Earth Wars
## Contents

Maps vii
Introduction xv

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Four Essentials</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Food, Water, Energy, Metals</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Geographical Flashpoints</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>The Trouble with Lines on a Map</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The Key Players</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Diggers, Drillers, and Dealers</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Food and Water</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Where the Rivers Run</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>“Going Out” for Energy</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>China and India Stake Their Claims</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Old Coal Still Burning brightly</td>
<td>91</td>
</tr>
<tr>
<td>7</td>
<td>Going Nuclear in a Post-Fukushima World</td>
<td>105</td>
</tr>
<tr>
<td>8</td>
<td>New Energy—Clean, Green, and Expensive</td>
<td>123</td>
</tr>
<tr>
<td>9</td>
<td>Coppery Red, the Colour of Earth’s True Love</td>
<td>139</td>
</tr>
<tr>
<td>10</td>
<td>Finding Steel’s Essential Ingredients</td>
<td>155</td>
</tr>
</tbody>
</table>
Chapter 11  U.S. Energy
Hail to the Shale  173

Chapter 12  Japan after the Deluge  189

Chapter 13  BRACQK (Brazil, Russia, Australia, Canada, Qatar, Kazakhstan) Is the New BRIC  203

Chapter 14  The Up and Comers
Turkey, Iran, Indonesia, Mexico  229

Chapter 15  What Happens Next
A Host of Global Opportunities  243

Conclusion
A World So Changed  257

Bibliography  263

Acknowledgments  269

About the Author  273

Index  275
Maps

Africa
South America
Introduction

What we are experiencing with the transformation of China is a once in a century or more event. It really is the start of a global rebalancing—a rebalancing that will continue to unfold over many decades.

—BHP Billiton Chairman Jac Nasser, 9 May 2011

Six hundred years ago, China neither needed nor wanted anything from the West. It was the Middle Kingdom, the centre of the world, the seat of all that a civilization could possibly need to advance and prosper. India viewed itself through a similar prism—one rich in culture, religion, and resources. There was trading, of course: seafarers from the Mediterranean, the Persian Gulf, the east coast of Africa, and the islands of Southeast Asia bought and sold all manner of spices, timber, textiles, gems, and opium along a route that stretched from Venice to Calicut in India and on to Guangzhou in China.

Then came the great age of European exploration, as fleets from Portugal, Spain, Holland, and England sailed out into the oceans in search of new worlds to conquer. By the twentieth century, China and India were supplicants to the dominant colonialists of Europe, America, and Japan, seemingly beaten by their technology and their industrial might. After decades spent throwing off the colonial yoke and then trying to catch up economically, the two Asian giants are now poised to become the drivers of global growth in the first half of the twenty-first century. Demography is helping shape their destiny: A massive population base of 2.5 billion people, all eager
to savour the full fruits of modern living, means there is increasing competition for scarce resources.

Whether it is lithium from a salt pan in the Andes, gas from the Caspian Sea, oil from a deepwater well off the coast of Brazil, coal from Africa’s Zambezi River region, iron ore from the Australian outback, potash from Canada, or uranium from a Kazakhstan mine, China and India are keen to ensure the security of their future resources supply. Renewable energy from multiple sources and technologies can help, which is why the Asian duo are among the world’s leading developers and users of solar, wind, and hydro power. Along with their urgent quest for control of natural resource projects around the globe, China and India know they must better nurture what they have at home. Each has substantial energy, food, and water supply capabilities, but pollution, contamination, and overuse are taking their toll of farmlands, river systems, and air quality.

In the race for global resources, tensions inevitably emerge. There are flashpoints everywhere—high food prices, for example, had a role to play in the violent political upheavals of the 2010–2011 Arab Spring. The world needs the sea lanes to stay open for trade, but maritime boundaries are a constant source of friction, and piracy adds an unwelcome element of danger for mariners. The oil and gas reserves of the South China Sea, for example, give an extra edge to China’s territorial disputes with Japan, Vietnam, and other Asian neighbours over island groups such as the Senkaku, the Paracels, and the Spratlys. India has its own territorial issues with China over Aksai Chin on the Tibetan Plateau, and resource-rich Arunachal Pradesh in the eastern Himalayas. In 1953, India’s then-Prime Minister Jawaharlal Nehru declared after a trip to China that the Chinese people cherished in their hearts the greatest of love for India, and wished to “maintain the friendliest of relations” with it. Nine years later, the two countries would be at war. While China–India economic ties have strengthened considerably since then, the edginess continues. At the same time, the United States, Europe, Russia, Japan, South Korea, Brazil, and half a dozen big, emerging economies such as Indonesia, Iran, Turkey, Mexico, Nigeria, and Saudi Arabia have their own interests to promote and protect.

On the political front, there are multiple changes ahead among the biggest economies. In China, Xi Jinping is likely to become chief of the Communist Party in October 2012 and president in 2013, with Li Keqiang his likely running mate as premier. Barack
Obama may well be a one-term U.S. president, while India’s Prime
Minister Manmohan Singh will remain until 2014 before a possible
transition to Rahul Gandhi. Angela Merkel may run again for
the German chancellor’s job in 2013, and we have already seen
massive changes in other European administrations such as Italy
and Greece in 2011. As for Japan, who knows? Since the end of the
Koizumi administration in 2006, it has had six prime ministers. There
will be a new president in South Korea in 2013, and in Indonesia
in 2014. In Turkey, Prime Minister Recep Tayyip Erdogan’s term
runs until 2015, as does that of Brazil’s President Dilma Rousseff.
In Russia, Vladimir Putin could be ensconced in the leadership
until 2024.

Worldwide, energy is the key requirement to keep economies
growing and living standards improving. But the era of easy energy
is over. The cheap and easily accessible oil of past decades is used
up or locked up in strategic reserves. Now the world has an energy
choice, but what a choice. The remaining oil is too political, coal’s
too dirty, nuclear’s too dangerous, wind’s too fickle, solar’s too
expensive, hydro’s too dislocating, geothermal is too hard to wrangle,
and fracked gas is too divisive. Even so, many of the world’s top
resources companies see gas as the great savior over the next
20 years, in what the International Energy Agency calls the impend-
ing “golden age of gas” in its World Energy Outlook. Russia already
sends Siberian gas to Germany via a 1,200 km undersea pipeline in
a foretaste of how that golden era may play out. Something similar
is happening in Central Asia, where gas is being piped to China
from Turkmenistan, with Uzbekistan and Kazakhstan soon to follow
as suppliers. Elsewhere, we’re in the era of deepwater drilling in
pristine Arctic environments, and getting to grips with the logistics
of “pre-salt” geology off Brazil’s coast in the South Atlantic. Some
energy companies see potential in the tar sands of Canada and
Venezuela, though this unconventional oil comes with its own set of
environmental challenges. In the United States, technology investors
are busy pouring molten salt into the pipes of solar concentrators to
store energy overnight, or creating giant offshore wind farms that
won’t run out of puff at an inopportune moment. China pumps
out solar panels at a rate and cost that has bitten deep into the
viability of German producers. In Europe, the focus is on integrated
power grids that will make the best use of renewable energy’s
potential. And all the time, we worry about the Pacific Ocean’s
volcanic ring of fire—or where best to put our next earthquake-proof and tsunami-proof nuclear power stations.

*Earth Wars* is an attempt to show just how interconnected our world has become in terms of the supply and demand for all sorts of resources, as living standards rise and energy consumption grows in advanced and emerging economies. As such, it is simply a snapshot of the conditions prevailing at the start of 2012, and some thoughts on where we are headed. China dominates the resources conversation, but the many challenges facing it are not to be minimised. Just keeping the country together is a constant battle for the leadership in Beijing, who must be ever mindful of the compact they have with the Chinese masses to deliver economic development in return for a delay in greater individual liberty. In India, democracy bumps up against the social frustrations of caste, color, corruption, religion, ethnicity, and gender every day, but the country’s optimism about the future is undiminished.

Geoff Hiscock
January 2012
CHAPTER

The Four Essentials

Food, Water, Energy, Metals

China has a foreign exchange reserve of $3 trillion and it is not surprising to think $1 trillion will be employed in assets outside of China within the next five to 10 years.

—Nomura China Chairman Yang Zhizhong, at the Boao Resources Forum in Perth, Australia, 12 July 2011

Food, water, energy, and metals: Keep up the supply of those four essentials, throw in some clean air and a peaceful disposition, and—short of a Hollywood-style 2012 cataclysm—the world will run smoothly forever. That’s the theory, anyway, for twenty-first century optimists. The reality is that a secure supply of the first four essentials is far from assured. Big-power rivalry, surging demand for commodities, a rise in living standards for hundreds of millions of people eager to savour the delights of their first car, TV, computer, or mobile phone—or in the case of a billion poorer people, enjoy a second daily meal—means that the pressure on the planet’s finite resources is rising rapidly. There is no easy safety valve to release. The 1.3 billion people in China, another 1.2 billion in India, and hundreds of millions in fast-growing, emerging economies such as Brazil, Russia, Indonesia, Turkey, Mexico, Poland, Nigeria, and
Vietnam do not want to be denied the fruits of their labours. They want what consumers in North America, Europe, and Japan already have. That is why the great battle for control of the world’s resources is well and truly underway.

There are many fronts in this war. One starts deep in the desert country of the West Australian outback, where the sun beats down remorselessly on a forbidding landscape of salt pans, shifting red sand dunes, spinifex, and rocky protrusions. This is the heartland of the Yilgarn Craton, a massive block of weathered rock that takes up a vast swathe of inland Australia, underpinning its claim as the world’s oldest continent. The mineral-rich craton is a crust created 2.7 billion years ago, pushed upward from the ocean floor as the earth began forming into the continents we know today.

A thousand kilometres (600 miles) by road northeast from the state capital of Perth stands one of the Yilgarn Craton’s most significant place names: Mount Weld, the remnant of a volcano that blew up eons ago. At its central core, perhaps three kilometres (2 miles) in diameter, is a rich pipe of carbonatite, the host rock for something much more valuable. Mount Weld is a hot zone, repository of what may be the most important mining deposit outside of China: 24 million tonnes of rare earths resource, resulting in 1.9 million tonnes of rare earths oxide. More importantly, by the middle of 2012, it will offer one of the first new sources of rare earths supply outside China in a decade.

Around Mount Weld, the high-summer temperature regularly tops 38°C (100°F), crisping the sparse vegetation. The dry lakes are thick with salt, a legacy from millions of years of sea spray borne on the winds of the Indian Ocean and deposited hundreds of kilometres inland from the western coast.

On the surface, the land looks unforgiving and potentially fatal for a wayward traveller. But it is the treasure below ground that lures people into this harsh environment. Fortune seekers from Britain, America, and China came in their thousands in the late nineteenth century to search for gold in an area now believed to contain almost a third of the world’s known gold reserves. A hundred years later, prospectors big and small pegged out claims for tenements rich in nickel, iron ore, copper, and zinc.

Now there is a new lure—rare earths: the 17 chemical elements that one day may prove the biggest mining bonanza of them all. Their names—scandium, yttrium, and the 15 lanthanides such
as lanthanum and cerium—are yet to loom large in the public consciousness. But in the ongoing battle for control of the world’s most valuable resources, rare earths and rare metals sit alongside oil, gas, uranium, coal, iron ore, copper, and gold as the materials that countries, companies, and consumers must have. Rare earths are in everything that is technologically hot: batteries for hybrid and electric cars, iPads, iPods, Blackberries and other smartphones, LED televisions, energy-efficient lights, lasers, camera lenses, permanent magnets, highly refractive glass, fluid catalytic cracking catalysts for oil refineries, catalytic converters for motor vehicle exhausts, X-ray machines, phosphors, computer memories, sophisticated military items such as night-vision goggles and missile guidance systems—the list goes on. In December 2010, the U.S. Department of Energy released its Critical Materials Strategy report that found five rare earth metals—dysprosium, neodymium, terbium, europium, and yttrium, as well as a processed rare metal, indium—were “most critical” in terms of supply for the United States over the next five years.¹ The big demand drivers are permanent magnets and battery alloy; by 2014, when global demand for rare earth oxides reaches 191,000 tonnes, about 55 percent will go to these two applications alone. The British Geological Survey’s own Supply Risk List (see Exhibit 1.1) has rare earth elements as fifth on its list, with niobium behind antimony, mercury, tungsten, and the six platinum group elements (iridium, palladium, platinum, osmium, rhodium, and ruthenium). China is the leading producer of 28 of the 52 elements on the list, including antimony, mercury, tungsten, and rare earths.

Getting a secure supply of rare earths is exercising the minds of politicians, prospectors, and investors around the globe, particularly after China—which accounts for 97 percent of global production—cut back its exports in 2010 and again in 2011 to make it clear that the needs of its domestic users would take priority over exports.

Exhibit 1.1 BGS Supply Risk List 2011 (1 = very low risk, 10 = very high risk)
Source: British Geological Survey, October 2011

<table>
<thead>
<tr>
<th></th>
<th>Antimony 8.5</th>
<th>Platinum group elements 8.5</th>
<th>Mercury 8.5</th>
<th>Tungsten 8.5</th>
<th>Rare earth elements 8.0</th>
<th>Niobium 8.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Japanese electronics and precision equipment makers in particular are heavily reliant on rare earths. Although they are able to recycle some from discarded computers, mobile phones, and other electronic detritus, they get most of their supply from China. In fact, between 50 and 60 percent of China’s rare earth exports go to Japanese buyers. But in September 2010, the buyers suffered something akin to a mini “oil shock.” Their supplies from China slowed to a crawl, tied down by the sort of bureaucratic double-shuffling that the Japanese themselves once employed as a nontariff barrier against unwanted imports. There was no export ban, the Chinese declared, but the result was the same: shipments ground to a halt, and the Japanese electronics industry got very nervous. Japan’s crime was to arrest the skipper of a Chinese fishing boat that collided with two Japanese coast guard vessels near a group of uninhabited islands in the East China Sea. The islands, known to Japan as the Senkaku and to China as the Diaoyu, are claimed by both sides. That there may also be oil and gas riches in the surrounding waters adds another economic dimension to their dispute.

One result from that confrontation was a quick deal by the Japanese trading house Sojitz to form a strategic alliance with the owner of the Mount Weld rare earths, the small Australian mining company Lynas Corp. Lynas, which bought the Mount Weld mining rights from global mining giant Rio Tinto in 2001, struck an agreement to supply its products to Sojitz and to accelerate its project’s expansion with Sojitz’s backing. It also has a joint venture with Germany’s Siemens for future production of neodymium-based rare-earth magnets. According to Executive Chairman Nicholas Curtis, Lynas owns the world’s richest known deposit of rare earths outside China. It claims an advantage in grade and composition over China’s massive 40-million-tonne reserves at the Bayan Obo mines in Baotou, part of Inner Mongolia. According to Lynas, three of the most valuable rare earth elements—dysprosium, europium, and terbium, worth between $1.4 million and $3.8 million a tonne at January 2012 prices—are found at Mount Weld in concentrations at least double that found in the Baotou reserve.

That makes Mount Weld one of the global markers for rare earths. Apart from China, others are in South Africa, the United States, India, Mongolia, Kyrgyzstan, Vietnam, Canada, Brazil, Sweden, and Greenland, meaning that rare earths are not as rare as their name implies. But they are hard to extract economically. Many of
the deposits found so far lack the concentrations that would make them a viable proposition. Others are in difficult or environmentally sensitive locations. Lead times to bring a mine into production can take up to a decade, plus the processing of rare earths ore is a dirty business, one that needs lots of water and leaves a lot of mess to clean up. Pollution is a major problem at Baotou, and few governments are prepared to sanction new projects because of the environmental issues. Lynas says its isolated Mount Weld operation, which began mining ore in mid-2011, meets international safety and environmental standards. It runs the crushed ore through a concentration plant on-site before stockpiling it for shipping to an advanced materials plant being built at Kuantan in the Malaysian state of Pahang, where it will be processed into separated rare earths products. Its first-phase production target of 11,000 tonnes in 2012 is expected to double in phase two to 22,000 tonnes.

China came close to buying Lynas in 2009, but a $500 million bid by the state-owned China Nonferrous Metal Mining (Group) Co., known as CNMC, to take a majority stake collapsed in the face of stringent conditions imposed by Australia’s Foreign Investment Review Board. The Australian government insisted the Chinese company keep its stake below 50 percent and take only a minority of board seats—a stance that was unacceptable to CNMC. But why would China want to buy a smaller rival when it already has 97 percent of the market and its Baotou reserve has enough for 200 to 300 years of supply?

Clean Energy Technologies

One reason is the future demand for clean energy technologies. China, along with India, is fast becoming a global leader in wind and solar power. Large-scale wind turbines rely on permanent magnets, built from critical materials such as dysprosium, neodymium, praseodymium, and samarium. The same holds true for the thin films used in a solar panel’s photovoltaic cells. The critical materials here are indium, gallium, and tellurium.

Lynas is not the only new candidate for a place at the rare earths top table. North American explorer Ucore hopes to have its Bokan Mountain project in Alaska, based on an old uranium mine, producing in 2015. Canada-listed Great Western Minerals has its Steenkampskrall project in South Africa, where an old Anglo-American thorium mine
that closed in 1965 is to be recommissioned for its rare earth resource, with first output likely in 2013. Stans Energy has a similar plan and timetable for its Kutessay II mine in Kyrgyzstan, a past producer of heavy rare earth elements in the Soviet era. Greenland Minerals and Energy, another Australian-listed rare earths hopeful, has a multielement deposit of rare earths, uranium, and zinc at its Kvanefjeld project, on the southwest tip of Greenland. It says the reserve could sustain a large-scale mining operation for decades, with the potential to supply 20 percent of global demand for rare earths at low cost because of the revenue from uranium and zinc. But Greenland is a delicate environment, with more than its share of logistical challenges. Nothing is likely to emerge from Kvanefjeld until 2015 at the earliest.

Well before then, a U.S. contender—Molycorp’s rare earths plant at Mountain Pass, California—will be back in production after being mothballed in 2002 under the weight of cut-price Chinese competition and an increasingly onerous set of environmental regulations. When Molycorp hits its stride at the end of 2012, it expects to be processing 20,000 tonnes a year of oxide, in what it calls its “mines to magnets” strategy. Molycorp also owns a rare-earth processing facility in Estonia, one of only two such plants in Europe. The United States is keen to see a steady supply of strategically critical materials coming from its own mines or from friendly nations. “Diversified global supply chains and multiple sources of materials are required to manage supply risk,” the Department of Energy noted in its December 2010 report. “This means taking steps to facilitate extraction, refining and manufacturing here in the United States, as well as encouraging additional supplies around the world.”

Industry expert Jack Lifton of Technology Metals Research says that whatever actions the United States takes, the focus must be on the security of the U.S. supply chain for rare earths, and their availability. “America has all of the technology to transform rare-earth ore concentrates, the first item in the rare-earth end-use product supply chain, into finished magnets and CFLs (compact fluorescent lamps),” he argues. “Yet we have simply abandoned these industrial steps, all of them, actually, for momentary cheaper prices.” Lifton also wants the world to be aware that there is a clear difference between light and heavy rare-earth elements in terms of supply. “The LREEs (light) are not rare . . . just too expensive to produce against the Chinese supply chain. On the other
hand, HREEs (heavy) are scarce even in China . . . ,” he wrote in December 2011.4

For resource seekers, a similarly strategic story is unfolding in South America, where the massive lithium deposits in the salars (salt pans) of the Andean plateau present what some analysts believe is the opportunity of a lifetime. Soft and silvery-white in colour, lithium is the lightest of all metals. It is used in ceramics, glasses, lubricants, pharmaceuticals, and, crucially, in lithium-ion batteries that power everything from watches, smartphones, iPods, and portable computers to hybrids and full electric vehicles (EVs). If the long-range forecasts are right, by 2020, up to 25 percent of the cars on the global auto market will be hybrids or EVs. That should mean a large market for batteries and consequent demand for lithium, though supply competition is likely to be fierce, with a likely oversupply until at least 2013.

**Lithium Triangle of the Andes**

In truth, there is no great shortage of lithium, but extracting it economically from salt-pan brines or hard rock can be another matter. Suppliers in South America, the United States, Australia, and China are working on a variety of resources and extraction techniques. For now, the cost advantage lies with lithium produced from brines, where the sun’s evaporative power does most of the work. High in the Andes, in a part of the world subject to intense solar radiation and known as the lithium triangle, the flat, white salars that extend across Bolivia, Chile, and Argentina are deemed to be the world’s richest source of lithium brines. Salar de Atacama in Chile, the adjoining Cauchari and Olaroz salars in Argentina and the massive 10,000-sq km Salar de Uyuni in Bolivia are the focus of global attention from investors, miners, and industrial groups keen to ensure they have a handle on lithium supply if—and this is a big if, given the recharging and recycling infrastructure required—demand for electric vehicles (EVs) takes off in the way some forecasters suggest, and if EV makers continue to use lithium in their batteries.

Lithium consumption in 2011 is around 120,000 tonnes of lithium carbonate equivalent (LCE). Only about 6,000 tonnes a year of LCE is for the batteries used in electric vehicles, but that ratio could change dramatically over the next decade if the long-awaited electric car age reaches critical momentum. In the view
of metals consultancy SignumBOX, the consumption figure for the automotive industry could reach 180,000 tonnes of LCE by 2025.\textsuperscript{5} Another analysis by the world’s biggest hard-rock lithium producer, Australia-based Talison Lithium, suggests demand for all applications, including transport, could reach between 350,000 and 500,000 tonnes of LCE by 2020. According to the U.S. Geological Service, global lithium supply in 2015 will be about 250,000 tonnes of LCE. The British Geological Survey’s 2011 supply risk list of 52 valuable metals confirms that lithium supply should not really be an issue. It puts lithium in the middle of the pack, ranked 23, equal to manganese, cobalt, gold, and cadmium, with a supply risk rating of 5.5 out of 10.\textsuperscript{6}

The relatively plentiful supply of lithium has not stopped a cavalcade of contenders for South America’s lithium brine resources. The players are many and varied, covering European, Japanese, Korean, Chinese, North American, Brazilian, and Australian interests. They include Japanese trading houses such as Toyota Tsusho, which has a stake in the Salar de Olaroz project with Australian miner Orocobre in Argentina; the South Korean trio of state-owned Korean Resources Corp. (Kores), trading house LG International and energy company GS Caltex, which are partners with Canadian explorer Lithium One in the Sal de Vida brine project in Argentina; Chilean fertiliser and mining group SQM (Sociedad Quimica y Minera de Chile), which mines Salar de Atacama in Chile and is the world’s biggest producer of lithium from brine; Frankfurt-based Chemetall, which also operates at Salar de Atacama; and Chinese investment house Citic, which aims to work with state-owned Bolivia Mining Corp. (Comibol) in developing the Uyuni resource. Comibol also has Kores and steel giant Posco as potential partners in taking Uyuni lithium further to processing and eventual manufacture of lithium batteries in Bolivia.

**Bolivia’s Ambitious Pitch**

Bolivia’s President Evo Morales, who upset some of the world’s biggest companies when he nationalized the country’s oil and gas resources after he came to power in 2006, has consistently maintained he is not interested in Bolivia being just the starting point in the global lithium supply chain; he wants to develop a domestic battery industry and potentially a plant to make electric vehicles.
In its ambitious pitch to investors, Comibol says Bolivia holds 70 percent of the world’s lithium reserves, with 100 million tonnes in the Uyuni, Coipasa, and other salt pans. It says that in comparison, Chile has 30 million tonnes, China 3 million tonnes, Argentina 2 million tonnes, and the rest of the world 7 million tonnes. That’s not a view shared by the U.S. Department of Energy, which in its *Critical Materials Strategy Report* of December 2010 and its update a year later, sees new low-cost lithium coming from Argentina, Chile, and the geothermal brines of the western United States, while noting that “currently and for the foreseeable future, Bolivia’s lithium is only an uneconomic resource.”

The U.S. view tallies with the way Canadian company Lithium Americas sees its low-cost resource in Argentina on the Puna Plateau. There, Lithium Americas, which has EV maker Mitsubishi Motors and auto component supplier Magna International as its strategic partners, says its site straddling the Cauchari-Olaroz salt pans is the world’s third-largest known lithium brine resource. It lies about 200 km east of the front-runner, Chile’s Salar de Atacama, and about 200 km north of second-ranked Salar del Hombre Muerto, where U.S.-listed FMC Lithium operates. For now, SQM, Chemetall and FMC are the big three of brine-based lithium production, while Talison dominates hard-rock production from its Greenbushes plant in Western Australia. Between them, they account for more than 80 percent of all lithium production, though China is looking to exploit its own high-altitude salt pans in the Qaidam Basin, and the United States has its long-running Kings Mountain mine in North Carolina, plus Silver Peak and other deposits in Nevada. A host of junior miners are seeking to make an impression in the lithium marketplace, but the going is tough. In November 2010, Edward R. Anderson, the president of metals consultant TRU Group, warned: “Competition through 2020 will be increasingly fierce, making it virtually impossible for aspiring lithium businesses to ever turn a profit. Millions of dollars invested in these companies will be lost by unsuspecting investors.”

The lithium brine producers have the cost and quality advantage, but not time—the evaporation process can take up to 18 months. Hard-rock producers, who mine spodumene or petalite and then process the ore with heat and acid to extract lithium, can get their product into the market more quickly, but at a higher cost. And just possibly, there is something new in the lithium wings: U.S.
startup Simbol Materials aims to process brine used by geothermal power stations in California’s Salton Sea and extract lithium chloride in just 90 minutes. Simbol’s professed goal is to “fundamentally transform the critical materials supply chain.” Its partner in this ambitious undertaking is the Japanese trading house ITOCHU Corp. TRU’s Anderson is skeptical of the Simbol claim, calling it a “very tall order” that does not change his view of the lithium supply-demand situation. In its 2010 report on electric vehicle batteries, the Boston Consulting Group predicted 14 million of the new cars sold in China, Japan, the United States, and Europe in 2020 would be EVs or hybrids. Of these, 11 million would have lithium-ion batteries. BCG said this battery market would be worth about $25 billion. But lithium is a very small part of a battery’s cost. The 20 kg of lithium likely to be found in an EV battery with a range of 160 km (100 miles) is worth about $100—hardly a critical factor in a vehicle selling for $30,000 plus. So why the rush to bring new supplies to market? The answer is that be it lithium, uranium, rare-earth elements, hydrocarbons, food, or water, everyone with a view longer than the next quarterly report wants to control the supply chain.

**Multitude of Factors**

Lithium and rare earths represent just a tiny part of the picture emerging in the early twenty-first century of a global struggle for resources between the big advanced economies (United States, Europe, and Japan) and the emerging economies of China, India, Brazil, and Russia. The search is breathtakingly broad in scope and geographic spread as each of the major players seeks control and security of supply over a string of valuable commodities. It reflects a multitude of factors coming together in the last few years to create a fear that someone somewhere is going to miss out. Those factors include the following:

- Very high economic growth rates of 7 to 10 percent a year in the world’s two most populous countries of China and India are pushing up demand for the commodities needed to supply the twin building blocks of their industrial and agricultural economies: power and steel.
- The growth of a middle class is creating a huge demand for motor vehicles in these same two economies and in the “second