The lightest metal found on Earth is the key component in a new generation of vehicle batteries designed to reduce carbon emissions, greenhouse gases and dependence on oil. FMC's commitment to sustainability is helping improve future supplies and performance.

A TWO-PART STORY
In 1835, Thomas Davenport, an American blacksmith, became the first person ever to use an electric DC motor to build a small electric motor railway. When he filed his patent application, he named his invention “Improvements in propelling machinery by magnetism and electromagnetism.”

In 1884, British inventor Thomas Parker created a “horseless carriage.” Parker had already experienced significant success with EVs. He's credited with electrifying the London Underground (now called “The Tube”). He also created overhead tramways in Liverpool and Birmingham. His efforts were driven by the desire to reduce the smoke and pollution that plagued Londoners of his time.

Electric vehicles found their first commercial application in the U.S. in 1897 as a fleet of electrical New York City taxis, built by the Electric Carriage and Wagon Company of Philadelphia. The short trips common to cab rides made the EVs an ideal choice. Passengers were able to get where they needed to go, and batteries were easily replaced and recharged.

When nickel-ion, rechargeable batteries were invented, Thomas Edison immediately recognized their potential for powering electric cars. After 10 years of trying to create a battery that would help automobiles travel a practical distance without recharging, Edison shelved his experiments.

Before her husband Henry's Model T's eventually began to dominate the industry, Clara Ford drove a 1914 Detroit Electric, which allegedly traveled 80 miles without recharging. Advances in the internal combustion engine and, ironically, an abundance of cheap crude oil fueled Ford's efforts to push the electric car out of the picture.

If only he had seen into the future.
Necessity: The Mother of Re-invention

Decades later, the problems associated with the world's choice for personal transportation – air pollution, the volatile oil market and concerns over greenhouse gases – remain. The same is true for the fundamental issue that prevents the mass acceptance of EVs: How do you create a cost-efficient battery that will increase the distance traveled, make it more practical for everyday use and eliminate the problems associated with the internal combustion engine?

In FMC’s lithium resources, and proprietary lithium technology, the world is discovering the resolution to this century-old problem – now destined to transform the future.

Lithium revives, recharges and reinvents batteries. It is the elemental source of power that enables us to replace vehicles that have been powered exclusively by the combustion of petroleum. The “vision” of hybrids, plug-ins and electric vehicles is no longer a pipe dream; it’s very real.

Lithium Leads the Charge

The lithium we extract and refine enables our world to reduce dependency on fossil fuels that are believed to contribute to greenhouse gases. The writing is clearly on the wall: As citizens of a shrinking planet, we need to reduce carbon emissions and set ourselves free from the expense and volatility of the world oil market.

FMC entered the rechargeable lithium-ion business in 1991, providing lithium carbonate to Sony. Today we are one of the three largest suppliers of lithium in the world, and the world’s Number One supplier of lithium hydroxide for battery and grease production, and lithium chloride for metal conversion and industrial uses.

Our long-term and historic role in bringing lithium to the marketplace speaks not only to our commitment to sustainability, but also our partnership with customers to create innovative, sustainable solutions. The projected growth in the EV market clearly parallels FMC’s own growth strategies through 2015 and beyond. A conservative projection from
industry experts indicates that lithium use will double in the next decade. FMC has made significant investments in resources and technology to make sure we stay ahead of this powerful, globe-changing rise in demand.

**Tiny Atom, Monumental Impact**

Lithium is the lightest of the metal atoms in the periodic table of elements. This soft silver-grey metal forms a strong alloy when combined with other metals such as magnesium. Pure lithium metal by itself is highly reactive with water, oxygen, carbon dioxide and nitrogen at room temperature. In contrast, lithium salt compounds like those used in batteries are still powerful but very stable.

The battery market comprises two broad segments: primary (single-use) batteries and secondary (rechargeable) batteries. Primary batteries run devices such as toys, flashlights, watches and pacemakers. Secondary batteries power items such as laptops, power tools and EVs. Both types use lithium because it’s the lightest metal and has the highest electrochemical potential. This enables lithium batteries to achieve very high energy and power densities in all applications.

Lithium is not a replacement for fossil fuel. Its true value is in its capability as a storage medium. This lightest of metals has the ability to store and release energy in a manner that is unsurpassed by any other material known to humankind. That makes it the best possible choice for moving away from the inefficient conversion of fuel to energy associated with the internal combustion engine and driving toward a new future in the EV marketplace.

**The Salt That’s Shaking up the Auto Industry**

Lithium is extracted from the earth from three main sources: Salars, pegmatites and sedimentary rocks. Salars contain brines (saline waters) at high concentrations of dissolved salts and represent 66 percent of the world supply of lithium. Pegmatites are igneous rocks found in the Earth’s crust and represent 26 percent of the supply. Sedimentary rocks such as clay make up the other 8 percent.
In recent years, lithium brines from Salars have become a major source of lithium compounds due to lower conversion costs and generally more environmentally friendly extraction methods than hard rock mines.

Salars are large, dry lake beds. Lithium brines occur in Salars which have formed as closed or restricted drainage basins where the evaporation rate is higher than the precipitation. The surface of the Salar is a salt-based crust that is hard and thick enough to operate vehicles over it or support building structures on it. The brines are located just under this surface of crusted salt deposits.

About two-thirds of the world’s current lithium supply is found in Salars in Chile and Argentina in the Andes Mountains. This region of the Andes contains some of the driest places on Earth. It is the perpetually arid nature of this location that made the Salars form in the first place.

**Nature’s Bounty in Argentina**

FMC’s two facilities are located in Argentina, where we extract and process two different products: lithium carbonate and lithium chloride. Both products are directly supplied into the market and further processed for downstream use. Within the lithium market, buyers and sellers of lithium salts tend to reference them on a common weight equivalent basis known as Lithium Carbonate Equivalents (LCE).

Potash, used widely as a source of potassium for fertilization in crop markets, is a common by-product from brine extraction and represents a future growth opportunity for FMC. We are installing our first potash production line in the current capacity expansion increase for lithium carbonate. The line is slated for completion in early 2012.

At first glance, our facilities in Argentina look more like farms than industrial sites. Evaporation ponds, which rely on the power of solar energy, are a key first and finishing step to our processes. In between, we use our own exclusive and patented Selective Absorption Process to extract lithium from the Salar brines.
We pump the brine from under the Salar crust, transfer it to solar evaporation ponds and let the sun work its magic. When the water evaporates sufficiently to leave behind a higher lithium concentration, the brine is pumped through a series of columns containing specialized resins and separation media to continue the purification process. We then put the product into high-concentration ponds and let the sun continue its work before converting the highly concentrated finished brine into lithium carbonate and lithium chloride.

In addition to our environmentally-friendly extraction method, we are diligent about reducing, reusing, and recycling waste generated directly from our manufacturing processes. Another element of the lithium sustainability story is our careful production of the best lithium products possible, as efficiently as possible, because that’s what matters most to our customers.

It matters because higher purity means more robust performance: an extra hour of power or an added year of battery life. Making the most of available resources in a responsible manner is good environmental stewardship, while product precision and purity provide peace of mind for our customers and shareholders.

More Power in Store...

In part 2 of this story, you’ll learn how lithium makes batteries work better and what FMC is doing to meet future demands for greater supply and higher performance.