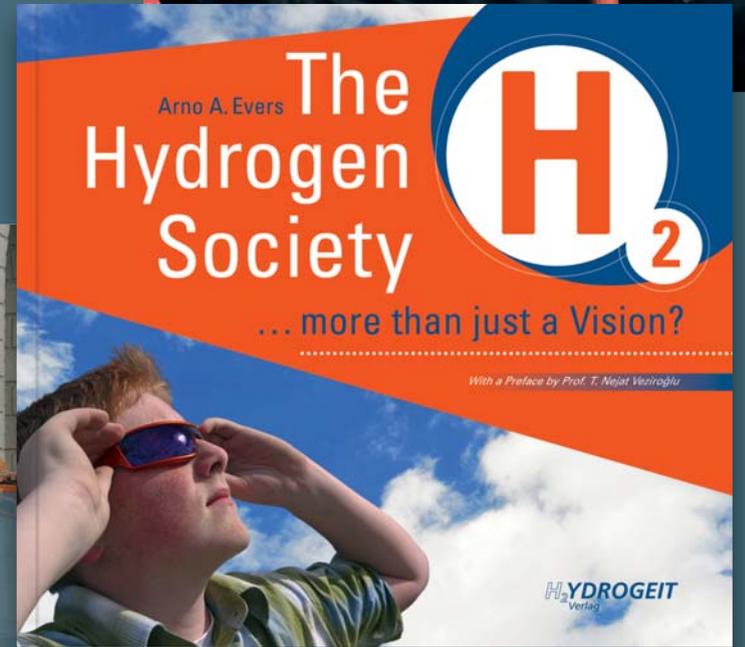


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**Roads to Reality:
 How Many Miles to Go?**

Many attempts have been made to bring hydrogen and fuel cells to the broad commercial market. Since the late 1990s, significant time and money has been invested by big industry and start-up companies. Governmental programs in the US, Japan, and Europe have supported this progress. And yet, aside from a few examples, the commercialization of hydrogen and fuel cells has not succeeded. Some experts state that changes in the energy system take time. But it seems that bureaucratic and governmental processes often undermine real progress, and often the line between lip service and genuine commitment is blurred as the technology is brought to market.



Impressions

**Ticket to Ride:
 Can Cars Carry that Weight?**

Exciting times these are! The automotive industry was once a symbol of technology leadership and an undisputed source of profits (creating well-paid jobs). Now it is "reaching a state of emergency". Former market leading auto makers have either been fully or partially bought by the government and in some cases management has even been transferred to the state. The small Italian company Fiat swallowed the big American manufacturer Chrysler. The German government had put up a Euro 1.5 billion bridge loan to keep General Motor's German daughter Opel afloat, to hand it over to automotive parts maker Magna International and Russian Sberbank. The deal eventually was cancelled and the taxpayers' money thereby evaporated! Japanese Toyota struggles with recalls of more than 8 million cars worldwide to address problems with removable floor mats and sticking accelerator pedals. The issue has even prompted a congressional inquiry and apologies from Akio Toyoda, chief executive, in the USA and China. At the same time, new competition begins to emerge (Figure 6.1): Asian car companies in India and China now exploit the potential of existing resources more effectively than their Western counterparts. Market proximity, low labor costs, and progressive innovation strategies are just some of their advantages. Nobody can blame them for wanting in on the action! For example, China started its domestic car production in 1985 and since then its production skyrocketed to over 6.7 million units in 2008. Back in 2003 the Chinese government forecasted a new vehicle production increase to 8 million cars not before 2010, a quantity which has already been reached in the year 2007. That means, we should not underestimate predictions from China.

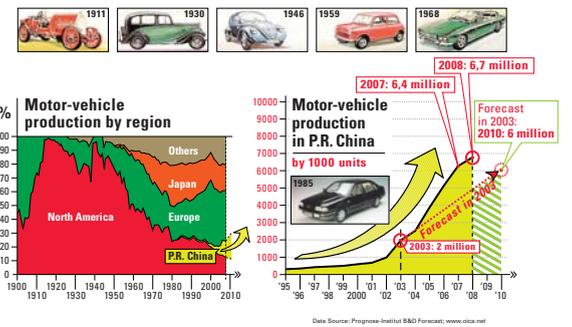
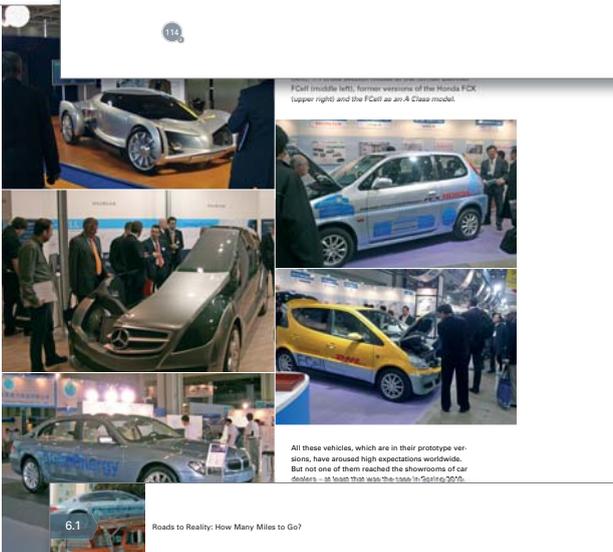


Figure 6.1 World Passenger Car Production 1900 – 2008

Electric vehicles are another global fad which is (in most cases) heavily reliant on state subsidies. But the big car manufacturers seem to be quite reluctant in introducing them into the commercial market. There are exceptions, though! A presently small American car company named Tesla Motors, Inc., is developing and selling a "... high performance, super efficient electric car ..." named Roadster. It features a range of 244 miles on a single charge and a supercar level 3.7 second 0 – 60 mph acceleration time. The price for such a device: Around US\$ 100,000 without extras, plus tax, where applicable. Showrooms in London, Munich and Monaco are open, waiting for wealthy customers to place their orders. But Tesla is also learning to drive more modestly with a planned all-electric Model S for a base price of US\$ 49,900¹⁾. It is designed to offer a variety of range options depending on the battery pack used, from 160 to 300 miles on a single charge. Volume production of the Model S will begin in 2012 with a target production capacity of 20,000 vehicles per year by the end of 2013. For the construction of two manufacturing facilities, Tesla is going to receive a US\$ 465 million loan from the U.S. Department of Energy (DOE) to support the mass production of its Model S. The producers, distributors, and sellers of electricity, however, are globally delighted about this new and profitable future line of business. This new business comes to them with no conceptual effort from their side whatsoever. Together with some car manufacturers and in most cases highly subsidized by governmental support, they now open "hundreds of ..." trial car battery charging stations like the ones in London, UK or Berlin, Germany. Battery manufacturers, (many based in Asia, and already strong on its own with their existing marketing, manufacturing, logistic and standards system), are working on solutions to reduce size and weight of the batteries for the powertrains in cars, and at the same time to improve power management and the cell energy density. Hydrogen vehicles, either with H₂ combustion engines (BMW, Ford) or fuel cell systems and electric motors in the powertrain, have existed since the early seventies. In the meanwhile almost every major car manufacturer has experimented with them. The waves of activities are intermittent, mostly depending on the



All these vehicles, which are in their prototype variations, have aroused high expectations worldwide. But not one of them reached the showrooms of car dealers – at least that was the case in 2009.

whim of the CEO's at the helm of the automakers and the availability of government funds. Both these factors change; they cannot be a sound foundation for future long-term commitments.

All of the hydrogen cars that exist today were hand built in rather limited numbers. I think I have driven them all at various locations worldwide. It was my pleasure to talk to the people, who had to get them on the road and kept them running. Intelligent and smart people who will desperately be needed in the future! It was always funny, though, to see the heavy trucks with the hydrogen cars loaded on them, waiting "around the block", to carry them on the long distant journey back to their base stations after the official ride and drive was done and the cameras were switched off.

Thanks to immense public relations efforts, some manufacturers act perfectly to create an impression that many more hydrogen vehicles exist than actually do. Some were given to celebrities for a certain period of time with much media attention – and later taken away again, of course without cameras rolling. The mass-market production of hydrogen powered cars, which was announced in the 90's as being ready in 2010, has been often postponed. According to recent "official" sources from the car industry, mass market production is now to come "... in 2015 or in 2020". Or maybe even later? Or maybe even not at all? These questions still remain unanswered. The trend in the world wide car industry for the last eleven decades was quite clear: Squeezing more and more functionality into much bigger and heavier cars. Every new model grew by a few inches and by more than a few pounds. New classes like 4-wheeled SUV's were invented, today being mostly driven in urban areas consuming large amounts of fuel quite senselessly.

Heavy black cars, burning huge amounts of petrol are hard to sell in 2009, even in San Diego, CA, USA

**from
 his book**



Shanghai Street view in 2004: times are changing ...

That is how the automotive industry has tried, and still tries, to keep its customers satisfied. But customers in the USA differ from customers in Germany, Japan, China, and India. Unfortunately, besides of some good examples from Asia, like the Nano – The People's Car from Tata Motors²⁾ in India, I can not see many activities being directed toward finding transportation solutions that suit the needs of the next generation. It looks like that today's car manufacturers do not even know what the future market really needs. It looks like the only sure goal for the existing system is to stretch the remaining resources, especially in form of crude oil to turn it in combustion engines, as long as possible. But all our gauges are edging toward empty. Although long recognized and taught as some progressive universities and engineering schools, only limited concept cars exhibit the capabilities of lightweight, low drag, or modern material design. Product life cycle

management often appears to be a foreign concept. There are no noticeable activities towards a new, more holistic approach regarding how to make the next generation of our more than 800 million cars more sustainable. What we need are meaningful activities towards universally networked and personalized new concepts for our entire transportation system on rail, road and in the air. But in my opinion, these new trends will not come from existing global automotive players. They may come from smaller companies, unknown today. Let them do their best! To achieve a shift in attitude towards vehicle design, manufacturing and usage, though, environmentally progressive visionaries, scientists, economists, designers, engineers and even laymen must not only take over the leadership, but also become the master builders of the twenty-first century. At this point, the informed and concerned citizen has more power than she or he knows. Her or his decision to purchase the "right" goods and services can be cheaper and more effective than any regulation under public law, which brings us to the next appliance for hydrogen and fuel cells: the micro-CHP system.

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