EMERGING THREAT OF RESOURCE WARS

HEARING

BEFORE THE

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CONTENTS

EMERGING THREAT OF RESOURCE WARS

THURSDAY, JULY 25, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON EUROPE, EURASIA, AND EMERGING THREATS,
COMMITTEE ON FOREIGN AFFAIRS,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 o'clock a.m., in room 2172 Rayburn House Office Building, Hon. Dana Rohrabacher (chairman of the subcommittee) presiding.

Mr. ROHRABACHER. I call to order this hearing of the Foreign Affairs Subcommittee on Europe, Eurasia, and Emerging Threats. Today's topic is the emerging threat of resources wars.

After the ranking members and I each take 5 minutes to make opening remarks, each member present will have 1 minute to make their opening remarks, alternating between majority and minority members. And without objection, all members may have 5 days to submit statements, questions, and extraneous materials for the record and hearing no objection, so ordered.

And now for my opening statement, an increasing global demand for supplies of energy and strategic minerals is sparking intense economic competition that could lead to a counter productive conflict. Who owns the resources, who has the right to develop them, where will they be sent and put to use, and who controls the transport routes from the fields to the final consumers are issues that must be addressed.

Whether the outcomes result from competition or coercion; from market forces or state command, we will be determining how to achieve and if we will achieve a world of peace and an acceptable level of prosperity or we won't achieve that noble goal. A "zero sum world" where no one can obtain the means to progress without taking them from someone else is inherently a world of conflict. When new sources of supply are opened up, as in the case of Central Asia, there is still fear that there is not enough to go around and thus conflict emerges.

Additional problems arise when supplies are located in areas where production could be disrupted by political upheaval, terrorism or war.

The wealth that results from resource development and the expansion of industrial production increases power just as it uplifts economies and uplifts the standards of peoples. This can feed international rivalry on issues that go well beyond economics.

We too often think of economics as being merely about "business" but the distribution of industry, resources and technology across

the globe is the foundation for the international balance of power and we need to pay more attention to the economic issues in our foreign policy and what will be the logical result of how we deal with those economic and those natural resource issues.

The control of access to resources can be used as political leverage, as we have seen with Russia and China. They both have demonstrated that. Indeed, China is engaged in an aggressive campaign to control global energy supply chains and to protect its monopoly in rare earth elements. This obviously indicates that Beijing is abandoning its "peaceful rise" policy. This is not an unexpected turn of events given the brutal nature of the Communist Chinese regime.

This hearing will look into this and will look at the economic and geopolitical tensions underlining the competition that we see for natural resources and we need to discuss that competition and we need to understand what is in the national interest of the United States and what must be protected to ensure that our people can enjoy a level of peace and prosperity in the future.

I now yield 5 minutes to the ranking member, Mr. Keating.

Mr. KEATING. Thank you, Mr. Chairman, and thank you for holding this timely hearing. Today's hearing topic provides us with an opportunity to look beyond Europe and Eurasia and examine the global impact of depleting resources, climate change and expanding world population and accompanying social rest.

In March, for the first time, the Director of National Intelligence, James R. Clapper, listed "competition and scarcity involving natural resources" as a national security threat on a path and on a par with global terrorism, cyber war, and nuclear proliferation. He also noted that "terrorists, militants, and international crime groups are certain to use declining local food security to gain legitimacy and undermine government authority" in the future.

I would add that the prospect of scarcities of vital resources including energy, water, land, food, and rare earth elements in itself would guarantee geopolitical friction. Now add lone wolves and extremists who exploit these scenarios into the mix and the domestic relevance of today's conversation and you can see the importance of this is clear.

Further, it is no secret that threats are more interconnected today than they were, let us say, 15 years ago. Events which at first seem local and irrelevant have the potential to set off transnational disruptions and affect U.S. national interests. We saw this dynamic play out off the coast of Somalia where fishermen were growing frustrated from lack of government enforcement against vessels harming their stock and where they took up arms and transitioned into dangerous gangs of pirates. Now violent criminals threaten Americans in multinational vessels traveling through the Horn of Africa. Unfortunately, I don't see a near term end to the coordinated international response that this situation requires.

I agree with Mr. Clapper that the depletion of resources stemming from many factors which above all include climate change has potential to raise a host of issues for U.S. businesses worldwide, for U.S. officials, and for individuals traveling abroad themselves. For this reason, Mr. Chairman, I have long advocated for alternate en-

ergy resources. It is representative of what will hopefully one day be our nation's first offshore wind farm.

I deal daily with obstructive businesses and individuals trying to get in the way of this and other projects in exchange for increasing their companies' net profits. I would like to add that given our distinguished panel of witnesses today and our subcommittee's jurisdiction, I am sure we will be hearing about the tremendous energy reserves in Central Asia and the need for diversifying energy markets. In this regard, I would like to take note that I have and will continue to advocate for the importance of increasing democratic governance and rule of law in that region. Energy production can get you only so far. I would like to hear from our witnesses on how the United States can engage with Central Asian governments to improve governance and transparency in the energy sector, both bilaterally and through international organizations such as the Extracted Industries Transparency Initiative.

However, as we discuss these important issues, I hope that we can continue to keep our own country's movement toward an energy-independent future and the obstacles in its path in mind itself.

With that, Mr. Chairman, I will yield back my time.

Mr. ROHRABACHER. Thank you very much and we also have with us Colonel Cook today who is a new member of the Congress and making himself a very fine reputation. Colonel Cook, do you have an opening statement?

Mr. COOK. Yeah, I will be very brief. I want to thank you, Mr. Chairman. You know, I want to thank you for having this hearing. I think it is an issue that doesn't get much attention. And in my former life besides being in the military for 26 years, I was a college professor and I have to admit I taught history and I always have got to give the old saw that people who do not understand history are bound to repeat it.

If you look at the history of conflicts and wars and everything else and whether you go back to that famous book, The Haves and Have-Nots, it is always about resources and who has it and who doesn't have them and who wants them. And maybe you could make an analogy on that. But I think we as a country, at least have not picked up on those lessons of history and we are very, very naive about the motivations of certain countries and why they do certain things. And obviously, there are things going on throughout the world right now in Eurasia which underscores some of the things that we are going to talk about today.

So I applaud having a hearing on this. I think the title says it all, resource wars, and if we don't have the war yet, we have had it in the past and we are going to have it in the future. So thank you.

Mr. ROHRABACHER. Thank you. And let me just note that Colonel Cook is a former Marine officer and my father was a Marine officer. I grew up on Marine bases.

Mr. COOK. Is that why I am on the committee?

Mr. ROHRABACHER. But how that fits right in in the course of what you were saying, Carl, is that my father joined the Marines to fight World War II and it is very clear that natural resources had a great deal to do with the Japanese strategies that led to the

Second World War and so we have some of our witnesses may be talking to us and will be talking to us on issues that are of that significance.

We have with us today Brigadier General John Adams, U.S. Army retired, is president of Guardian Six Consulting, LLC, and the author of the report, "Remaking American Security Supply Chain Vulnerabilities and National Security Risks Across the Defense Industrial Base," published by Alliance for American Manufacturing this May. General Adams served his final military assignment as Deputy U.S. Military Representative to the NATO Military Committee in Brussels, Belgium and on September 11, 2001, General Adams was stationed at the Pentagon as Deputy Director of European Policy in the Office of the Secretary of Defense. And we know what happened on that day. During his 30 years in the Army, General Adams' assignments have ranged from aviation to military intelligence. He is a veteran of Desert Storm. He also has three masters' degrees in international relations, strategic studies, and English. Excellent, General, that we have a General that has a degree in English. And is currently a Ph.D. candidate in political science at the University of Arizona.

We also have with us Edward C. Chow. He is a senior fellow of the Energy and National Security Program at the Center for Strategic and International Studies. He spent 20 years with the Chevron Corporation in the United States and overseas including as the country manager for China from 1989 to 1991 and he was then based in Beijing. He holds a bachelor's degree in economics, a master's degree in international affairs from Ohio University. He has just returned last week from a trip to Central Asia.

We also have with us Dr. Jeffrey Mankoff. He is deputy director and fellow in the Russian and Euro-Asian Program at the Center for Strategic and International Studies. He was a 2010–2011 Council on Foreign Relations International Affairs fellow based in the Bureau of European and Euro-Asian Affairs at the United States Department of State. From 2008 to 2010, he was associate director of International Security Studies at Yale University and received a Ph.D. in diplomatic history and an M.A. in political science from Yale with his B.A. in international studies and Russian studies from the University of Oklahoma. Good to have him with us.

And Neil Brown currently serves as non-resident fellow at the German Marshall Fund's Energy Transition Forum and Lugar Diplomacy Institute, senior advisor at the Goldwyn Global Strategies and is the founding director on the Board of the Lugar Center. He previously served as senior professional staff member for the Energy Security at the United States Senate Foreign Relations Committee and as a senior advisor to Republican Richard Lugar who we all remember very well and are grateful for his service and grateful for your service to him. He is also, I might add, a Rhodes Scholar.

So we have a very distinguished panel. I would ask each of you to limit your spoken remarks to 5 minutes, put the rest in the record, and then we will have a dialogue about the issues you have brought to us today. We will start with Mr. Chow and you may go straight ahead, sir.

STATEMENT OF MR. EDWARD C. CHOW, SENIOR FELLOW, ENERGY AND NATIONAL SECURITY PROGRAM, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES

Mr. CHOW. Thank you, Mr. Chairman, members of the committee. It is my distinct honor and privilege to testify before you today. I understand that you wish me to address the issues related to resource competition in Central Asia including on pipeline transportation to markets outside the region. I will stay within my competence on issues related to international oil and gas, although I understand the committee is interested in other natural resource competition which will be addressed by other witnesses.

When the Soviet Union collapsed in 1991, Central Asia offered a unique opportunity for western oil companies to enter a known oil- and gas-producing province which was previously closed to them. The Soviets had made a number of world-class discoveries, which they did not have the technical capability to exploit, most notably onshore Kazakhstan and offshore Azerbaijan. At the same time, these newly independent countries needed investments to enhance their economic autonomy and thereby protect their future political sovereignty. Oil and gas resources represented obvious immediate opportunities for Western investments.

The United States was also interested in helping these countries preserve their political independence by increasing their economic options away from over reliance on Russia. Additionally, as the largest oil importer in the world, we had an interest in seeing incremental oil and gas supplies outside of the Middle East and OPEC flow into global markets, whether we ourselves import those volumes or not.

With the help of Western investments, Central Asia and the Caucasus today produce around 3.5 percent of global oil supply and hold around 2.5 percent of the world's known proven reserves in oil. For comparison, this is equivalent to four times that of Norway and the United Kingdom combined. Another way of looking at this is to say the region produces around 8.5 percent of non-OPEC oil and holds around 9.5 percent of non-OPEC oil reserves. In other words, oil production in Central Asia has added significantly to global supply and will continue to do so in the future.

In many ways, the energy future of the region lies as much or more in natural gas than in oil. Central Asia is estimated to hold more than 11 percent of the world's proven gas reserves, mostly concentrated in Turkmenistan which has lagged behind Kazakhstan and Azerbaijan in attracting outside investments. The region currently produces less than 5 percent of global gas supply, so there is tremendous potential for growth.

In addition to production from Soviet-era discoveries, new discoveries of major oil and gas fields have been made in the region. Deserving special mention are Kazakhstan's Kashagan field offshore Caspian Sea, which is the largest oil discovery in the world for over 30 years; Turkmenistan's Galkynysh gas field, which is the largest onshore gas field in the world; and, Azerbaijan's Shah Deniz gas/condensate field.

Given its landlocked geography, Central Asia has to rely on long-haul pipelines to take its oil and gas to market. Previously Soviet pipelines in the region almost all head to European Russia either

to feed the domestic Soviet market or for trans-shipment to European markets. Control of these pipelines continued to give Russia leverage over transit of oil and gas from the region to market after the end of the Soviet Union.

However, Western investments in oil and gas production also led directly to investments in new pipelines, which are not controlled by Russia's Transneft for oil and Gazprom for gas. These include a number of projects I have put into the record which I will in the interest of time not discuss right now.

These new pipelines have diminished Russian control of oil and gas exit out of Central Asia and the Caucasus and helped achieve the objectives from the 1990s of giving the region more economic options and allowing its oil and gas production to flow freely to world markets.

When the Soviet Union collapsed in 1991, China was just about to convert from a net oil exporter to net oil importer. It was slow off the mark in the race for Central Asian oil and gas. By the time it focused on this region, most of the large production opportunities have already been acquired by Western companies. From a Chinese point of view, they have been playing catch up ever since.

Today China is the second largest oil importer in the world and an increasingly important importer of gas. With stagnant Chinese domestic production and rapidly growing energy demand, China is destined to replace us as the world's largest oil importer in a decade or so. Its companies have been investing in oil and gas around the world, including in neighboring Central Asia. Chinese companies now produce around 30 percent of Kazakhstan's oil, although from smaller fields than those operated by Western companies, and hold the only onshore concession in Turkmenistan.

In part because of disappointments in dealing with Russia on oil and gas, China has focused on pipeline development from Central Asia including an oil pipeline from Western Kazakhstan and gas pipeline from Turkmenistan through Uzbekistan and Kazakhstan to China. China has replaced Russia as the largest importer of Turkmen gas and this volume is slated to double or triple in the coming years.

The next growing source of competition for Central Asia oil and gas is likely to come from India, which follows closely China in growth in oil and gas demand and consequently oil and gas imports. Indeed, as Chinese demographic growth slows and population ages, India's energy demand is commonly forecasted to grow faster than China's in a decade or so.

With all due respect to the committee, the concept of resource wars is often exaggerated. The investments I referred to in Central Asia oil and gas production and pipeline development require tens of billion dollars and many years to mature. Conflict generally freezes such investments and resources are then stranded for many years. It is true that there is resource competition in Central Asia, as is true around the world.

Our policy concern should be for such competition to be conducted in a rule-based manner, without political coercion, as the chairman mentioned, or non-transparent business practices, to the disadvantage of the citizens of the host countries and global consumers. As long as the rules of competition are fair, our oil, serv-

ices and equipment companies can compete in Central Asia, where they are doing rather well, and market competition will drive economic efficiency to the benefit of all. Observing the nature of resource competition and assessing its political consequences will remain an important task for your committee. In Central Asia itself, my humble opinion is control of water resources are more likely to lead to direct conflict than with oil and gas.

Thank you for your attention.

[The prepared statement of Mr. Chow follows:]

Statement before the House Foreign Affairs Committee, Subcommittee on Europe, Eurasia, and Emerging Threats

"EMERGING THREAT OF RESOURCE WARS"

A Statement by

Edward C. Chow

Senior Fellow, Energy and National Security Program

Center for Strategic and International Studies (CSIS)

July 25, 2013

2172 Rayburn House Office Building

House Committee on Foreign Affairs
Subcommittee on Europe, Eurasia, and Emerging Threats
Hearing on "Emerging Threat of Resource Wars"
July 25, 2013

Written Statement
By
Edward C. Chow
Senior Fellow
Energy and National Security Program
Center for Strategic and International Studies

Mr. Chairman, members of the subcommittee:

It is my distinct honor and privilege to testify before you today. I understand that you wish me to address the issues related to resource competition in Central Asia, including on pipeline transportation to markets outside the region.

I do this informed by more than twenty years of experience working in Central Asia starting in 1991 when I was employed by Chevron, which was one of the first Western companies to enter the region when it signed the foundation agreement for the Tengiz joint venture with Kazakhstan here in Washington in May 1992. Since 1999, I continued to follow the region in think tanks and as an occasional consultant to the United States and foreign governments, international financial institutions, and multinational corporations.

In the interest of full disclosure, I should let the Committee know that I currently advise our Department of State on how to advance the Turkmenistan-Afghanistan-Pakistan-India (TAPI) Gas Pipeline – a subject we can return to later if you are interested.

I will stay within my competence on issues related to international oil and gas, although I understand the committee is interested in other natural resource competition, which will be addressed by other witnesses.

When the Soviet Union collapsed in 1991, Central Asia offered a unique opportunity for Western oil companies to enter a known oil and gas producing province, which was previously closed to them. The Soviets had made a number of world-class discoveries, which they did not have the technical capability to exploit, most notably onshore Kazakhstan and offshore Azerbaijan.

At the same time, these newly independent countries needed investments to enhance their economic autonomy and thereby protect their future political sovereignty. Oil and gas resources represented obvious immediate opportunities for Western investments.

The United States was also interested in helping these countries preserve their political independence by increasing their economic options away from overreliance on Russia. Additionally, as the largest oil importer in the world (still today with America's unconventional oil and gas revolution), we had an interest in seeing incremental oil and gas supplies outside of the Middle East and OPEC flow into global markets, whether we ourselves import those volumes or not.

With the help of Western investments, Central Asia and the Caucasus today produce around 3½ percent of global oil supply and hold around 2½ percent of the world's known proven reserves in oil (or four times that of Norway and the United Kingdom combined). In many ways, the energy future of the region lies as much or more in natural gas than in oil. Central Asia is estimated to hold more than 11% of world proven gas reserves, mostly concentrated in Turkmenistan which has lagged in attracting outside investments compared to Kazakhstan and Azerbaijan. The region currently produces less than 5% of global gas supply, so there is tremendous potential for growth.

In addition to production from Soviet-era discoveries, new discoveries of major oil and gas fields have made in the region. Deserving special mention are Kazakhstan's Kashagan field offshore Caspian Sea, which is the largest oil discovery in the world for over thirty years; Turkmenistan's Galkynysh gas field, which is the largest onshore gas field in the world (second only to the combined reserves of Iran's South Pars and Qatar's North Field offshore Persian Gulf); and Azerbaijan's Shah Deniz gas/condensate field.

Given its landlocked geography, Central Asia has to rely on long-haul pipelines to take its oil and gas to market. Previously Soviet pipelines in the region almost all head to European Russia either to feed the domestic Soviet market or for transshipment to European markets. Control of these pipelines continued to give Russia leverage over transit of oil and gas from the region to market after the end of the Soviet Union.

However, Western investments in oil and gas production also led directly to investments in new pipelines, which are not completely controlled by Russia's Transneft for oil and Gazprom for gas. These include the Caspian Pipeline Consortium, supported by international oil companies (led by Chevron), Kazakhstan, and Russia to bring crude oil from western Kazakhstan to the Russian Black Sea coast; the Baku-Supsa and Baku-Tbilisi-Ceyhan pipelines, supported by Western oil companies (led by BP) and Azerbaijan, that bring crude oil from Azerbaijan to respectively the Georgian Black Sea coast and the Turkish Mediterranean coast; and the South Caucasus Gas Pipeline to bring natural gas from Azerbaijan through Georgia to Turkey, which is planned to be expanded and extended in the next phase of Shah Deniz gas field development across Turkey with a new trans-Anatolian pipeline to markets in southeast Europe.

These new pipelines have diminished Russian control of oil and gas exit out of Central Asia and the Caucasus and helped achieve the objectives from the 1990s of giving the region more economic options and allowing its oil and gas production to flow freely to world markets.

When the Soviet Union collapsed in 1991, China was just about to convert from a net oil exporter to net oil importer. It was slow off the mark in the oil and gas patch of Central Asia. By the time it focused on this region, most of the large production opportunities have already been acquired by Western companies, e.g., Tengiz, Karachaganak, and eventually Kashagan in Kazakhstan and the Azeri-Chirag-Guneshli and Shah Deniz fields in Azerbaijan. From a Chinese point of view, they have been playing catch-up ever since.

Today China is the second largest oil importer in the world and an increasingly important importer of gas. With stagnant Chinese domestic production and rapidly growing energy demand, coupled with increasing unconventional oil and gas production in the U.S. and American conservation and substitution away from oil, China is destined to replace us as the world's largest oil importer in a decade.

Its companies have been investing in oil and gas around the world, including in neighboring Central Asia. Chinese companies now produce around 30% of Kazakhstan's oil, albeit from smaller fields than those operated by Western companies, and hold the only onshore concession in Turkmenistan.

Chinese policymakers appear to favor land-based pipelines as a hedge against overreliance on predominately maritime imports of oil and gas. In part because of disappointments in dealing with Russia on oil and gas, China has focused on pipeline development from Central Asia, including an oil pipeline from western Kazakhstan and gas pipelines from Turkmenistan through Uzbekistan and Kazakhstan to China. China has replaced Russia as the largest importer of Turkmen gas and this volume is slated to double or triple in the coming years.

The next growing source of competition for Central Asia oil and gas is likely to come from India, which follows closely China in growth in oil and gas demand and consequently oil and gas imports. Indeed, as Chinese demographic growth slows and population ages, India's energy demand is commonly forecasted to grow faster than China's in a decade or so.

Although it is better located than China to receive oil and gas from the Persian Gulf, India too would like to diversify its oil and gas imports, including to Central Asian supply. This explains Oil and Natural Gas Corporation (ONGC) of India's recent forays into projects in Azerbaijan and Kazakhstan as well as the interest of Gas Authority of India Ltd (GAIL) in the Turkmenistan-Afghanistan-Pakistan-India (TAPI) Gas Pipeline.

These interests converge with long-standing American interest to promote diversity of pipeline routes out of Central Asia so that no single country can dominate oil and gas transit. In the case of TAPI, it also coincides with our interests in the economic integration of Afghanistan into Central and South Asia, regional stability, and better relations between Pakistan and its neighbors.

With all due respect to the Committee, the concept of resource wars is often inflated. The investments I referred to in oil and gas production and pipeline development require tens of billion dollars and many years to mature. Conflict generally freezes such investments and resources are stranded for many years.

It is true that there is resource competition in Central Asia, as is true around the world. Our policy concern should be for such competition to be conducted in a rule-based manner, without political coercion or non-transparent business practices, to the disadvantage of the citizens of the host countries and global consumers. As long as the rules of competition are fair, our oil, services and equipment companies can compete in Central Asia, where they are doing rather well, and market competition will drive economic efficiency to the benefit of all.

It is too early to know whether Chinese oil companies and Indian parastatals will transform into international oil companies just as BP, Total, ENI, Statoil did with rather similar origins in state ownership and control. The example of Russia, where majority-state owned and controlled Rosneft and Gazprom dominate the oil and gas patch, suggests this development is not inevitable.

Observing the nature of resource competition and assessing its policy consequences will remain an important task for your committee. In Central Asia itself, my humble opinion is control of water resources are more likely to lead to direct conflict than with oil and gas.

Thank you for your attention

Mr. ROHRABACHER. Thank you for your testimony and I might add that we have had already one hearing on water in Central Asia and we do plan several more hearings focused on water there and elsewhere in the world, but especially focused on Euro-Asian needs because it is the Eurasia Subcommittee.

And now Dr. Mankoff.

STATEMENT OF JEFFREY MANKOFF, PH.D., DEPUTY DIRECTOR AND FELLOW, RUSSIA & EURASIAN PROGRAM, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES

Mr. MANKOFF. Chairman Rohrabacher, Ranking Member Keating, members of the committee: Thank you for the opportunity to testify before the subcommittee on Europe, Eurasia, and Emerging Threats.

The discovery of new offshore oil and gas deposits in the Eastern Mediterranean Sea is one of the most promising global energy developments of the last several years. Handled wisely, these deposits off Israel and Cyprus, as well as potentially Lebanon, Gaza, and Syria, can contribute to the development and security for countries in the Eastern Mediterranean, and across a wider swathe of Europe. Handled poorly, these resources could become the source of new conflicts in what is an already volatile region.

According to the United States Geological Survey, the Levant Basin in the Eastern Mediterranean holds around 122 trillion cubic feet of natural gas, along with 1.7 billion barrels of crude oil. While these currently recognized volumes are comparatively small relative to those found in the Persian Gulf, Russia, or the Caspian sea basin, they are large enough to have a significant impact on the energy security of states in the Eastern Mediterranean and to make some, albeit more limited contribution to energy security in Europe.

The oil and gas resources of the Eastern Mediterranean sit, however, at the heart of one of the most geopolitically complex regions of the world. The Israeli-Palestinian conflict, tensions between Israel and Lebanon, the frozen conflict on Cyprus, and difficult relations among Turkey, the Republic of Cyprus, and Greece all complicate efforts to develop and sell energy from the Eastern Mediterranean. The Syrian civil war has injected a new source of economic and geopolitical uncertainty, and standing in the background is Russia, which is seeking to enter the Eastern Mediterranean energy bonanza, and to maintain its position as the major supplier of oil and gas for European markets.

Amidst all this uncertainty, however, the recently discovered gas fields in the Eastern Mediterranean are starting to come into production. A second exploration well was recently drilled off of the coast of Cyprus, while Israel's Tamar field started production in June. With mounting uncertainty in Egypt, and indeed, across much of the Arab world, the ability to meet its energy needs from domestic sources is a critical contribution to Israel's energy security.

Yet, Israel's transformation into a significant energy producer is not without its challenges. Most immediate perhaps is the question of how Israel will sell its surplus gas on international markets. The most economical option, at least in the short term, would be the

construction of an undersea pipeline allowing Israeli gas to reach European markets through Turkey. Such a pipeline from Israel to Turkey pipeline would be less expensive to build than new Liquified Natural Gas facilities, would reinforce the recently strained political ties between Turkey and Israel, and would contribute to the diversification of Europe's energy supplies by bringing a new source of non-Russian gas to Europe.

Such a pipeline, however, would likely either run off the coasts of Lebanon and Syria, or have to go to Turkey through Cyprus. Both options are fraught with peril. Though Lebanon and Israel have not demarcated their maritime border, Beirut argues that Israel's gas fields cross into Lebanese waters, and Hezbollah has threatened to attack Israeli drilling operations. Syria, of course, is in a state of near anarchy. In this perilous environment, finding investors willing to build a pipeline will be challenging, and even if built, such a pipeline would be difficult to secure. Going through Cyprus is also difficult, largely because of the difficult relationship between the Republic of Cyprus and Turkey. However, Cyprus's own gas fields represent another potential source of conflict. Turkey has not recognized the Republic of Cyprus's exclusive economic zone and in fact has pressured companies seeking to do business there, and recently also began its own exploratory drilling off of the de facto Turkish Republic of Northern Cyprus without permission from the government in Nicosia. The revenues from Cypriot energy could benefit communities on both sides of the island, but only if a political agreement can be worked out in advance.

The major alternative to a pipeline from Israel to Turkey would be to build an LNG, a Liquified Natural Gas facility to liquefy gas for sale to markets in Asia and the Middle East. Russia, in particular, backs this idea.

The push to build new LNG facilities though is only one way in which Moscow and its energy companies are seeking a larger role in the Eastern Mediterranean. In addition a February 2013 marketing agreement signed with the Israelis at Tamar, Russian companies are also interested in Israel's much larger Leviathan field, as well as in the offshore oil and gas off of Lebanon. Of course, given Russia's interest in preventing competition for its gas in Europe, there are legitimate questions about whether Gazprom would actually follow through on developing any of these concessions that it might win in the Eastern Mediterranean.

One reason the United States has cared about Eastern Mediterranean gas is because of its potential to bolster the energy security of U.S. allies in Europe. Today, this concern is less pressing than in the past. The recent announcement of the Trans-Adriatic Pipeline, connecting to the

Trans-Anatolian Pipeline heralds the beginning of the long-awaited Southern Gas Corridor, which will bring news supplies from the Caspian to Europe. While small, these projects can be scaled up in the future. The United States itself is also poised to become a significant gas exporter. Finally, the ongoing implementation of the European Union's Third Energy Package is creating a more competitive, liberalized and deeper market in Europe itself.

While all these developments promote European energy security, as the Congressional Research Service has noted, Russia will re-

main the principal supplier of Europe's gas for many years. The potential volumes from the Eastern Mediterranean could bolster European energy security around the margins, but they are not sufficient not to change this fundamental reality. For that reason, Washington's main objective in the Eastern Mediterranean should be less about Europe and more about ensuring that energy does not become a source of new resource conflicts, whether between Israel and its neighbors or over Cyprus. The United States' push for Israeli-Turkish reconciliation, which the promise of energy cooperation has helped facilitate, is a good example of the positive role that the United States could play. U.S. diplomacy in Cyprus should proceed in similar fashion.

Likewise, sharing the benefits of energy should also be one element in an settlement of the conflict between

Israelis and Palestinians.

The United States has no reason to oppose the role of Russian companies in the Eastern Mediterranean in principle, however, it should work with partner governments in the region to ensure transparency and that the promised production does, in fact, occur. Eastern Mediterranean energy can advance a range of U.S. interests in the wider region. Absent sustained diplomatic engagement, however, it can also be the source of new conflicts in what is already a very dangerous area. Avoiding that outcome should be the primary focus of U.S. engagement on the future of Eastern Mediterranean energy.

Thank you.

[The prepared statement of Mr. Mankoff follows:]

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Statement before the House Foreign Affairs Committee,
Subcommittee on Europe, Eurasia, and Emerging Threats

"EASTERN MEDITERRANEAN ENERGY"

A Statement by

Dr. Jeffrey Mankoff
Deputy Director and Fellow, Russia and Eurasia Program
Center for Strategic and International Studies (CSIS)

July 25, 2013
2172 Rayburn House Office Building

Testimony to U.S. House of Representatives Committee on Foreign Affairs, Subcommittee on Europe, Eurasia, and Emerging Threats, 25 July 2013

Dr. Jeffrey Mankoff, CSIS

Chairman Rohrabacher, Ranking Member Keating, members of the Committee: Thank you for the opportunity to testify before the subcommittee on Europe, Eurasia, and Emerging Threats.

The discovery of new offshore oil and gas deposits in the Eastern Mediterranean Sea region is one of the more promising global energy developments of the last five years. Handled wisely, these deposits off Israel and Cyprus (as well as potentially Lebanon, Gaza, and Syria) can contribute to development and security for countries in the Eastern Mediterranean, and across a wider swathe of Europe. Handled poorly, these resources could be the source of new conflicts in an already volatile region.

According to the United States Geological Survey, the Levant Basin in the Eastern Mediterranean holds around 122 trillion cubic feet (or 3.45 trillion cubic meters) of undiscovered, technically recoverable natural gas, along with 1.7 billion barrels of crude oil.[1] Most of the currently known deposits are off the coast of Israel, and in adjacent fields of off Cyprus. Additional, still undiscovered fields may be located off the coasts of Lebanon and Syria. While the currently recognized volumes are small relative to those found in the Persian Gulf, Russia, or the Caspian Sea Basin, they are large enough to have a significant impact on the energy security of states in the Eastern Mediterranean, and make some, albeit more limited, contribution to energy security in Europe.

The oil and gas resources of the Eastern Mediterranean sit, however, at the heart of one of the most geopolitically complex regions of the world. The Israeli-Palestinian conflict, tensions between Israel and Lebanon, the frozen conflict on Cyprus, and difficult relations among Turkey, the Republic of Cyprus, and Greece all complicate efforts to develop and sell energy from the Eastern Mediterranean. The Syrian civil war has injected a new source of economic and geopolitical uncertainty, and standing in the background is Russia, which is seeking to enter the

[1] U.S. Geological Survey, "Natural Gas Potential Assessed in Eastern Mediterranean," Apr 8, 2010, http://www.usgs.gov/newsroom/article.asp?ID=2435

Eastern Mediterranean energy bonanza, and to maintain its position as the major supplier of oil and gas for European markets.

Amidst this geopolitical uncertainty, the recently discovered gas fields in the Eastern Mediterranean are coming into production. A second exploration well was recently drilled off of Cyprus, while the government in Nicosia signed an agreement with the companies doing the exploration to build a liquefied natural gas (LNG) plant, though questions remain about financing. Israel's Tamar field started production in June. With mounting uncertainty in Egypt (from which Israel previously imported the bulk of its gas), and indeed, across much of the Arab world, the ability to meet its energy needs from domestic sources is a critical contribution to Israel's energy security.

Yet Israel's transformation into a significant energy producer is not without its challenges. Most immediate perhaps is the question of how Israel will sell its gas on international markets. The most economical variant in the short-term would be the construction of an undersea pipeline allowing Israeli gas to reach European markets through Turkey. An Israel-Turkey pipeline would be less expensive to build than new LNG facilities, would reinforce the recently strained political ties between Jerusalem and Ankara, and would contribute to the diversification of Europe's energy supplies by bringing a new source of non-Russian gas to Europe.

Such a pipeline, however, would likely either run off the coasts of Lebanon and Syria, or go to Turkey through Cyprus. Both options are fraught with peril. Though Lebanon and Israel have not demarcated their maritime border, the government in Beirut argues that Israel's gas fields cross into Lebanese waters, and Hezbollah has threatened to attack Israeli drilling operations. Syria, of course, is in a state of near-anarchy. In this perilous environment, finding investors willing to build a pipeline will be challenging, and even if built, the pipeline would be difficult to secure. Going through Cyprus is also difficult, first, because of the poisonous relationship between Cyprus and Turkey, and second because a pipeline through Cyprus would force Israel and Cyprus to compete for market share, potentially making it difficult for Cyprus (and eventually Lebanon) to attract investment to develop their own offshore gas.

Cyprus's own gas fields represent another potential source of conflict. Turkey has not recognized the Republic of Cyprus's exclusive economic zone where exploration is currently under way. Ankara has pressured companies seeking to do business there, and recently began its own exploratory drilling off of the *de facto* Turkish Republic of Northern Cyprus without

permission from Nicosia. The revenues from Cypriot energy could benefit communities on both sides of the island, but only if a political agreement can be worked out in advance.

The major alternative to a pipeline would be to build an LNG facility in Israel or Cyprus to liquefy gas for sale to markets in Asia and the Middle East. Russia in particular backs this idea, and indeed, a company tied to Gazprom signed an agreement to market LNG from Israel's Tamar field in February. Not only are gas prices in Asia around 50% higher than in Europe, but supplying Eastern Mediterranean gas to Asia would ensure that this new production does not become a competitor to Russian gas in Europe. Building an LNG plant in the Eastern Mediterranean would also allow Russia to increase its share of the global LNG market, which currently hovers at just 5%.

This push to build new LNG facilities is just one way in which Moscow and its energy companies are seeking a larger role in the Eastern Mediterranean. Russian companies including Gazprom and Novatek bid on development rights off of Cyprus. Novatek initially won a concession to develop the so-called Block 9, before the Cypriot government withdrew the concession in December 2012. In addition to their marketing agreement at Tamar, Russian companies are also interested in Israel's much larger Leviathan field, as well as Lebanon's offshore, where Gazprom submitted an unsuccessful bid for the right to explore earlier this year. Of course, given Russia's interest in preventing competition for its gas in Europe, there are legitimate questions about whether Gazprom would actually follow through on developing any concessions it wins in the Eastern Mediterranean.

One reason the United States has cared about Eastern Mediterranean gas is because of its potential to bolster the energy security of U.S. allies in Europe. Today, this concern is less pressing than in the past. European gas demand is falling, even as new sources of gas are being developed. The recent announcement of the Trans-Adriatic Pipeline (TAP), connecting to the Trans-Anatolian Pipeline (TANAP) heralds the beginning of the long-awaited Southern Gas Corridor, which will bring news supplies from the Caspian to Europe, and can be scaled up in the future. The United States itself is also on the cusp of becoming a significant gas exporter. Finally, the ongoing implementation of Europe's Third Energy Package is creating a more competitive, liberalized energy market.

While these developments promote European energy security, as the Congressional Research Service has noted, Russia will remain the principal supplier of Europe's gas for many

years. The potential volumes from the Eastern Mediterranean could bolster European energy security around the margins, but are not sufficient not to change this fundamental reality, regardless of who produces or transports them.

For that reason, Washington's main objective in the Eastern Mediterranean should be less about Europe and more about ensuring that energy does not become a source of new conflicts, whether between Israel and its neighbors or over Cyprus. Washington's push for Israeli-Turkish reconciliation, which the promise of energy cooperation facilitated, is a good example of the positive role the U.S. can play. Its diplomacy in Cyprus should proceed in similar fashion. Likewise, sharing the benefits of energy should also be one element in a settlement between Israelis and Palestinians.

Secondly, the U.S. should work to ensure that the potential benefits from Eastern Mediterranean gas are in fact realized. As much as possible, the United States should leave it to the private sector to determine how the Eastern Mediterranean's gas is produced and sold, while working to defuse tensions and ensuring that the benefits of the region's resources are shared fairly. Washington has no reason to oppose the role of Russian companies in the Eastern Mediterranean in principle, though it should work with partner governments in the region to ensure transparency and that promised production does, in fact occur.

Eastern Mediterranean energy can advance a range of U.S. interests in the wider region. Absent sustained diplomatic engagement, however, it can also be the source of new conflicts in an already perilous area. Avoiding that outcome should be the primary focus of U.S. engagement on the future of Eastern Mediterranean energy.

Mr. ROHRABACHER. Thank you very much. Now we have about 10 minutes before a vote is called. And so it is intention of the chair to finish the testimony. We will then retreat to the floor where we will be casting our ballots on very important issues and then we come back immediately thereafter, for the question and dialogue session of this hearing.

Gentlemen, you may proceed. We are about to have some votes, so if you can keep it to 5 minutes that would be great.

STATEMENT OF BRIGADIER GENERAL JOHN ADAMS, USA, RETIRED, PRESIDENT, GUARDIAN SIX CONSULTING, LLC

General ADAMS. Chairman Rohrabacher, Ranking Member Keating, and members of the subcommittee, I want to thank you for taking the time to examine emerging foreign threats to the national security and interests of the United States related to the irresponsible and predatory actions of other nations in their pursuit for national resources.

I am a 30-year veteran of the United States Army and my firm Guardian Six Consulting recently partnered with the Alliance for American Manufacturing, a labor-management partnership between some of America's leading manufacturing companies and the United Steelworkers to take a look at vulnerabilities to the American defense industrial base.

Our report, "Remaking American Security," examined a range of vulnerabilities and in particular instances in which reliance on offshore companies deepen the supply chain, puts U.S. national security at risk. The defense industrial base really needs to be managed as a part of our force structure. Our report took the approach of linking strategy to forces that we need to win to the capability those forces possess to the programs that enable those capabilities. Then we drill deeper. Which supply chains do we need in place and secure so that those programs can be successful?

Remaking American security examines 14 defense industrial base nodes vital to U.S. national security. We investigated lower-tier commodities and raw materials and subcomponents needed to build and operate the final systems. Based on our research, the current level of risk to our defense supply chains and to our advanced technological capacity is very concerning. The bottom line is this, foreign control over defense supply chains restricts U.S. access to critical resources and places American defense capabilities at risk in times of crisis.

In the report, we devote a chapter to the importance of access to specialty metals and rare earth elements. Increasingly, these resources are central to modern life and central to modern defense preparedness. And each year, the U.S. Department of Defense acquires nearly 750,000 tons of minerals for an array of defense and military functions. In spite of this clear demand, over time, the United States has become dependent on imports of key materials from countries with unstable political systems, corrupt leadership, or opaque business environments. The United States used to have relatively easy access to many mineral ores, but this situation has changed dramatically as the United States has neglected to preserve its mining base and global demand for minor and unusual chemical elements has surged.

Compounding the tensions over access to specialty metals, many countries rich in natural resources take a stance of resource nationalism. Within the past decade, countries have attempted to leverage and manipulate extractive mining by threatening to impose extra taxes, reduce imports, reduce exports, nationalize mining operations and restrict licensing. Moreover, the countries themselves, notably China, have taken a more aggressive posture toward mineral resources and now compete aggressively with Western mining operators for extraction control.

Meanwhile, advanced industrialized countries, including the United States, have abandoned mining and mining exploration even though global demand for economically and militarily significant ores and chemical elements has risen and will continue to rise. These factors, taken together, present a dangerous and unsustainable situation for our economic and national security.

Specialty metals are used in high-strength alloys, semiconductors, consumer electronics, batteries, armor plate, and many more defense-specific and commercial applications. We possess significant reserves of many specialty metals with an estimated value of $6.2 trillion. However, we currently import over $5 billion of minerals annually and are almost completely dependent on foreign sources for 19 key specialty metals.

The United States must maintain strategic reserves of those defense-critical elements, strategic elements, that face likely shortages while seeking alternative sources. Congress is beginning to give appropriate attention to this issue and shifting more toward a bottom-up approach to securing the supply chains of key materials but more must be done. The Federal Government has not formulated a comprehensive policy approach to address the national security risks of inadequate access to many of these key minerals.

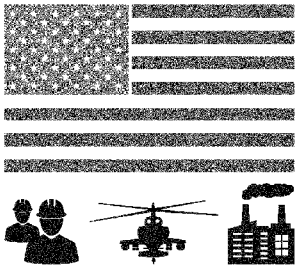
In the middle of a complex defense drawdown, as well as sequestration which cuts budgets and deprives our defense planners flexibility, the defense industrial base can seem like a distant and abstract concern, but it is not. Preserving a robust and innovative defense industrial base is a national imperative and that starts at the most basic level.

Thank you. I look forward to your questions.

[The prepared statement of General Adams follows:]

May 2013

REMAKING AMERICAN SECURITY



SUPPLY CHAIN VULNERABILITIES & NATIONAL SECURITY RISKS ACROSS THE U.S. DEFENSE INDUSTRIAL BASE

BRIGADIER GENERAL JOHN ADAMS, U.S. ARMY (RETIRED)

ALLIANCE FOR american manufacturing

A Report Prepared for AAM by GUARDIAN SIX Research . Analysis . Strategy

CHAPTER 3 • SPECIALTY METALS

EXECUTIVE SUMMARY

Specialty metals are used in countless ways, including high-strength alloys, semiconductors, consumer electronics, batteries, and armor plate, to name a few. The United States possesses significant reserves of many specialty metals, with an estimated value of $6.2 trillion. However, it currently imports over $5 billion worth of minerals annually, and is almost completely dependent on foreign sources for 19 key specialty metals.

Industrial metals are a group of specialty metals that are most often added to base metals to form alloys. These metals play critical roles in many steel alloys, adding hardness, heat resistance, and strength. They are often highly reactive transition metals and require complex and expensive extraction processes. In a few cases they can only be extracted as byproducts of other metals. As such, production is dictated by production of their carrier metals, resulting in limited supply and mounting demand.

Rare earth elements (REEs), a second important group, have unique properties that make them essential for many defense products, especially high-technology ones. Currently, China dominates REE production, controlling 90 percent of global supply. This market share was achieved in part by undercutting competitors through overproduction, which drove U.S. and other mines out of business. Upon obtaining a near monopoly, Chinese producers have scaled back production to inflate prices through restricted supply. Quotas limiting the amount of raw REEs that may be exported have been used to force foreign investment in Chinese manufacturing, while exports to Japan were halted temporarily in 2010 after a diplomatic incident. Western companies scrambled to invest in REE mining to secure supplies just as the speculative bubble burst in fall 2011, sending prices downward and leaving the industry outside China in disarray. China still controls the global supply chain of REE oxides.

Production of the platinum group metals (PGMs) is dominated by South Africa. The country possesses more than 90 percent of known PGM reserves, and accounts for almost 40 percent of global palladium production and 75 percent of world platinum production. PGMs are commonly used in automotive engines and advanced electronics, and do not have viable substitutes. South Africa's dominance over PGM production threatens the integrity of defense industrial base supply chains, as political and economic instabilities within South Africa could restrict U.S. access to these metals. Recent

SPECIALTY METALS

HARNESSING THE PERIODIC TABLE

MANUFACTURING SECURITY

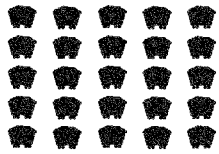
Specialty metals are crucial to U.S. national security and are used in a wide range of military end-items

COMPUTER CHIPS AND DEVICES | MISSILE GUIDANCE | AIRCRAFT COMPONENTS

U.S. CONSUMPTION

= 1,000

Total U.S. annual consumption of new non-fuel minerals per capita



25 THOUSAND POUNDS

RARE EARTH VULNERABILITY

China is the leading supplier of rare earth elements essential to national security

CHINA PRODUCES 90% OF THE WORLD'S SUPPLY OF REES

U.S. DEPENDENCY

The U.S. is wholly reliant on foreign suppliers for 19 key minerals used in specialty metals

100% IMPORT-RELIANT FOR **19 KEY MINERALS**

VALUABLE METALS

Many specialty metals are vastly more valuable than other commonly used metals

$3600 PER KILOGRAM

$1.60 PER KILOGRAM

MITIGATING RISKS

Protecting U.S. access to specialty metals

STRENGTHEN NATIONAL STOCKPILE | DEVELOP DOMESTIC CAPACITY | INTERAGENCY & INTERNATIONAL COORDINATION

MILITARY EQUIPMENT CHART
SELECTED DEFENSE USES OF SPECIALTY METALS

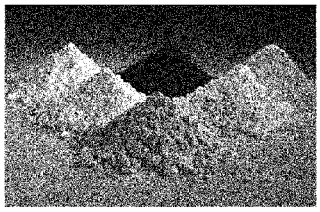
DEPARTMENT	WEAPON SYSTEMS	PLATFORMS	OTHER SYSTEMS
ARMY	▪ Missile guidance systems (gallium, neodymium, and rhenium) ▪ BGM-71 TOW Anti-Tank missile (tantalum)	▪ Platforms that use Steel Armor Plate (molybdenum) ▪ M1 Abrams main battle tank (tantalum)	▪ Lithium-ion batteries (lithium) ▪ Night Vision devices (lanthanum and gallium) ▪ Laser rangefinders (neodymium)
MARINE CORPS	▪ Missile guidance systems (gallium, neodymium, and rhenium) ▪ Submarine-launched ballistic missiles (tungsten)	▪ Platforms that use Steel Armor Plate (molybdenum)	▪ Lithium-ion batteries (lithium) ▪ Night vision devices (lanthanum and gallium) ▪ Laser rangefinders (neodymium)
NAVY	▪ Missile guidance systems (gallium, neodymium, and rhenium)	▪ Platforms that use Steel Armor Plate (molybdenum)	▪ Lithium-ion batteries (lithium) ▪ Night vision devices (lanthanum and gallium) ▪ Laser Rangefinders (neodymium)
AIR FORCE	▪ Missile guidance systems (gallium, neodymium, and rhenium) ▪ GBU-28 laser-guided bomb	▪ Jet engines (rhenium and tungsten) ▪ MQ-1B Predator drones (indium) ▪ F-22 Raptor fighter (yttrium) ▪ C-17 Military transport aircraft (yttrium)	▪ Lithium-ion batteries (lithium) ▪ Night vision devices (lanthanum and gallium) ▪ Laser Rangefinders (neodymium)

reforms have increased taxes on PGM mines and introduced Chinese investment into those mines, increasing scarcity and forcing prices to rise while creating uncertainty over the future availability of the commodities.

Mitigating these risks is complex, and strategies will vary among commodities. The United States should maintain strategic reserves of those defense-critical elements that face likely shortages (REEs and PGMs) while seeking alternative sources. Congress is beginning to give this issue the necessary attention, and is shifting towards a more bottom-up approach to securing the supply chains of key materials—but more must be done. The federal government has not formulated a comprehensive and coherent policy approach to address the national security risks of inadequate access to many key minerals and metals. Strengthening efforts to identify substitutes and improve recycling will help mitigate these risks.

INTRODUCTION

This chapter will investigate "specialty metals," categories of metals that are also known as industrial, rare, or precious metals. Other common names for these types of metals include military, green, clean, critical, minor, technology, and strategic metals. It should be noted that specialty metals are *not* base metals (e.g. iron, copper, nickel, lead and zinc), or metals that oxidize, tarnish, or corrode easily. In addition, specialty metals are *not* energy metals (e.g. uranium and thorium). This chapter will examine specialty metals, comparing their properties and assessing their vulnerabilities with respect to U.S. military capabilities and U.S. economic



competitiveness associated with the extraction and production of these metals.

It is currently estimated that an average U.S. consumer's lifestyle requires roughly 25,000 pounds of non-fuel minerals per year, requiring massive efforts to either extract or import these materials.[1] Each year, the U.S. Department of Defense (DoD) acquires nearly 750,000 tons of minerals for an array of defense and military functions.[2] For example, tungsten, which is almost as hard as diamond, has the highest melting point of all non-alloyed metals, and is commonly used in turbine blades, missile nose cones, and other applications requiring exceptional heat resistance. Other minerals acquired are Rare earth elements (REEs) (some of which are used to fabricate permanent magnets), which maintain their magnetic fields even at high temperatures and are used in missile guidance and nearly every other small motor. Yet another example is palladium, which is part of the platinum metals group (PGMs), and is used in catalytic converters.

Despite possessing an estimated $6.2 trillion worth of key minerals reserves, the United States recently recorded a small surplus on the trade balance of raw mineral materials: it exported $9 billion and imported $8 billion of unprocessed minerals in 2012. However, the United States runs a deficit of $27 billion on the balance

of processed mineral materials because it exported $120 billion and imported $147 billion in 2012.[3] In short, although the U.S. is self-sufficient in many minerals and has the chemical engineering know-how to process them, to some extent, it has chosen to rely on imports.

Increasingly, it is recognized that minerals are central to modern life and modern defense preparedness. Yet the federal government has not formulated a comprehensive and coherent response to the mineral/materials supply vulnerabilities, and there is no standard definition of which minerals or materials are critical and strategic and how the government should improve access to key minerals.[4]

The Defense Logistics Agency (DLA) Strategic Materials stores 28 commodities at 15 locations. In FY2012, DLA Strategic Materials sold $1.5 million of minerals and materials from its stockpile. At the end of the fiscal year, mineral materials valued at $1.4 billion remained. The stockpile is meant to help remedy the fact that the U.S. is completely import-dependent for 19 key minerals (including arsenic, asbestos, bauxite, graphite, fluorspar, indium, manganese, mica, niobium, tantalum, yttrium, and all REEs).[5] (The DLA Strategic Materials stockpile does not adequately compensate for the import dependence on a host of minerals because it emphasizes zinc, cobalt, chromium, and mercury, which are mined or recycled in the United States.) The stockpile is meant to protect against domestic and foreign supply constraints, spiking prices, and excessive speculation. However, because the U.S. government lacks a working understanding of which minerals are absolutely critical and which are strategic, the selection of metals for inclusion in the future stockpile managed by the DLA seems somewhat arbitrary.

In the past, a global abundance of minerals has been more than able to meet U.S. demand. However, as mineral-producing countries begin to consume more of their domestic production to fuel their own growing economies, the quantities available in the global marketplace have decreased. The increased demand for minerals has encouraged resource nationalism, where countries seek to exert greater control over the extraction and processing of key elements. Furthermore, many minerals are mined in only a few countries (some of which are politically unstable), exposing the United States and other importing countries to potential supply disruptions and other risks.

This situation is widely recognized as critical. In the words of one observer, "the whole periodic table is under siege... the growing demand for complex materials is leading to exploding demand for elements that are now used in only small quantities."[6]

The metals in this chapter fall into three different groups. The first group is industrial metals (e.g. antimony, manganese, tungsten, molybdenum, vanadium, and magnesium), which are usually mixed with base metals to create alloys to manufacture different kinds of steel products. Demand has risen for these alloyed metals because of their special properties that make them essential in aviation, engine turbines, green technology, and nuclear energy. Many of these metals are scarce because they are the byproduct of the other processes and because they are expensive to produce. Moreover, processing these metals involves advanced industrial chemistry and metallurgy that is more complex than extracting copper, zinc, and iron ore.

The second group consists of REEs, which are found across a surprisingly wide variety of applications and devices that enhance modern life in advanced industrialized countries. REEs are almost exclusively mined in China, which has by far the largest concentration of these elements. Mining REEs requires a more complex process than that used to mine gold or zinc, for example. From initial extraction to production, the process takes approximately 10 days. REEs are separated based on atomic weight, with actual processing duration based on the specific element. The most abundant REE is cerium. Terbium, a heavy REE, is more difficult to extract, and its extraction can take an additional 30 days.[7] Neodymium is also found with cerium, but the mine must first separate cerium and then extract the neodymium. This explains the length of production time and the costs. Importantly, companies cannot know beforehand whether valuable REEs are mixed in with the more common kinds, as each individual mine is different. Geologists and mining engineers must study each mine to find out which elements are available. The many engineering and processing challenges make REE mining among the most difficult types of mining operations.[8]

Mine operators need to know in advance how the REEs are going to be used so that they can determine the appropriate extraction and refining process. (Different processes must be used depending on the intended end-use of the REE.[9]) In fact, REEs are not inherently rare, but they are costly to mine and process because they are found in minute quantities mixed in with other ores. As Table 4 shows, REEs are used in a strikingly diverse range of products, including high-tech permanent magnets (see this report's chapter on magnets) and night vision devices (see this report's chapter on night vision devices).

The third group of specialty metals is very small and consists of the platinum group metals (PGMs), which are used in a range of applications such as vehicle production, future power sources, and many key military technologies. Palladium and platinum are used in catalytic converters. The largest concentrations of these deposits and reserves are found in South Africa.

Key themes discussed in this chapter are:

- Within the past decade, many countries rich in natural resources have taken a stance of "resource nationalism" and are attempting to control and manipulate extractive mining by threatening to impose extra taxes, reduce exports, nationalize mining operators, and restrict licensing.
- Western countries and mining operators face competition from less developed countries for access to specialty metals as well as from China, which has moved aggressively offshore to guarantee access to natural resources.
- Advanced industrialized countries, including the United States, have abandoned mining and mining exploration, even though global demand for economically and militarily significant ores and chemical elements has risen and will continue to rise.
- Many specialty metals are found in only a handful of countries, and often in regions that are politically and economically unstable.
- The risk of disruptions to the supply chains that use specialty metals is high, jeopardizing U.S. national security.

- Various U.S. agencies recognize the risks, but they provide different and divergent answers and solutions. The lack of a mechanism to coordinate policies among agencies hampers the development of a comprehensive and coherent strategy.

A NOTE ON CRITICALITY

Access to many natural resources is largely a function of geography. Although different types of specialty metals face different levels of risk (as described below), PGMs are consistently classified as facing the highest risks. Global reserves are situated almost exclusively in South Africa, which is the only country possessing significant long-term production capability. Limited global production capacity is coupled with high and increasing demand for PGMs, leading to high, unstable prices. Any number of events could create temporary or protracted shortages of PGMs, the most likely of which being internal political and economic instabilities associated with the South African government. The geographic concentration of PGM reserves, the high potential for disruption to the primary global provider, and the scarcity imposed by heightened demand indicate an *extreme* risk of these metals becoming unavailable.[10]

An insufficient supply of PGMs would have a *significant* impact on national defense capabilities. Although PGMs are most commonly known for their role in catalytic converters that reduce emissions from internal combustion engines, they also play an important role in advanced electronics used by the military (such as guided missile systems) due to their exceptional performance and ability to withstand high temperatures.

BACKGROUND

The issue for most advanced industrialized countries is that demand for rare elements has risen, while proven reserves and mining operations are increasingly

THE COST OF FAILURE TO ADDRESS POTENTIAL SPECIALTY METALS SUPPLY CHAIN DISRUPTIONS (a notional though realistic scenario)

The inauguration of the new South African president has led to a strengthening of ties between the Republic of South Africa and the People's Republic of China. In return for financial assistance in achieving its internal developmental policies and goals, South Africa has agreed to export manganese exclusively to China. Department of Defense supply chain specialists have begun to seek other sources of the metal; however, the effect on the market of this exclusive deal is expected to be pronounced. South Africa possesses one of the largest deposits of this mineral, and the removal of this source is expected to significantly increase prices for remaining sources. Reduced manganese supply means increased defense costs, as the U.S. military is a major consumer of manganese as a component of a variety of weapons systems and capabilities, including in the manufacture of steel armor plate and munitions.

concentrated in a handful of countries that have sought to exploit their geological advantages and their desire to meet their own growing domestic needs. In 2011, the British Geological Survey published a "risk list" that employed four variables (detailed below) to assess the risk factors of 52 elements or element groups with economic value.[11] The variables they used were scarcity (or the abundance of elements in the earth's crust); production concentration (the location of current production); reserve base distribution (the location of reserves); and governance (the political stability of those locations). Using these categories, experts determined that the chemical elements or element groups with the highest supply vulnerabilities were antinomy, which is produced in China and is used in micro-capacitors; PGMs, which are produced in South Africa and used in automobile catalytic converters, fuel cells, seawater desalination equipment; mercury, which is produced in China; tungsten, which is produced in China and is a hard metal used in all cutting tools; REEs, which are produced in China; and niobium, which is produced in Brazil and used in MRI scanners, touch screens, micro capacitors, and ferroalloys.[12]

As the United States frees itself from fossil fuel dependence, it may replace it with dependence on energy sources from power-generating equipment that relies on specialty metals.

The German government also has expressed concern, as the country's large manufacturing base requires substantial amounts of REEs. As demand from emerging economies has risen, the German government has been aggressive in securing access to REEs in regions or countries other than China. The German government entered into multiple agreements with Kazakhstan to give German companies better access to REEs.[13]

Last but not least, the European Union has pushed the governments of its member states to agree to a "critical metals" list, and to approve new policies to ensure continuous access to gallium, indium, tantalum, and tungsten, in addition to REEs. One of the measures on the agenda is to establish a critical metals stockpile, which would include gallium, indium, tantalum, and tungsten.[14]

It is not surprising that the U.S. Geological Survey (USGS), DoD, the Department of Energy (DoE), and the Congressional Research Service have joined the chorus of concerned voices by publishing numerous reports and presenting long lists of critical minerals. Critical minerals are indispensable to modern life and security, yet they may be at risk because of their geographic availability, the costs of extraction and processing, the dearth of (manmade) substitutes, and limited potential for recycling. USGS puts REEs highest on their list,[15] followed by cobalt, indium, and tellurium, which are needed for many important applications including magnets for motors and super alloys common in turbine blades and other aeronautical functions. In light of the rapid growth in demand for advanced batteries, most of which require minute amounts of lithium, USGS also has raised concerns about the possibility of depleting all known reserves of the element (see this report's chapter on lithium-ion batteries).

Tables 1 and 2 demonstrate the trend of the last 10 years during this relatively short period of time, U.S. import dependence has radically increased across the board.

A wide variety of metals are plagued by the same issues that account for this current state of affairs. For one, political leaders of advanced industrialized countries have abandoned mining in light of the substantial negative externalities and pollution of waterways, soil, and air. Take the example of REEs. In reality, they are abundant in the earth's crust, but they tend to be found in small concentrations and deposits. They rarely exist in pure form and must be extracted from other oxides, which increases the costs of processing. More importantly than the expense of extraction, RE mining also creates radioactive environmental pollutants.[16] In every mining operation, the extraction process results in tailings (ground rock, processing agents, and chemicals), which cannot be fully reclaimed or reused or recycled. Frequently, the unrecoverable and uneconomic metals, minerals, chemicals, and process water are discharged, normally as slurry, to a final storage area. RE mining, however, produces tailings that contain radioactive uranium and thorium, which pose additional environmental threats beyond the risks associated with normal mining waste. In Western countries, governments and the public essentially have decided that it is easier to offshore this process to localities with less vocal and organized citizens or less democratic and transparent regimes. China, for example, has witnessed extreme degradation of its soil, water, and air quality to a degree that would not be tolerated in advanced industrialized countries.[17]

Another issue is that global demand is being driven higher by new discoveries of these metals' special properties, and by new technological innovations in how to design, fabricate, and incorporate them into consumer and military products. For example, neodymium (an REE) combined with iron and boron was discovered to possess strong magnetic properties, and it became the foundation of the high-tech permanent magnet sector (discussed in this report's chapter on high-tech magnets). Other examples include: gallium and tellurium, which are used in completing types of solar panels; rhenium, used in the super alloys employed in jet turbines; indium, which is used in flat panel displays; and graphite, used in lithium-ion (Li-ion) batteries. Green technology (such as hybrid cars, wind turbines, electric motors, and lightweight metals) relies heavily on specialty metals and REEs.

Many technological devices consume tiny amounts of specialty metals, without which the product would not operate or would need to be much larger and heavier. For example, every guided missile requires modest amounts of oxides, the form in which REEs occur in the mineral ore. While the amount of REEs used in a guided missile is genuinely small in quantity, without them the missiles would be heavier, less precise, and less advanced. In a similar vein, some metals must be able to withstand high temperatures, which are primarily achieved by adding minor elements to steel.

Additionally, more than two billion people (notably, the populations of China and India) are moving towards higher standards of living more closely resembling those in advanced industrial nations such as the United States and those in Europe. This development means that demand for electronic devices, green technology, and other advanced applications will continue to rise and in spite of economic crises in Europe, the United States, and Japan.

Table 1: U.S. Net Import Reliance for Selected Nonfuel Mineral Materials in 2000

Material		Percent
ARSENIC (TRIOXIDE)	China, Chile, Mexico	100%
ASBESTOS	Canada	100%
COLUMBIUM (NIOBIUM)	Australia, Guinea, Jamaica, Brazil	100%
BAUXITE & ALUMINA	Brazil, Canada, Germany, Russia	100%
FLUORSPAR	China, South Africa, Mexico	100%
GRAPHITE (NATURAL)	China, Mexico, Canada	100%
MANGANESE	South Africa, Gabon, Australia, France	100%
MICA, SHEET (NATURAL)	India, Belgium, Germany, China	100%
QUARTZ CRYSTAL	Brazil, Germany, Madagascar	100%
STRONTIUM	Mexico, Germany	100%
THALLIUM	Belgium, Canada, Germany, United Kingdom	100%
THORIUM	France	100%
YTTRIUM	China, Hong Kong, France, United Kingdom	100%
GEMSTONES	Israel, India, Belgium	100%
BISMUTH	Belgium, Mexio, United Kingdom, China	95%
ANTIMONY	China, Mexico, South Africa, Bolivia	94%
TIN	China,Brazil, Peru, Bolivia	86%
PLATINUM	South Africa, United Kingdom, Russia, Germany	83%
STONE	Italy, Croatia, Spain, India	80%
TANTALUM	Australia, China, Thailand, Japan	80%
CHROMIUM	South Africa, Kazakhstan, Russia, Zimbabwe	78%
TITANIUM CONCENTRATES	South Africa, Australia, Canada, India	76%
COBALT	Norway, Finland, Zambia, Canada	74%
RARE EARTHS	China, France, Japan, United Kingdom	72%
BARITE	China, India, Mexico, Morocco	71%

Source: U.S. Geological Survey, Mineral Commodity Summaries 2000 (Washington DC: U.S. Geological Survey).

Table 2: U.S. Net Import Reliance for Selected Non-fuel Mineral Materials in 2011

Material		Percent
ARSENIC (TRIOXIDE)	Morocco, China, Belgium	100%
ASBESTOS	Canada, Zimbabwe	100%
BAUXITE & ALUMINA	Jamaica, Brazil, Guinea, Australia	100%
CESIUM	Canada	100%
FLUORSPAR	Mexico, China, South Africa, Mongolia	100%
GRAPHITE (NATURAL)	China, Mexico, Canada, Brazil	100%
INDIUM	China, Canada, Japan, Belgium	100%
MANGANESE	South Africa, Gabon, China, Australia	100%
MICA, SHEET (NATURAL)	China, Brazil, Belgium, India	100%
NIOBIUM (COLUMBIUM)	Brazil, Canada, Germany, Russia	100%
QUARTZ CRYSTAL (INDUSTRIAL)	China, Japan, Russia	100%
RARE EARTHS	China, France, Estonia, Japan	100%
RUBIDIUM	Canada	100%
SCANDIUM	China	100%
STRONTIUM	Mexico, Germany	100%
TANTALUM	China, Germany, Kazakhstan, Australia	100%
THALLIUM	Russia, Germany, Kazakhstan	100%
THORIUM	France, India, Canada, United Kingdom	100%
YTTRIUM	China, Japan, France, United Kingdom	100%
GALLIUM	Germany, Canada, United Kingdom, China	99%
IODINE	Chile, Japan	99%
GEMSTONES	Israel, India, Belgium, South Africa	98%
GERMANIUM	China, Belgium, Russia, Germany	90%
BISMUTH	China, Belgium, United Kingdom	89%
DIAMOND (DUST, GRIT, & POWDER)	China, Ireland, Republic of Korea, Russia	89%

Source: U.S. Geological Survey, Mineral Commodity Summaries 2012 (Washington D.C.: U.S. Geological Survey)

Finally, metal and mineral suppliers have witnessed booming mining sectors due to rising prices. Thanks to the rising value of natural resources, producing countries have pursued a policy of resource nationalism. Many of the most sought-after elements are found in developing countries that face multiple economic and political challenges. To finance development projects or to extract rents, governments of these countries might be tempted to push for a greater share of the profits made by mining companies. Examples of this trend are ubiquitous. Ghana has been reviewing mining contracts, and may renegotiate existing arrangements to increase governmental revenue. Zambia doubled its copper royalty to six percent. Guinea, which controls the largest known reserves of both bauxite and iron ore, has taken a 15 percent stake in mining operations. In Namibia, a state-owned company controls all new mining and exploration. Foreign mining operations in Zimbabwe must cede a 51 percent stake to local owners.[18]

To ensure the country benefits from its mineral wealth, South Africa may impose a 50 percent windfall tax on mining profits and a 50 percent capital gains tax on prospecting rights. The ruling African National Congress wants to collect a larger share of the resource boom. Even Australia, an advanced industrialized country, plans to impose a new, $8 billion tax on mining.[19]

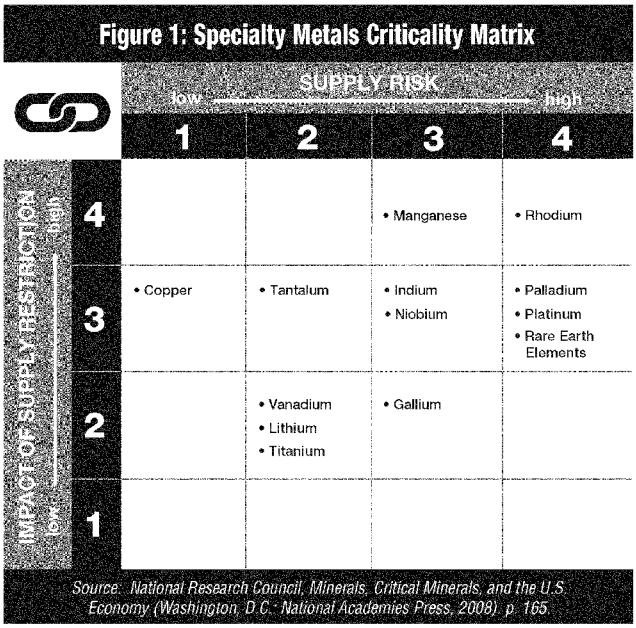
This state of affairs has not gone unnoticed. Since the mid to late 2000s, increased scrutiny and heightened alarm surround the fact that the U.S. economy and national security depend on specialty metals—many of which are vulnerable to supply threats resulting from sovereign risk and resource nationalism, geological scarcity, lack of viable substitutes, byproduct sourcing, and inadequate post-consumer recycling and recovery programs.[20]

In 2008, the National Research Council Committee on Critical Mineral Impacts on the U.S. Economy (Committee on Earth Resources) compiled a statistical approximation to assess supply restrictions impact on the entire U.S. economy and defense capabilities. The report also took into consideration the technical substitution potential of a mineral.[21]

The National Research Council report presented a criticality matrix that juxtaposed the probability of a supply disruption with the overall economic impact of that supply disruption. Supply disruptions can be caused by the physical unavailability of a commodity or by increasingly restrictive prices as a result of scarcity or of artificial means. The study considered five factors that contribute to availability: geological; technical; social and environmental; economic; and political. Economic impact was assessed by the availability of a close substitute, the costs associated with that substitution, and the consequences of the supply restriction. The committee examined 11 metals or metal groups: copper, gallium, indium, lithium, manganese, niobium, PGMs (including iridium, osmium, palladium, platinum, rhodium, ruthenium), REEs, tantalum, titanium, and vanadium to determine their criticality. The study's conclusions are presented in Figure 1.

Indium, manganese, niobium, PGMs, and REEs fall in the "critical" zone of the matrix.[22] They are considered critical because of the importance of their applications in catalytic converters, industrial chemical production, electronics, batteries, liquid crystal displays, and hardeners or strengtheners in steel and iron alloys. In addition, if a physical disruption or sudden price surge jeopardizes supplies, there are no readily available mineral substitutes for these applications.

Figure 1: Specialty Metals Criticality Matrix



Source: National Research Council, Minerals, Critical Minerals, and the U.S. Economy (Washington, D.C.: National Academies Press, 2008) p. 165.

However, the study concludes that essentially any mineral could be considered critical, because both economic importance as well as factors influencing availability could change. Additionally, the report stresses that import dependence alone is not means for alarm; however, the concentration of supplies in a small number of countries plagued by political instability could be disastrous. Alternatively, rapid growth in the internal demand of exporting countries could limit the quantities available on the global market, resulting in rising prices and restricted supply.

INDUSTRIAL METALS

Industrial metals (also called minor metals) are in vogue because new uses for these metals are discovered frequently. They are classified as minor metals because until recently they were largely ignored by industry. They are not readily available or mined in the United States. Often, the elements are in fact rare and are not abundant in the earth's crust, with only a few parts per million of recoverable ore, even in the geologically significant deposits. As many of these elements are only found in a few dense concentrations globally, extraction may be dominated by a handful of countries. Subsequently, the price and supply of the element may be subject to export controls, price manipulation, and sudden disruptions. In some cases, elements are in fact a byproduct of a primary ore and are uneconomical to extract independent of the refining process for those other ores. These metals are therefore relatively costly and challenging to produce. Finally, the time required to adapt to new production and utilization processes is long, making planning and investment difficult.

The United States (along with almost all Organization for Economic Co-operation and Development [OECD] countries) relies heavily on imports for these materials, while the main producers are often countries with rapidly expanding economies (such as China, Russia, Chile, and South Africa) with sizeable and increasing domestic demand for these metals. Because certain metals are only commercially produced in a few countries, they can claim near monopolies over global reserves and influence pricing and availability.

The evolution of computing circuitry over the past three decades clearly illustrates the critical importance of industrial metals. The number of elements used in computer circuitry has expanded from 12 in the 1980s, to 16 during the 1990s, to over 60 today.[28] These circuits are found in nearly every piece of modern technology, and especially in highly specialized, high-tech defense applications.

The summary of the industrial metals sector below includes an overview of the different metal groups, selected elements, their most significant uses, and some of the concerns surrounding these commodities. The next section presents a more general discussion of the dominant risks facing this sector. The critical importance of these metals should be readily apparent. At the most basic level, many of them are used in heat-resistant, hard metal alloys that are used in aircraft, ships, submarines, and countless other defense-related applications. Other metals are at the core of solar energy, which is necessary for defense satellites and has a growing importance for civilian energy. Others still are used in electronic components such as rechargeable batteries, which are essential to consumer electronics, communication, and hybrid engines.

THE UNIVERSE OF INDUSTRIAL METALS

Most of the elements in industrial metals are used in alloys in order to improve heat resistance, reduce the weight of a metal item, or harden steel. (Table 3 provides an overview of the different metals and their defense applications and describes the particular risks or vulnerabilities associated with each industrial metal.) Many industrial metals are in demand in consumer electronics, high-energy rechargeable batteries, and the computer industry. They also are indispensable in numerous and wide-ranging military

defense applications. Radar systems, airframes and engines, optical equipment, armor plating, coatings, electronic display screens, solar cells, and military batteries rely on small but vital quantities of industrial metals.

The universe of industrial metals can be divided into different chemical classifications. Each chemical group possesses different properties and advantages, which are further discussed below.

ALKALI AND ALKALI EARTH METALS

Alkali and alkali earth metals are located in the first two columns of the periodic table (excluding hydrogen). They are highly reactive elements, and as such, are not found in their elemental form, but instead as compounds in the earth's crust. Alkali metals (such as lithium) are relatively soft with low melting points, and form weak bonds with other elements because they have only one electron available for bonding. Alkali earth metals (such as beryllium) are harder and denser than the alkali metals, though not to the same extent as the transition metals.

LITHIUM

Lithium (Li) is a light and highly reactive metal, and is a key component of the rechargeable, high-energy lithium-ion (Li-ion) batteries that are widely used in the military and have a bright future as the main power source for electric or hybrid vehicles. Chile, Australia, Argentina, and China are the leading producers of lithium; almost the entirety of the U.S. import market comes from Argentina and Chile. Chile possesses over half of the world's known lithium reserves and is the main producer, extracting lithium from the Atacama Desert.[24] U.S. production of lithium is insignificant.[25] Because lithium is highly reactive and reacts with water, producing the pure form of lithium is very complex and requires a dry environment.[26]

Increase in demand for lithium, especially from China, have caused a recent expansion of production in many countries. Production of lithium was reported to have increased 20 percent in both Australia and Chile in 2011, while Chinese production was reported to have increased 30 percent.[27] This expansion corresponds to the growing demand for high-purity lithium for use in Li-ion batteries.

Analysts in the advanced battery sector and green technology community express considerable concern about the world's reliance on lithium, because most of the reserves are concentrated in two countries (Chile and Argentina) and may outstrip global demand as soon as 2017. Currently, there is no substitute for lithium, which is the ideal material to create rechargeable batteries and energy network stations to store surplus power from solar and wind power (see this report's chapter on lithium-ion batteries).[28] Unlike with other specialty metals, the main concern about lithium is not price or the potentially monopolistic behavior by foreign governments but rather that the world may face supply restrictions as reliance on technologies that require lithium increases and the world's known reserves of lithium are depleted.[29]

BERYLLIUM

Beryllium (Be) currently is considered a material critical to U.S. national defense, and is retained in the DLA Strategic Materials stockpile. Beryllium is critical to many military systems, including the airborne Forward-Looking-Infrared (FLIR) system, missile guidance systems, and surveillance satellites. There are no

Table 3: Industrial Metals
Properties, Uses, and Defense Applications

Element	Atomic Symbol	Atomic Number	Uses and Applications	Significant Producers
Lithium	(Li)	3	Batteries	Chile, Australia, China, Argentina
Beryllium	(Be)	4	Lightweight alloys, radiation windows, nuclear reactors	U.S., China
Gallium	(Ga)	31	Low melting-point alloys, high-power high-frequency electronics semiconductors, light emitting diodes (LEDs), solar cells	China, Germany, Kazakhstan, Ukraine
Indium	(In)	49	Liquid crystal displays (LCDs), low melting-point alloys, bearing alloys, transistors, thermistors, photoconductors, rectifiers, mirrors	China, South Korea, Canada
Germanium	(Ge)	32	Fiber optics, infrared optics, solar photovoltaic cells, semiconductors, alloys	China
Antimony	(Sb)	51	Flame retardant, semiconductors, bearing alloys, batteries	China
Tellurium	(Te)	52	Thin-film photovoltaic panels, semiconductors, steel alloys, vulcanizing agent, synthetic fibers	China, Canada, Philippines
Vanadium	(V)	23	Nuclear reactors, springs, carbide stabilizer (alloys), batteries	China, South Africa, Russia
Molybdenum	(Mo)	42	Tempered steel, gun barrels, boiler plates, armor plating, nuclear energy, missile components	China, U.S., Chile
Tantalum	(Ta)	73	Tantalum carbide (hard-metal), Tantalum capacitors	Brazil, Australia, Mozambique, Rwanda
Tungsten	(W)	74	Tungsten carbide (hard-metal), drilling and cutting tools, specialty steels, heat sinks, turbine blades	China
Rhenium	(Re)	75	High-temperature alloys and coatings, jet engines	Chile, U.S., Peru, Poland, Kazakhstan
Palladium	(Pd)	46	Catalytic converters, multi-layer ceramic capacitors (chips), hybrid integrated circuits	South Africa, Russia, Canada, Zimbabwe
Platinum	(Pt)	78	Catalytic converters (diesel)	South Africa, Russia, Canada, U.S.

substitutes for beryllium, and in previous years there was a shortage of high-purity beryllium due to high production costs and health and safety issues. Foreign-sourced beryllium is not of sufficient purity for defense applications.

In 2005, under Title III of the Defense Production Act (P.L. 81-774), DoD invested roughly $90 million in a private-public partnership with domestic beryllium producer Brush Wellman, Inc. (now called Materion Brush Beryllium and Composites) to produce a primary beryllium plant in Ohio.[30] That plant became operational in early 2011, dropping the reported U.S. import dependence from 61 percent in 2010 to 21 percent in 2011. Twelve percent of the annual U.S. beryllium consumption is attributed to defense applications. The USGS reports that the U.S. currently possesses about 65 percent of the world's beryllium reserves and, with the opening of the Materion Brush plant in 2011, accounts for almost 90 percent of world production.[31]

TRANSITION METALS

The group of transition metals contains 38 elements that are grouped together due to their common electron configuration, and are generally hard, malleable, and possess high melting points. They are good electric conductors and are often magnetic. The uses of transition metals are vast, making their use common.

RHENIUM

Rhenium (Re) is a rare metallic element that is important to the defense community because of its contribution to the properties of high-temperature alloys and coatings. The USGS reports that nearly 70 percent of rhenium is used for high-temperature engine turbines common to jet engines, while an additional 20 percent is a key catalyst in refining oil.[32] Rhenium is also used as a promoter in catalysts in gas-to-liquid operations, which may become more important in the future in light of the rapid expansion of shale gas output in the United States and elsewhere.

Rhenium is obtained almost exclusively as a byproduct of the processing of a special type of copper deposit known as a porphyry copper deposit. Specifically, rhenium is obtained from the processing of the mineral molybdenite (a molybdenum ore), which in itself is a copper byproduct. Therefore, rhenium is among the most expensive and volatile metals in the world, and its price fluctuated from $10,000/kg in 2008 to $3,500/kg in March 2013.[33] Currently, the United States is the world's second leading producer of rhenium (after Chile), with about a 12 percent market share. However, because rhenium is a byproduct of a byproduct, its production is limited by the production of molybdenum, which is in turn limited by copper production. In 2012, the U.S. imported nearly seven times its domestic production of rhenium, mainly from Chile and Kazakhstan.[34] Rhenium is part of the DLA Strategic Materials stockpile.

MOLYBDENUM

Molybdenum (Mo) is an important alloying agent that contributes to the hardening and toughness of tempered steels, and is used in steel armor plate, gun barrels, and boiler plates. Almost all ultra-high strength steels contain up to eight percent molybdenum. Molybdenum is used in nuclear energy applications and for missile and aircraft parts. Molybdenum is both mined as a primary ore and recovered as a byproduct of copper. The United States is

the second largest producer of molybdenum with about one quarter of the global share, and currently exports about half of its annual output.[35]

VANADIUM

Vanadium (V) is used predominantly as an additive in steel that is then used in nuclear energy applications and in rust-resistant springs and high-speed tools. Ferrovanadium, an alloy of steel, accounts for 95 percent of the vanadium used in the United States. Vanadium is a non-substitutable component of aerospace titanium alloys; however, for many other applications, other metals such as molybdenum, tungsten, manganese, niobium, or titanium may be substituted for vanadium.[36] Small amounts of vanadium are added to iron alloys to improve corrosion resistance; ferrovanadium is mostly used in gears for cars, jet engines, and springs. The type of vanadium used in steel does not face immediate supply constraints. Due to increasing demand for steel in expanding economies, the demand for vanadium is expected to increase.

Three countries —China, South Africa, and Russia—dominate the vanadium market, and together account for more than 96 percent of current global production. The United States depends on imports for 80 percent of its domestic consumption of ferrovanadium; its main import sources are South Korea, Austria, Canada, and the Czech Republic.[37]

Twenty percent of the vanadium market consists of vanadium pentoxide, which is more valuable than ferrovanadium. In 2012, the major exporters of vanadium to the United States were Russia (47 percent), South Africa (32 percent), and China (19 percent). Vanadium pentoxide is used as a catalyst in petroleum refineries, in ceramics, and in super-conductive magnets. Currently, however, vanadium pentoxide is considered suitable for vanadium redox batteries, a new type of advanced rechargeable battery that is able to store renewable energy coming from wind or solar generation. This new type of battery can store more energy more efficiently than Li-ion batteries, with a faster recharge time and a longer lifecycle (see this report's chapter on Li-ion batteries).[38]

Demand for vanadium pentoxide is expected to expand 30 percent in the next three years while supply is tight; 90 percent of the vanadium on the market is not suitable for processing into vanadium pentoxide, and is only appropriate for strengthening steel.[39] Vanadium pentoxide (used in large format batteries) is a byproduct of combusting fossil fuels containing vanadium. The byproducts containing vanadium pentoxide can be in the forms of dust, soot, boiler scale, and fly ash.

TANTALUM

Tantalum (Ta) is used in several alloys due to its thermal and corrosion resistances, ductility, and strength. Many types of tantalum minerals are mined in different parts of the world and possess slightly different properties. In many applications, it cannot be substituted without lessening quality. For example, tantalum carbide is among the most durable materials currently known.[40] The United States has no identified reserves of tantalum and depends on imports for all its tantalum consumption.

Tantalum is found in selected geological regions of the world, namely in the eastern areas of the Democratic Republic of Congo as well as in Australia, Brazil, Canada, and Mozambique. Furthermore, a related mineral, coltan, the industrial name for a columbite–tantalite mineral

from which columbium (also known as niobium) and tantalum are extracted,[41] is widely used to manufacture capacitors found in consumer electronics, computers, and automobiles.[42] In the last 10 years, demand for coltan-extracted tantalum has surged, stirring armed conflicts in central Africa as paramilitary groups mine and smuggle the chemical elements in order to finance their own activities. Coltan is the mineral equivalent of "blood diamonds," which received large amounts of publicity and incited a human rights campaign in the late 1990s and early 2000s. Coltan-related conflicts also have destroyed the habitat of lowland gorillas and the livelihood of numerous indigenous communities.

In spite of tantalum's importance to the U.S. economy and national security, the DLA Strategic Materials sold off most of its tantalum mineral, tantalum metal powder, metal ingots, and metal oxides in the 2000s. In 2013, it still holds small quantities of tantalum carbide powder. The latter is extremely hard and brittle, and is commonly used in tool bits for cutting applications or sometimes added to tungsten to create a metal alloy. The United States consumes 120,000 metric tons annually, with no reserves; the United States imports all tantalum from China, Germany, Australia, and Kazakhstan.

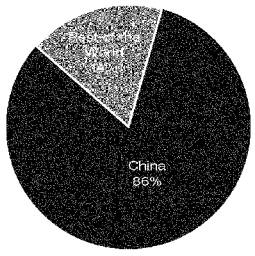
Although USGS forecasts that supplies of tantalum are sufficient for projected demand, and significant untapped reserves exist in Brazil and Australia, a third of the current tantalum production originates from politically unstable sub-Saharan African countries.[43]

TUNGSTEN

Tungsten (W) possesses the highest melting point of all metals (3,400 degrees Celsius or 6,150 degrees Fahrenheit) and is nearly as strong as diamond. Additionally, it is an excellent electrical conductor. The most common use is as tungsten carbide, a "hard metal" known for industrial drilling and other cutting tools.[44] Additionally, tungsten carbide and tungsten alloys are used for armaments, heat sinks, turbine blades, and rocket nozzles.[45]

China is the largest producer of tungsten is, accounting for about 80 percent of global production and possessing roughly two-thirds of world tungsten reserves. China is also the world's top consumer of tungsten, and using a majority of the tungsten it produces. The Chinese government actively intervenes in the tungsten industry to limit supply: foreign investment is forbidden; exports are controlled by licenses, taxes, and quotas; overall

Figure 2: Global Production of Tungsten in 2010



Source: International Tungsten Industry Association, 2011, http://ermiondemining.com/irt/Company%20Presentations/Ermondale%20Mining%20Website%20Presentation%20January%202012.pdf

production is limited; and exploration and new operations are tightly controlled. In the immediate future, China is expected to be even more protective of its domestic supply, and is likely to attempt to further reduce exports as well as increase tungsten imports.[46]

Accordingly, tungsten prices are expected to increase in light of increasing demand and constricted supply. Historically, the United States and Russia have stockpiled tungsten, although both countries have been disposing of their stockpiles over recent years. The Russian stockpile is thought to be depleted, while the entire U.S. government holding of tungsten has been authorized for disposal.[47]

Although the United States imports a fair amount of tungsten, thanks to improved recycling of scrap consumed by processors and end-users, import reliance dropped from 63 percent in 2010 to 36 percent in 2011.[48] Nevertheless, there is only one domestic source of tungsten concentrates in the United States. The U.S. military cannot function without tungsten, and there are no substitutes for most applications. World demand slackened due to the global financial crisis, but scarcity will push up tungsten prices, especially since strategic manufacturing sectors would be willing to pay inflated prices.[49]

POST-TRANSITION METALS

Post-transition metals are softer than transition metals, with lower melting points, but they have high electronegativity, meaning that they are better at attracting electrons than the transition metals and more readily form polar bonds. They are malleable, ductile, and generally good conductors.

GALLIUM

Gallium (Ga) is not produced in the United States even though it is a critical component of optoelectronic devices, solar cells, light-emitting diode (LED) lights, and photo-detectors. Gallium is essential for creating high-brightness LEDs, and many governments in Asia are committed to introducing widespread LED lighting.[50] Therefore, demand for gallium likely will increase. Moreover, gallium is also a key component for thin film photovoltaic technology, a sector expected to grow by a factor of 9 by 2018; however, falling prices of silicon-based solar cells are limiting the current demand for more expensive gallium-based cells.[51] The primary military application of gallium is in high-power, high-frequency communications, such as those used in missile guidance systems. Gallium semiconductors can function at much higher temperatures than silicon, allowing them to function at a much higher capacity and reliability than more common silicon-based chips.[52] While silicon-based alternatives may be viable for commercial uses, they are not suitable replacements for defense-related applications.

The leading producers of gallium are China, Kazakhstan, and Ukraine. The United States is roughly 99 percent import-dependent on gallium, which is produced as a byproduct of bauxite (aluminum ore) and zinc ores, making it very difficult to accurately calculate gallium reserves. United States bauxite resources generally are not economical to extract, because their high silica content makes domestic production uneconomic and very unlikely.[53] Because gallium is primarily a byproduct of bauxite, and only a small portion of gallium in bauxite is recoverable (approximately 50 parts per million [ppm]), it is uneconomical to recover gallium independently of aluminum. The demand for

aluminum will likely continue to dictate the world's supply of gallium.

INDIUM

Indium (In) is used in liquid crystal displays (LCDs) as the compound indium tin oxide, and is a byproduct of zinc ores. Indium is unevenly distributed in the earth's crust, causing the United States to be completely reliant on imports (although lower-grade imported indium is refined domestically). Due to its low abundance in most ores (less than 100 ppm in most zinc ores), recovering indium separately is uneconomical except as the byproduct of refining other ores. Currently, over half the world's indium is produced in China, with another 16 percent coming from South Korea. While there are techniques for reclaiming indium from discarded LCD screens, this option is only economically viable when indium prices are already high.[54]

Indium is used in transistors, thermistors, photoconductors, and low melting point alloys. It can also be used to create corrosion-resistant mirrors.[55] Indium is used in short-wave infrared (SWIR) imaging, including advanced night vision applications. Its advantage over traditional night vision systems is that a single SWIR device can function in both daylight and night, and does not require the extreme cooling that alternative technologies require. Such indium devices are used in Unmanned Aerial Vehicles, such as the Spectre-Finder and Predator. Because this technology does not rely on detecting heat but rather reflected light, it provides crisp images in starlight conditions, allowing for much greater accuracy in identifying targets than the alternative imaging technologies.[56]

METALLOIDS

Metalloids are elements that possess properties of both metals and non-metals. They are generally metallic in appearance, but are often brittle rather than malleable. They often possess good semiconductor qualities, and can serve as good insulators. Chemically, they behave as both metals and non-metals depending on the substance with which they react.

GERMANIUM

Germanium (Ge) is constrained in its availability because it is not found in concentrated deposits. It is relatively rare in the earth's crust (approximately 1.6 ppm), and while certain minerals do contain high levels of germanium, those minerals do not exist in any mineable deposits. Instead, germanium is most often produced as a byproduct of zinc extraction. Significant quantities of germanium are also recoverable from ash that comes from the burning of certain coals in energy production. China is the main producer of germanium, with a 68 percent market share, although significant reserves do exist within the United States. In 2011, the price of germanium nearly doubled as a result of increased Chinese export taxes and the closing of one germanium plant in China due to "environmental concerns."[57] However, germanium recycling has become increasingly common, with roughly 30 percent of consumed germanium coming from recovered scrap (recycled optical devices and window blanks in decommissioned tanks and other military vehicles).[58]

Germanium is used in fiber and infrared optics and in solar photovoltaic cells. Silicon shares many similar semiconducting properties with germanium, and may be a suitable substitute (at the expense of performance).

The estimated value of U.S. germanium consumption in 2012 was only about $55 million. Germanium sales represent an extremely small market. Yet germanium has been considered a critical material, and DLA Strategic Materials holds a small stockpiled inventory in case of sudden shortages. None was released in 2012.[59] The United States has known reserves of germanium though it has not mined them. Certain military applications will not work without germanium, and the metal's price fluctuates wildly because of the policy decisions by the most important mining regions.

The Chinese government restricts supplies by imposing new export controls or closing down germanium mines. These export restrictions are aimed at encouraging more finished production in China and stimulating the growth of an industry that relies on raw germanium such as optical lenses, fiber optics, LEDs, and solar cells. Chinese authorities have also identified germanium as a strategic resource and included it in their stockpile.[60]

ANTIMONY

Antimony (Sb) is used in a variety of applications, including semiconductors and batteries. It is most widely used as a flame-retardant, which accounts for about 36 percent of its use, and for which there is no effective substitute. While antimony sometimes occurs in pure form, it is more common as stibnite (Sb2S3, a sulfite), with other heavy metals, and as oxides.

China accounts for about 88 percent of annual antimony production, and over 60 percent of the global antimony reserves. Government officials in the Hunan region (where nearly 60 percent of China's antimony is produced) recently closed many antimony plants, citing health and safety concerns. As a result, the price of antimony increased by 20 percent between January and September 2011. Additionally, at current production levels, the Chinese supply is projected to be depleted within five years.[61] The U.S. previously stockpiled antimony; however, these stocks were disposed of by 2003.

TELLURIUM

Tellurium (Te) is a relatively uncommon element, and acts as a semiconductor. Tellurium's major use is as an alloying additive in steel to improve machining characteristics. It is also used as a vulcanizing agent for rubber and as a catalyst for synthetic fiber and is important for photovoltaic (solar) cells, which will likely become a major source of solar electricity in the future. These cells are incredibly thin—usually only 1 to 10 micrometers (μm) thick—and can be flexible and highly adaptable to various designs in different applications. Tellurium is also used in creating fiber-optics capable of functioning in harsh environments, which are likely to become increasingly prevalent in military aircraft.

Tellurium is most often produced as a byproduct of copper processing. Tellurium is extremely rare, with its presence in copper concentrates often below 100 ppm.[62] Most imported tellurium comes from China, although tellurium is also produced in the United States, which possesses sizeable reserves (about 15 percent of known global reserves).[63] The metal is commercially profitable to recover only when it is concentrated in residues collected from copper refineries.

EXTRACTION RISK FACTORS

Many of these metals or metal-type elements are in fact byproduct metals of a carrier metal such as zinc, copper, or bauxite. Consequently, many of these metals are uneconomical to produce independent of the production of the carrier metal. Demand for the carrier metal therefore drives the production of these industrial metals, creating the potential for undesirable market conditions including price spikes and shortages. Germanium, gallium, and indium, for example, are all extracted from zinc ores; gallium is also obtainable from the processing of bauxite (aluminum) ore; tellurium, gallium, and molybdenum are recovered as byproducts of copper ores. Rhenium is a special case, as it is produced as a byproduct from molybdenum, which in itself is a byproduct of copper, making it among the most expensive metals in the world.[64]

Many of these elements simply are not found in concentrations high enough to warrant extraction as a primary product and are produced only as the byproduct of other metals. This fact raises problems with both increasing supply and supply availability. For example, it is uneconomical to increase the mining of copper in order to extract more tellurium. In 2009, copper production approached $80 billion, while the production value of tellurium was only about $30 million.[65] Because tellurium's abundance in copper ores is very low (less than 100 ppm), there would have to be a massive increase in copper production to have any impact on the tellurium supply. Given the values of the two markets, and the resultant drop in copper prices if such an expansion were to occur, producers would lose money overall if they attempted to expand the supply of tellurium. Expanding tellurium production does not appear economically viable despite the fact that tellurium's role in photovoltaic panels that could dramatically reduce the costs of solar energy.

Another example is gallium, which is experiencing a surge in demand due to increased interest in LED lighting. Gallium arsenide (GaAs) is commonly used in high-efficiency, high-brightness LEDs because it has the ability to convert electricity directly into laser light. Many governments, including that of South Korea, are encouraging the adoption of LED lighting in the private sector and mandating it in the public sector, resulting in a rapid increase in gallium demand. According to the USGS, gallium consumption more than doubled between 2009 and 2011, resulting in a price increase of more than 50 percent.[65] However, gallium is mostly extracted as a byproduct of bauxite (aluminum). If demand for bauxite ore declines, then there would also be a reduced supply of gallium, even though the demand for gallium appears to be rapidly increasing.

GEOPOLITICAL RISKS

The United States relies on imports for many of the industrial metals (see Tables 1 and 2), a trend that has grown over the last decade. According to data collected by the USGS, the United States now imports more than 50 percent of 43 key minerals (compared to 29 in 1995). The United States is now totally reliant on importing 19 minerals, compared to 10 in 1995. Thus, import reliance or dependence has increased as the importance of certain minerals has grown.

The concentration of an important commodity among only a small number of

sources creates significant potential for supply disruptions. For example, cobalt and tantalum are produced in the Democratic Republic of the Congo. The extraction of these elements has fed political instability, poverty, and human rights violations. In other situations, the presence of raw materials encourages monopolistic practices and price manipulation. For example, South Africa nearly has a monopoly over PGMs; citing concerns over shrinking reserves, China, the dominant producer of antimony, has tightened its production restrictions. As countries become dependent on the extraction and global production of often-scarce elements, they may be tempted to impose extra fees, taxes, and prices in order to exploit their unique position in the global market. They also may be tempted to restrict exports in order to build up a domestic processing and fabricating industry, as China did with the REs market. Even in the best of cases, the United States faces risks if it depends on a few suppliers of critical elements, since a major earthquake, accident, industrial strife, or lack of investments may disrupt supplies.

RARE EARTH ELEMENTS

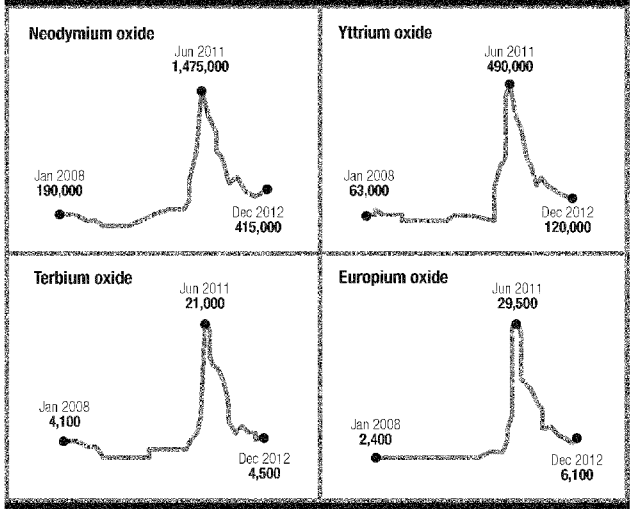
REEs are necessary for many of the modern world's most advanced technologies: missile guidance systems, flat-screen TVs, cellphones, generators in windmills, and motors in hybrid cars, to name just a few. During the last decade, China has cornered the market on REEs—a group of 17 elements including scandium, yttrium, and 15 lanthanide elements at the bottom of the periodic table (see Table 4). Demand for REEs is expected to continue to increase.

In the short term, REE demand has fluctuated, because the state of the global economy strongly determines the need for REEs. Demand rose again in 2009, after the immediate impact of the global economic crisis had passed. As demand increased, the Chinese authorities cut export quotas, artificially reducing the supply of REEs. This fueled fears of possible shortages and caused stockpiling, driving prices to historically high levels by 2011. In 2012, prices plunged by as much as 90 percent in international markets (see Figure 3).

During the two years of surging prices for REEs, many mining companies and investors decided to go into the business of extracting REE oxides. When prices fell suddenly, mining companies suffered financial setbacks. In fact, the collapse of prices has been devastating for Western mining companies, which were trying to bring online new operations to take advantage of the high prices and reduce the West's dependence on Chinese oxides. Molycorp of the U.S. and Lynas of Australia suffered financial difficulties and ran into operational problems. Both companies have seen their share prices drop by more than half.[67] Many smaller players have also suffered calamitous financial setbacks, and their fate hinges on being able to mine so-called heavy REEs. Not all 17 rare earth elements are equally rare; DoE has identified five of them as "critical." Neodymium, a light REE, and dysprosium, a heavy REE, are used in permanent magnets for wind turbines or electric vehicles. Europium, terbium, and yttrium are heavy REEs, and are used in flat-screen electronics and energy-saving lightbulbs. Demand growth for these REEs will be strong, while mining them will be challenging.

REE mining is unlike any other type of mining. Unlike other metals used in many consumer and defense items, REEs are

Figure 3: Price Trends for Four Rare Earth Elements 2008-2012 (Renminbi per ton)



Source: Adapted from: Helen Thomas, "Miners ready to take punt on rare earths," The Financial Times, December 30, 2012.

to some extent abundant though they are hardly ever found in high enough concentrations to make mining them economical. Rather, REEs are mingled with other metals and must be carefully extracted and refined. REEs are often found together; mine operators must identify and isolate the individual oxides. Moreover, each REE oxide possesses different and distinct properties; mine operators must take the customer of their oxides into consideration. Thus, a mine that has a contract to sell neodymium must first refine the oxides and then extract the neodymium elements. The length of this process makes REE mining costly and complex. First the miner must extract the ore, and then the mine operator must separate the REEs according to atomic weight. The various separation processes differ in complexity because some REEs (such as cerium) are common, while others (such as terbium) require a month of separation before ample oxides can been extracted.[68] Accordingly, mine operators cannot ramp up production quickly in response to changing global demand. Not only is it time-consuming to extract and refine the

Table 4: Rare Earth Elements, their Applications and Uses

Element	Atomic Symbol	Atomic Number	Applications and Uses
Scandium	(Sc)	21	Lightweight alloys
Yttrium	(Y)	39	Lasers, high-temperature superconductors, microwave filters, metal alloys
Lanthanum	(La)	57	High refractive glass, battery-electrodes, fluid-catalytic cracking, hybrid engines, metal alloys
Cerium	(Ce)	58	Chemical oxidizing agent, fluid catalytic cracking, metal alloys
Praseodymium	(Pr)	59	Magnets, lasers, ceramic capacitors
Neodymium	(Nd)	60	Magnets, lasers, neutron capture, hybrid engines, computer components
Promethium	(Pm)	61	Nuclear batteries
Samarium	(Sm)	62	Magnets, lasers, neutron capture, masers
Europium	(Eu)	63	Phosphors, lasers, nuclear magnetic resonance
Gadolinium	(Gd)	64	Magnets, high refractive glass, lasers, x-ray tubes, computer components, neutron capture, magnetic resonance
Terbium	(Tb)	65	Phosphors, magnets
Dysprosium	(Dy)	66	Magnets, lasers, hybrid engines
Holmium	(Ho)	67	Lasers
Erbium	(Er)	68	Lasers, vanadium steel
Thulium	(Tm)	69	Portable x-ray machines
Ytterbium	(Yb)	70	Lasers, chemical reduction
Lutetium	(Lu)	71	PET scanners, high refractive glass, chemical catalyst

Leslie Hook, "Chinese rare earth metals prices soar," The Financial Times, May 26, 2011, http://www.ft.com/intl/cms/s/0/751cab5a-87b8-11e0-a6de-00144feabdc0.html#axzz258RqVhv; and Department of Energy, Critical Materials Strategy (December 2010), http://energy.gov/sites/prod/files/edg/news/documents/criticalmaterialsstrategy.pdf

REE oxides, but deposits vary by mine and each separation plant must be tailored to the specific local situation of that particular mine. For this reason, REEs represent some of the most technically challenging mining operations.[69]

Nevertheless, it is worth remembering that REEs are important to many renewable energy technologies. To a large extent, green energy technologies rely on an abundance of REEs. Electric vehicles use large amounts of neodymium and dysprosium (magnets) and lanthanum. Wind

Table 5: Selected Defense Uses of Rare Earth Elements

REE	Defense Use
Lanthanum	Night vision goggles
Neodymium	Laser rangefinders, guidance systems, communications, magnets
Europium	Fluorescents and phosphors in lamps and monitors
Erbium	Amplifiers in fiberoptic data transmission
Samarium	Permanent magnets that are stable at high temperatures, precision-guided munitions, and "white noise" production in stealth technology

Source: Hobart King REE - Rare Earth Elements and their Uses http://geology.com/articles/rare-earth-elements/

turbines need large quantities of neodymium and praseodymium for their powerful magnets. Energy-efficient lighting, such as LEDs and compact fluorescent bulbs, use RE phosphor powders made from yttrium, europium, and terbium.[70]

In short, the appeal of REEs lies in their ability to perform highly specialized tasks effectively (see Table 4). Europium is needed to create the red phosphor for television and computer monitors; cerium is needed to polish glass. Because they are light-weight and have high magnetic strength, REEs have reduced the size of many electronic components dramatically, and are common in consumer electronics, cars, and many military platforms. Common devices such as flash memory sticks depend on rare earth magnets (REMs), which can contain dysprosium, gadolinium, neodymium, praseodymium, and samarium. These elements are used in nuclear control rods, smart missiles, carbon-arc lamps, miniature magnets, high-strength ceramics and glass, and countless other applications.[71]

In spite of their importance to the overall economy and national security, for most of the past decade, the United States did not have a secure supply of REEs. (The Mountain Pass mine closed in 2002 and re-opened in 2012.) By 2010, Chinese producers moved into the global market for REEs and ended up controlling about 97 percent of world production and refining of REEs (see Chart 2).[72] The situation has changed somewhat since 2012 because U.S. and Australian mining companies, drawn by the high prices, opened or re-opened REE mines. Currently China is estimated to control 90% of global supply of REEs.[73] Since the 1990s, Chinese authorities pursued an explicit policy of controlling a resource they considered "strategic and critical."[74] In the 1990s, Chinese operators (both legal and illegal) flooded international markets with low-priced oxides, ores, and raw materials. Many mining companies in the United States and Australia (a country with a wealth of natural recourses) could not compete against these prices, causing many non-Chinese mining companies to shut down. Subsequently, Chinese

Table 6: United States Usage of Rare Earth Elements (2008)	
Usage of Rare Earth Elements	**Percent of Usage**
Metallurgy & alloys	29 %
Electronics	18 %
Chemical catalysts	14 %
Phosphors for monitors, television, lighting	12 %
Catalytic converters	9 %
Glass polishing	6 %
Permanent magnets	5 %
Petroleum refining	4 %
Other	3 %

Source: Hobart King REE - Rare Earth Elements and their Uses
http://geology.com/articles/rare-earth-elements/

operators have gained control over many different mineral resources while driving out production in advanced economies. In Australia, dozens of mines closed in the early 2000s due to a collapse of prices for many metals. In the United States, the Mountain Pass Mine in California, which is owned by Colorado-based Molycorp, closed in 2002 as production became uneconomical due in large part to Chinese mercantilist practices.

In the 2000s, Chinese authorities decided that, rather than exporting raw materials, it would be preferable if the processing, refining, and fabrication of final product applications would take place in China itself so that Chinese companies could reap the benefits of the added value. In 2007, Beijing instituted a 25 percent export tax on europium, terbium, and dysprosium. In 2010, Chinese authorities implemented further export restrictions on REEs by tightening export quotas.[75] The impact of a series of new measures to restrict the export of REEs meant that foreign REE consumers were paying a third more for REEs than Chinese fabricators. According to the World Trade Organization, Chinese manufacturers of REEs have a distinct price advantage over foreign firms.[76] In response, many foreign refiners and producers of final products that use REEs relocated to China to gain access to REEs and to avoid the export quotas and taxes. Japanese and U.S. companies established

a foothold in China and moved production and manufacturing offshore. (In another chapter of this report, we examine permanent magnets and present an extreme case of outsourcing and offshoring that has led to a situation wherein the defense industrial base wholly depends on Chinese processing of REEs and the U.S. economy and defense industrial base must import virtually all of their high-tech magnets.)

China's near monopoly in this strategic sector raised concerns in Washington, D.C., and Tokyo, particularly when China suspended REs shipments to Japan during a diplomatic dispute in 2010. That incident, combined with broader concerns about the reliability of Chinese supply, triggered a surge of investment in RE mines outside China and brought down prices and speculative hoarding of REE oxides. Subsequently, the small REE global market has been depressed. In response, China cut production of REEs at its mines, in an effort to bolster global prices; this production cut has had a huge impact on prices. Current market dynamics do not support high RE prices. Supply is up and demand is down.

Supply is up because non-Chinese companies have aggressively invested in REE mining. Japanese companies have opened rare earths mines and processing in Kazakhstan, India, and Vietnam. The production of elements outside China is predicted to grow tenfold over five years, from 6,000 tons in 2011 to 60,000 tons in 2015.[77] According to industry analysts, as of March 2013, 50 rare earth mineral resources are active, associated with 46 advanced rare earth projects and 43 different companies, located in 31 different regions within 14 different countries. The large and sudden investments in REE mining and processing have brought prices down, especially as global demand has softened.

However, China may ultimately retain its dominant position. The price squeeze is making it unprofitable to continue operations in advanced industrialized countries. Molycorp reopened Mountain Pass Mine when prices skyrocketed. But the mine mostly produces light REs, which are relatively abundant and the least valuable. Australia's Lynas Corp. opened a mine called Mt. Weld, which also produces light rare earth oxides. Both companies have promised to find more valuable heavy REEs. These oxides are more difficult to locate; China possesses them in abundant quantities. Even if mines outside China can locate heavy REs, the issue remains that China is an extremely low-cost producer. It will be difficult for companies in the United States or Australia to compete with Chinese mines when Chinese authorities are lax in enforcing health, safety, and environmental rules. REE mining is notorious for generating massive amounts of toxic waste. Occupational safety rules as well as environmental controls make mining in the United States (and other OECD countries) more expensive than in China. However, the cost differentials between countries may be especially striking when the extraction is accompanied by a comparatively high amount of radioactive tailings, as is the case with REEs

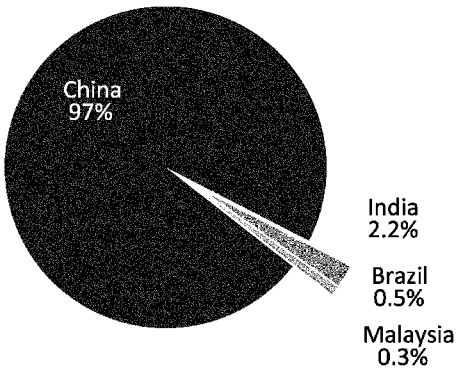
Ultimately, the real issue is not the oxides. Mining and separating the oxides is the first step in using REEs for commercial and defense applications. The real trick lies in converting the oxides into powders, metals, alloys, and magnets. Mining is costly, but the real technological skill involves processing the RE oxides into usable items. That technology has shifted to China, which has sought to build up a "mine-to-magnet" vertical integration. The supply chain starts with oxides and then moves to refining, purification, manufacturing metal alloys, and finally to fabrication of magnets.

The critical technology for manufacturing these magnets is overseas—mostly in China. China captured the market gradually by transferring U.S. technology to China and flooding the market with cheap magnets in the early 2000s. Since then, China has continued to improve its manufacturing expertise and now possesses a depth of engineering skills.

This explains why Molycorp bought a Canada-based REE company, Neo Material Technology, which runs major manufacturing facilities in China. Molycorp cannot process the oxides into fabricated and finished products in the United States. The U.S. mine ships RE material to China, where REEs such as dysprosium and neodymium are transformed into military-grade magnets.[78]

In the FY2007 National Defense Authorization Act (NDAA), Congress passed reforms to the specialty metals restrictions and created the Strategic Materials Protection Board (SMPB). The SMPB was meant to determine what protections were necessary to ensure the supply of materials for national defense purposes; assess potential risk associated with the non-availability of those materials; and advise policymakers on how to ensure

Figure 4: Global REE Production, 2010
(133,000 Metric Tons)



Source: Marc Humphries, Rare Earth Elements: The Global Supply Chain (Washington, D.C. CRS, June 8, 2012), http://www.fas.org/sgp/crs/natsec/R41347

that supply. The SMPB is required to meet at least once every two years, publish recommendations regarding materials critical to national security, and vet the list of specialty metals.

The SMPB met twice in 2008 and issued its report and recommendations in December 2008 and February 2009.[79] The boards concluded that specialty metals were *not* "materials critical to national security," but instead "strategic materials" that warranted monitoring but not domestic source restrictions.[80] Alternatively, the Board recommended relaxing or removing domestic source requirements in an effort to reduce costs and more readily access specialty metals produced abroad.

The FY2010 NDAA required the Government Accountability Office (GAO) to assess the domestic and global availability of REMs, their importance to defense programs, and the potential for the supply of these metals to be restricted. As a result in the April 2010, GAO issued the report "Rare Earth Materials in the Defense Supply Chain" (GAO 10-617R).[81] The report stated that dependence on Chinese suppliers puts future availability of REMs—especially neodymium—at risk. The report also stated that projected domestic supply options would take seven to 15 years before becoming fully operational, primarily due to state and federal regulations. At the time of the GAO report, DoD was still in the process of evaluating defense vulnerabilities, and was scheduled to complete its analysis by September 2010. That report has never been released to the public.

The FY2012 NDAA calls for DLA to submit a plan to DoD to establish a stockpile of REMs, as well as to provide a broader assessment of source reliability. The DLA report, which was scheduled for completion in July 2012, would require a DoD decision on the plan within 90 days of submission. At present, the DLA maintains a stockpile of 28 materials with a value of about $1.4 billion, but does not currently stockpile any REs.[82] In a significant change that increases the authority of the U.S. government to address stockpile deficiencies, Sec 901(a) of the FY2013 NDAA says that the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy is now responsible for "[e]nsuring reliable sources of materials critical to national security, such as specialty metals, armor plate, and rare earth elements." DoD issued its *Strategic and Critical Materials 2013 Report on Stockpile Requirements* in March 2013 and identified 23 strategic and critical materials. The report calls for a fund of $1.2 billion to mitigate the shortfall of key materials.

Separate from the NDAA, the 112th Congress introduced at least 13 bills (nine in the House of Representatives, four in the Senate)[83] relating to REs; however, none has yet passed out of the relevant committee. Additionally, the Congressional Research Service has conducted at least three studies focused on REs and specialty metals, while GAO has released one. Broadly speaking, these reports indicate that Congress should demand renewed assessment by DoD of the "strategic materials" categorization in light of recent global supply chain concerns, and suggest policies including stockpiling REs and reinvesting in domestic research and production. These suggestions appear to be conditional on a new assessment of the SMPB/DoD, which appears reluctant to take any further action without an additional mandate from Congress. It does not appear that DoD is likely to alter its opinion expressed in the FY2011 Industrial Capability Report to Congress, which stated that, although securing a non-Chinese source of REs is essential,

only minimal provisions (such as prioritizing defense applications over commercial applications) are required.[84]

To some extent, DoD's position dovetails with the interests of large defense contractors who prefer to source the small amount of magnets they need from cheap Chinese suppliers rather than to deal with U.S.-based producers.

In conclusion, although prices have dropped and shortages have disappeared in the short term, the Chinese authorities continue to meddle and intervene in the global market for RE oxides, mostly because they control the global mining of these oxides and seek to take advantage of that position. The long-term Chinese goal is to foster a high-tech RE industry in China while preserving RE reserves.[85]

PLATINUM GROUP METALS

The PGMs (also sometimes called platinum group elements, or PGEs) include iridium (Ir), osmium (Os), palladium (Pd), platinum (Pt), rhodium (Rh), and ruthenium (Ru). PGMs have excellent resistance to heat and serve as catalysts for chemical reactions, contributing to their uniqueness and importance in a variety of applications.

The most prominent application of PGMs is in catalytic converters, which dramatically reduce the pollution from automobiles. Many PGMs, especially palladium, are used as catalysts in fuel cells that find wide applications in the auto industry. Since the global car industry is projected to expand in the next decades (Chinese and Indian consumers), demand for palladium will continue to grow.[86] In addition, palladium is also used in fuel cells in hybrid cars. Thus, the switch to cars emitting fewer pollutants will not necessarily sharply reduce the demand for palladium.

In addition, platinum and palladium are extremely common in most electronic devices, including military hardware. Although the actual per-unit metal content is minute, a huge quantity of palladium is needed to meet the growing demand for electronic goods. Multilayer ceramic capacitors (MLCC), which regulate the flow of electricity through a circuit, represent the largest demand for palladium from the electronics industry. While the automotive industry mostly consumes palladium as components of catalytic converters, automobiles also contain a large number of hybrid integrated circuits (HIC), which make use of silver-palladium tracks to connect different components of the circuit.[87]

Platinum is reportedly used in some capacity during the fabrication process of more than 20 percent of all manufactured goods.[88] It is malleable, ductile, resistant to corrosion, and possesses a high melting point around 1,770 degrees Celsius (3,215 degrees Fahrenheit). Its uses include electronics and chemical catalysts, in addition to many other applications. Platinum is up to 30 times as rare as gold (another precious metal).

Platinum and palladium supplies are potentially at risk due to their geographic concentration in areas that face political instability. In 2011, global production of platinum was dominated by South Africa (72 percent) and Russia (14 percent). The material is found in large commercial concentration in only a few regions of the world, yet the future of energy, transportation, and the environment relies on platinum. Platinum's catalytic property aids emissions control in transportation

and combats pollution. Demand is bound to increase, not only in advanced industrialized countries, but also in emerging markets as governments seek to control emissions and smog. U.S. federal agencies' reports identify platinum as subject to supply risks with enormous consequences for the U.S. defense and the economy at large.[89]

In 2011, South Africa accounted for about 38 percent of palladium production, and Russia 41 percent. In all, South Africa controls more than 95 percent of known PGM reserves.[90] Two North American mines extract palladium, but their share of global new production amounts to only 14 percent.[91] Since the 1980s, the Russian government has held a stockpile of palladium. The actual size of the Russian stockpile has long been a closely guarded secret. But when prices were exorbitantly high in the early 2000s, they sold a large portion of the stockpile, bringing down the price of palladium.

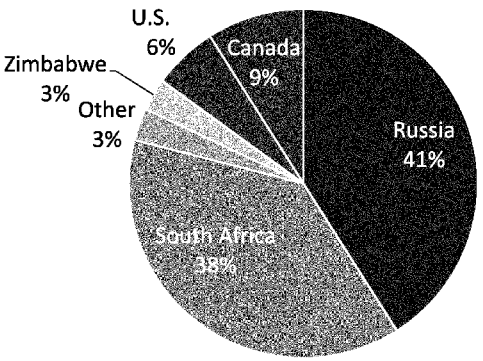
South Africa traditionally has been aligned with the West; its business environment is open to Western foreign direct investments and capital flows. Yet many observers are extremely concerned about the political situation in South Africa and the possibility that its political instability may place future supplies at risk. South Africa copes with many internal tensions and conflicts. For example, different factions within the ruling African National Congress are pressing for a more aggressive policy towards the natural resource sector in order to extract greater revenues to accelerate economic development and foster wider redistribution.

Additionally, the South African government has failed to invest in society's infrastructure; as a result, many public sectors are starved of capital. Also, the current vulnerabilities in the mining sector may create a window of opportunity for more determined outside forces to gain control over a slice of the South African mineral wealth. The South African Mining Charter requires mining companies to be at least 26 percent owned by historically disadvantaged South Africans.[92] After two decades, the black empowerment objectives have not fundamentally changed the ownership structure of the mining industry, except for some smaller junior mines. These mines are scrambling for capital infusions, which may come from Chinese investors, which means that Chinese companies are moving into the PGM sector by propping up junior mining companies in South Africa. Another issue is that labor relations in some of the largest mines are fraught with conflict and tension. In the summer of 2012, a standoff between management and miners resulted in the deaths of dozens of miners and a shutdown of platinum mines. Strikes and labor unrest subsequently spread to other mines, pushing up prices of platinum and gold.[93]

As industrial strife and stoppages reduced the supply of platinum to its lowest level in a decade, the sluggish global economy and a rebound in scrap supply have kept prices within its historic range. Platinum sales from South Africa dropped by 12.5 percent in 2012, yet platinum's price fell from a high of $2,290/oz in 2008 to $1,605/oz in March 2013.

The risk is that the depressed prices will deter investments in ailing South African mines and therefore generate future supply constraints. Low prices for platinum and other PGMs have exacerbated the plight of the South African mining industry, which needs to make enormous investments to upgrade existing facilities and improve productivity.[94]

Figure 5: Global Palladium Production, 2011



Source: Luke Burgess, "Investing in Palladium Investment U Research," Investment U Research, February 24, 2012. http://www.investmentu.com/2012/February/investing-in-palladium.html

While major South African mining companies face an uncertain and difficult future, Chinese investors have entered the market to assist junior mines in South Africa—a move that matches its larger strategy in sub-Saharan Africa. Concerned about supply risks to its the Chinese economy and determined to build up its military capabilities, Chinese authorities identify access to raw materials as one of their major foreign policy goals. To prevent any supply disruptions, China has been very active in sub-Saharan Africa, which is one of the regions of largely untapped metals and minerals. In turn, China's investments and presence is welcomed in some African countries. Chinese authorities also do not exert pressure on African governments about human rights, transparency, political freedom, internal politics, environmental standards, or ethical trading practices.[95] The entry by Chinese investors or state holdings into the South African PGM sector should be a source of concern, especially as the established mining sector struggles with low productivity and underinvestment.

For these reasons, most OECD countries perceive PGMs as one of the groups of specialty metals with the single highest

risk factor. First, there are no obvious substitutes for palladium and platinum, yet they are indispensable for the global production of vehicles, engines, and computer storage devices. Moreover, supply risks are high because of the political conditions in South Africa, which pull the South African government in conflicting directions, resulting in disappointing mining performance. Labor disputes add another layer of uncertainty, as discontent among workers about working conditions and pay creates a volatile atmosphere. The financial situation in some smaller start-up mines is often delicate, and provides Chinese operators with the means to gain control over sectors of the mining operations. Finally, many mines require major upgrades, and the overall transportation, power, and public service infrastructures in South Africa are in steady decline.[96]
The other country with substantial deposits of PGMs is Russia. Mining in Russia is a risky business and many mines have failed to attract private sector capital. With the fall of communism, state-owned mines were privatized and distributed to a handful of individuals. Because commodity prices were low, capital was sent overseas rather than reinvested in the mines, resulting in the decline of the Russian mining sector.[97]

Today, while greater attention is devoted to the mining sector, Russia is perceived as an unpredictable place for investments. Its economic and political environment is stable, but the mining sector is subject to arbitrary non-transparent decisions and immense bureaucratic hurdles. Obtaining a permit to explore a region is daunting because of the many technical and administrative rules. Once a company has secured an exploration license and identified a resource, it must apply for a mining license, which requires extensive paperwork as well as approvals from different levels of governments and authorities. The whole process may take years and discourages investment and expansion. Foreigners are also dissuaded by various laws that privilege domestic operators over foreign investors. The Russian state has issued laws protecting "strategic" assets, including raw materials.[98]

MITIGATING THE RISKS

The metals and chemical elements discussed in this chapter are a diverse group and require a differentiated approach, but the following recommendations will mitigate risks for most of them.

Increase the exploration of alternative sources for the elements and thereby secure a diversification of the supply chain. Deposits of specialty metals are found in smaller concentrations in various parts of the United States. For example, northeast Minnesota is thought to possess deposits of underground copper, nickel, platinum, palladium, and gold. While it seems unlikely that this region can meet all U.S. needs, mining these deposits would lessen the reliance on imports from unstable parts of the world and also reduce the impact of any future supply restrictions.

The United States should continue the search for substitute and synthetic materials to replace REEs and REMs. Even if mining companies find more geological concentrations of exotic elements, in reality at some point the United States will run out of easily accessible resources. Manmade composites would be the long-term solution to increased dependence on the scarcer elements of the periodic table.

Recycling must be improved, strengthened, and increased. Manufacturers and

producers should use extracted materials in ways that facilitate recycling and re-use. The more that is recycled, the less the economy will be dependent on imports.

A new system of stockpiling or inventory should be designed to mitigate the impact of possible supply disruptions. The DLA currently stores 28 commodities valued at over $1.4 billion. Although the stockpile contains quantities of PGMs, it does not hold REEs, and it does not appear to be properly coordinated with other agencies. To operate more efficiently, DLA Strategic Materials should adopt a sensible and proactive plan to acquire materials when prices are weak and coordinate with downstream users. Congress has recently taken steps that will enable U.S. stockpiling efforts to be more proactive; however, sustained, high-level attention will be necessary.

The United States should continue to adequately fund the USGS, which collects and analyzes data, without which it would be very difficult to pursue a mitigation strategy in the first place. USGS is a critical agency in gathering and disseminating information on the state of affairs of our natural resources. Past budget cuts have caused the USGS to struggle to meet one of its principal objectives: to inform the nation of the status of its geological resources and warn of the potential for emerging supply constraints.

Enforce greater interagency coordination, which is critical to mapping out a proper long-term strategy for managing our specialty metals supply chain. DoE, DoD, and the White House Office of Science and Technology Policy all have issued reports on how to address the critical materials agenda. There should be greater coordination and collaboration in establishing a common approach to addressing the risks of supply constraints of critical and strategic materials. In addition, since other advanced industrialized countries face very similar challenges, it would also be helpful to foster greater international cooperation and coordination among the European Union, Japan, Australia, and Canada, including possible collaboration on topics such as resource mapping, substitutes, and recycling.

U.S. foreign and security policy has paid limited attention to sub-Saharan Africa, which possesses some of the world's richest concentrations of key minerals. China has been very active in Africa to ensure that it has a presence in countries with large concentrations of strategic minerals. Because the continent supplies many of the most strategic minerals, U.S. foreign, trade, and security policy should focus on ensuring continued access to African mineral deposits.

CONCLUSION

Many minerals already were labeled as critical and strategic in the early 1980s. Advanced technologies upon which our economy and national security depend are themselves heavily dependent on specialty metals and minerals. Nevertheless, over time the United States has become more dependent on imports of key minerals from countries with unstable political systems, corrupt leadership, or opaque business environments. Moreover, the countries themselves (notably, China) have taken a more aggressive posture towards mineral resources and now compete with Western mining operators for extraction control.

The United States is not the only Western country that has increasingly ignored the economics of mineral extraction. Many

electronic devices, green technology, and advanced weapon systems rely on a host of exotic chemical elements. An overarching strategy linking DoD with other government and industry stakeholders is imperative to address potential shortages before they impact U.S. national security.

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Mr. ROHRABACHER. General, you were right on 5 minutes.
Now Mr. Brown, can you do the same?

STATEMENT OF MR. NEIL BROWN, NON-RESIDENT FELLOW, GERMAN MARSHALL FUND OF THE UNITED STATES

Mr. BROWN. Being fourth in the batting order and knowing my problems at baseball, I know that I won't be able to follow the General quite so well as that precision.

It is a real pleasure to come to this side of the Capitol and join this distinguished committee. When I joined the Senate committee staff in 2005, we held a lot of hearings on these sorts of issues and at that time it was a lot of doom and gloom. For decades, really, we had become conditioned as Americans to be on the receiving end of oil and gas, particularly oil decisions with governments that did not have our best interests at heart.

So I am particularly grateful for this committee, for you, Chairman and Ranking Member, for holding this hearing at a time where Americans are doing what we do best which is changing the rules of the game through innovation in oil and gas and unconventional sources, efficiency, alternative energy, we are giving ourselves not only economic opportunities, but much more significant foreign policy flexibility and opportunities around the world, including in Central Asia which is important both for the issues that Ed mentioned in terms of the volume of oil and gas and other minerals the region has, but also for the strategic benefits and importance given that it sets above Iran, Pakistan, and Afghanistan.

There are, I think, two major energy forces happening in Central Asia. One is China which is using its financial clout to access resources and the other is Russia. Russia is after power of a different sort which is political power, by maintaining as much control as possible over transit, in particular, it wants to further its own interests in keeping its friends in power.

I thought that some context might be useful. Congressman Keating mentioned that local events around the world can really impact the prices Americans pay at the pump, our economy, our national security. And really what has happened in the global oil market in particular is that the rising demand of emerging economies, particularly China, India, and in the Middle East, ironically, has over time really narrowed the margins in the global oil market which meant particularly in the mid-2000s that even small disruptions, attacks in the Niger Delta on Shell's facilities could have an impact right here at home. Now the recession, I guess one good side of the recession is that demand slowed down so that we got a bit more of a window and also more recently the U.S. has boosted supply, again giving more flexibility. But that structural shift in markets has not changed. So we can expect more of the same, unfortunately, when the economy picks up.

Now I want to skip to—seeing my time—skip to what is happening with Russia. And really what you have is on the Central Asia side, pipelines running north and that is Russia's lever of control, one of its most important levers of control over those governments and on the eastern side of Europe, the supply routes. So we have major concerns in Central Europe, Eastern Europe, the Balkans, the Baltics, and dependence on Russia for gas, in particular.

Now if Russia were simply to allow markets to work, that dependence would still bring economic detriment, but it would not be, I suppose, a strategic concern. But unfortunately, that is not the way Russia operates. We have seen time and again their willingness to use energy as a weapon or for coercion.

So the U.S. strategy has really focused on diversification.

It was mentioned previously the Southern Corridor which recently has had a boost in picking of a pipeline route to deliver Caspian gas on into Europe, but there is still much more work to be done.

I would like to have entered into the record a report that the Foreign Relations Committee on the Senate side put out in December that goes into this in great detail so that if my testimony, when you read that, doesn't cure your insomnia, then the report will definitely take care of it.

Mr. ROHRABACHER. Without objection the report will be submitted for the record at this point in the record.

Mr. BROWN. Thank you. Three key recommendations from that report and the analysis is for the first time, the United States has the ability to directly aid our allies on gas supplies. We have an abundance of natural gas and those allies want that gas whether that is Turkey which would like to reduce its dependence on Iranian gas or Central Europe that would like to reduce its dependence on Russian gas. The Congress is currently considering a bill that Congressman Turner put out that would automatically grant export licenses, so I recommend that to you.

The second recommendation is that even as we think about our own LNG exports, we also have to focus on pipelines. And to that extent we need much more high-level engagement on a concerted basis because decisions in these regions on energy are made at the highest levels of government, so you need to have that kind of constant attention and the loss of the Nabucco project which would have delivered gas directly into Central Europe means that we need to think of new ways to make sure that we have pipeline interconnections to help our allies there.

And finally, we need to reemphasize the prospect of a Trans-Caspian pipeline to link infrastructure that originates now in Baku to Turkmenistan. It has been talked about a long time and it is extremely challenging, but without U.S. leadership the opportunity will be lost and I know this committee is also considering a resolution on that issue, so that is well on your radar. Thank you.

[The prepared statement of Mr. Brown follows:]

Changing the Rules in Global Resource Competition

Testimony for the House Committee on Foreign Affairs,
Subcommittee on Europe, Eurasia and Emerging Threats
July 25, 2013

Neil R. Brown
Non-resident Fellow
German Marshall Fund of the United States

Thank you Chairman Rohrabacher and Ranking Member Keating for holding this hearing on the critical role natural resources play in our nation's national security and economic health. Your focus on Central Asia is important given that region's role both in energy markets and for U.S. national security concerns in neighboring Iran, Afghanistan, and Pakistan. Having served for nearly eight years as the Republican lead for energy security on the Senate Foreign Relations Committee staff, it is an honor to return to the Hill to appear before this distinguished committee.

In broad terms, Central Asian energy is the playing field for two major forces. China, in its global quest for the raw materials necessary to fuel economic growth, uses its financial clout to access Central Asia's natural gas. Russia wants power of a different type. It seeks to maintain its dominance over export routes for Central Asian oil and gas in order to maintain political influence in the region and in Europe. My friend Ed Chow will address the China question in discussing eastern export routes from the region, so I will focus on dynamics to the west and with Russia. First, however, I will give some context to changing energy market dynamics and ways in which energy translates into conflict.

Since the 1970s, Americans have been conditioned to understand their vulnerability to oil-driven threats. Energy has an imposing presence in diverse national security concerns around the globe. In the extreme, the United States can be compelled into military action to ensure steady supply lines. More commonly, energy fuels challenges ranging from Iran's nuclear program, to anti-American propaganda in Venezuela, to deepening corruption as just a few examples.

Global oil and natural gas markets have undergone fundamental structural shifts in recent years. Demand growth is primarily focused in emerging economies, especially in China, India, and the Middle East, thus leading China in particular to pursue natural resources in Central Asia and around the world. In the mid-2000's, surging global demand and struggling supply replenishment for oil shrunk global spare capacity margins, which essentially is a measure of the world's ability to increase oil production in case of man-made or weather-induced shortfalls. In that market situation, even relatively small losses in supply sent prices skyrocketing. More recently, economic recession slowed demand growth while unconventional oil and gas boosted supply. Prices remain high due to structural shift in demand, but prices are less volatile than otherwise would be expected. The current respite

for markets is likely temporary, however, absent substantial policy changes to shift demand trajectories in emerging markets when their economies regain steam. We can, therefore, expect ongoing state-backed competition for natural resources. One should bear in mind, however, that such a pursuit is also an indicator of economic activity and thus signals an opportunity for the United States to sell goods and services to growing China.

In the U.S., the rise of unconventional oil and gas, renewable, and efficiency technologies gives us the opportunity to help rebalance energy geopolitics, assert more flexibility in foreign policy, and build economic opportunities for American businesses. In oil, surging unconventional production has taken pressure off markets, and increased use of alternative fuels like ethanol and improved penetration of fuel efficiency technologies has arrested oil demand growth. That is benefiting our foreign policy as well as our economy. As one example, it has enabled much stronger enforcement of sanctions on Iranian oil than otherwise could have occurred. In natural gas, U.S. unconventional production is nothing short of revolutionary. Although trade in gas remains dominantly regional rather than global, that is changing and already foreign markets are feeling the price impacts of our production.

With that market context, potential conflicts centered on energy resources generally can emerge from at least four sources: instability due to lack of energy access, poor governance of energy resources, efforts to control energy-rich territory, and use of energy itself as a strategic tool or even as a weapon.

First, reliable access to electricity is something we take for granted in the United States, but billions of people around the world are not so fortunate, entrenching a structural barrier to economic growth. Lack of electrification is a critical threat to political stability in countries such as Pakistan, Afghanistan, and, as we have seen recently, in Egypt. With a surplus of electric generation and natural gas export potential, Central Asia can be an important source of power for Afghanistan, Pakistan, and India and thus also decrease their incentive for trade with Iran. Globally, those billions of people with no or limited electricity do have purchasing power, as we have seen in telecommunications and personal goods industries. By focusing on energy access, U.S. entrepreneurs can build markets for our goods and services, fostering mutually beneficial trade relationships rather than simply capturing raw materials. Chairman Royce has offered legislation to help spur those relationships in the African context.

Second, poor governance of energy resources can entrench corruption, authoritarianism, and be more of a curse than a cure for economic development. That not only undermines U.S. foreign policy objectives, it also can lead to internal instability and jeopardize U.S. private investments. Perhaps the most vivid example is the Niger Delta, where international oil company infrastructure is regularly attacked and oil stolen to fund violent insurgents. While Central Asian countries are currently being spared that level of conflict, control of oil and gas revenues is essential to supporting the authoritarian streaks and wasteful spending of leaders in the region. U.S. levers to influence resource governance in energy-rich regimes are limited and, in Central Asia, compete with other strategic priorities.

Information on natural resources transactions is essential to empower citizens and investors. Congress has already taken a critical step to push back on energy-fueled

authoritarianism with passage of the so-called Cardin-Lugar Amendment, which will put on public view oil, gas, and minerals payments to governments. The European Union has also now approved similar rules, which will bring more scrutiny to Russian companies in particular. The U.S. is also leading by example with the U.S. Extractive Industry Transparency Initiative process now underway in which companies, civil society groups, and administration officials are working together to disclose payments to the federal government. I encourage Congressional representatives to contribute to that process.

The final two manifestations of energy in conflict differ in that in one control over physical energy reserves is the object of conflict and in the other energy resources are being used as tools, or weapons of war, for other ends.

The drive for territorial control over energy resources remains present in the world, although it tends to be more of an internal state occurrence than inter-state. Recent examples include division of Sudan and South Sudan, jockeying for control of oil and gas in Northern Iraq, and control of mines in Congo. Fortunately, Central Asia is relatively calm on that front with delineation of the energy-rich Caspian seabed occasionally enabling unwelcome tension between littoral states. In particular, Russia objects to a proposed Trans-Caspian Pipeline to diversify Turkmen gas export options through a link to Europe outside of Russian territory. Affirmation of Congressional support for the pipeline proposal, along with continued partnership with Azerbaijan to improve maritime security capacity, would be welcome.

Regrettably, Russia's willingness to use its energy resources to assert influence over its neighbors is likely the best example we have of energy intimidation, the fourth manifestation of energy in conflict that I will mention today. On the supply side, energy-rich Central Asia depends on transit routes through Russia and Russian companies as intermediaries to get its gas to markets. On the demand side, Central and Eastern European and Baltic countries rely on Russia for up to 100% of their gas imports. If Russia simply allowed gas markets to function, this situation would still have negative pricing consequences but would not rise to the level of strategic concern for the United States and our allies. Regrettably, that is not the case. Natural gas in particular is as much a strategic tool as it is a financial boon to the Kremlin. Russia rewards its friends in Europe with low prices and penalizes its rivals with higher prices. It seeks to expand its gas empire with acquisition of infrastructure and to block alternative supply routes. In the extreme, as former Senator Richard Lugar has argued, cutting gas supplies in the middle of winter could be a more effective instrument of aggression than bombers or tanks.

In both Central Asia and Europe, over-dependence on Russia challenges the independence, economic prosperity, and political stability of afflicted countries and is detrimental to efforts to expand NATO and the European Union. With bipartisan support, the United States has worked to help rebalance energy geopolitics across the region. A core feature of U.S. engagement is to enable diversification of supply routes for exporters in Central Asia and Azerbaijan and for importers in Europe. Unlike China, which can simply pay for and build new pipelines, the U.S. relies upon private investment and rigorous diplomacy to enable that investment.

The centerpiece of our strategy is pursuit of the Southern Corridor to link Central Asian and Azerbaijani oil and natural gas to global and European markets. The oil component was completed with inauguration of the Baku-Tbilisi-Ceyhan pipeline. Natural gas has been more challenging, due to commercial hurdles, political unease, and in no small part to Russia's efforts to thwart the project. Just last month, however, a long-anticipated decision was made on which pipeline route to Europe will be utilized to carry Azerbaijani gas and in coming months the final investment decision of the gas developers in the Shah Deniz consortium will be made. To be clear, the Southern Corridor is not an anti-Russia strategy; rather, it is an attempt to bolster friends and encourage markets to work.

In addition to U.S. and EU diplomacy, U.S. unconventional natural gas is improving the bargaining position of our allies in Central and Eastern Europe. Liquefied natural gas (LNG) supplies once intended for the United States are now available on the world market, and as U.S. gas pushed down coal prices, lower-priced coal helped reduce European gas demand already stunted by slow economic growth. The fact that U.S. natural gas prices are not fixed to oil also encouraged more frequent delinking of the two in Europe where some countries have successfully bargained for lower prices from Gazprom. We should not be tempted by complacency, however. So long as physical alternatives to Russian gas are limited, our allies will remain vulnerable to resurgence of political manipulation in gas, and Central Asian countries may only have China as a viable alternative to Russia.

In December 2012, the Senate Foreign Relations Committee issued a report entitled "Energy and Security from the Caspian to Europe," in which Marik String and I elaborate on those issues in detail, and I ask that the report be entered into the record. I will share three key recommendations for the U.S. to continue rebalancing energy power dynamics.

For the first time, the United States can directly aid in the gas needs of our allies by simply allowing our markets to work through permitting LNG exports. While the physical quantities of U.S. gas moving to Central and Eastern Europe and the Baltics would likely be small, the pricing impact and political symbolism for our allies is significant. U.S. LNG exports also could help replace the approximately 20 percent of Turkish gas demand that is currently met by Iran. LNG trade will also promote economic growth at home and bolster economies of our trade partners. Congressman Mike Turner and Senator John Barrasso have offered bipartisan legislation to accomplish these goals, and many of our strategic allies are anxious for Congress to act.

At the same time, we cannot ignore the realities of pipelines -- or lack thereof -- both in Central Asia and Central Europe. High-level U.S. engagement remains vital and must be commensurate with the reality that decisions on energy are made at the highest levels of government in the region. With the failure of the Nabucco West pipeline proposal to bring gas relief directly to Central Europe, we now need to work to ensure interconnections and alternatives are pursued to bolster allies such as Hungary and Romania. Finally, U.S. advocacy for a Trans-Caspian Pipeline, which would establish a non-Russian trade route between Turkmenistan and western markets, should be rejuvenated. The pipeline would be relatively simple from a technical point of view, but it is enormously complex politically with wavering engagement from Ashgabat and opposition in Moscow. United States leadership is essential for building confidence of Turkmen leaders and helping put in place transit guarantees with Azerbaijan and Turkey.

I conclude with an observation. For decades, our nation has faced vulnerability to the whims of oil-backed regimes. In recent years, Americans have done what we do best – change the rules of the game in our favor – in this case with innovation in oil, gas, renewables, and efficiency and rigorous diplomacy. While we cannot simply divorce our economy from supply and demand decisions made in Beijing or Moscow, we now have more options for economic growth and security benefits than many people would have thought possible just a few years ago. I appreciate the Chairman, Ranking Member, and members of the subcommittee for their interest in pursuing those opportunities.

Thank you.

** The views shared herein do not necessarily reflect those of the German Marshall Fund of the United States.*

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Mr. ROHRABACHER. I want to thank all of you for giving us some food for thought and we will go and vote and it is the chair's intention to call this hearing back to order 5 minutes, Mr. Keating, 5 minutes after the last vote, is that all right with you, Mr. Keating? Okay, so 5 minutes after the last vote which we expect to have ready at around 11:30. We should be back around 11:30. So this hearing is now not adjourned, but in recess.

[Recess.]

Mr. ROHRABACHER. The hearing will come to order. I want to thank you for holding off. The ranking member, Mr. Keating, will be joining us momentarily. He gave us permission to proceed in the meantime without him.

I found all of the witnesses to be offering some very compelling testimony today and I think the record of this hearing will be of great value to all of us and to a great number of people will be looking through this record.

One major truism of our era is we are now living in a time that is different than it was 50 years ago in that we have huge chunks of the world population that seem to be perched and ready to uplift their standard of living, especially in India and China. And we are talking about together they represent maybe half of the world's population I believe. And half of the world's population which in the past seemed to be relegated to living the rest of eternity in poverty and deprivation.

This will obviously, if indeed, their well being and their economic well being is to be uplifted, that will, will it not, create a huge drain on natural resources. It takes energy to have prosperity for normal people. It takes clean water as well, I might add. And it takes industrialization or at least the production of wealth using technology to uplift large populations. So thus, we face a world now that is going to have if, indeed, India and China are to increase their standard of living, this will create a major—it will exacerbate everything we have been talking about today.

And for example, Mr. Chow, you mentioned in your testimony the growing competition in Central Asia for Central Asian oil and that India is part of this for this oil and gas competition for that. There are different ideas. We have heard testimony today about pipelines that could then maybe connect India and China to this oil and gas in Central Asia. But any pipeline that would go through or get to India from Central Asia it seems like it would have to come through and what is being looked at now as an Afghan—Turkmenistan-Afghan-Pakistan-Indian pipeline, TAPI, I think they call it.

And is that realistic, Mr. Chow, that they could—is that pipeline really a pipe dream, considering the fact of what is going on in Afghanistan and the turmoil that pipeline would have to go through?

Mr. CHOW. Thank you, Mr. Chairman, for that question. I think in my written testimony I made clear to you that I am helping the Department of State in figuring out how to advance this pipeline project and challenges for that project is indeed daunting for quite obvious reasons that we don't need to go into detail here.

I think the fundamental reason why this might work, and I say might, is that you have a country in Turkmenistan that has the fourth largest gas resources in the world that seeks diversification

of its export routes so that it doesn't become over reliant on China as it once was over reliant on Russia for its natural gas exports. And at the same time, as you have already mentioned, we have got this booming energy market in India. If it is possible to connect the two, and geography dictates that therefore you have to go through Afghanistan and Pakistan, then there are fundamental ingredients that would make that project work economically if you can manage the political and security risks involved.

So I think the economics are there. The interest of the government to seek alternative export routes is there. By the way, it converges rather well with U.S. national interests in the sense that our interests and the stability of the region in integrating Afghanistan into both South and Central Asian economies and also to promote better relationships for Pakistan with its neighbors, most prominently India and Pakistan. So it is a very challenging project.

I have worked in this industry quite a long time. The fundamental economics are there. Whether politically and in terms of security it is achievable we will have to find out.

Mr. ROHRABACHER. So let us note that you are saying it is a challenging project, but it is not challenging engineering-wise, is it? The challenge has to do with political decisions and political stability and within Afghanistan and that region. India would certainly have an important, let us say be an important customer for that oil, but at the same time wouldn't that be something the Chinese would not want to have developed?

Mr. CHOW. I think that that is fair to assume.

Mr. ROHRABACHER. So what we have, Dr. Chow, is the great powers of that region, India and China, have conflicting interests over what to do with that natural resource and again, that is what this hearing is all about and we should take note of that and learn from it and maybe try to project what that means in the future.

Do any of the other panelists have a comment on that?

Mr. CHOW. I would just add, Mr. Chairman, if you will permit me, that we should not underestimate the interests of the national leaders of the countries involved in Central Asia to balance the interests so that they are not overly dependent on any one of the regional powers. So they have a fundamental interest in diversity of export groups.

Mr. ROHRABACHER. Yes. Mr. Brown?

Mr. BROWN. Maybe to add just a couple thoughts to that because you have hit on something that is both a positive and a negative in this world which is, even on just a humanitarian basis, we want poor people to rise up out of poverty. And who can blame them for wanting air conditioning and cars and all the sorts of things that they want?

Mr. ROHRABACHER. Refrigerators or clean water.

Mr. BROWN. Exactly. And in an ironic sort of way, when we see China, India, and other emerging economies go out searching for these resources, it is an indicator of economic activity which on the other side benefits the United States in terms of being a strong trading partner where we can sell our goods and services. So it really is a double-edged sword.

In my prepared testimony, I mentioned one manifestation of energy and conflict that we do see happening and that is around the

issue that you have raised which is electrification and access to power. We see in countries like Pakistan, we just saw it in Egypt where the inability of governments to provide such a basic resource as power can lead to instability that can then overthrow those governments and directly impact U.S. activities. That is why the work that Ed is doing on TAPI, there is also discussions that the World Bank is working on in electrification to bring from Central Asia, that is essential.

There is also a huge multi-billion person market out there that U.S. companies can access to provide power, whether that is from big stationary plants that might use coal or natural gas or renewables. It is much like the telecommunications and kind of personal goods, soaps and what not, industries found in emerging markets where these may be poor people, but they do have purchase power. And so unlike countries that just want to take natural resources, the U.S., we have a position to really invest and also make money in the trading relationships.

Mr. ROHRABACHER. Let us hope that there will be some stability enough so that those natural resources and that is what this is all about, will be able to be utilized to help human beings.

If I was, however, if I was in India and I was trying to calculate what I should be doing strategically considering that what seems to be an adversarial relationship with China and Pakistan, but China, it seems to me that I would want to help those elements in Turkmenistan and Afghanistan that might be willing to align themselves with India's interests. And again, we are talking about fundamental reasons for conflict.

Mr. Mankoff, you mentioned the gas off of the Israeli coast, would that gas, and we heard mention of Egypt a moment ago, would that gas be something that could be used for bringing peace between Egypt and Israel and especially now that maybe you have a different potential direction for Egypt rather than the Muslim Brotherhood and anti-Israeli government? Could perhaps Israel step forward and try to say that that gas could be used for Egypt as well in a peaceful endeavor?

Mr. MANKOFF. Yes. Thank you for your question. The fundamental challenges that face that part of the world are ultimately rooted in politics. And energy, I think, can play a role in addressing the conflicts between Israel and her neighbors, but in and of itself is not sufficient to do that. I think you have to have political agreements, political solutions to some of the problems between those countries and energy can be a carrot or an inducement for reaching those agreements.

There has been discussion in Israel about exporting some of this gas to Jordan, for example, although apparently that has now been caught up in internal Israel politics.

Mr. ROHRABACHER. Right now, Israel is in negotiations on water with Jordan.

Mr. MANKOFF. Yes.

Mr. ROHRABACHER. And especially about—this has been going on for a few years now, between the Red Sea to Dead Sea project which there has been step-by-step, but they have been negotiating at a time when there are other factors that were driving Israel and Jordan apart. They had this mutual interest in negotiating for

water. Perhaps would Egypt and now in the situation that it is and the Government of Egypt is now in a precarious situation, perhaps this would be a good time to try to demand some positive ties based on economic dual interest.

General, did you have a comment on those things?

General ADAMS. No sir.

Mr. ROHRABACHER. Any comment on the Chinese part with Central Asia and the pipeline?

General ADAMS. No, sir. That is not something we covered in our report.

Mr. ROHRABACHER. All right, thank you very much. I will now turn to my ranking member, Mr. Keating.

Mr. KEATING. Thank you, Mr. Chairman, and as you can see, the chairman knows the shortcuts better than I do coming back from votes.

I find this whole issue very important for two reasons because the effects of it can go either way. These can be areas of conflict that make the situation worse, but they could also be areas as your testimony indicated where if things fall the right way, that these countries could be—have greater control over their own economy, their own energy sources, for instance, and make them more stable and profitable and being able to do more ancillary business from this. So how this breaks is not just unilateral. It can go both ways.

Along those lines, General Adams, coming from Massachusetts we are very proud to have John Adams in front of us testifying. But you mentioned the issue of corruption. One of the things in this region that could inhibit business investment are these corruption issues. If you would like to address what we could do to help in that regard and then any of the panel members if you would like to comment on that. Because I see that as one of the real issues that could hinder private investment in that area.

General ADAMS. Thank you, Congressman Keating, and the opportunity to answer that question. Allow me to answer the question in the context of what we investigated in our report, specifically the lack of access that the United States has to key minerals and materials that we need for our defense supply chains. And there is, in fact, concerns and we are concerned based on our research that corrupt business practices and manipulation of markets is one of the reasons that we have a lack of access to key raw materials, specifically rare earth elements.

As you know, China decided two decades ago that they would shore up their extraction industry, their mining industry for rare earths and they were successful in doing that. And they were also able to basically drive other mining countries out of business of doing rare earth minerals. The last U.S. mine, the Molycorp mine in California, went out of business in 2002. There were other reasons than the fact that the Chinese were driving the prices so that the mine was not economically competitive, but that was certainly a huge factor. And then having attained a near monopoly in the mining of key rare earth elements and minerals, China continued to not only involve themselves in the extraction industry, extraction of oxides, but the entire supply chain for rare earth elements and production of such things as advanced magnets which is a key—we have advanced magnets in all modern defense electronics.

Smart bombs, for example, have to have advanced magnets. China pulled that supply chain into China. Now is that corrupt? Certainly, there is manipulation. Is that something that we allowed to happen because we had our eye off the ball? I would argue that that is the case. And I will come back to that in just a moment.

There is a another example I would like to give where the platinum group of metals, platinum is used in a wide variety of applications, but the commercial application we are all familiar with is the catalytic converter. But almost every modern engine has to have platinum group of metals in it, small parts of it, but there has to be platinum group of metals, minerals in every modern engine. Most of it is mined in South Africa. And I don't want to go into a long, political discussion of the instability in South Africa, it is what it is. And we have to remember the role of the Chinese in that as well. The Chinese have established over the last 20, 30 years, excellent ties with countries in sub-Saharan Africa. Is that something that again we should note at this point, especially in this august committee. I would argue, yes, we should.

So the platinum group of metals comes largely from South Africa. We need that for our defense materials, our defense equipment and again, is the market being manipulated or is it corruption? I would argue certainly it is manipulation.

What we need to do and I won't belabor the point, but what we need to do is to go to strategy and base our need for our strategic materials in the need for defense strategic that fits the threats of the next 20, 30 years. We are pretty good at doing strategy. We have got a lot of people over across the river who do that pretty well and they get a lot of help from this building as well. But we are good at that. And we are good at designing programs that let us execute the strategy. But what we need to do is decide what are those key strategic materials? And if we find that market manipulation is part of the reason we don't have access, then we need to enforce fair trade laws and we need to make sure that we have protection of existing laws and regulations and provide for domestic sourcing for key industries. We have to have a coherent strategic at the U.S. Government level to determine what those critical raw materials are. And then we need to act upon that to make sure that we have got secure access to them for our war fighters. Thank you.

Mr. KEATING. I am reminded, General, with your comments what some of the top military people in our country said when they said what is our greatest threat and many of them have come down to the fact it is our economy. And I think that is part of what you are saying.

Mr. Brown?

Mr. BROWN. Congressman, I appreciate you bringing up corruption. It is one piece of a very ugly side of natural resources, particularly in oil and gas, but also in some minerals where they can be a magnet for some of the worst governance practices in the world. They can embolden authoritarian leaders that may choose to be authoritarian against their own people's interests or against our interests. And we see that around the world.

In the extreme, it can even lead to conflict. It undermines political stability and you see internal conflict around the use of those

resources and the revenues. So the best example of that, of course, is the Niger Delta. And as you mentioned, that is a good example of a major company then having its infrastructure, its oil be shut in because of that violence.

Central Asia, fortunately, does not face that level of violence, but we all know that the revenues from these resources are supporting some rather poor governance practices and of course you see the same thing in Russia. I think the unfortunate side is that we have limited leverage on governance of resources, precisely because the governments are rich because of them so we have very little aid money going in. At the same time, we have competing priorities, we have strategic needs in Central Asia, so we can only do so much.

But there is a good news story which is that Congress a couple of years ago took the step to institutionalize norms that are focused on the fact that information is the necessary first step to improve governance in these countries, to empower civil society, to empower the press and to empower investors. So laws are now in place that will bring to light the revenues that are paid to these governments so that then that information can be used effectively.

In your opening comments, you also mentioned the voluntary Extractive Industry Transparency Initiative. Well, probably not that many people know, but the U.S. now has decided to lead by example. And so the government led by the Department of the Interior, companies, and civil society are, just yesterday actually, there was the most recent meeting. They are coming up with common practices so that we can show the American people what the Federal Government is bringing to bear. And that is going to have tremendous impacts in our diplomacy because one of the things when you go talk to these governments and say well, you should be more transparent, etcetera. They say, "What you doing?" I am happy to say that the U.S. Government is now going to be at the lead of that and I encourage Congress to become involved in those discussions because you are the people who are going to have to explain it to Americans when they ask.

Mr. KEATING. Yes, Doctor.

Mr. MANKOFF. I would just like to add a word about Central Asia. For the last decade plus, the United States' engagement in this part of the world has been driven very heavily by the conflict next door in Afghanistan and that has created a kind of dependence if you will on these relatively untransparent, corrupt, and often brutal governments in Central Asia. But because of the dependence that we have had on them for security cooperation, it has been difficult for the United States to place issues of transparency in governance at the top of the bilateral and regional agenda in dealing with these countries.

As we begin the transition to the withdrawal of international forces from Afghanistan over the next year and a half, one of the benefits of this change is that we will be in a position where we are less dependent upon these countries for achieving our core security objectives. And that means that the United States will have increased leverage to push on some of these issues that you raised in your comments.

Now certainly as Mr. Chow said, the governments in Central Asia are very interested in diversifying their engagement so that they do not become overly reliant, either economically or politically on either the Russians or the Chinese which means that they all have and have all expressed a very strong interest in continued and deepening engagement with the United States. In a post-Afghan Conflict environment that means that the United States has the opportunity to push harder to be more insistent and to make its engagement more conditional on these governments meeting their obligations on issues of governance and transparency including their management of natural resources.

Mr. KEATING. I would just have one other last comment, if I could, Mr. Chairman, and that would be many of these resources, these rare minerals are there, but there aren't transportation networks. There aren't infrastructure support to get them. It would be too expensive. So one of the things that came to my mind is if we are engaged somehow in assistance that is private or the governmental side in these, maybe there can be linkages between some of those infrastructures being built and making sure this transparency with the mining and the development of many of these rare materials.

General, that is my last question.

General ADAMS. Sir, if I may respond to that? You may know that we have looked closely at Afghanistan for possible extraction of raw materials, specifically rare earth elements in Kandahar and how difficult that would be. And what I want to mention is that the search for alternate sources is a good thing and we should continue to do that and we should do that first here domestically. We have got great alternate sources for rare earths in Alaska and in northern Great Plains as well as California.

And I said the last mine in California closed in 2002. Of course, it opened again, the Molycorp mine opened in 2012, so the search for alternate sources for specifically rare earths should continue. That is a very good thing for us to do. But it begs the question here that we ought to consider as we are looking at sequestration and limited budgets, the U.S. Geological Survey is key to that and it was key to evaluating the potential for rare earth extraction in Afghanistan as well and they get a lot of help from the Department of Defense especially when we are talking about security.

I have met with our Department of Defense executive for working with economic aspects of our Afghanistan involvement. It looks like it is going to be prohibitive for us to get rare earths from southern Afghanistan for security reasons. But the search is the important thing and I would like to just put a plug in for the USGS, the U.S. Geological Survey. Absolutely essential. It is like the canary in the mine. They are so essential to our being able to detect and identify and to program how we identify these key raw materials for our use. If we are going to use strategy to determine which ones we need to protect, USGS is key.

Mr. KEATING. Thank you, General. I yield back.

Mr. ROHRABACHER. And now we have Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman. Thanks for this hearing. Most of my questions were answered during the dialogue so I don't have a lot of questions, but I am on the Energy and Minerals

Subcommittee of the Natural Resources Committee here in the House and so the rare earth issue has been something that we have been following for at least the last 3 years that I have been here. I do concur with the General that we have missed some opportunities over the last 30 years, but if the administration and Congress will look forward to developing those relationships with the countries that China currently has the relationships with, that have the rare earths, but I will also say that and you just touched on it, we have got a lot of rare earths in this country that are currently the mining areas and the resources are currently off the table for mining activity and production just due to a lot of policies, current, and in the past. And so I believe we need to open up more of those resources here in America. It is not only an energy-independence policy, but a security policy with regard to rare earths.

I also want to mention, Mr. Chairman, I am co-chair of the Transatlantic Working Group with members of European Parliament. And we had members of European Parliament in Washington last week and one of the topics of conversation was their reliance, European countries' reliance on the natural gas coming from Russia and how concerned they are about stability of that going forward. And we talked about opportunities that United States' oil and natural gas companies have to export LNG to Europe to supply the needs of natural gas to our European traditional allies. And how Europe is definitely looking to the U.S. as a source for that.

So there is opportunity if we can expedite LNG terminal applications in this country. We have an abundance of natural gas and everyone is aware of that. We have got opportunity to export that to countries that are more friendly and it is not only the European Union countries that I talked to, but my understanding is that some of the V4 countries, Hungary, Czechoslovakia, Poland, Slovakia, are very interested in those LNG exports as well which kind of raises my awareness that it is a real issue because they are sitting so close to those pipelines that come through those countries from the resources to the East. And so I think there is an opportunity for American companies in the energy sector, but also think America can take advantage of the resources we have got here, but also echo the General's comments.

And let me pause to thank you for your service to our nation, sir. I appreciate it.

To echo your comments, we have got to go forward and think about the relationships we have with the countries, South Africa, sub-Sahara countries, but also all across the globe that have the rare earths that we are so reliant on in the automotive sector and the technology sector.

You had mentioned cell phones, cell phones that operate with numerous rare earth minerals that make them work. Without those rare earth minerals, they don't work. They don't hold that data or they don't transmit that data.

So Mr. Chairman, I am not going to ask any questions, but I want to thank you because these gentleman have done a fabulous jobs of answering my questions. You guys have done a good job of asking questions that were along the lines, so I thank you so much for this important topic. And with that, I yield back.

Mr. ROHRABACHER. All right, well, thank you very much.

General, if my notes are correct, you testified that there were—Mr. Duncan, oh, he is off.

I was going to say underscoring Mr. Duncan's point, your testimony was that we important 750,000 tons of vital minerals and material every year. Is that annually?

General ADAMS. 750,000 tons.

Mr. ROHRABACHER. Whew. All right. I want to thank the witnesses as well. I think that this should be viewed, and the subject should be viewed in terms of national security, but also in terms of in humanitarian terms as well because as I emphasized earlier on, unless we succeed in this arena, ordinary people who now live in total deprivation around the world have no chance at all of improving their standard of living.

And while we may, for example, it might be a good thing and it is a good thing that if we can bring some competition to the Russian pipeline that now supplies the natural gas to Europe, it would be a good thing that Azerbaijan and others have a competition with that. Competition is good for people's standard of living, and as we have found out in the United States.

And so those of us who support the idea of pipelines and helping develop transportation systems for these things, it is not anti-Russian to do that, but it is pro-human being to try to develop more availability of resources, of natural gas to people everywhere and especially those that are currently under the domination of one source for a vital material like natural gas and such.

That is, by the way, one of the reasons why President Reagan opposed that natural gas pipeline from Russia during his administration because he did not want to provide a country that didn't have free elections which was the Soviet Union to have such a dominant role over Western Europe. Whether or not it is a country that has free elections or not, it is a good idea to have several sources for gas and several sources for the vital minerals and materials that we have been talking about today.

So with that said, I want to thank all of you for your testimony. This has been one of the many hearings we will have on the need for us to focus on water resources and other resources that are necessary to preserve the peace and to make sure that people have a right to improve their standards of living throughout the world. So with that said, this hearing is adjourned.

[Whereupon, at 12:22 p.m., the subcommittee was adjourned.]

APPENDIX

Material Submitted for the Hearing Record

SUBCOMMITTEE HEARING NOTICE
COMMITTEE ON FOREIGN AFFAIRS
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515-6128

Subcommittee on Europe, Eurasia, and Emerging Threats
Dana Rohrabacher (R-CA), Chairman

July 24, 2013

TO: MEMBERS OF THE COMMITTEE ON FOREIGN AFFAIRS

You are respectfully requested to attend an OPEN hearing of the Subcommittee on Europe, Eurasia, and Emerging Threats in Room 2172 of the Rayburn House Office Building (and available on the Committee website at www.foreignaffairs.house.gov):

DATE: Thursday, July 25, 2013

TIME: 10:00 a.m.

SUBJECT: Emerging Threat of Resource Wars

WITNESSES: Mr. Edward C. Chow
Senior Fellow
Energy and National Security Program
Center for Strategic and International Studies

Jeffrey Mankoff, Ph.D.
Deputy Director and Fellow
Russia & Eurasian Program
Center for Strategic and International Studies

Brigadier General John Adams, USA, Retired
President
Guardian Six Consulting, LLC

Mr. Neil Brown
Non-Resident Fellow
German Marshall Fund of the United States

By Direction of the Chairman

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COMMITTEE ON FOREIGN AFFAIRS

MINUTES OF SUBCOMMITTEE ON *Europe, Eurasia, and Emerging Threats* HEARING

Day *Thursday* Date *July 25, 2013* Room *2172 Rayburn*

Starting Time *10:06 am* Ending Time *12:22 pm*

Recesses [*1*] (*10:49* to *11:48*) (____ to ____) (____ to ____) (____ to ____) (____ to ____) (____ to ____)

Presiding Member(s)

Chairman Dana Rohrabacher

Check all of the following that apply:

Open Session [✓]
Executive (closed) Session [ ]
Televised [✓]

Electronically Recorded (taped) [✓]
Stenographic Record [✓]

TITLE OF HEARING:

Emerging Threat of Resource Wars

SUBCOMMITTEE MEMBERS PRESENT:

Reps. William Keating, Paul Cook, Jeff Duncan (SC), and Steve Stockman.

NON-SUBCOMMITTEE MEMBERS PRESENT: *(Mark with an * if they are not members of full committee.)*

none

HEARING WITNESSES: Same as meeting notice attached? Yes [✓] No [ ]
(If "no", please list below and include title, agency, department, or organization.)

STATEMENTS FOR THE RECORD: *(List any statements submitted for the record.)*

Prepared Statement of Mr. Edward Chow
Prepared Statement of Dr. Jeffrey Mankoff
Prepared Statement of Brigadier General John Adams, USA, Retired
Prepared Statement of Mr. Neil Brown
Senate Foreign Relations Committee Report Submitted by Mr. Neil Brown, "Energy and Security From the Caspian to Europe"

TIME SCHEDULED TO RECONVENE _____
or
TIME ADJOURNED *12:22 pm*

Subcommittee Staff Director

MATERIAL SUBMITTED FOR THE RECORD BY MR. NEIL BROWN, NON-RESIDENT FELLOW, GERMAN MARSHALL FUND OF THE UNITED STATES

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ENERGY AND SECURITY FROM THE CASPIAN TO EUROPE

A MINORITY STAFF REPORT

PREPARED FOR THE USE OF THE

COMMITTEE ON FOREIGN RELATIONS
UNITED STATES SENATE

ONE HUNDRED TWELFTH CONGRESS
SECOND SESSION

DECEMBER 12, 2012

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[NOTE: The entire report is not reprinted here but is available in committee records and on the Internet at http://www.gpo.gov/fdsys/.]