

Another False Dawn?

The Future for Metals Used in Vehicle Electrification



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This is what the automobile industry has been through in recent years



Some of the reasons why the auto industry has been in trouble

Pension liabilities

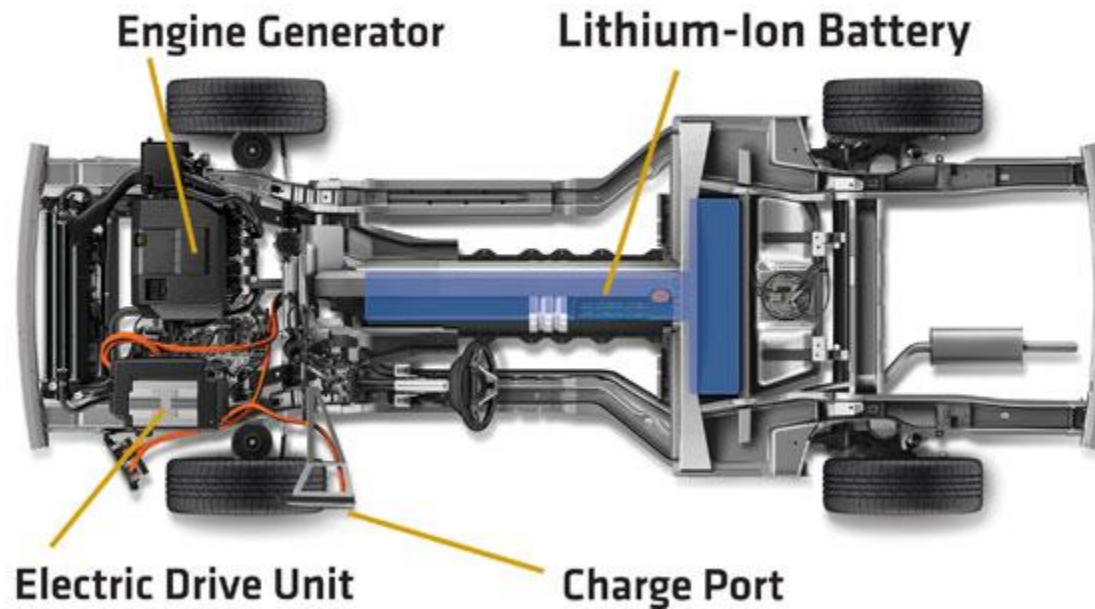
The GAO concluded that GM will have to add \$12.3 billion by 2014, while Chrysler is expected to need \$2.62 billion more during that time for its pension plan to keep it properly funded.

Foreign competition

Overcapacity

94 million cars can be produced this year with global capacity of 65 million according to The Economist

Innovation can save the industry



Everyone seems to be getting “on board”

Virtually every automaker on the planet either has plans to produce an EV or is actively doing so

However, the question remains...

Is this another false dawn for the Electric Vehicle industry?

We don't think so

Electrification of transportation will continue, though the industry and associated supply chains will evolve in fits and starts – this will NOT be linear

The future will be “electrified” and EVs are one part of this trend

There are three reasons why we think this is so:

Urbanization - 20 million Chinese citizens are moving from the countryside to the city each year

Oil prices are projected to rise

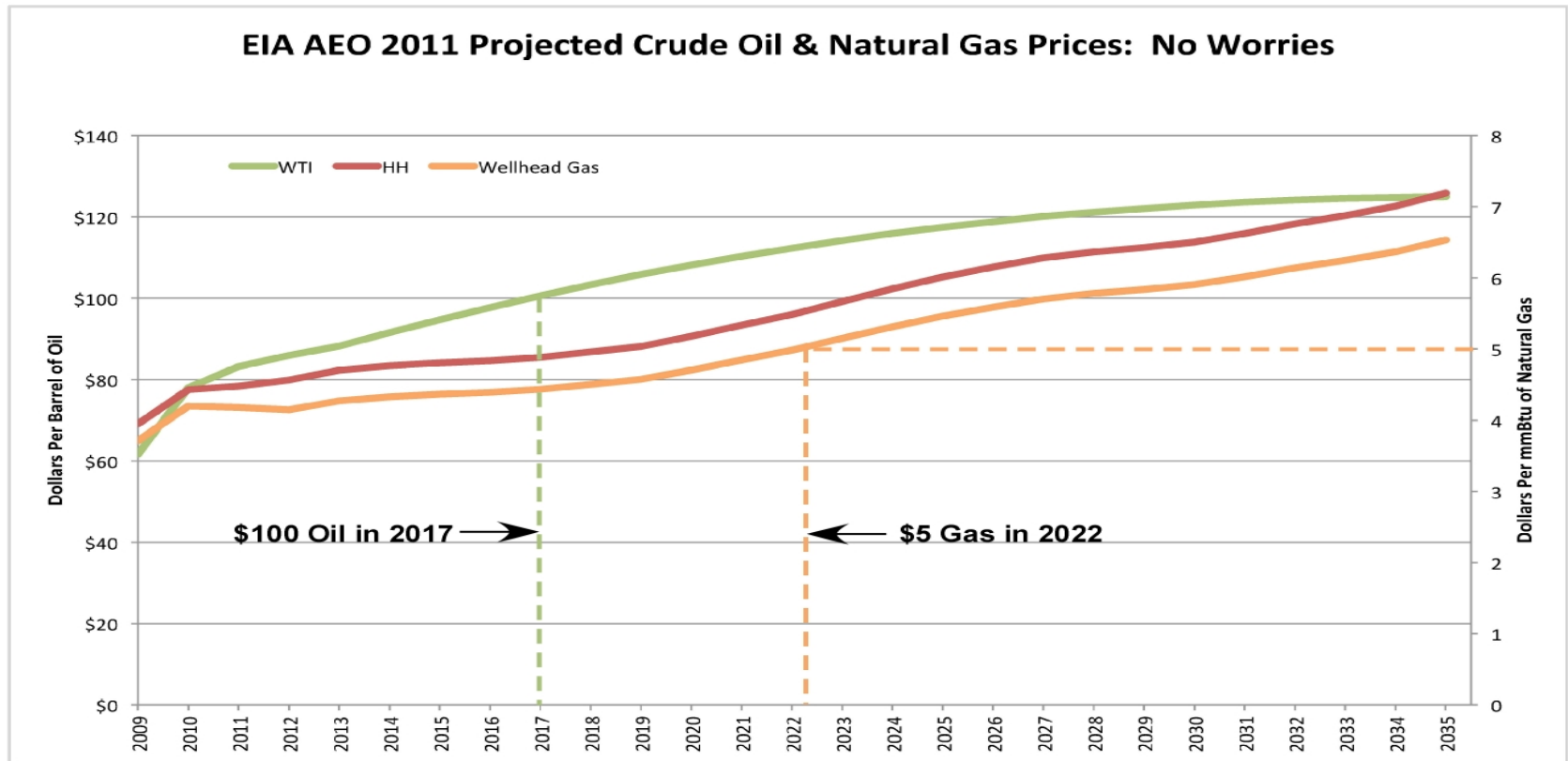


Figure 1. Projected crude oil and natural gas prices. Source: EIA AEO 2011.

Demographics are changing as well...

The Economist predicts that the total population of the world will be 10 BILLION by 2085

Not only is this a huge number of mouths to feed, but it also puts undue stress on the transportation sector and associated raw materials

Avenues of Demand for EVs

Fleets – GE commits to purchase 25,000 Chevy Volts by 2015

Buses and Taxis – BYD in Shenzhen, China

Rental cars – Hertz in China

E-bikes, e-motorcycles, e-scooters – 26 million in forecast sales in 2011 with a projection of 138 million by 2017 according to Pike Research

Niche markets

Asia is KEY - China in particular

EV forecasts

EV demand forecasts are literally all over the map, but we've seen estimates of 500,000 EVs (of various types) on the roads in North America by 2015 and 600,000 in China

If we assume that a total of 2 million EVs are on the roads globally by 2015 (base case), you can get a rough picture of the raw materials necessary to allow for successful EV adoption

This excludes “two-wheeled” EVs which are expected to see the most immediate growth

And don't forget about raw materials used in “traditional” auto manufacturing...

A few of the metals used in EV and auto manufacturing....

**Lithium
Cobalt
Graphite
REEs
Platinum/Palladium
Silver
Copper
Steel
Aluminum
Magnesium
Etc.....**

Lithium

Though lithium is “critical” for the lithium-ion battery used in EVs, there is no current or forecast supply shortage for the metal (though there is evidence of the market tightening)

Steady supply is a positive if you’re an end user, but as an investor, you must be aware of several factors....

Lithium

**Production of ~120,000 tonnes of LCE
(2010 - USGS)**

76% of the demand is industrial: used in glass, ceramics, and greases while the remainder (24%) is used in batteries and this is forecast to rise to 45% by 2015

Majority of supply comes from Chile, Argentina, Australia, and China

Current price of roughly \$6,000/t LCE

How much lithium is used in various applications?

Cell Phones	5 grams
Lap Tops	10 grams
Hybrid EV	6 kilograms
Plug-In EV	12 kilograms
40 KWh EV	24 kilograms
1 MW Bulk Storage	800 kilograms

Discovery Investing Keys to Investing in Lithium Miners (and other metals)

Management experience in the lithium space

Byproduct production – this leads to arguably the most important facet....

Lowest-cost producer

Off-take agreements are a plus

Geopolitics is always important – resource nationalism

Graphite

Production of 1.1 M tonnes in (2010 - USGS)

80% of world supply comes from China today but they only export 40% of their production and add a 20% export tax

Given the above, could this be the rare earth story all over again?

Approximately 20x more graphite is used in an EV battery than lithium

Graphite

No domestic graphite production

SignumBox forecasts 13,000 additional tonnes of lithium demand for the EV industry by 2020. This means 260,000 tonnes of large flake high purity graphite would be needed – roughly 25% of total graphite supply today

This ignores other avenues of demand for graphite including nuclear reactors (traditional and pebble bed), solar energy, e-bikes, etc...

Is there enough current or near-term production to support an EV industry? This is a question to keep in mind

Rare Earth Elements

This story has been well told – China controls the market

The benefits they provide in efficiency are undeniable

The bubble in this sector has begun deflating as too many companies are chasing a piece of a small market (~120,000 t produced in 2010)

Export quotas in China have fallen...

	Export Quotas (tonnes REO)	Change From Previous Year	ROW Demand (tonnes)	ROW Supply (tonnes)
2005	65,609		46,000	3,850
2006	61,821	-6%	50,000	3,850
2007	59,643	-4%	50,000	3,730
2008	56,939	-5%	50,000	3,730
2009	50,145	-12%	25,000	3,730
2010	30,258	-40%	48,000	5,700-7,700

...with a predictable effect on REO prices

REO	Oxide Price FOB Jan 4, 2011 (\$/kg)	Oxide Price FOB July 7, 2011 (\$/kg)	% Change
Cerium	\$60	\$147	145%
Lanthanum	\$59	\$141	139%
Praesodymium	\$85	\$231	172%
Neodymium	\$86	\$295	243%
Samarium	\$34	\$129	278%
Europium	\$620	\$5,870	847%
Gadolinium	\$43	\$188	337%
Terbium	\$595	\$4,210	608%
Dysprosium	\$285	\$2,510	781%
Yttrium	\$70	\$162	131%

Source: Metal-pages.com

The era of “easy money” in REE stocks is OVER

Focus on deposits in safe geopolitical jurisdictions

Look for deposits with a decided slant towards heavy rare earth elements

And don't forget about METALLURGY!

Though supply promises to remain tight for various REEs, this is not the case for ALL REEs, clouding the ultimate demand picture somewhat

Cobalt

Production of 88,000 tons (USGS – 2010)

24% of cobalt is used in rechargeable batteries – forecast to rise to 45% by 2018

Bulk of production from Congo (45,000 of 88,000 tons) – beware of geopolitics (again)

10x more high purity cobalt used in a lithium-ion battery compared to lithium

No North American mining of cobalt currently, though this is about to change

Cobalt and the auto industry

A typical hybrid electric vehicle (HEV) uses 3 to 5 lbs of cobalt in its Nickel-Metal Hydride battery

A typical HEV that uses a lithium-ion battery uses 5-7 lbs of cobalt

What does this mean going forward?

Some quick math

If we assume 2,000,000 HEVs on the world's roads by 2015, this would require up to over 6,000 tonnes of ADDITIONAL high purity cobalt on world markets (optimistic scenario)

This does NOT include forecast increases in other types of EVs

Therefore, if the “traditional” uses for cobalt increase at global GDP rates, and there is even a marginally larger increase for cobalt used in EVs, then there exists a window for juniors here

Key Takeaways

This is NOT a “False Dawn”

Electrification is here to stay

However, there are always caveats such as:

Lack of charging infrastructure
Cost of the car
Range anxiety

Key Takeaways

Desire for a higher Quality of Life will ensure that the metals we discussed will remain in healthy demand

The EV represents an opportunity to re-invent a domestic supply chain

The battery business alone is worth multiple billions of dollars

Access to the raw materials is key

Those companies with quality management, a stable geopolitical story, and lowest cost of production amongst other factors will be the beneficiaries of vehicle electrification and the electrification of future society

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