Can the Inauguration of the Lithium Era Be taken for Granted?

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Abstract

In the latest issue of Industrial Minerals recent events affecting the battery market for lithium carbonate were examined. The argument advocated in 2008 that the oil market, technological development and resistance to change may determine whether lithium-ion (Li-ion) batteries will be adopted by the global automobile industry for its transition to electric propulsion was further advanced. In addition, a discussion on the prevailing economic recession questioned the view that this might delay the introduction of this revolutionary innovation into the market especially for Range-Extended Electric Vehicles (REEV) and Battery Electric Vehicles (BEV). Here this topic is taken up once again to review and complement the original idea in light of some new incidents in the world economy. In particular, the oil market is analyzed not only in terms of oil prices but also in terms of their volatility. Likewise, a discussion on the launch of the first-mass produced REEVs with a specific kind of lithium-ion batteries in China seeks to unfold a new set of options for technological development of such energy storage systems. Finally, resistance to change is focused in terms of a transition from an energy market dominated by multinational oil companies to a market ruled by state-owned national companies.

Oil price movements and volatility

The precipitous and uninterrupted fall of oil prices since late September 2008 has motivated many analysts to think that the electric car race should be once again dismissed. In the recent Industrial Minerals article it was argued that oil prices cannot drop forever and that a long run perspective of the world economy calls for not-so-low oil prices in order to avoid a supply crunch. In addition, an argument was put forward that “Peak oil” and climate change may also prevent an ever-lasting decrease of oil prices. In this context, “temporary” low oil prices were not really seen as a main obstacle to Li-ion battery innovations.

This contention may now be reinforced by the hypothesis that oil price volatility, a close companion of oil price movements for the last three years or so, has induced (and may in fact continue to do so) both major REEV and BEV as well as advanced battery makers to accelerate the current electric rush in spite of the prevailing downward trend of oil prices in the world economy.

One of the major traditions of the induced innovation theory (e.i. the demand pull school) in the economics literature that attempts to explain the rate or direction of technical change in terms of changes in the economic environment emphasises the importance of market demand on the supply of knowledge and technology[1]. In accordance with this view, one can expect that the larger the market demand for REEVs and BEVs as well as advanced energy storage systems, the larger will be the supply of such car and battery innovations. Moreover, if the price of oil constitutes one of the main determinants of the market demand for REEVs and BEVs as well as for advanced rechargeable batteries, it then follows that the price of oil may also stimulate or hinder REEV and BEV as well as rechargeable battery innovations.

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From a different perspective, much has been written about the negative impact of volatility (i.e. uncertainty) on industrial business expectations (See for example a

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[1] See Vernon W. Ruttan, “Induced Innovation, Evolutionary Theory and Path Dependence: Sources of Technical Change”, The Economic Journal, 107, September, September, pp.1520-1529. For an earlier version of this article on the web see: http://ageconsearch.umn.edu/handle/12974.

recent OECD paper by Murray Pellissier and Angelo Fussari published in 2007 in which this argument is confirmed for South Africa). Along similar lines, in an interview to UPI.com British Prime Minister has recently warned about the risks of oil price volatility for the world economy: "Even as we move to a low carbon economy the world will continue to need large (amounts of) oil for the foreseeable future… This in turn will mean that oil producers particularly those with the lowest crossed reserves will continue to need to invest in capacity... But at the same time volatile prices make that investment less certain, sowing the seeds for continued volatility in the future"[2]. Now of course oil corporations may not be the only economic agents affected by oil price volatility. Car makers (in response to consumers´ concerns), as well as advanced battery producers (in response to car makers´ concerns) might have also picked up the view that nowadays fossil fuels have become a rather less reliable source of energy for automobiles due to their high price volatility.

As can be seen in Table 1 and Figure 1, yearly average oil prices clearly reflect an upward trend in the last 8 years, whereas volatility (as measured by the standard deviation) of oil prices also show an undisputable (albeit much stronger) increasing tendency in the last three years.

Table 1

Movements and Volatility of Oil Prices

Year	Brent (US Dollars Per Barrel)		WTI at Cushing US Dollars Per Barrel)	
	Average	Standard Deviation	Average	Standard Deviation
1998	12,48	1,58	14,42	1,56
1999	17,90	5,03	19,34	4,54
2000	28,66	3,40	30,38	2,97
2001	24,46	3,41	25,98	3,57
2002	24,99	2,94	26,18	3,21
2003	28,85	2,48	31,08	2,63
2004	38,26	5,64	41,51	5,79
2005	54,57	6,16	56,64	6,26
2006	65,16	5,87	66,05	5,60
2007	72,44	11,76	72,34	12,88
2008	97,19	28,70	99,89	28,46

Source: Energy Information Administration. Yearly averages and standard deviations were obtained using daily oil prices.

This provides an explanation for the recent interest of the global automotive industry in electric vehicles following General Motors´ announcement in January 2007 that by 2010 it will introduce the first mass-produced Li-ion powered plug-in hybrid electric cars[3]. It also explains why all major battery producers have decided to invest heavily in the development of advanced batteries to be launched into the market in the coming years. The dominance of lithium-ion batteries in the booming market of rechargeable batteries in recent years (See Figure 2) largely explains why they chose this technology.

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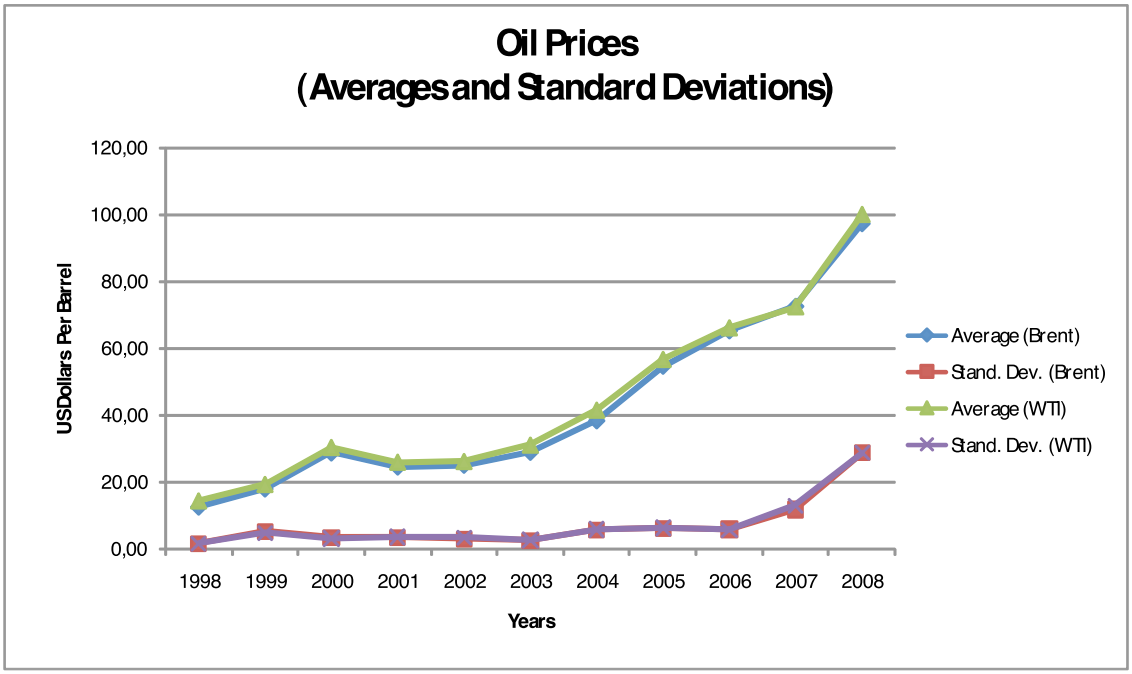
[2] The argument may also go the other way around. Untimely and insufficient investment, for instance, may also introduce disruption in the oil economy leading to greater price volatility.

[3] Of course high oil prices remain one the most influential factors for the adoption of "green" technologies in the car industry. However, as the data seem to reflect, under high oil price volatility, temporary low oil prices may not constitute a real hindrance to this possibility.

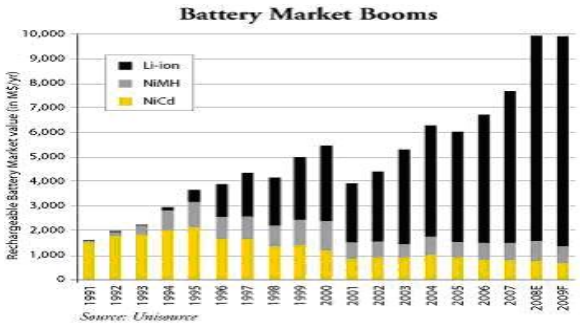
However, the puzzle remains as to why despite the recent fall of oil prices they are still investing billions of dollars in such endeavour. And here the argument is that given the current critical situation of the world economy, battery makers may be placing relatively more emphasis on oil price volatility and uncertainty rather than (average) oil price movements for their decision to invest in the development of such advanced energy storage systems.

Figure 1



Source: Table 1.

Figure 2



In this connection, assuming oil price volatility, even if the recent downward trend of prices continues and eventually leads to a lower yearly average oil price in 2009 than in 2008, it appears highly unlikely that the transition of the automotive industry to electric propulsion with lithium batteries will be reversed or even halted[4].

Recent Events in Lithium-ion Battery Technological Development

[4] As it will be shown below, the analysis applies to all lithium-ion batteries both common lithium (cobalt-oxide, manganese-oxide and nickel-oxide) batteries as well as to the rather less common lithium iron phosphate batteries that are beginning to appear in the market.

About a month ago Buying your Dreams (BYD), a Chinese company, surprised the world with the launching of the first mass-produced lithium powered REEV into the market[5]. The Lithium Iron Phosphate battery these vehicles use can be singled out today as one of the most significant breakthrough innovations in the advanced energy storage system sector in many years[6]. What is so crucial about this type of batteries is that they use about an eighth of lithium in comparison to other lithium-ion batteries (See Table 2)[7].

Table 2

Chemical Composition of Different Types of Li-Ion Batteries

LCP		LFP		LMP	
Chemical Element	**Index**	**Chemical Element**	**Index**	**Chemical Element**	**Index**
Fe	0.005%	Fe	42%	Fe	0.1%
Mn	11%	P	16%	Ca	0.3%
Mg	0.7%	Mn	0.5%	PP	3.3%
Co	1%	Ca	0.3%	Ni	1.7%
C	5.1%	Graphite	5%	Mn	18.6%
Li	28%	Na	0.01%	C	5.1%
Cu	10%	C	3.1%	Li	25%
Al	6%	Li	3.4%	Cu	10%
PP	3.3%	PP	3.3%	Al	6%
Graphite	7.1%	Cu	10%	Graphite	6%
Ni	8.1%	Al	6%	PU	3.1%
Lix	9%	Lix	8%	Lix	9%
F	3.1%	F	3.3%	F	3.1%

[5] See Peter Fairley, "China´s New Green Machine" in Technology Review, 16 December 2008.

[6] See: http://en.wikipedia.org/wiki/Lithium_iron_phosphate.

[7] The author is heavily indebted to an **anonymous commentator on Peak Oil News** for this important piece of information.

Source: http://www.thunder-sky.com/technical_en.asp?id=345&typeid=81&orderby=1.
LCP: Lithium-ion Cobalt batteries
LFP: Lithium-ion Iron Phosphate batteries
LMP: Lithium-ion Manganese batteries

This seriously erodes one of the most important "Peak Lithium" arguments posed by William Tahil in his well known paper titled "The Trouble with Lithium" regarding the minimum lithium content required by lithium-ion batteries for REEV and BEV[8]. Given their specific chemical composition, LFP batteries, which (following *The Economist*) appear to cost now roughly half as much as rival lithium based designs, are likely to reflect an even more pronounced downward trend in cost in the coming years[9].

Lastly, contrary to some sceptical views that have tended to downgrade the recent advances in lithium-ion batteries for REEVs and BEVs, there are clear signs that the world is just about to see even more radical breakthroughs in lithium-ion battery technological development that will certainly pave the way to electric propulsion in the global automotive industry in a very short time frame[10].

State-Owned Oil Corporations and Resistance to Change

As portrayed in Wikipedia´s entry "Who Killed the Electric Car?", in the 1990s "fearful of losing business to a competing technology", oil companies "supported efforts to kill the [Zero Emission Vehicle] ZEV mandate. They also bought patents to prevent modern NiMH batteries from being used in US electric cars". But how much have since oil corporations changed? Do they have today the same power to contribute to killing the upcoming REEVs and BEVs?

Following a recent analysis, nowadays 95% of oil (and gas) reserves are in government-owned companies and only 5% of oil (and gas) reserves are in international oil companies. These companies include: ExxonMobil, BP, Chevron, Royal Dutch Shell, Total, ConocoPhillips, and ENI (See Figure 3). By contrast, most oil (and gas) production is still in the hands of international corporations[11]. However, this is likely to change in the next 20 years or so. In fact, as the International Energy Agency Chief Economist Fatih Birol has recently predicted, "80% of the increase in oil and gas production by 2030 would stem from national companies". Since these companies typically face difficulties to invest, Birol concludes that oil (and gas) prices are expected to zig-zag "more in the future". Hence the "transition from an energy market dominated by multinational oil companies to a market ruled by national companies", may have indeed contributed not only to ameliorating the negative influence of the former on the emergence of REEVs and BEVs but also to

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[8] For a critique of Tahil´s main arguments, see the author´s EV World articles:
1) Peak Lithium or Lithium in abundance, 23 May 2008; and
2) Revisiting Peak Lithium or Lithium in Abundance, 04 June 2008.

[9] See "Lithium-ion 8% p.a. growth expected", Industrial Minerals (www.indmin.com), January, pag 26.

[10] As a recent article published by MIT´s Technology Review suggests, a very interesting future lies ahead for lithium as a crucial component of the next nanotube superbatteries that charge quickly, have a high power output, and have a long life.

[11] See Jim Letourneau, "Chavez Chagrined: Will Oil Companies Return to Venezuela?, Seeking Alpha, January 16 2009.

a greater volatility in oil prices further encouraging adoption of green technologies in the car industry. It remains to be seen how the new players in the game, namely oil producing countries, will behave under the new circumstances, although there are already some indications that at least some of them may be seriously committed to "seeking a lead in clean energy".

Taken together, the above arguments do indeed appear to signal the inauguration of the lithium era in the world.

Figure 3