combination of emergent markets (China, India and Brazil) and the **launching of more hybrid models**.

The **power of suppliers** and the **threat of substitutes** can be considered forces of least importance. The core know-how of Toyota has been internally developed and suppliers, as it is usual in the automotive industry, play a secondary role, being relatively easily to swap. Substitutes can be defined only for very specific uses; there is no generic substitute.

The following table summarizes and assesses Toyota's HEV positioning.

Threat of new entrants	5	Not relevant issue
Power of suppliers	5	Core know-how internally developed
Power of buyers	4,5	Brand image copes well this force
Threat of substitutes	5	No generic substitute
Rivalry among competitors	5	First movers advantages Technological reference

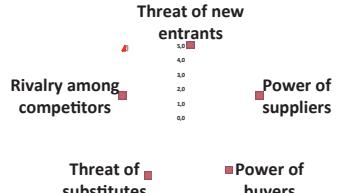


Figure 4.4: Toyota's coping assessment with the HEV industry

## 4.2 General Motors Company

General Motors Company (GM), formerly incorporated (until 2009) as General Motors Corporation, is an American multinational automotive corporation headquartered in Detroit, Michigan. The company produces cars and trucks in 31 countries and does business in some 157 countries. These vehicles are sold under the following brands: Buick, Cadillac, Chevrolet, GMC, Opel, Vauxhall, and Holden, as well as two joint ventures in China.

### 4.2.1 Core segments, core markets and power train portfolio

General Motor Corporation is a generalist group attending all light vehicle segments with its brands Buick, Cadillac, Chevrolet, GMC, Opel, Vauxhall, and Holden. The forecasted production for 2011 was 7.931.465 units (ranked #1).

The core segments at 2011 are **Segment B (22,9%)** of the forecasted production, +66,94% expected evolution 2005-2020), **Segment C (21,3%, +40,05%)**, **Segment J (14,7%, -16,41%)**, **Segment PU (11,4%, -51,38%)** and **Segment E (11,2%, -25,52%)**.

GM mainly sells its products in **Nafta (38,8% of group's total sales, -46,6% evolution 2005-2010)**, **Western Europe (17,2%, -24,2%)**, **China (16,2%, +209,9%)** and **BRI (14,9%, +97,3%)**.

The distribution of the segments by sales is presented in the figure 4.5.

Segments	NAFTA		Western Europe		China		BRI	
	Sales 2010 by segment	Evolution 2005-2010						
Segment B	6,3%	-52,8%	24,3%	-8,4%	15,2%	265,7%	40,1%	111,8%
Segment C	4,5%	-86,9%	28,7%	-35,6%	49,0%	226,1%	3,3%	-60,3%
Segment J	83,7%	-39,0%	2,9%	1211% (1)	-	-	3,9%	-15,7%
Segment PU	95,4%	-48,3%	0,1%	294% (2)	-	-	-	-
Segment E	69,2%	-37,9%	0,01%	-99,5%	22,8%	185,0%	0,2%	27,8%

(1) In 2005: 2.049 units; In 2010: 26.880 units [Sales WE, Segment J]  
(2) In 2005: 191 units; In 2010: 754 units [Sales WE, Segment PU]

GM offers a wide range of internal combustion engines (both Otto and Diesel) and two options for hybrid engines. The internal combustion engines' portfolio ranges from 995 cc (68 CV, 93 Nm) to 7.008 cc (512 CV, 637 Nm) for Otto engines, and from 1.248 cc (75 CV, 190 Nm) to 6.599 cc (403 CV, 1.037 Nm) for Diesel. Concerning the hybrid technologies, GM proposes the following combinations:

- I. Otto, 1.400 cc, 4 cylinders (156 CV, 183 Nm). Electric motor permanent magnet AC synchronous (151 CV, 370 Nm).
- II. Otto, 6.000 cc, 8 cylinders (252 CV, 498 Nm). Electric motor permanent magnet AC synchronous (85 CV, 177 Nm).

GM is also going to introduce EV's technology in segment A, but it is not available yet. The electric version of the Chevrolet Beat was unveiled in New Delhi, India, in June 2011; however, it is still unknown whether this model is going to be sold in the U.S. as the Chevrolet Spark.

## 4.2.2 Green technologies portfolio

GM offers various hybrid models, under different brands, for the segments J and Pick-Up and a mild-hybrid model for segment E. These are the segments, which show the highest sales figures in the U.S., although declining. In segment C, which is the one with the biggest market share in China, GM offers a range extender model, targeted to the Chinese and U.S. markets. Green technologies are not proposed in the remaining segments, except segment A, in which a pure electric vehicle is planned.

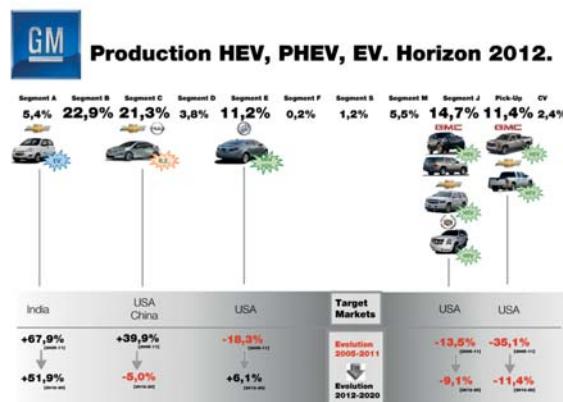


Figure 4.6: GM's green technology portfolio

### 4.2.2.1 GM's coping with the EV industry

Contrary to the hybrid technology General Motors has been the first in terms of electric technology. The company presented the **EV1** in 1996, and with this, **GM pioneered the electric vehicle**. Although the EV1 was originally intended to be sold on the market, it was only available for lease in specific areas: first in California and later also in Arizona. But GM stopped the project in 2003 arguing that demand was too low. Impediments for large-scale commercialization were batteries' low range, high costs and lack of charging infrastructure.

In recent years the situation has improved reasonably for the electric industry. Firstly, utilities and governments are working together with OEMs around the world in order to develop the recharging infrastructure, and special funds are allocated to launch pilot projects via government-industry partnerships. An example of this is the Memorandum of Understanding that GM has **with General Electric to deploy EV charging stations in Shanghai's Jiaging district**. Secondly, R&D efforts have allowed reduce battery costs and improved its durability and life

spans. However, over the medium term, strong R&D programs for advanced energy storage concepts are compulsory, to help bring the next generation of batteries to market and to establish secure supply chains. In order to soften the **power of battery suppliers**, General Motors has several agreements. Its plan is to **invest heavily to support in-house development** and manufacturing capabilities **of advanced batteries, electric motors and power control systems**.

General Motors reached a worldwide licensing agreement with Argonne National Labs to use their advanced patented cathode material for lithium-ion batteries. The licensing agreement is extended not only to GM but to **battery partner LG Chem** as well for use in **the next generation Chevrolet Volt**. The use of these cells will allow the next generation Volt to be less expensive, require less battery management and to potentially achieve greater range.

Additionally, General Motors has awarded a **production contract to A123 Systems**, a developer and manufacturer of advanced nanophosphate lithium ion batteries and systems, for complete battery packs to be used in future GM electric vehicles to be sold in select global markets.

The knowledge General Motors has acquired from the development of the EV1 electric car in the early 1990s could be crucial in the medium term if the market shifts to the electric vehicle industry and give the company a competitive advantage, in the way of technical knowledge, that will help GM to overcome the **rivalry among the competitors** in this field.

In the **long-term**, as the world's cities continue to grow, GM thinks that a reinvention of personal mobility is required. By 2030, it is expected the world's more than eight billion people to operate one billion vehicles, and over two-thirds of these people will live in cities. The prototype of GM's vision for urban mobility is the **EN-V, short for Electric Networked Vehicle**, which was unveiled in 2010 at the Shanghai World Expo to support the theme of "Better City, Better Life". The two-seat vehicle is powered by electric motors and lithium-ion batteries store electricity to enable 40 kilometers of travel before recharging, which can be accomplished via conventional household power in as little as four hours. The promise of these technologies is so real that GM has signed a

## Memorandum of Understanding with Sino-Singapore Tianjin Eco-City to explore integration of next-generation EN-Vs in an effort to solve the urban mobility challenge, providing a competitive edge at the expense of high exit barriers.

The next generation of electric vehicles is going to need efficient storage options, including lithium-ion batteries and hydrogen fuel cells. That is why, GM is working on the development not only of the electric technology but also the hydrogen technology.

Regarding the hydrogen technology, General Motors has conducted research for more than 40 years, and is actively **engaged** in all elements of the **fuel cell propulsion system development in-house**. Between 1997 and 2009, GM presented several FCV models under the banner of project HydroGen. In total, GM tested around 100 FCVs, sometimes in collaboration with governments, for instance, in 2008 with the German Clean Energy Partnership. Moreover, the Chevrolet Equinox fuel cell electric vehicle demonstration programs, such as Project Driveway, are the largest in the world.

**By all these investments** in terms of electric and fuel cell technology, GM is trying to **differentiate in features and services**, which minimize the risk of price wars and **raise higher barriers against its competitors**. GM aims to be the leader in the future with new technologies and needs to build a strong image and brand reputation.

Regarding pure electric vehicles' current situation, there are two announcements made by General Motors: an electric version of the Chevrolet Beat, unveiled in New Delhi, in June 2011(it seems that this model is going to be commercialized in the U.S. as the Chevrolet Spark in 2013) and the Opel's concept car RAKe, an electric tandem two-seaters vehicle. This means that GM will have to compete with an important number of well-established OEMs in a more and more crowded segment A within the electric vehicles industry, thus, increasing the **power of buyers**. The reduced number of customers could easily generate a price war between different manufacturers.

The same arguments previously presented for Toyota are valid to deduce that for GM the

**threat of new entrants** and the **threat of substitutes** are the least important forces in the electric vehicle industry.

The following table summarizes and assesses GM's EV positioning.

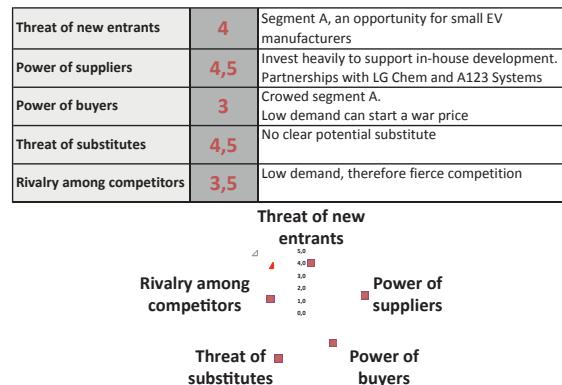


Figure 4.7: GM's coping assessment with the EV industry

### 4.2.2.2 GM's coping with the HEV industry

For more than three decades, General Motors has established a market portfolio that has positioned it well in the traditional auto manufacturing industry. Currently, the company has a **market share of 11,9%** of the total **global vehicle industry**, which makes it the world biggest carmaker in 2011, regaining the top position that gave in to Toyota in 2007. Furthermore, the company has a good market reputation with strong brands and it is known for the quality of the cars it produces, with affiliates in Europe (Opel/Vauxhall), Australia (Holden) and two joint ventures with Shanghai Auto Industry Corp. (SAIC) in China.

In addition, along with its joint venture partners, GM holds the leading position in the BRIC markets, which collectively represent the biggest opportunity for growth over the five years, unlike the stagnant and mature markets where it is more difficult to introduce new products. Specifically, China's demand conditions are exquisite due to the increasing awareness for environmentally friendly vehicles and governmental support. GM has made a significant investment in China covering from R&D, core parts supply to vehicle manufacturing and has built a leading position there with share increasing from 3,4% in 2000 to current 12,8%, **gaining competitive advantage over its competitors**.

By having such a strong presence globally and leading the industry in sales, General Motors'

power to cope with the **rivalry among existing competitors** at a global level is high. It has the capacity required to use a wide range of **aggressive marketing strategies** and improve the **services offered, such as OnStar**, a service that provides subscription-based communications in-vehicle security, hands free calling, turn-by-turn navigation, and remote diagnostics systems throughout the United States, Canada and China. The service currently has more than six million customers.

Nevertheless, **GM's image** compared to other OEMs (e.g. Toyota) in the **field of hybrid vehicles is weaker**. This is mainly due to the fact that fuel efficiency was not a dominant focus in GM's activities, as a reflection of the domestic context, where low petrol taxes led to the development of increasingly larger cars, such as pick-ups and SUVs. That is why, GM has a short tradition in developing hybrid cars and it has been criticized for waiting so long.

General Motors introduced its first hybrid in 2005, in the Silverado pick-up truck, although this was in the form of a mild-hybrid. To counterbalance Toyota's success in the US with its full hybrid Prius and stimulated by new tax incentives granted by the Bush Administration in 2006, GM began to collaborate with Daimler to develop a full hybrid; it formed the Global Hybrid Cooperation, which BMW joined later as well, to accelerate development and share investments (this collaboration ended in 2009). **The first GM full hybrid became available** in 2008, **11 years after the introduction of the Prius**. This resulted in **losing market share** and making an extra effort to catch up with Toyota, Honda and Acura, and their manufacturing of hybrid cars. In order to strengthen the company's position and be the leader in innovation as well as in sales, they decided to improve fuel efficiency and introduce more hybrid models.

Currently, GM offers seven hybrid models and continues to develop plug-in hybrid electric vehicle technology (PHEV), which includes the Chevrolet Volt / Opel Ampera electric vehicle with extended range capabilities. Although **the international demand for light hybrid vehicles is rising** and is expected to reach to 4,5 million units in 2013, this is not enough to ensure GM's success in gaining market share in hybrid vehicles, since the number of products available in the market is also increasing for most of the

segments and the cost of switching vendors for the customers is low. In order to achieve a balance between other car manufacturers hybrids portfolio and soften **the power of buyers**, GM plans to **expand its product offering**.

As previously mentioned, one of the main strengths of GM is its leadership in sales, which provides GM with the capital required for **heavy investments in technology** and supply and demand-side **economies of scale**. These advantages enable GM to diminish the **threat of new entrants**, hindering the entry of new generalist groups at a global level by raising fences in term of capital requirements, economies of scale and proprietary technology.

Some R&D projects carried out by GM around the world are the followings:

- GM Canada is expected to conduct \$1 billion in R&D work from 2009 through 2016, led by the Canadian Regional Engineering Center in Oshawa, Ontario. Current projects include smarter-car research and work on next-generation electric vehicles that lend themselves to widespread use.
- GM has invested \$250 million to build a research facility in Shanghai to expand alternative fuel cell vehicles and hybrid cars.

Additionally, GM has taken advantage of the **Chinese government's regulations**, which foster overseas car manufacturers to enter in the Chinese market and **lower the fences in favor of new entrants**. GM has 11 joint ventures and two wholly owned foreign enterprises that employ more than 35,000 people in China. These include the GM China Advanced Technical Center and the 50/50 joint venture, PATA (Pan Asia Technical Automotive Center). These entities support Shanghai GM (SGM), another 50/50 joint venture, in their efforts to achieve their goal of reducing fuel consumption and CO<sub>2</sub> emissions by 15% by 2015.

As already mentioned, regarding the hybrid vehicles industry, the **power of suppliers** and the **threat of substitutes** can be considered forces of least importance.

The following table summarizes and assesses GM's HEV positioning.

Threat of new entrants	5	Not relevant for major OEMs Economies of scale. High barriers
Power of suppliers	5	Heavy investments in technology, in-house
Power of buyers	4	Product offer expansion
Threat of substitutes	5	No generic substitute
Rivalry among competitors	4,5	Strong presence globally.

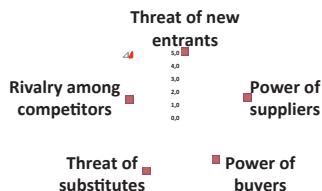


Figure 4.8: GM's coping assessment with the HEV industry

### 4.3 Renault SA

Renault is a French automaker producing cars, and vans. Its 1999 alliance with Nissan makes it fourth-largest automotive group. Headquartered in Boulogne-Billancourt, Renault owns the Romanian automaker Automobile Dacia and the Korean automaker Renault Samsung Motors. Renault also owns subsidiaries RCI Banque (providing automotive financing) and Motrio (automotive parts).

#### 4.3.1 Core segments, core markets and power train portfolio

Renault is a generalist group attending all light vehicle segments with its Renault, Dacia and Renault Samsung brands. The forecasted production for 2011 was 2.755.409 units (ranked #10).

The core segments at 2011 are **Segment B (40,2%)** of the forecasted production, +117,0% evolution 2005-2020), **Segment CV (13,0%, -14,7%)**, **Segment M (11,4%, -36,8%)** and **Segment C (11,3%, -42,0%)**.

Renault's products are mainly sold in **Western Europe (64,9% of group sales, -5,6% evolution 2005-2010)**, **BRI (10,8%, +237,0%)** and **Eastern Europe (9,1%, +22,9%)**.

The distribution of the segments by sales is presented in the figure 4.9.

Segments	Western Europe		BRI		Eastern Europe	
	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010
Segment B	57,4%	+45,5%	15,9%	+186,0%	10,9%	+519,2%
Segment CV	77,7%	+21,2%	3,8%	+63,8%	9,2%	+179,0%
Segment M	98,0%	+53,3%	0,5%	+87,8%	1,0%	+37,7%
Segment C	90,8%	+17,0%	1,6%	+49,1%	1,6%	+35,2%

Figure 4.9: Renault's sales distribution by segments

The current power train portfolio of Renault includes alternative internal combustion engines (both Otto and Diesel) and electric motors. The internal combustion engines' portfolio ranges from 1.149 cc (75 CV, 109 Nm) to 3.498 cc (240 CV, 330 Nm) for Otto engines, and from 1.461 cc (75 CV, 184 Nm) to 2.998 cc (241 CV, 459 Nm) for Diesel. Concerning the electric technologies, Renault proposes the followings:

- I. Permanent magnet AC synchronous electric motor, 20 CV, 57 Nm.
- II. Permanent magnet AC synchronous electric motor, 60 CV, 226 Nm.
- III. Permanent magnet AC synchronous electric motor, 70 CV.
- IV. Permanent magnet AC synchronous electric motor, 95 CV, 226 Nm.

Renault does not have any hybrid power train available or announced.

#### 4.3.2 Green technologies portfolio

Renault's portfolio of low emission models covers segments A, B, C and commercial vehicles and is consisted of pure electric vehicles. All models are offered under Renault's brand and are targeted to the segments' market.

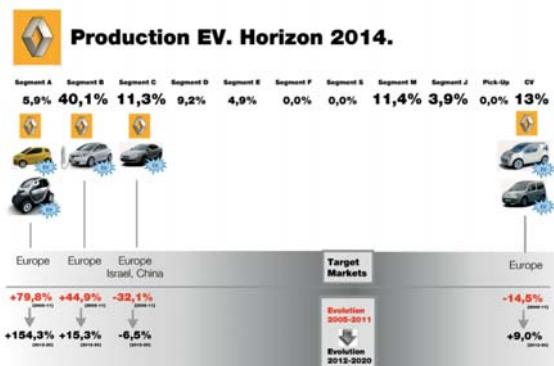


Figure 4.10: Renault's green technology portfolio

##### 4.3.2.1 Renault's coping with the EV industry

The Renault-Nissan Alliance has positioned itself as the **world leader in proposing the EV as the first realistic large-scale alternative to the internal combustion engine vehicle**. With a mass-production and mass-market approach to this new market, Renault intends to make a real environmental impact and offer affordable electric vehicles to the end customer. To achieve this, Renault proposes a full vehicle line-up with four

electric vehicles by 2012 and further new models to follow from 2014 to 2016. Renault's ZE range allied with Nissan's should enable the Alliance to put a cumulative 1,5 million EVs on the road worldwide by 2016.

Instead of proposing a low-volume product to early adopters, or only to consumers with high disposal income, the Alliance is adopting a pioneering industrial approach to EVs and is investing €4 billion to develop and manufacture a comprehensive EV range, as well as competitive lithium-ion batteries, which will be produced in 5 different plants worldwide.

Although all these investments allow Renault to offer vehicles at a purchase price similar to their petrol or Diesel equivalents, once typical government incentives are taken into account, the **battery costs are still higher than conventional ICE parts**, and it will take several years for the market to grow sufficiently for volumes to increase and costs to decrease naturally, which makes meanwhile the **power of suppliers critical in this field**.

In terms of turning the weakness related to the supply of batteries into a strength, joint ventures have been agreed with specialists in lithium-ion battery technology, during 2009 and 2010. This provides Renault-Nissan with its **own electric battery requirements plus the capacity to sell battery packs to third-party manufacturers**. Some of the agreements are the followings:

- Nissan has agreed with NEC in Japan a joint program to develop and build lithium-ion batteries for electric cars. Nissan's advanced lithium-ion battery plant in Sunderland will have a production capacity of 60,000 batteries per year and will start manufacturing in 2012. Thanks to its alliance with Nissan, Renault can take advantage of its partner's joint venture with NEC for batteries (AESC).
- In November 2009, a letter of intent was signed between the Alliance, the French Atomic Energy Commission (CEA) and the French Strategic Investment Fund (FSI) to set up a joint venture company that would develop and manufacture batteries for electric vehicles at the Renault Flins plant in northern France. Production capacity is targeted at 100,000 batteries a year from mid 2012.

Apart from the batteries' issue, Renault-Nissan must face other challenges in order to widespread adoption of EVs. They are not alone in the EV industry and the **rivalry among competitors** is constant. Renault believes there is a need to have greater economies of scale to cover all relevant technologies and to cover global markets including emerging ones. These supply and demand-side **economies of scale raise fences against other competitors** and **balance the price wars** in their favor, **gaining market share**. In this way, Renault is trying to drive down costs by sharing costs with Nissan, through manufacturing standardization, cross production, cross-cultural management, common platforms and common parts. Moreover, on April 7, 2010 the Alliance announced a **strategic co-operation with Daimler** that covers a wide range of projects as well as sharing of best practices. It will be managed by RNVB for the Alliance and Daimler through a new Cooperation Committee giving representation to all parties. The RNVB team worked to boost the efforts being made across the Alliance in areas such as global expansion and new product programs.

In addition, the **high R&D investment, €4 billion in projects**, represents a competitive advantage and a **high barrier for existing competitors**, as well as for potential new entrants. For example, in Israel for the first time in history, all the conditions necessary for electric vehicles mass-marketing will be brought together in a partnership between the Alliance, Better Place and the Israeli government. The target date is 2011. Renault will provide the vehicles and their lithium-ion batteries will be provided by Nissan through its Automotive Energy Supply Company (AESC) joint-venture with NEC.

Wider use of the EV requires adequate recharging infrastructure, which is why, the Renault-Nissan **Alliance** has signed **more than 100 partnerships aimed at preparing markets and charge points in public and private locations worldwide**. By having such a **strong presence globally in terms of EVs** and being the first OEM developing commercial mass-produced electric vehicles, Renault acquires an **image of reference and brand reputation**, which lead to gain market share and obtain competitive advantage over its competitors. Furthermore, all these partnerships show **Renault's commitment in leading the EV industry and constitute important exit barriers**.

The latest announcements are listed below:

- **Announcements made in 2010:** Andalusia (Spain), Reunion Island (France), Ryokan Association (Japan), Hertz (worldwide), Christchurch City Council (New Zealand), Orlando (USA), Houston (USA), Massachusetts (USA), Avis (worldwide), ChaDeMo Association (Japan), Wuhan (China), Castilla y Leon (Spain), Acciona (Spain), ENEL (Italy), ENDESA (Spain), Madrid (Spain), Ireland, Sao Paulo (Brazil), Milton Keynes (United Kingdom), Mobi-e (Portugal), Sevilla (Spain), Istanbul Enerji (Turkey), Ankara (Turkey), Unibail-Rodamco (Europe), Avis (Europe), Amsterdam (NL), Cordoba (Argentina), Ireland (Ireland).
- **Announcements made in 2011:** E-Laad (NL), Colizen (France), renewal of GDF SUEZ (France), La CREA/EDF/Schneider Electric/ERDF / E.Leclerc (France), Georgia (Georgia), GASKİ Enerji (Turkey), Hertz (Europe), The Mobility House (Austria and Switzerland), Axa (Europe).

In Western Europe, in particular, these commercial partnerships are starting to bring concrete results. For example, German energy company RWE has already installed more than 1,000 charging stations on the street. Acciona and Endesa, partners in Spain, installed more than 2,000 public charging stations across the country in 2010. In Italy, as part of a pilot operation that started at the end of the year in the Milan region, partner ENEL started deploying more than 500 charging stations in the cities of Milan and Brescia.

In line with the electric technology R&D, the Alliance is also developing some research on fuel cell-powered electric vehicles (FCV). Two prototypes are currently in an advanced engineering phase:

- Nissan's pioneering X-Trail fuel cell vehicle has been undergoing 'real-world' testing for more than three years, with examples leased to government authorities in Japan
- Renault's prototype Scénic ZEVH2, based on a Renault Grand Scénic, is a joint Alliance development. It is fitted with fuel cell stack, high-pressure hydrogen storage tank and compact lithium-ion batteries.

This diversification reduces the risk related to focusing all the efforts on electric technology and allows Renault to be updated in other green technologies that might be important in the long term, because nobody knows for a certain fact if the electric vehicle industry will be the leader in the future.

Regarding the **power of buyers**, Renault needs to be extremely careful on how far in the future it is looking ahead and it needs an improved understanding of consumer willingness to change vehicle purchase and travel behavior. Customers are **price sensitive** and might also have a further preference towards ICE and hybrid technologies in cars, thinking they are more reliable. The most powerful way to overcome this reticence is by practical demonstration. Thus, Renault has launched a fleet deployment program on an unprecedented scale to prepare for the commercial launch of its electric vehicles. Between the end of 2010 and mid-2011, **Renault made more than 600 prototype vehicles available** to its partners, to be tested under real conditions of use for hundreds of thousands of kilometers **as part of pilot programs in 10 countries**.

Additionally, the reduced number of **customers** could **create price wars**. One of the major strategies Renault has in order to keep up with the competitiveness of the industry, is **the leasing of the batteries**. This model makes it possible to **reduce the EV's initial cost** and also using rechargeable stations not only to charge the battery but also to replace the empty one for a full one in a short period of time, allowing **longer distance trips**. Therefore, making EV more tempting for the customers. As an example, Renault revealed the prices of the Fluence ZE and Kangoo ZE models: €21,300 including VAT + €79 including VAT / month for the battery subscription and €15,000 before VAT + €72 before VAT for the battery subscription, respectively. **These prices**, which include a tax incentive of €5,000 in France, **make Renault's offering a credible alternative in terms of price to combustion-powered vehicles**.

The **threat of new entrants** and the **threat of substitutes** are not significant forces for Renault within the EV industry.

The following table summarizes and assesses Renault's EV positioning.

Threat of new entrants	5	Not relevant for major OEMs in mainstream seg. High R&D investment
Power of suppliers	5	Agreement with NEC, CEA and FSI to develop and manufacture its own batteries
Power of buyers	4,5	Broad offer. Cost competitive thanks to the battery leasing programmes. Buyers price-sensitive further preference towards ICE an HEV
Threat of substitutes	5	No clear potential substitute
Rivalry among competitors	5	Commitment in leading the EV industry. Image of reference and brand reputation

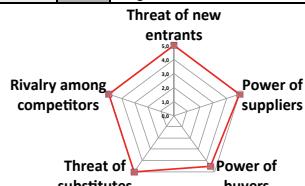


Figure 4.11: Renault's coping assessment with the EV industry

#### 4.3.2.2 Renault's coping with the HEV industry

Renault's strategy in the field of hybrid vehicles is non-existent and it has expressed a view that hybrid vehicles are essentially not profitable and costly to both the OEM and the customer. The group has completely focus all its efforts on electric technology, which is risky considering that the promises of the implementation of full electric vehicles are still uncertain and the use of hybrid engines, on the other hand, is growing at present. Nevertheless, Renault has shown a diesel-electric power train in a mild hybrid configuration, the Ondelios concept car, at the 2008 Paris Motor Show.

In order to hedge its bets Nissan is developing both a 'parallel hybrid' system and a plug-in 'series hybrid'. This would be an advantage for Renault, since thanks to the Alliance with Nissan, Renault can take advantage of its partner's technical knowledge and industrial facilities in areas where Nissan has already operations.

## 4.4 BYD

BYD Automobile Co Ltd is a Chinese automobile manufacturer based in Shenzhen, Guangdong Province, China. The firm was established in 2003 and is a part of BYD Co Ltd, a rechargeable battery maker.

### 4.4.1 Core segments, core markets and power train portfolio

BYD's product portfolio offers nine models, attending segments A, C, D, M and J. The

forecasted production for 2011 was 532.756 units, which makes the company the sixth largest Chinese carmaker by units sold (ranked #26 globally).

The core segments at 2011 are **Segment C (61,1%)** of the forecasted production), **Segment A (23,6%)** and **Segment D (12,9%)**. The 2005-2020 expected production evolution by segments is presented below.

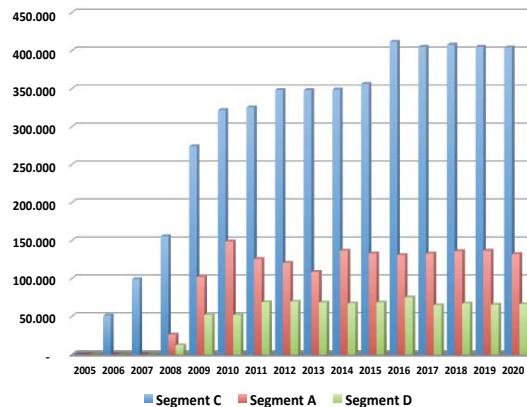


Figure 4.12: BYD's core segments production evolution

BYD's products are **mainly sold in China**. However, some models are exported to other developing countries: Peravia Motors distributes some cars in the Dominican Republic, a Russian company, TagAZ, assembles BYD models in Russia, others are also offered in Ukraine...Moreover, the company is trying to enter the European and Israeli markets and hopes to sell vehicles in the United States, too.

The current BYD's power train portfolio includes a reduced offer of internal combustion engines (only Otto), two combinations of hybrid power trains and just one for electric power train. The internal combustion engines' portfolio ranges from 988 cc (68 CV, 90 Nm) to 2.378 cc (162 CV, 220 Nm) for Otto engines. Concerning the hybrid technologies, BYD proposes the following combinations:

- I. Otto, 998 cc, 3 cylinders (67 CV, 90Nm). Permanent-magnet type synchronous motor (102 CV, 400 Nm). Dual clutch, 6 speed transmission.
- II. Otto, 1.998 cc, 4 cylinders (104 CV, 186 Nm). Permanent-magnet type synchronous motor (114 CV, 450 Nm). Dual clutch, 6-speed transmission.

Concerning the electric technologies, BYD proposes the following configuration:

1. Permanent magnet synchronous motor (102 CV, 450 Nm).

#### 4.4.2 Green technologies portfolio

BYD has several low emission models that cover segments C, D, M and J. Three plug-in hybrid models are offered in segments C, D and J, targeted to the Chinese, U.S. and European markets. Moreover, a full electric model is available in segment M for China. (The EV in segment C was cancelled). Although segment A is important there is no HEV/EV offered currently.

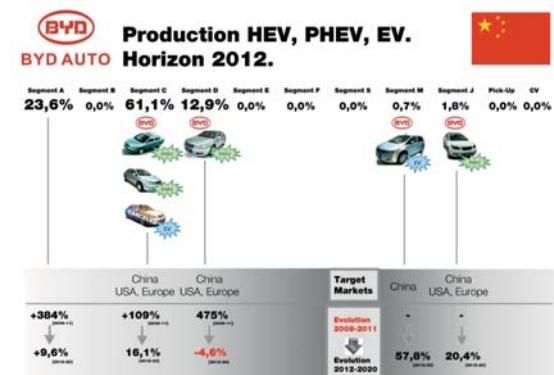


Figure 4.13: BYD's green technology portfolio

##### 4.4.2.1 BYD's coping with the EV industry

When in 2003, Mr. Wang entered the automotive industry, he thought his battery know-how would give him an edge in building electric cars. Looking at the EV, the battery is the main cost driver and differentiator of this class. The other components of the car are standardized and do not play a larger part in evaluating the EV. Therefore, **BYD is in a very unique position in the electric vehicle industry** since it can use its **battery strength** to produce non-pollutant vehicles and create a good new brand.

Initially depending on external suppliers, the acquisitions of nearly 200 companies and their integration into BYD, including a R&D center, allowed to focus on internal strengths. This makes BYD **the only vertically integrated car manufacturer** within the electric mobility industry **that makes its own batteries and provides the whole package to the customer**: charger, battery and car. Thus, **the power of suppliers almost disappears**.

In terms of **rivalry among existing competitors**, BYD has several strengths to cope with this force, but also substantial weaknesses. Among its strengths are those related to the company's good financial condition, core technology and government support, which help BYD rival with the traditional OEMs.

The company has kept **robust growth rate yearly** since in 2003 it started the auto business and has focused on the research, development and manufacturing of a **wide range of new energy products, including the EV charging facilities, energy storage systems and solar energy stations**, which raise barriers facing new entrants.

The newly developed **ferrous-based battery has cost, capacity and safety advantages** compared to the lithium-ion battery. These features **improve customer value and can support higher prices**. Based on the "Fe Battery" technology, BYD has worked out a Green City Solution, which aims to electrify the urban public transportation system with pure electric buses and taxis.

To acquire more technical knowledge and raise fences against its competitors, BYD has announced the setting up of a R&D center in Hong Kong Science Park, and its **collaboration with the Hong Kong Automotive Parts and Accessory Systems R&D Centre (APAS) and the Hong Kong Productivity Council (HKPC)** to promote the development of electric vehicles. Also in 2010, BYD worked with China Southern Power Grid and Pengcheng Electric Taxi Co., Ltd to build the EV charging stations and complete the distribution, layout of monitoring network of the charging stations and other charging facilities.

Another factor that helps BYD strengthen its condition over its competitors is that it has the world's biggest home market, China. Moreover, the awareness for electric mobility in China is high, so BYD uses this awareness to **gain governmental support and market share** respectively. The government's imprint is visible on the company's financial statements. BYD received US\$56 million, US\$62 million and US\$57 million in government subsidies, respectively, in 2008, 2009 and 2010. Additionally, **in 2011, BYD launched its first electric bus, K9, in Shenzhen**, and eight months later it provided 200 e-buses and 250 electric taxis for the city's World University Games. This

business was basically a gift from the city government.

Additionally, in October **2009**, **Warren Buffett invested US\$232 million** - a 10% equity stake - in **BYD**, catapulting the company into the international spotlight. This investment from Mid-American Holdings, 87%-owned by Berkshire Hathaway, gave the company not only the **capital to consider global expansion** but also the credibility to test the waters in a foreign market.

Although BYD is well represented in China, **its presence worldwide is still weak**. There is also a quality gap from traditional OEMs, **the brand image is still weak** in general, and it faces **resistance from American and European consumers** who perceive Chinese-made goods as being cheap and of low quality. The company has also bad reputation for mimicking car designs rather than for innovating them and has often been criticized for its copycat models.

Furthermore, BYD's entrance into a new market involves that the company must face a completely new set of consumers, dealership networks and branding hurdles on its own.

In order to gain brand image and **rival competitors under better conditions**, BYD has **several agreements** with some of the most respected companies worldwide. In 2009 **BYD and Volkswagen** agreed to work together on developing lithium-ion batteries for electric and hybrid vehicles, as part of VW's BlueMotion technologies initiative. In March 2010, a memorandum between **BYD and Daimler** was signed to develop a new electric vehicle specific to the requirements of the Chinese market, which will be marketed under a new brand jointly created and owned by both companies. The technology partnership aims at **combining Daimler's electric vehicle architecture know-how and BYD's excellence in battery technology systems**.

Regarding the **power of buyers**, the reduced EV offer can represent a drawback, **just one model, the E6**, with a price of \$39,300 - after government subsidies. This model belongs to segment M, where the risk of starting a war price is lower than in other segments where the full electric vehicle offering is broader. Nevertheless, consumers have too many choices and BYD

faces a difficult task in convincing Chinese consumers to choose the E6 over entry-level luxury cars from companies such as BMW and Volkswagen AG's Audi.

The **threat of new entrants** and the **threat of substitutes** are not important forces for BYD as explained in the other cases.

The following table summarizes and assesses BYD's EV positioning.

Threat of new entrants	<b>3</b>	More important in the Chinese market
Power of suppliers	<b>5</b>	Vertically integrated car manufacturer Own batteries
Power of buyers	<b>4</b>	Segment, features, support higher prices
Threat of substitutes	<b>4,5</b>	No clear potential substitute
Rivalry among competitors	<b>3</b>	Weak global presence American and European consumers resistance

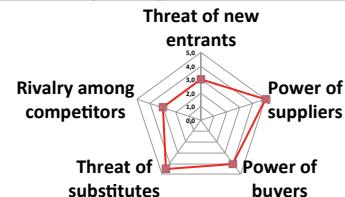


Figure 4.14: BYD's coping assessment with the EV industry

#### 4.4.2.2 BYD's coping with the HEV industry

From the world's biggest manufacturer of mobile phone batteries to a car company with global pretensions, BYD has entered into the international stage pushed by its founder Wang Chuanfu. **"Independent R&D, brand and development"** is the core idea of the auto company, which aims on creating a brand with international respect and reputation of quality, to promote the national automobile industry of China.

Today, **R&D** activities are **focused on the low emission vehicles and diversification in the battery business**, making BYD the **first mover integrating forward into the car industry**. Instead of being the battery supplier of other car manufacturers, the company decided to build its own cars under BYD's brand.

BYD started selling a plug-in hybrid electric vehicle with a gasoline engine (F3DM) in December 2008, moving one step ahead of General Motors and Toyota. Being the first in the Chinese marketplace has provided BYD with important assets (brand reference and market share) against the **rivalry among existing competitors**. BYD mainly has three kinds of

rivals: other private auto enterprises (e.g. Geely), state-own enterprises (e.g. Chery) and joint ventures (e.g. GM-SAIC), which means that the Chinese market is very crowded and the competition is becoming more and more intense.

**Another important aspect** for BYD is related to **the features** it can offer. The F3DM can go 100 kilometers on its battery on a single charge and an additional 300 kilometers with its 1.0 liter gasoline engine. Although the price more than doubles the basic gasoline model, it is still **half the price of the Toyota Prius**. This softens the **power of buyers**, which could consider buying BYD's hybrid model because of its affordable price. Moreover, in order to fulfill consumers' needs and desires BYD expands its product offering with another two plug-in hybrid vehicles: a SUV (S6DM) and a mid-size sedan (F6DM).

For long-term growth, BYD will continue to follow the development path of **self-research and development, self-production** and self owned brand and launch diversified quality products with competitiveness and focus on enhancing **brand awareness and reputation**. These raise **barriers against new entrants**. Furthermore, opposed to Chinese companies implementing high-tech equipment from foreign partners, the founder, Mr. Wang, reinvented the manufacturing process by replacing machinery with manpower **taking advantage of the local labor cost**.

The **threat of substitutes** is higher forbidd than for the cases studied above, since its product line-up is poor, with lack of diesel engine offering and **diesel powered vehicles could be a good cost-performance trade-off for price sensitive customers**. On the other hand, the **power of suppliers** is low since BYD follows the strategy of internalizing most of the value chain activities, conducting **70% of the value creation inside the company**.

The following table summarizes and assesses BYD's HEV positioning.

Threat of new entrants	4,5	More important in the Chinese market
Power of suppliers	5	Most value creation inside the company
Power of buyers	3	Price sensitive customers: F3DM costly for the Chinese market
Threat of substitutes	3,5	Poor product line-up. Lack of diesel engines. Diesel vehicles good performance trade-off
Rivalry among competitors	3,5	International weak brand image

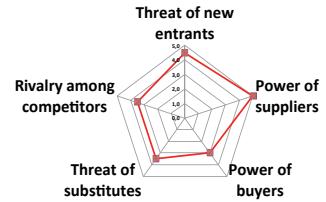


Figure 4.15: BYD's coping assessment with the HEV

## 5 Strategy assessment

Developing a strategy in an industry observing revolutionary **technological changes** can become a daunting proposition. In such cases, the firms are facing a **high level of uncertainty** about the needs of customers, the products and services that will prove to be the most desired, and the best configuration of activities and technologies to deliver them. Because of all this uncertainty, **imitation and hedging** are rampant: unable to risk being wrong or left behind, most companies match all features, offer all new services, and explore all technologies.

During these periods of development, the industry's productivity frontier is being established and re-established. Important growths can make such times profitable for many companies, but profits will be temporary because imitation and strategic convergence will ultimately destroy industry profitability. The companies that are enduringly successful will be those that begin as early as possible to **define and embody in their activities a unique competitive position**. A period of imitation may be inevitable in emerging industries, but that period reflects the level of uncertainty rather than a desired state of affairs.

In high-tech industries, this imitation phase often continues much longer than in other sectors. Excessively technology-focused, companies might pack more features, not all necessary, into their products and push the prices down. **Rarely are trade-offs even considered**. The drive for growth to satisfy market pressures, leads companies into every product area. Although a few companies with fundamental advantages prosper, the majority will suffer high levels of competitor's rivalry.

## 5.1 Toyota Motor Corporation

### 5.1.1 EV strategy and business model analysis

After almost 15 years of launching the first hybrid vehicle, Toyota has constructed an image of **engineering excellence** in the alternative power train car field. Having proved that the firm's products can be successful both performing different activities from rivals or similar ones but in a different way, Toyota **may be considering entering the EV industry**: although competitive advantages can usually seem solid, they are at least temporary when market positioning can easily be copied by competitors.

After a preliminary attempt during the late nineties, Toyota announced the resuming of its research and development on electric vehicles and the commercial launch of two models in 2012.

The first model is a **Segment A two-seat car** targeting urban-based high-incomes profiles (Japan, Europe and the U.S.), that request **mobility solutions** for its personal needs. **Compactness** and **enough battery range** for a daily urban use are the minimum features requested. **Brand image is assumed**. This model permits Toyota to satisfy few needs (autonomy, charge) of many customers (urban focused early-adopters), which represents a **variety-based positioning**. This choice will determine which activities are requested, and how are they performed, in order to offer a valuable customer value proposition.

The other EV model that Toyota will launch (only for the US market) is a **Segment J SUV** that will be developed in partnership with the US luxury electric carmaker **Tesla Motors**. The performances of this vehicle in terms of range (160 Miles) broadens the possibilities of use but restricts the targeted customer profile to late early-adopters with a higher purchasing power. Serving more need of few buyers is known as a **needs-based positioning**, and conditions the activities requested for this specific customer value proposition.

The two different approaches of Toyota regarding the EV industry are **coherent with its current product portfolio**: **Segment J** represents a **19%** of its production and it is

mainly focused on NAFTA (50%) and Chinese (21%) markets. Toyota offers **three hybrid models** in Segment J (two Toyotas, one Lexus) and a complete offer of **eighteen ICE models** under all group's brands except Scion. The evolution in production of this segment has been +33% (2005-2011) and it is forecasted to grow another 15% from 2012 to 2020. Being the second segment in importance among the group (just 2% far from leading Segment C), and the specific weight of Segment J in both a mature market and an emergent economy, the **approach of Toyota can be classified as consistent**: it aligns **technology mastering** (participation in Tesla), **core segments**, **core markets** and **product portfolio**.

Regarding Toyota's offer in **Segment A**, the product portfolio presents six ICE models (four Daihatsu and two from Toyota). **This segment represents just a 5%** of the production of the group and it is focused on Eastern Asia (72,7% of total sales in 2010) and Western Europe (25,7%) and its evolution in production has been -2,13% (2005-2011) and is forecasted to be +41,32% from 2012 and 2020. The EV offer of the group for this segment is limited to the **electric version of the Toyota IQ**, the urban two-seat car concurrent to the popular Smart Fortwo from Daimler. This **approach makes sense** because profits from a platform already existing and lies on a technology suited for the use this kind of vehicle may have. It is important to observe that due to the variables still existing on EV's technologies, **Segment A will be the validation platform** for most of the products from classical and new OEMs. **The risk** that Toyota assumes with this product in a segment with low specific weight is **low and therefore acceptable**.

An outside analysis seems to indicate that Toyota **discarded to become a straddler** and develop in parallel several alternative power train technologies. Although that the first Toyota Prius appeared in 1997 in parallel with the semi-prototype electric RAV4 EV (only in California), the fact that Toyota discontinued the project few years later, seems to indicate that the group observed some incompatibilities among both activities or internal limits in coordination or control. The **trade-offs** among the activities, led to a deeper internal development of the hybrid technologies that has **positioned Toyota as the leading OEM** in this field. In this sense, resuming the RAV4 EV project in partnership with Tesla

and the deepening in hybrid technologies that the plug-in devices represents, proves that **technical trade-offs are clearly established** within the group.

It is difficult to assert whether Toyota's commitment to hybrid technologies has reinforced other technical development activities within the company. The deeper knowledge acquired in engine control and fuel-saving technologies has certainly generated positive synergies with classical power trains. However, **Toyota has been pointed out for having lost competences in Diesel engines development**. The incipient diversification that the two EV represent may be considered as a **proper opportunity for a fine fitting among activities**. Technical knowledge exchange between Toyota and Tesla Motors will be mutually beneficial and reinforce the customer value proposition for both technologies. An illustrative example is the **transversal use of the recharging net** from both the hybrid and the pure electric vehicles and the effect that this fact can have in terms of public acceptance of the green portfolio.

The diversification in EV carried out by Toyota responds to the **need of positioning the firm in an industry not yet defined**. The choice of specific products and segments is consistent with the current product portfolio, the potential customers' needs and the growth rate of the markets to which these products are aimed. In order to cope with a potential new *status-quo*, the **participation in Tesla Motors' capital must be understood as an extension of Toyota's strategy** regarding the green technologies: do the choices and trade-offs that will permit to **reach, soon and consistently, the productivity frontier and raise the firm's competitive advantage**.

Business models (BM) can be deconstructed in **four interlocking elements** that define not only the value for both the customer and the company but also how this value is delivered to the firm and the final user. The **customer value proposition (CVP)** identifies the way to create value for the target customers, helping them to find a solution for a fundamental problem on a given situation. The second element is the **profit formula**: the blue print that defines how the company creates values for itself while providing value to the customer. It includes the revenue model, the cost structure, the margin model and

the resource velocity turnover. The third element focus on the **key elements** required to deliver the value proposition to the targeted customer: the way in which people, technology, products, equipment, information, alliances, etc. and how they interact will also define how value is created for the company. The last element is the managerial and operational **key processes** that allow companies to deliver value in a way they can successfully repeat and increase in scale. Recurrent tasks as training, development, manufacturing, budgeting, sales and services belong to this group. These four elements form the building blocks of any business and when significant changes are needed to all of them, a new business model may be required.

The **disruptive innovation that the EV represents**, can address specific needs of potential customers: the **cost of mobility is the transversal advantage** for all EV users that in specific cases can also profit from other benefits such as **tax reduction, urban parking areas or unlimited urban access**. The **CVP** seems to be more fulfilling for the Segment A model from Toyota than for the RAV4 due to the customers' profile. **Early-adopters seem to be more attracted for a compact** and expensive urban car than for a big and familiar **SUV, better fitting the needs of late early-adopters** or even **early majority** profiles.

The **importance of electric components' suppliers** within the value chain alters the specific weights for all the players involved. The **leveraging of existing technologies** such as the Li-ion batteries in another industry implies the **redefinition of the profit formula**. The **current status-quo of the EV technology** can also be understood as an **entry barrier** for those OEMs that do not want to include in its portfolio compact urban Segment A cars. This represents an **opportunity for small car manufacturers** that can offer a specific CVP focused on the specific needs of a targeted customer profile. This multiplicity counteracts the commoditization trend to which the big OEMs may converge in this segment and, more important, the **industry profitability is redefined**. **Similar conclusions** can also be valid for bigger segments (e.g. **Segment J**), with the exception that **competition will come from the classical players**.

As for any technological evolution, it seems logical to expect **shifts in the basis of competition**: what defines an acceptable solution in a market will change over time becoming

necessary to regularly adapt the way in which the value is generated in the company and delivered to the customer. Some **key resources and services can be more valuable for the Segment A product (brand image, services, sales)** while others (**alliances, partnerships, development**) are **more necessary for less conditioned product as the EV RAV4.**

Being all the four elements affected, Toyota should propose a **different BM** not only for the company but also **game changing for the industry**. The feasibility and consistency of this new model must assure that, the CVP nails the job-to-be done, the interaction of the four elements is guaranteed, the new BM is unfettered by the negative influences of the precedent or principal one and that it disrupts competitors.

The following table summarizes and assesses Toyota's strategy and business model within the EV industry.

Outperform rivals	4	Image of engineering excellence in the alternative power train car field
Strategic positioning	4,5	Variety and based-need positioning. Consistent with product portfolio
Activities' trade-offs	4,5	Diesel engines development slowing down Internal limits in coordination and control
Fit among activities	5	Knowledge exchange among Tesla and Toyota. EV-PHEV
Strategies' threats	4,5	Although industry not yet defined, deepen the strategy (participation in Tesla)
Business model	4	CVPs well defined Premium brand image, services and dealers

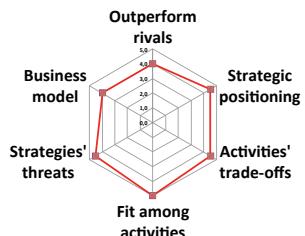


Figure 4.16: Toyota's EV strategy and BM.

### 5.1.2 HEV strategy and business model analysis

As far as HEV industry is concerned, Toyota attempts to **achieve sustainable competitive advantage** by preserving what is distinctive about the company, focusing its strategy on developing **hybrid technology as the core technology of the immediate future**.

Toyota masters, in terms of volume, the global HEV industry. The company has had an enormous success with the Prius model, released

initially in Japan in 1997 and with global sales totaling 2,36 million (August 2011).

With the commercialization of its first hybrid model, more than a decade ago, Toyota managed to outperform its rivals by offering buyers vehicles with a different technology, based on hybrid power trains instead of the traditional internal combustion engines, delivers greater value to customers (fuel saving, differentiation, emission reduction...), allowing the company to charge higher average unit prices.

Toyota set a precedent making **profitable hybrid vehicles' mass production** for the first time. Since then, the company has devoted significant resources to bringing the on-cost of a hybrid power train down whilst improving performance. As means of performing more efficiently and achieve cost advantage Toyota has developed many **new management concepts and tools** as total production maintenance (**TPM**), **kanban** system (**JIT**), target costing, **lean management**, the **Toyota Way** and others. Moreover, Toyota's value chain activities, its linkages across them, and its linkages with the value chain of its suppliers are configured in such a way that they provide the Japanese competitor with a distinctive capability.

When Toyota launched its first hybrid model, the strategic positioning was **based on customers' needs**. The company tried to serve most of the needs of a particular group of customers. This group was less price sensitive than the average, more aware of environmental issues, fond of green behavior and innovative technologies. In addition, these customers' need of mobility was broad, both urban drive cycles and longer distances commuting. Furthermore, since the launch of the second-generation of the Prius in 2003, the model has switched from being essentially a **niche vehicle to a mainstream product** and Toyota has expanded considerably its **hybrid vehicle offer** (under Toyota and Lexus brands) to include models across the range of segments, aiming its strategic positioning to cover a **broader group of customers**.

For 2012, Toyota will be offering four HEVs, plus one PHEV targeted to Japan, USA and Europe in segment C. This segment represents the 21,3% of the company's total production and is expected to increase 12,5% between 2012-2020. Moreover, its sales are distributed among Nafta 33,1%, Eastern Asia 32,0% and China 17,1%. Along with segment

C, segment J (18,7% of total production and +32,3% of expected evolution 2012-2020) is one of the most important ones for Toyota, especially in Nafta with 50,3% of the global sales. Therefore, it offers three more hybrid SUVs in this segment, targeted to the U.S and Japan.

Regarding the segments M, E and B, which represent the 14,5%, 12,9% and 12,1% of the global production respectively, Toyota will be offering another four HEV models in each one, targeted to Japan, Europe and the U.S. These segments are also expected to have high evolution rates for the period 2012-2020 (32,3%, 10,4% and 30,7%, respectively).

All this variety shows that Toyota's **approach to the hybrid vehicle industry is highly consistent: it aligns technology mastering, core segments, core markets and product portfolio**. Furthermore, Toyota is so committed to the hybrid technology that the company's **product portfolio extends beyond the main segments**, offering a hybrid model targeted to Japan in segments D, F and S which represent the 2,4%, 0,3% and 0,2% of the total production. This secondary approach, clearly need-based, restricts the targeted customer profile to those with a **higher purchasing power and brand image awareness**.

Nevertheless, some competitive activities are incompatible, and gaining in one area can be achieved only at the expenses of another area. In such cases, activities' **trade-offs are needed**. This could be the reason why **Toyota has set aside internal combustion developments** (Diesel, downsized ICE) as part of its fuel efficiency strategy. Toyota has become a reference for its well-known hybrid technology and trying to lead other green technologies **could mislead its customers or even undermine its reputation**. Probably for the same reason, Toyota **gave up its electric powered programs (RAV4) in 2003, considering them counterproductive**. Due to those trade-offs, Toyota's image in terms of hybrid vehicles is strong and constitutes a **powerful barrier against repositioners and straddlers**.

Apart from positioning and trade-offs, **fit and reinforce among activities** is fundamental for sustaining a competitive advantage and increase brand identity. In this sense, the aggressive **cost management of its increasing hybrid portfolio**,

is supported, among other factors, by the goal of offering the technical and economic advantages that the next-generation technologies may represent. The company has recently established a **department for battery research that appears to be focusing on zinc-air cells** as the next generation of its battery technology primarily for its plug-in hybrid cars. Toyota hopes to have a new battery type, with improved range, under production for 2020, which coincides with its **all-hybrid mandate**.

In terms of deepen a strategic position and avoid the strategy's threats, related to broaden, that can compromise it, Toyota is trying to **communicate its strategy better to the customers through the expansion of its product line-up across most of the segments**. The company is expanding globally (U.S., Europe, China...) to reinforce its position.

As far as the business model is concerned, there are some modifications, but in general it doesn't represent any disruptive change from the traditional business model for the OEMs. The **mobility concept remains invariable** for ICE powered vehicles as for hybrid vehicles: car's ownership concept is the same, drivers do not have to worry about running out of electricity in longer trips and ICE vehicles characteristics such as performance, safety, reliability and efficiency are guaranteed by the customer value proposition. Additionally, due to the efforts that the company is making expanding the hybrid vehicles offering to all segments, the target customer is also similar.

The main change lies in the **greater value that is delivered to customers**. The identification of the desires and demands of the consumers has led Toyota to offer **environmentally friendlier vehicles**, which allow fuel consumption savings while keeping vehicles' performance.

In order to create value for the company while providing value for customers, companies conclude **strategic partnerships upwards and downwards** the value chain system for a better coordination of the entire chain. This involves the alignment of the value chain members to the same goal, which is the creation of the superior customer value. Regarding the hybrid industry, the players involved are the traditional except battery suppliers, which represent the main change. This implies the **redefinition of the profit formula of the BM. Toyota's partnership with Panasonic**

for battery technology exemplifies the new key elements for the firm's success.

In terms of the **key resources** and **key processes**, Toyota has **skilled people, automated and efficient plants** with embedded **quality control systems**. This is backed by marketing and sales through advertising and dealership networks, and service through the use of guarantees and warranties. All these elements are the same as the traditional automotive industry.

This analysis shows that significant changes are not needed to all the four elements for the hybrid vehicles industry BM. Nevertheless, **plug-in hybrid technologies may force a move to new business models** with similarities with the full electric vehicles' one.

The following table summarizes and assesses Toyota's strategy and business model within the HEV industry.

Outperform rivals	5	Making profitable HEVs mass-production for the first time
Strategic positioning	5	From niche vehicle to mainstream. Wide variety of segments covered
Activities' trade-offs	4,5	Gave up its electric programs in 2003. EV development resumed with Tesla
Fit among activities	4,5	R&D on next generation of batteries, EV-PHEV. Aggressive cost management
Strategies' threats	5	Deepen the strategy expanding globally. Growth that is consistent with strategy
Business model	5	CVP: all segments covered. Strategic partnerships



Figure 4.17: Toyota's HEV strategy and BM.

## 5.2 General Motors Company

### 5.2.1 EV strategy and business model analysis

There is a general acceptance that electric vehicles have a significant role to play in the transport infrastructure of the future, and the leading OEMs are rapidly becoming committed alongside many newer players. Therefore, companies must respond to competitive and market changes. In order to **stay ahead of rivals, GM has brought electrification squarely back** on to its automotive agenda. Its pure EV offer is

limited to a single model and the **strategic positioning of the firm can be described as conservative**, contrary to the hybrid initiatives, where GM sets a clear difference over its competitors.

The Spark EV was firstly unveiled in June 2011, in New Delhi, as the Chevrolet Beat EV, and was originally targeted to the Indian market. However, the latest news indicate that finally this **segment A model** is going to be **launched in 2013** as the Chevrolet Spark, largely **focused on California** and perhaps other U.S. states that have adopted its emission standards. This model permits GM to satisfy few needs (**compactness and enough battery range for a daily use are the features required**) of urban focused early adopters, which represent a **variety-based positioning**.

With this approach GM is proposing an EV model in a segment with low specific weight, 5,4% of its total production, but with an interesting growth potential, +67,9% evolution (2005-2011) and +51,9% expected evolution (2012-2020). Moreover, the idea is to sell low volumes, 2.000 cars a year. Therefore, the risk GM is taking is low. **The company is going to use segment A as validation platform for EVs**, which is the same strategy as most OEMs: PSA C-Zero, Mitsubishi i-MiEV, Daimler Smart, VW E-up, etc.

Back in 1996 GM launched the EV1, which was powered by lead-acid batteries, at Los Angeles Motor Show. By that time, GM was leading the way in terms of investments in EVs, pumping a reputed U.S. \$1 billion into its EV1 project. However, the company **discontinued the project in 2003** making a clear **trade-off**: probably due to internal and resources limitations, GM chose to be in the forefront in the development of alternative fuel vehicles rather than lead EVs' technology. General Motors currently offers **19 FlexFuel vehicles**, estimated to be 40% of their U.S. vehicle sales, capable of operating on gasoline, E85 ethanol or any combination of both.

On the contrary, in terms of the **hydrogen fuel cell technology**, it seems that **GM never made a trade-off**, since it has conducted research for more than 40 years in parallel to other research activities, and is engaged at all levels for **the in-house fuel cell development**. This can be justified by the fact that regardless of whether a vehicle uses a hydrogen-powered fuel cell or a battery charged from the grid, **the electric propulsion**

**systems feature many common components and sub-systems.** Traction motors and generators, power electronics and battery management systems work in much the same way for each type and **improving one type can benefit all.** Each alternative drive vehicle also relies on systems like electric power assisted steering, electronic brake control and electric climate control. The more the company's positioning rests on activity systems with second- and third-order fit, the more sustainable its advantage will be.

**GM is being cautious** in its positioning in an industry which is still not defined and the only EV product that it will be offering is consistent with the potential customers' needs and growth rate of the markets. In order to **deepen this strategic position and strengthen the whole industry**, GM is **collaborating with two utilities** based in Michigan, in order to **install a recharging net for grid-connected vehicles in the region.** The three partners will jointly set up nearly 5,300 charging points in Michigan at homes and work places. Furthermore, the company is looking to expand to China, which is likely to reinforce its position, deploying together with **General Electric EV charging stations in Shanghai's Jiading district.**

As previously mentioned, the EV represents a disruptive innovation that can address specific needs of potential customers. **GM's CVP only focuses on Segment A**, in which early-adopters seem to be more attracted. EVs would find its natural *home* in urban environments and compact cars fit better urban mobility needs.

**The importance of electric components suppliers'** within the value chain alters the specific weights for all the players involved, which **implies the redefinition of the profit formula.** In order to create value for the company while providing value for customers, GM is committed to working with all stakeholders, from policymakers, like those in the United States with whom it achieved new fuel economy standards, to **business partners, such as LG in South Korea**, with whom it is promoting the electric vehicle development in that country.

The way in which the value is generated in the company and delivered to the customer through the key resources and processes, must be

reconceived. **For Segment A products, the company should focus on brand image, services and sales.** Partnerships with utilities are also important, **developing new business models that offer economic incentives to EV owners** as for example, provide grid load support and second life for batteries, reducing the life-cycle cost of EVs. Therefore, GM should propose a different BM not only for the company but also game changing for the industry.

The following table summarizes and assesses GM's strategy and business model within the EV industry.

Outperform rivals	3,5	Limited offer, only segment A. Not GM's core competence
Strategic positioning	4	Variety-based positioning. Conservative strategy
Activities' trade-offs	4,5	For several years, EVs trade-off, in favour of fuel-cell vehicles.
Fit among activities	5	Electric propulsion systems feature common components: EV-HEV-Fuel Cell vehicles
Strategies' threats	4,5	Deepen strategy, installing recharging network
Business model	3,5	CVP: focused on urban mobility needs Profit formula redefinition: partner LG Chem



Figure 4.18: GM's EV strategy and BM.

### 5.2.2 HEV strategy and business model analysis

Traditionally, larger and low fuel-efficiency cars, such as pick-ups and SUVs, have been GM's core competence. However, GM's stance changed in 2003, when the firm decided to introduce a new strategy based on HEVs, answering the allegations that the company had abandoned hybrid technology in favor of fuel cells and responding to the early lead that the Asians (Toyota and Honda) had taken. According to this, in order to pump up sales figures and quickly amortize development costs, GM **started offering hybrid variants in its most popular models.** The company targeted the **highest fuel consuming vehicles first**, attempting to achieve a sustainable competitive advantage by preserving what was distinctive about GM. Simultaneously, it achieved **differentiation performing a different activity from rivals**, which were not so interested in pick-up trucks and SUV's hybrid power trains.

Currently, GM's **hybrid portfolio covers several segments** from a **need-based positioning** point of view. Each of the segments is targeted to a group of customers, with the idea of serving most of their needs. In short, each hybrid model is tailored to provide the same service and performance as its corresponding ICE vehicle, but with the higher value that the lower fuel consumption represents.

**Segment J** stands for a 14,7% of GM's global production and is mainly focused on Nafta (83,7% of total sales). GM offers **four hybrid models** in this segment (under the brands GMC, Chevrolet and Cadillac) targeted to the U.S. market and a complete offer of seventeen ICE models under all group brands. The evolution in production has been -13,5% (2005-2011) and it is forecasted to decrease -9,1% (2012-2020). **GM's approach to this segment can be considered consistent:** it aligns core segments and core markets, and tries to **balance the decreasing sales** with hybrid models that allow lower fuel consumption. Similarly to segment J, **Pick-ups' segment** represents 11,4% of total production and is mainly focused on Nafta (95,4% of global sales). Moreover, the production evolution is also decreasing, -35,1% (2005-2011) and -11,4% (2012-2020). GM offers **two hybrid models** in this segment (under the brands GMC and Chevrolet) targeted to the U.S. market and the ICE pick-ups add up to nine models. GM's approach to this segment is similar to the previous case.

In **segment E, a mild hybrid model** is available under the brand Buick and targeted to the U.S. market. This segment represents 11,2% of total production and sales are distributed 69,2% and 22,8%, in the U.S. and China, respectively. This model could be a viable option to expand the hybrid offer in the Chinese market.

In a deeper analysis, it can be seen that at the heart of GM's current hybrid offering is the two-mode system first seen in 2007 on the Chevrolet Tahoe, GMC Yukon and Cadillac Escalade hybrids and as a front-wheel drive option in the already discontinued Saturn Vue Green Line; all of them larger sedans, crossovers and SUVs. The rear wheel drive version is aimed to the full-size SUVs and light trucks. **GM has acknowledged a product gap** for an advanced **full hybrid** offering to smaller, lower-torque engines in **more compact vehicles**.

This is a **trade-off made by GM in order to obtain larger margins generally available on upper segment vehicles**, leaving aside the most cost competitive segments. In addition, the choices made by GM, a company known for delivering big cars, is a **powerful barrier to imitation, improving its reputation instead of confusing customers**: GM manages to **maintain brand image and reputation consistency**.

However, the main rebirth on the company's strategy and the **strongest commitment to moving forward in hybrids** has been the presentation of the **plug-in hybrid range extender Chevrolet Volt** targeted to the U.S., Europe and China. In addition, GM has announced that the Volt technology platform will be used on other models such as the Cadillac Converj coupé.

The Chevrolet Volt, which is equipped with a 1.4-litre, four-cylinder, flex-fuel ICE, a generator and a 16kWh battery pack and has an electric-only range around 64km, belongs to **segment C**, focused on the Chinese (48,9%) and European (28,7%) markets. This segment, in terms of production volumes, is more important than segment J and pick-ups, representing **21,3% of global production**, therefore is understandable why the company has **chosen this segment to demonstrate that they are serious when it comes to electrification of the automobile**.

**Range extender technology** is attractive to OEMs, because it **facilitates the possible transition to EVs by providing an intermediate step** that reduces battery size and cost, while **building consumer confidence in EV technology**. Range extenders can also be tuned to operate the ICE within an efficient range to optimize fuel economy and minimize CO<sub>2</sub> emissions.

Although earlier GM electric vehicles were not built in mass-production numbers, **the technical knowledge acquired certainly contributed to the range extenders development**. By adapting sub-systems such as the EV1-descended motors developed for the front-wheel drive hybrid system and electronically controlled brakes from the fuel cell Equinox, the engineers were able to focus more resources on the new lithium-ion battery and overall vehicle integration. This means that the **fit among the company's activities has been beneficial for sustainability and competitive advantage**.

GM is **deepening its strategic position and trying to reinforce it**, by several means: extending new product lines (GM is adding more hybrid model to its portfolio), making its activities more distinctive (a range extender vehicle and hybrid pick-ups) and offering **services that rivals do not such like the OnStar system** that offers the driver a set of services (navigation, phone calls, booking service). Although initially was a service for GM car owners, the **company has recently started to sell it to non-GM car owners**.

Regarding the **business model**, there are some modifications, but generally it doesn't represent any disruptive change from the traditional business model definition. While the mobility concept continuous invariable, a **greater value is delivered to customers**. GM's success depends in part on offering vehicles and services that meet customers' needs, such as the hybrid models. Nevertheless, with the range extender Volt, **the possibility of adapting the BM is much greater**.

GM is trying to grow its business aligned with the needs of society, namely **alternative energy** and advanced technologies that help reduce dependency on petroleum, **improve fuel efficiency** and reduce emissions. These sustainability goals are best achieved when integrated into its BM.

GM's **sustainability progress** is based on four sections:

- Design: leading in the R&D of advanced technologies
- Build: maximizing the benefits of operating the facilities in an environmentally and socially responsible manner
- Sell: offering sustainable vehicle choices for consumers around the world
- Reinvest: ensuring the company's economic viability, enhancing quality of life in its communities.

The company is also expanding its Greening Supply Chain Initiative to **additional suppliers** and joint ventures in China, and trying to become the clean-tech patent leader for fuel cells, hybrid electric vehicles, solar energy and advanced technology improvements. Therefore, GM is probably **redefining its profit formula with the increasing weight of its hybrid offer**.

Additionally, in order to **reduce costs** and improve the **revenue model for the European operations**, which have been faltering for years, GM was reported to be in talks about a **possible tie-up with the French automaker PSA Peugeot Citroën**, focused on joint development and production of some parts or models. With this possible alliance GM could take advantage of PSA's know-how to develop diesel hybrid vehicles.

Also in terms of the **key resources** and **key processes**, GM is focusing on **marketing and sales** through advertising and dealership networks, and service, which are similar to the traditional automotive industry.

The following table summarizes and assesses GM's strategy and business model within the HEV industry.

Outperform rivals	4,5	Differentiation: hybrid SUVs, pick-ups and a range extended
Strategic positioning	5	Brand image and reputation consistency
Activities' trade-offs	4,5	Product gap: full hybrid compact cars. Cronological trade-offs consistency
Fit among activities	5	Range extended an intermediate step between HEV-EV. Lithium-ion battery integration
Strategies' threats	4,5	Strategy reinforcement: product line-up extension, premium services
Business model	4,5	CVP: core competence segments covered and first movers with range extended technologies

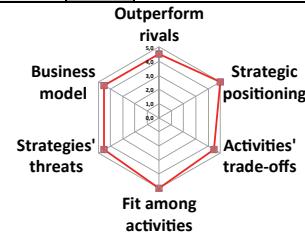


Figure 4.19: GM's HEV strategy and BM.

## 5.3 Renault

### 5.3.1 EV strategy and business model analysis

Renault aims to become the first full-range car manufacturer to commercialize wide zero-emission vehicles' portfolio. The strategic technical choice of offering full electric vehicles as the **key technology** of the future may permit Renault to reach a differentiation status from its rivals.

Apart from offering a full range of electric vehicles, Renault also establishes a difference selling its **EVs at lower cost** than its competitors, thanks to its business model. This strong strategic positioning represents a **competitive advantage** for Renault in a market that is expected to have 45

OEMs competing globally with around 75 EV models, by 2015. Moreover, Renault estimates that EVs will account 10% of the world market by 2020.

Currently, Renault's EV portfolio covers several segments (A, C and CV) and by the mid-2012, an electric compact car (segment B) will be launched. Beyond 2012, Renault will continue to extend its electric car range to cover all segments. With this variety, the company is creating valuable positions that emerge from a **variety-based and a need-based positioning**.

The first model, Kangoo ZE went on sale in October 2011, targeting the European market. It is a **commercial vehicle** aimed to professionals that need to transport light goods, mostly in an urban environment. This model allows Renault to **satisfy few needs (limited by autonomy) of many customers (urban dealers)**, which represents a **need-based positioning**. The CVs' segment ranks the second in terms of production volumes, representing 13% of global production and although the evolution in the period 2005-2011 was -14,5%, it is expected to grow +9% between 2012-2020. Regarding the sales in 2010, the distribution is the following: 77,7% in Western Europe, 9,2% in Eastern Europe and 3,8% in BRI markets. Therefore, Renault's approach to this segment is consistent, aligning core segments, core markets and core technologies.

The second model, launched in Israel in November 2011 and later in other countries, is the Fluence ZE, a family sedan that belongs to **segment C** and is targeted to the European, Chinese and Israeli markets. This segment represents 11,3% of total production and is focused on Western Europe (90,8% of global sales in 2010). Its expected production evolution is -6,5% (2012-2020). The Fluence tries to serve more needs (both daily urban use and longer trips with the *quick drop* stations) of fewer customers, since this model requires higher purchasing power, which represents a **need-based positioning**. The battery lease model proposed by Renault, reduces the price considerably being possible to target more potential customers and being redefining the OEM's positioning towards a **variety-based** one.

As regards **segment A**, Renaults offers a tandem type urban vehicle, Twizy, targeted to the

European market. This segment only represents 5,9% of the total production, however the evolution has been +79,8% (2005-2011) and it is forecasted to grow another +154,3% from 2012 to 2020, which means that in five years segment A will rank second. The Twizy model satisfies few needs (personal mobility in an urban environment, convenient for commuting to work) of many customers (early adopters who live in big cities), which constitutes a **variety-based positioning**. Renault's approach in this segment is coherent and responds to the rivalry existing in the field of compact urban vehicles.

The fourth model is ZOE, which belongs to **segment B**. This segment is **Renault's core segment**, representing 40,1% of the production and sales (with an increasing trend) distributed as following: Western Europe 57,4%, BRI 15,9% and Eastern Europe 10,9%. ZOE is targeted to the European market, basically for urban use and in general, to satisfy few needs of many customers, which coincide with the variety-based positioning. However, Renault is working on the *quickdrop rapid exchange stations*, which allow ZOE's drivers to **broaden its needs** and convert the positioning in a combination of variety and need-based.

The foregoing variety indicates that Renault's strategic positioning **tries to meet different needs, access different customers and offer a broad product portfolio**, which **may give the company a strong reputation and brand image** in the EV field, while at the same time, **raise barriers against repositioners**.

Clearly, Renault **rejected to become a straddle**, choosing to focus completely on electric vehicles. The company made a **clear trade-off in terms of hybrid technologies**, despite the fact that HEVs' use is growing at present and that the potential of success of full EVs is still uncertain. Doing so, **Renault avoids inconsistencies in image and reputation, and also incompatibilities among activities**. What is more, the group concentrates all its coordination and control resources to a unique objective.

As mentioned in previous sections, **fit among the activities is fundamental for sustaining a competitive advantage**. Renault uses **its alliance with Nissan to reinforce its activities** and takes inspiration from its partner's experiences to **improve vehicles' performances**. In terms of

quality, the Alliance Quality Charter defines quality procedures and establishes joint tools. In addition, the Quality functional task team (FTT) studies the most efficient quality practices of both Renault and Nissan. In terms of manufacturing, both groups exchange best practices: the Renault Production System (SPR) and the Nissan Production Way (NPW). This consistency ensures that **the competitive advantages of activities cumulate and makes the strategy easier to communicate** to customers, employees and shareholders, improving its implementation.

Additionally, the Renault-Nissan alliance has been among the first OEMs to **launch infrastructure projects** and either Nissan or Renault, have **established memorandum of understanding** with a growing list of states, regional and local **governments, energy utilities, recharging equipment suppliers and research institutes** around the world.

In order to **deepen its strategic position, Renault is looking for extensions in its services and complementary activities**. This is the reason why, the company established a cooperative relationship with Better Place to develop battery swap technology increasing the added value of its products. Moreover, **Renault is trying to expand globally**, working on several **infrastructure and demonstration programs worldwide**, which leverage its position and identity. Some of the countries in which the Alliance has established memorandums are Australia, Brazil, Canada, China, Colombia, Denmark, France, Georgia, Germany, Hong Kong, Japan, Ireland, Italy, Monaco, New Zealand, Portugal, Reunion Island, Singapore, Spain, Switzerland, Taiwan, Turkey, the UK and the US.

As far as the EV industry is concerned, it entails a **disruptive innovation** and a radically **different value chain**, which leads to a **new business model**. There is also a change from the traditional *ownership* concept to the *mobility* concept such that consumers pay for use or per kilometer.

Renault has identified the desires and demands of its customers and offers them a **customer value proposition** with the following premises:

- Electric vehicles will retail at the **same price** as equivalent diesel models (without the battery, which is rented)
- **Running costs are roughly 20% lower** than an equivalent ICE vehicle since electricity costs much less than petrol (around €1 per 100 km)
- **Maintenance costs are half** those of an equivalent combustion vehicle because electric motors require less servicing
- Electric motors offer **similar levels of performance** as that of gasoline and diesel cars.
- Electric cars are **easily recharged at home**, at special terminals in parking lot areas and at *quick drop* rapid exchange stations

The first point of the customer value proposition is only possible with the **development of the battery-leasing model, which reduces the initial purchase price and eliminates the concerns about battery life and replacement**. In addition, EV users can benefit from purchase incentives, reduced electricity charges and free parking.

In order to get the job done, Renault is **involved in cooperation with governments on infrastructure development**. As previously mentioned, the company also has partnerships with **mobility operators** worldwide, such as **Better Place**. Rather than focusing only on recharging EVs' batteries in situ in the vehicle, California-based Better Place has developed **battery exchange station technology** in collaboration with Renault-Nissan to develop EVs in which a flat battery pack is removed and housed under the vehicle's floor. Better Place claims that **the process takes less time than filling a car with gasoline**.

The growth of the EV segment will introduce **new players** to the automotive industry throughout the value chain and will require the **redefinition of the profit formula**. In order to create value for the company while providing value for customers, **Renault carefully develops new alliances with new entrants to the industry, both the manufacturers of the electric drive train and the energy distribution network**. An example of this is the **joint venture between Renault, Nissan, CEA and FSI** that focus on advanced **research, manufacturing and the recycling of EV batteries**.

Last but not least, Renault takes advantage of its alliance with Nissan in terms of **manufacturing standardization, cross production and cross-cultural management**. As an example of **key process**, the Renault Production System (RPS), the standard used by all the Renault plants, borrowed extensively from the Nissan Production Way, permitted Renault a 15% productivity improvement.

In terms of **key resources**, the Renault-Nissan Alliance built a unique experience in **multicultural management at all levels**. Each year, more than 30 teams with Renault and Nissan employees from all regions and functions work together to identify synergies and best practices. Thousands of people with cross-cultural experience have been in collaboration since the beginning of the Alliance.

The following table summarizes and assesses Renault's strategy and business model within the EV industry.

Outperform rivals	5	First company mass-producing EVs at lower cost
Strategic positioning	5	Several segments: A, B, C & CV Core segments, markets & technology alignment
Activities' trade-offs	5	Renault rejected to become a "straddler" Hybrid vehicles trade-off
Fit among activities	4,5	Activities reinforcement, the Alliance: quality procedures and joint tools
Strategies' threats	4,5	Deepen the strategy: cooperation with Better Place Global expansion, infrastructure & demonstrations
Business model	5	CVP: battery leasing model, affordable price Key partnerships: Nissan, CEA and FSI for batteries

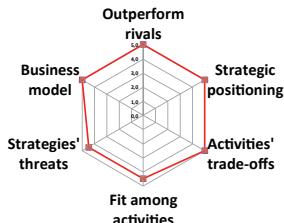


Figure 4.20: Renault's EV strategy and BM.

## 5.4 BYD

### 5.4.1 EV strategy and business model analysis

OEMs in the fast growing Chinese market have a great deal of catching up to do where ICEs are concerned before their products can be described as truly competitive. However, alternative power trains, and particularly EVs, are relatively early in their development lifecycle, offering therefore offer a playing field in which Chinese carmakers can be competitive. The increasing level of urban car ownership within those countries also means

that the EV's driving cycle is well suited to the growing middle class.

In this context, BYD is able to outperform its rivals establishing a difference and **delivering greater value to customers**. Although its pure EV offer is limited to one model, e6, its **driving range is announced to be over 300 km**, which is the longest range for a pure-electric passenger vehicle in the world. Moreover, BYD offers a **10-year warranty for the Fe battery**, rechargeable in just 40 minutes.

Furthermore, **BYD's strategic positioning also differentiates from competitors, performing different activities** and products such as the **electric bus, k9**, which is claimed to run 250 km on a single charge in urban environments. This bus employs many advanced technologies developed by BYD itself, as for example, the non-polluting Fe battery of which chemical materials can be easily recycled. The solar cells installed on top of k9 can supply more power to supplement the battery.

**BYD first started manufacturing an ICE vehicle for segment C, in 2005**. Since then, the company has been trying to expand its product portfolio to other segments and it seems that its most committed choice has been offering a **full EV, the e6, in segment M, where there is no other green technology vehicle to compete with**. Moreover, the company only has another ICE model (launched in 2010) in segment M, which represented 0,7% of its total production in 2011, but is expected to grow +57,8% from 2012 to 2020.

**With this variety-based approach** to the EV industry, the firm is trying to serve broad needs (thanks to its autonomy and rapid charge) of few customers (early adopters). However, as the EV infrastructure evolves and buyers' confidence increase, BYD hopes that consumers' interest in its product will increase progressively.

BYD has been **focusing on** cleaner, more efficient alternative energy sources to fulfill the first pillar of its **Green Dreams Strategy: solar power, energy storage and electrified transportation**. In order to **avoid inconsistencies** in their core strategy, BYD has **traded-off some activities such as the ICE development**. The product's portfolio just covers five segments (A, C, D, M &

J) with nine ICE vehicles altogether. What is more, none of these models is Diesel powered.

To further promote the commercialization and popularity of electric vehicles, **BYD strives to be an integral green solution supplier**, focusing on **EV charging technology** and developing several different **charging facilities** to meet various world standards. The **transversal use of the recharging net from both the plug-in hybrid and pure electric vehicles** represents an opportunity for a **fine fitting** among the company's activities.

Among all other influences, the desire to grow has perhaps the most perverse effect on strategy and BYD must be cautious in its attempt to compete in foreign countries. Although expanding globally is likely to reinforce a company's unique position and identity, **BYD's decision to enter the U.S. organically is a high-risk venture** and has some threats related to it. First, **U.S. consumers' acceptance** of Chinese products. Second, BYD exposes itself to the multiple challenges of not only misunderstanding a new consumer profile, but also having to learn an **unfamiliar dealing network**. Furthermore, the company admits that **quality control and safety standards have a long way to go** in order to meet European and American standards.

However, BYD can leverage its **cost advantage and proprietary battery technology** to bring value to customers, allowing growth that is consistent with the strategy.

As far as the business model is concerned, BYD's case is special. The **vertically integrated BM** and the **production method that relies on workforce** are its main characteristics, **focused on cost-performance and cost leadership**.

Based on this model, BYD gains competitive advantage and is able to address broad needs of potential customers. With its electric model, the company offers a **customer value proposition with a controlled cost of mobility enabling an important autonomy range**. BYD's EV fits better the **needs of a majority of profiles**, avoiding the competition taking place in the crowded segment A with cars restricted to an urban environment.

BYD's **profit formula** is related to in-house production for most of the parts. The company

has ten production facilities as part of its vertically integrated supply and assembly structure and employs 150.000 people in China, which agree with the stated aim of owning and managing every level of the supply chain.

The following table summarizes and assesses BYD's strategy and business model within the EV industry.

Outperform rivals	4,5	Range Diversification in EVs (bus)
Strategic positioning	4,5	Variety-based positioning, segment M low competition. Autonomy and rapid charge
Activities' trade-offs	4	Focusing on: solar power, energy storage & electrified transportation. Trade-off ICE development
Fit among activities	4	Transversal use of recharging net, EV-PHEV
Strategies' threats	3	Desire to grow, entering Europe and the U.S. high-risk venture. Quality issues
Business model	3,5	CVP: reduced mobility cost. In-house production for most of the parts

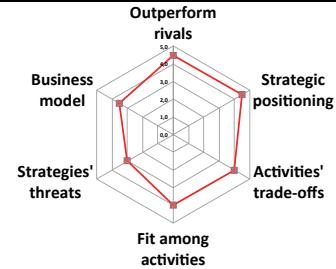


Figure 4.21: BYD's EV strategy and BM.

#### 5.4.2 HEV strategy and business model analysis

BYD has been working to solve challenges in developing new energy vehicles, including cost of battery packs and the limited range of electric vehicles on the market. As a solution BYD came up with an **exclusive Dual Mode (DM) electric vehicle technology** that allows users to manually switch to an all-electric mode or switch to a hybrid mode engaging an ICE. With this technology the company **delivers a greater value than competitors and establishes a difference in terms of features**.

The BYD DM system is the next generation of the current hybrid system, and might be the most advanced one in the world. It integrates an advanced generator and motor controlling technology with a 1.0 liter gasoline engine as a range-extender. This provides both **robust performance and good fuel economy** with low emissions. In addition, BYD **also differentiates** from rivals **in the way** that the company **delivers the value**, reinventing the manufacturing process by **replacing machinery with manpower** taking advantage of the local labor cost.

Currently, BYD's hybrid portfolio covers two segments (C and J) and constitutes a **need-based positioning**. Both plug-in hybrid models are targeted to a group of customers with higher purchasing power, with the idea of serving most of their needs (broad autonomy and flexibility) and are tailored to provide the same service as its corresponding ICE vehicle but with an added value (lower fuel consumption).

In December 2008, the F3DM was launched as the world's first mass-produced Dual Mode vehicle. This **segment C** model's sales began in China to fleet markets. Later, in March 2010 an F3DM with an innovative solar panel charging system on the sunroof, opened for sales to retail customers for the price of approx. U.S.\$29.800 (before subsidy or incentive). At present, this model is available in China, the U.S. and Europe. It can run 60 km solely on electric power, consuming 16 kWh, which means that with electricity prices around 15 cents/kWh, the operating expense of the F3DM in EV mode is U.S. \$ 2,5, only the 1/5 that of an average gasoline powered vehicle. That is why, although the initial purchasing price is higher, it is offset by its **low operating expense**.

Segment C represents **61,1% of BYD's total production** and is mainly focused in China. The evolution in production has been +109% (2006-2011) and it is forecasted to increase another +16,1 (2012-2020). Therefore, BYD's approach to this segment is **consistent, aligning core segments, core markets and core technologies**.

The other plug-in hybrid model, S6DM, is a **segment J SUV**, targeted to the Chinese, European and the U.S. markets. Moreover, it can travel over 500 km starting with a full electric charge and a full tank of gasoline. Regarding segment J, it is expected to grow 20,4% from 2012 to 2020 (before 2011 this segment was non-existent), so BYD's approach to this segment is the sign of the company's **desire of expanding** both product line-up and markets.

What is presented in the previous section, in terms of BYD's trade-offs and fit among the activities, is valid for its hybrid vehicle strategy. In order to **avoid inconsistencies**, BYD has made **trade-offs**, regarding the **internal combustion engine development**. Additionally, the **transversal use of the recharging net** from both the **plug-in hybrid and pure electric**

vehicles represents an opportunity for a **fine fitting** among the activities.

BYD is trying to deepen its strategic position, reinforcing its brand worldwide. The agreement the company has with Daimler helps BYD to gain reputation, since Daimler is at the forefront of developing innovative technologies and also well known for its quality. Moreover, the company is looking for extensions of the product line-up. In 2009, the firm presented the F6DM, a plug-in hybrid mid-size sedan (segment D) but it is unknown whether the model is going to be launched.

As presented in this section, BYD's hybrid offer is limited to **plug-in hybrid models**. For this reason, the need for moving towards a new BM is important, and significant changes are going to be needed to all four elements.

However, thanks to the Dual Mode technology, users are able to choose whether to continue with the same mobility concept, switching to a hybrid mode engaging an ICE. In this case, the **customer value proposition would be the same as the classical auto industry**. The main change lies in the **greater value** that is delivered to customers when they switch to an all-electric mode, which allows fuel consumption savings.

Based on its vertically integrated model, BYD's **profit formula is related to in-house production for most of the parts**. This involves the alignment of the whole value chain internally. However, the company is too focused on sales and profits, **disregarding relationships with external suppliers**.

In terms of the **key resources and processes**, **BYD has failed to equip itself with mass production facilities**. The company relies on manpower, taking advantage of the local labor cost, which is effective to produce models at lower prices.

The following table summarizes and assesses BYD's strategy and business model within the HEV industry.

Outperform rivals	4	Robust performance and good fuel economy
Strategic positioning	4,5	Need-based positioning. Consistent aligning core segments and core technologies
Activities' trade-offs	4	ICE development trade-off
Fit among activities	4,5	Transversal use of recharging net, EV-PHEV
Strategies' threats	3	Desire to grow, quality and safety standards may not meet European and U.S. Requirements
Business model	3,5	CVP: plug-in hybrid tech. and good performance Profit formula: relied on workforce

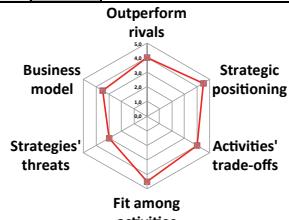


Figure 4.22: BYD's HEV strategy and BM.

## 6 Key findings

- The current important **drawbacks** that the electric vehicles present (**autonomy**, testimonial recharging net, **high costs**) hamper its use following the traditional mobility model (for everyday use, reliable and durable, easy to use and fix, and affordable for the majority of citizens) for which hybrid solutions are perfectly fitted.
- Although its use limitations, the role of the **urban early adopters** is the **key for the EV to succeed**.
- As the **electric motors** and the **batteries** become the components with the **highest added value**, the influence of the suppliers over the OEM increases up to the point that the **car manufacturer could become an integrator of Tier1's products** or even observe a forward integration from the suppliers that could become themselves a car producer.
- For the current **EV industry**, the **validation in an urban environment** is for the moment **compulsory**. HEV are tested and approved without specific requirements.
- In order to properly **assess the strategies** of the main OEMs regarding electric and hybrid products, it is necessary to **analyze both industries separately**.
- The **forces that define the profitability** of the **EV industry** are: the power of **suppliers**, the rivalry among **competitors** and the power of **buyers**.

- The forces that define the profitability of the **classical automotive industry** (including hybrids) are: the **rivalry among competitors**, the power of **buyers** and the threat of **new entrants**.
- OEMs must **define those assets** that permit them **to cope with the forces** that shape the industry in which they are competing.
- In developing a strategy in an industry observing **revolutionary technological changes**, the firms face a **high level of uncertainty** about the needs of customers, the products and the services. Under these circumstances, **imitation and hedging are rampant**.
- The **current features** of the electric or the hybrid vehicles, **define the kind of strategic positioning** that the product may adapt. Some business models try to ease the drawbacks implicit for a specific positioning equalizing both.
- Most of the firms have been **forced to do trade-offs**. Depending on capabilities or degree of commitment with a certain technology, classic OEMs usually discard technical options while newcomers straddle.
- The **fitting among activities** generates interesting synergies that **reinforce the technical development** of the **multiple solutions**. A proper coordination of activities is the only argument that can justify straddling.
- The consistency of a product definition strategy not only lies in the **correct alignment of technology mastering with core segments, core markets and product portfolio** but also in the establishment of a **network of alliances**, joint ventures or partnerships that can guarantee the provision and testing of key components.
- The **mastering of an specific technology** represents a **competitive advantage** that avoids technical dependence and permits the generation of revenues from its trading. Diversification from this stage is advisable.
- For those generalist new-comers that are defining their technologies portfolio, **diversification can become a risky strategy**: technical development is long, expensive and hazardous and first-movers have already established dominant positions in the market.

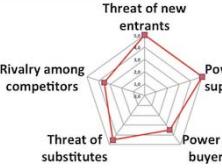
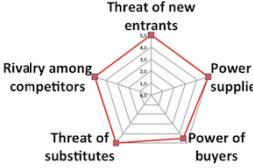
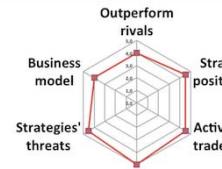
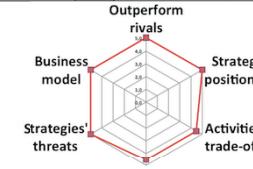
## TOYOTA MOTOR CORPORATION

Power Train Technology				Green Technologies Portfolio			
Alternative internal combustion engines				Production HEV, PHEV, EV. Horizon 2012.			
Otto engines		Diesel engines		 Production HEV, PHEV, EV. Horizon 2012.			
Min	Max	Min	Max	Segment A	Segment B	Segment C	Segment D
998 cc (69 CV, 969 cc (423 1364 cc (90 4461 cc (286 96 Nm) CV, 515 Nm) CV, 20,9 Nm) CV, 663 Nm)				5,1%	12,1%	21,3%	2,4%
Hybrid engines				Segment E	Segment F	Segment G	Segment H
Otto engines		Electric motor		12,9%	0,3%	0,2%	14,5%
1797 cc, 4 cylindres (98 CV, 147 Nm)		AC synchronous (88 CV, 206 Nm)		0,3%	0,2%	18,7%	9,5%
2362 cc (150 CV, 187 Nm)		AC synchronous (143 CV, 270 Nm)		0,2%	14,5%	9,5%	3,0%
3456 cc, V6 (296 CV, 368 Nm)		AC synchronous (150-200 CV, 275 Nm)		CV			
4968 cc, V8 (395 CV, 520 Nm)		AC synchronous (224 CV, 300 Nm)					
Transmission				Segment I	Segment J	Pick-up	CV
ECVT				14,5%	18,7%	9,5%	3,0%
ECVT				Segment K	Segment L	Segment M	Segment N
ECVT				14,5%	18,7%	9,5%	3,0%
ECVT				Segment O	Segment P	Segment Q	Segment R
ECVT				Segment S	Segment T	Segment U	Segment V
ECVT				Segment W	Segment X	Segment Y	Segment Z
Target Markets				Segment A	Segment B	Segment C	Segment D
Japan Worldwide				5,1%	12,1%	21,3%	2,4%
Japan Europe USA				Segment E	Segment F	Segment G	Segment H
Japan, USA Europe Worldwide				12,9%	0,3%	0,2%	14,5%
Japan Thailand, China Australia				0,3%	0,2%	18,7%	9,5%
Japan, USA Europe Worldwide				14,5%	18,7%	9,5%	3,0%
Target Markets				Segment I	Segment J	Pick-up	CV

Core Markets and Segments									
GLOBAL SALES	NAFTA Sales		China Sales		Eastern Asia Sales		Western Europe Sales		
	Percentage of global sales	Evolution 2005-2010							
6.582.973	30,1%	-19,8%	12,5%	425,6%	34,5%	-8,9%	9,2%	-14,0%	
Segments		NAFTA		China		Eastern Asia		Western Europe	
Segments		Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010	Sales 2010	Evolution 2005-2010
Segments		by segment	2005-2010	by segment	2005-2010	by segment	2005-2010	by segment	2005-2010
Segment C		33,1%	-18,5%	17,1%	278,1%	32,0%	85,8%	7,3%	-49,6%
Segment J		50,3%	15,9%	21,4%	1862%(1)	8,1%	0,2%	6,2%	-52,6%
Segment M		14,0%	-41,7%	4,9%	447%*	67,1%	-3,3%	3,5%	37,8%
Segment E		51,1%	-32,6%	29,8%	524,3%	13,8%	-39,7%	0,1%	-97,3%
Segment B		12,9%	8,0%	5,9%	211,2%	48,9%	-19,7%	27,8%	-19,7%

\*from 2009 to 2010

(1) In 2005: 10.216 units; In 2010: 200.456 units [Sales China, Segment J]

EV INDUSTRY		HEV INDUSTRY																																					
Toyota's coping assessment with the EV industry		Toyota's coping assessment with the HEV industry																																					
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## GENERAL MOTORS COMPANY

**Power Train Technology**

Alternative internal combustion engines

Otto engines		Diesel engines	
Min	Max	Min	Max
995 cc	7.008 cc	1.248 cc	6.599 cc
(68 CV, 93 Nm)	(512 CV, 637 Nm)	(75 CV, 190 Nm)	(403 CV, 1.037 Nm)

Hybrid engines

Otto engines		Electric motor	Battery capacity
1400 cc, 4 cylinders	(156 CV, 183 Nm)	151 CV, 370 Nm	16 kWh (Lithium-ion)
6000 cc, 8 cylinders	(252 CV, 498 Nm)	85 CV, 177 Nm	-

Electric technologies

Electric Motor	Transmission	Batteries
85 kW	n.a.	n.a.

**Green Technologies Portfolio**

**Production HEV, PHEV, EV. Horizon 2012.**

Segment	Production	Target Markets
Segment A	8,4%	India
Segment B	22,9%	USA
Segment C	21,3%	China
Segment D	3,8%	USA
Segment E	11,2%	USA
Segment F	0,2%	USA
Segment G	1,2%	Target Markets
Segment H	5,5%	USA
Segment I	14,7%	USA
Segment J	11,4%	Target Markets
Segment K	2,4%	USA
CV	0,0%	Target Markets

**Core Markets and Segments**

GLOBAL SALES	NAFTA Sales		Western Europe Sales		China Sales		BRI Sales	
	Percentage of global sales	Evolution 2005-2010						
2.617.209	38,8%	1.163.561	17,2%	1.089.857	209,9%	1.005.072	14,9%	
6.748.807	-49,6%		-24,2%		16,2%		97,3%	

Segments	NAFTA		Western Europe		China		BRI	
	Sales 2010 by segment	Evolution 2005-2010						
Segment B	6,3%	-52,8%	24,3%	8,4%	16,2%	269,7%	40,1%	111,8%
Segment C	4,5%	-86,9%	28,7%	-35,6%	49,0%	226,1%	3,3%	-60,3%
Segment J	83,7%	-39,0%	2,9%	1211% (1)	-	-	3,9%	-15,7%
Segment PU	95,4%	-48,3%	0,1%	294% (2)	-	-	-	-
Segment E	69,2%	-37,9%	0,01%	-99,5%	22,8%	185,0%	0,2%	27,8%

(1) In 2005: 2.049 units; In 2010: 26.880 units [Sales WE, Segment J]  
(2) In 2005: 191 units; In 2010: 754 units [Sales WE, Segment PU]

Worldwide	
Production 2011	Evolution 2005-2020
Segment B	22,9%
Segment C	21,3%
Segment J	14,7%
Segment PU	11,4%
Segment E	11,2%
Total production	7.931.465

**EV INDUSTRY**

GM's coping assessment with the EV industry

Threat of new entrants	4	Segment A, an opportunity for small EV manufacturers
Power of suppliers	4,5	Invest heavily to support in-house development. Partnerships with LG Chem and A123 Systems
Power of buyers	3	Crowded segment A. Low demand can start a war price
Threat of substitutes	4,5	No clear potential substitute
Rivalry among competitors	3,5	Low demand, therefore fierce competition

**Strategy & Business Model assessment**

Outperform rivals	3,5	Limited offer, only segment A. Not GM's core competence
Strategic positioning	4	Variety-based positioning. Conservative strategy
Activities' trade-offs	4,5	For several years, EVs trade-off, in favour of fuel-cell vehicles.
Fit among activities	5	Electric propulsion systems feature common components: EV-HEV-Fuel Cell vehicles
Strategies' threats	4,5	Deepen strategy, installing recharging network
Business model	3,5	CVP: focused on urban mobility needs. Profit formula redefinition; partner LG Chem

**HEV INDUSTRY**

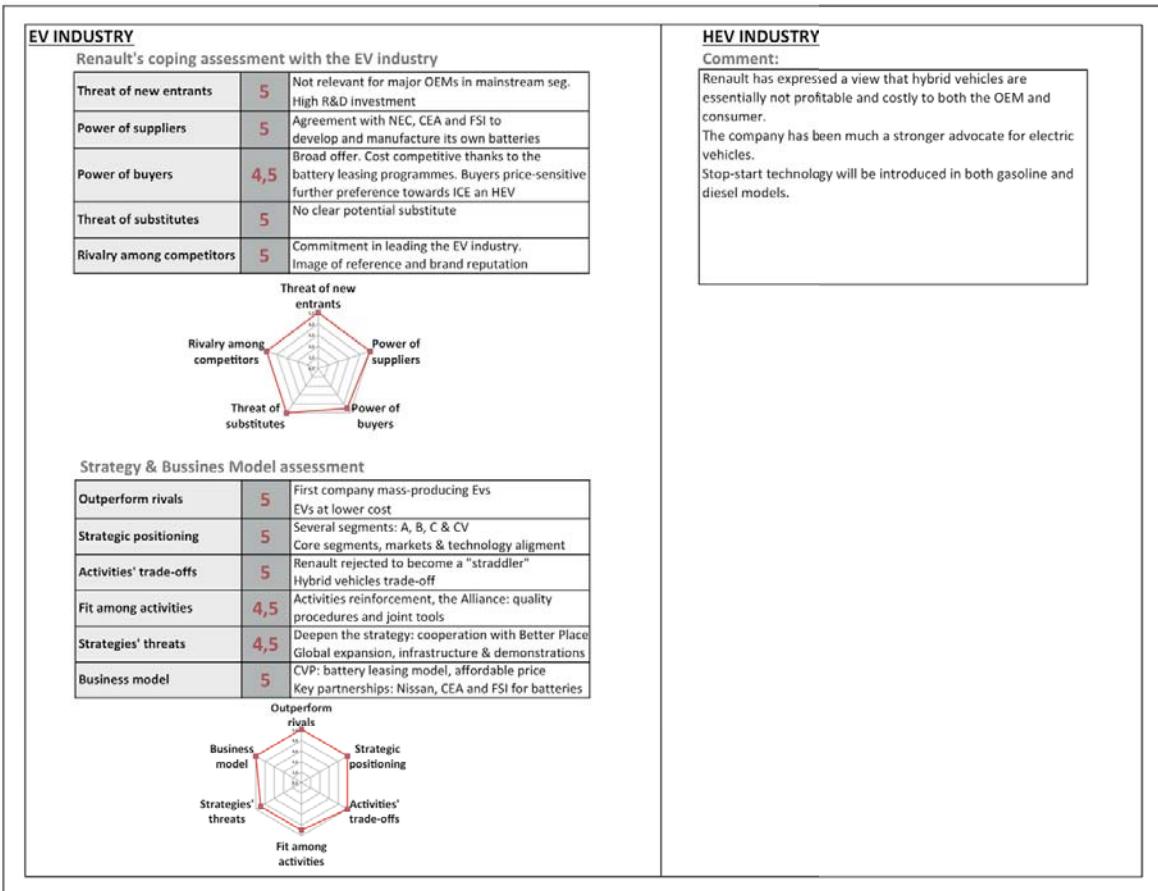
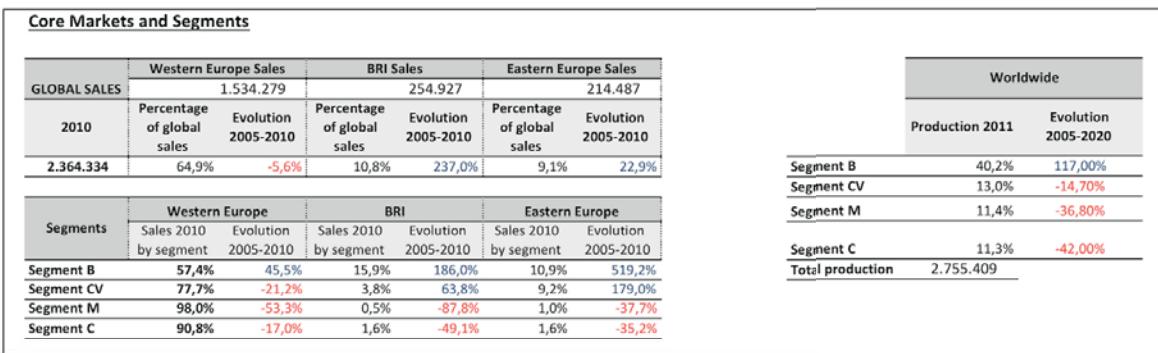
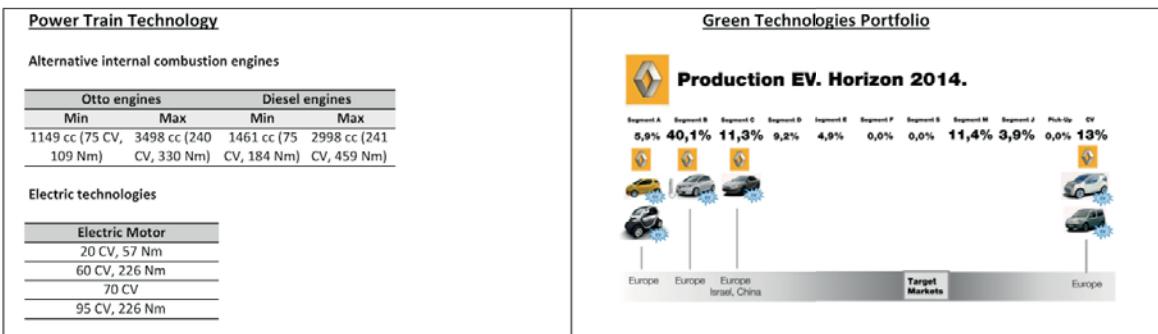
GM's coping assessment with the HEV industry

Threat of new entrants	5	Not relevant for major OEMs. Economies of scale. High barriers
Power of suppliers	5	Heavy investments in technology, in-house
Power of buyers	4	Product offer expansion
Threat of substitutes	5	No generic substitute
Rivalry among competitors	4,5	Strong presence globally.

**Strategy & Business Model assessment**

Outperform rivals	4,5	Differentiation: hybrid SUVs, pick-ups and a range extended
Strategic positioning	5	Brand image and reputation consistency
Activities' trade-offs	4,5	Product gap: full hybrid compact cars. Cronological trade-offs consistency
Fit among activities	5	Range extended an intermediate step between HEV-EV. Lithium-ion battery integration
Strategies' threats	4,5	Strategy reinforcement: product line-up extension, premium services
Business model	4,5	CVP: core competence segments covered and first movers with range extended technologies

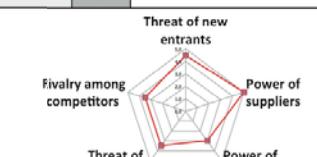
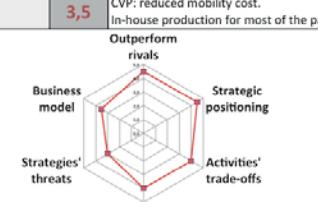
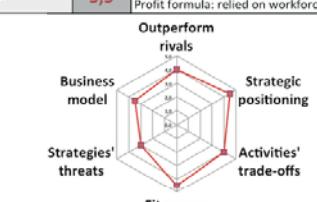
## RENAULT S.A.



## BYD AUTO

Power Train Technology		Green Technologies Portfolio										
Alternative internal combustion engines												
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Core Markets and Segments							Worldwide	
GLOBAL SALES	NAFTA Sales		Western Europe Sales		BRI Sales		China Sales	
	Percentage of global sales	Evolution 2005-2010						
2010								
	519.806							
Segments	NAFTA		Western Europe		BRI		China	
Segment C	Sales 2010 by segment	Evolution 2005-2010						
Segment B								
Segment D								
							Production 2011	
							Evolution 2005-2020	
							Segment C	61,1%
							Segment A	(2)
							Segment D	(3)
							Total production	532.756
<small>(1) In 2005: 135 units; In 2010: 404.132 units [Sales Segment C]            (2) In 2005: 0 units; In 2010: 132.080 units [Sales Segment B]            (3) In 2005: 0 units; In 2010: 66.170 units [Sales Segment D]</small>								

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## References

- [1] *Gauging interest for plug-in hybrid and electric vehicles in select markets*, Ernst & Young, 2010
- [2] *The Slow Road to Going Green*, JD Power and Associates White Paper, 2011

## Author



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