ENERGY AND MINERAL REQUIREMENTS FOR RENEWABLE AND ALTERNATIVE FUELS USED FOR TRANSPORTATION AND OTHER PURPOSES.

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND
MINERAL RESOURCES

OF THE

COMMITTEE ON RESOURCES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

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OVERSIGHT HEARING ON THE ENERGY AND MINERAL REQUIREMENTS FOR RENEWABLE AND ALTERNATIVE FUELS USED FOR TRANSPORTATION AND OTHER PURPOSES.

Thursday, May 18, 2006
U.S. House of Representatives
Subcommittee on Energy and Mineral Resources
Committee on Resources
Washington, D.C.

The Subcommittee met, pursuant to call, at 11:00 a.m. in Room 1324, Longworth House Office Building, Hon. Jim Gibbons [Chairman of the Subcommittee] presiding.

Present: Representatives Gibbons and Drake.

STATEMENT OF THE HON. JIM GIBBONS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEVADA

Mr. GIBBONS. Good morning, everyone. The oversight hearing by the Subcommittee on Energy and Mineral Resources will come to order.

The Subcommittee is meeting today to hear testimony on the energy and mineral requirements for renewable and alternative fuels used for transportation and other purposes. Under Committee Rule 4(g), the Chairman and the Ranking Member can make opening statements. If any Members have other statements, they can be included in the hearing record under unanimous consent.

Let me begin by adding my remarks this morning. We are looking at the status of two mineral commodities that are critical to our existing and future use of electricity—that being copper and platinum. We are looking at these two metals, and why are we talking about alternative fuels at the same time? Well, all of us have heard about how we must break our addiction to oil and move on to using alternative fuel vehicles and hybrid cars. We will look at how these commodities are used in electrical systems, gas-electric hybrid vehicles, and in fuel cells for hydrogen vehicles and stationary power generation.

We will hear today about how deposits containing these metals are distributed both nationally and internationally. We will hear about the state of the domestic and international supply of these metals, and we will also hear about the existing demand and projected demand for these commodities in the world markets. We will ask if there will be enough supply coming out of the ground to meet the projected demand, and we will also examine our nation's mineral policies and ask, what can we do to enhance access to future supplies? Just what is the story of copper in our modern world? Is it the metal that has served us throughout the development of civilization? In fact, it is that metal.

Early in our civilization, it served us in the crafting of weapons until it was replaced by iron. It has been used to make jewelry, bronze statues, bells, and brass buttons. It is used in the plumbing and wiring of our houses, offices, and factories and in our air conditioners, a critical use for anyone who has ever been in Washington, D.C., in August, may I say?

Most of us folks would think of copper as an old economy metal, and they would be right, but it is also the premier, new economy metal. We use it to generate, distribute, and use electricity. It is at the heart of electronics and telecommunications, and it will play an increasing role in transportation uses. Hybrid vehicles—cars and buses—many of which are now running on Washington streets, combine combustion-based engines, electric motors, and batteries. Copper is in those electric motors and in the rest of the wiring. The difference is in the amount of copper. A hybrid car uses about twice the amount of copper used in a luxury car. The hybrid cars use about 100 pounds per car. Buses use even more.

We are in a world in which citizens of India and China are seeking to have a lifestyle that approximates ours, and they compete with our own hybrid cars, air conditioners, computers, and televisions. The question to ask ourselves is this: Is there enough copper to meet everyone's needs? We will hear about the answer to that question from our first panel of experts. They represent the supply chain, from the end user to the producer.

But first I want to talk about platinum. This is a mineral commodity that has a very interesting role in the new economy. For many years, it was a jeweler's and a chemist's metal. Platinum plus diamonds was the ultimate expression of devotion, and chemical reactions aided by platinum turned raw petroleum into refined products.

In the 1970s, platinum was enlisted by Detroit to help clean up the air. Catalytic converters have helped us significantly reduce air pollution from the cars we drive. Overall, automobile emissions have been reduced by 31 percent, and per-vehicle carbon monoxide emissions are 85 percent lower.

The use of platinum in the jewelry and transportation industry now accounts for about 80 percent of platinum usage, but it also gives us a significant success story: cleaner air and significant platinum recycling. Almost 12 percent of demand is met by recovering platinum from scrapped catalytic converters. This is a true resource conservation and recovery story.

Now we are on the verge of seeing new uses for platinum in the transportation sector. It is used in fuel cells, which have the potential to make cars and buses even cleaner and to drastically reduce our dependence on foreign sources of petroleum. We will hear about platinum usage from a fuel cell manufacturer today. We will hear about the types of fuel cells and what generally goes into making them. We will hear about the potential for growth of fuel cell usage in the transportation industry, and, once again, we will be asking about the sources of supply and ask ourselves if there is enough to go around.

Last, we will hear about the national security implications of having adequate supplies of mineral commodities and the clear need we all have for unbiased public sources of mineral commodity information. Speaking on this matter, I would like to commend the Interior Appropriations Committee for supporting the energy programs under the jurisdiction of the House Resources Committee authorized by the Energy Policy Act of 2005.

I am very pleased that the Appropriations Committee restored funding for the USGS Mineral Information Team and admonished the Administration to not continue to propose the elimination of the program in future budget requests. The Mineral Information Team provides invaluable information on the worldwide use, production, and demand for mineral commodities and keeps tabs on what the U.S. imports are and from where they are coming.

Demand for mineral commodities has risen dramatically over the past few years, largely due to China and India's economic growth and industrialization. Their competition has driven up the prices of commodities to all Americans. It could threaten the vital national security interests of this nation by fully depriving us of foreign sources of supply.

In some cases, the denial of access to mineral resources could result in a decision to commit U.S. forces to maintain that access. In this circumstance, knowledge is both power and security. I hope the Administration will finally take careful note of the views of the Congress in this matter.

So now I want to thank the witnesses for joining us today. I look forward to your testimony. Under unanimous consent, I will ask that the written statement of the Ranking Member, Mr. Grijalva, be submitted for the record.

[The prepared statement of Mr. Gibbons follows:]

Statement of The Honorable Jim Gibbons, Chairman, Subcommittee on Energy and Mineral Resources

The Subcommittee meets today to review the status of two mineral commodities that are critical to our existing and future use of electricity—copper and platinum.

Why are we looking at these two metals and why are we talking about alternative fuels at the same time?

Well, all of us have heard about how we must break our addiction to oil and move on to using alternative fuel vehicles and hybrid cars.

We'll look at how these commodities are used in electrical systems, gas-electric hybrid vehicles and in fuel cells for hydrogen vehicles and stationary power generation.

We will hear how deposits containing these metals are distributed both nationally and internationally. We will hear about the state of the domestic and international supply of these metals. We will hear about the existing demand and projected demand for these commodities in the world markets.

We will ask if there will be enough supply coming out of the ground to meet the projected demand.

We will examine our nation's mineral policies and ask what we can do to enhance access to future supplies.

Just what is the story of copper in our modern world? It is the metal that has served us throughout the development of civilization.

Early in our civilization, it served us in the crafting of weapons, until it was replaced by iron. It has been used to make jewelry, bronze statues, bells and brass buttons. It is used in the plumbing and wiring of our houses, offices and factories—and in our air conditioners—a critical use for anyone who has ever been in Washington, DC in August.

Most folks would think of copper as an old economy metal “and they would be right. But it is also the premier new economy metal.

We use it to generate, distribute and use electricity—it is at the heart of electronics and telecommunications and it will play an increasing role in transportation uses.

Hybrid vehicles—cars and buses—many of which are now running on Washington’s streets, combine combustion based engines, electric motors and batteries. Copper is in those electric motors and in the rest of the wiring.

The difference is in the amount of copper—a hybrid car uses about twice the amount of copper used by a luxury car—the hybrids use about 100 pounds per car “buses even more.

Now we are in a world in which the citizens of India and China are seeking to have a lifestyle that approximates our—complete with their own hybrid cars, air conditioners, computers, and televisions.

The question to ask ourselves is this—- is there enough copper to meet every one’s needs?

We will hear about the answer to that question from our first panel of experts—they represent the supply chain from the end user to the producer. But first I want to talk about platinum.

This is a mineral commodity that has a very interesting role in the new economy. For many years it was a jeweler’s and a chemist’s metal—platinum plus diamonds was the ultimate expression of devotion—and chemical reactions aided by platinum turned raw petroleum into refined products.

In the 1970’s, platinum was enlisted by Detroit to help clean up the air—catalytic converters have helped us significantly reduce air pollution from the cars we drive.

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Their competition has driven up the price of commodities to our citizens. It could threaten the vital national security interests of the nation by fully depriving us of foreign sources of supply.

In some cases the denial of access to mineral resources could result in a decision to commit U.S. forces to maintain that access. In this circumstance, knowledge is both power and security. I hope the Administration will finally take careful note of the views of the Congress in this matter.

So now, I want to thank the witnesses for joining us today and I look forward to your testimony.

[The prepared statement of Mr. Grijalva follows:]

Statement of The Honorable Raul Grijalva, Ranking Democrat, Subcommittee on Energy and Mineral Resources

Mr. Chairman, I join you in welcoming our panels of expert witnesses to today's hearing.

As the title of today's hearing implies, our domestic copper and platinum resource bases can be used to produce alternative transportation vehicles, such as hybrid cars, and fuels for industrial, commercial and residential uses. Currently, according to several sources, including the Copper Development Association, the U.S. is completely self-sufficient in copper resources and production.

My home state of Arizona, in fact, continues to produce about 60 percent of the nation's copper and in 2004 brought in record revenues to the U.S. economy, as noted in a recent report published by the Arizona Mining Association.

Yet, while copper production is good for the economy, I have concerns about the treatment of copper mining workers, especially with regard to the July 2005 labor union strikes against Asarco Mining Company in Phoenix, Arizona. Mining companies are flush with cash and yet are not giving the proper raises and benefits to their miners.

Further, the Environmental Protection Agency (EPA) identifies sites containing copper as some of the most serious hazardous places in the nation. When the soils of farmland are polluted with copper, animals will absorb concentrations that are damaging to their health. Asarco continues to pollute the environment by operating its copper smeltering plant in Hayden, Arizona. Industrial exposure to copper fumes, dusts, or mists may result in metal fume fever in human beings.

Today, with copper and platinum commodities at record high prices, and a world market that is unstable for the foreseeable future; we must take caution to produce and use such minerals in a manner that does not leave the American public vulnerable to increased health and safety issues and greater pollution in our environment.

In conclusion, I hope that this Subcommittee will look beyond the surface of using these two very expensive commodities as part of our National energy strategy. I look forward to a spirited discussion with today's witnesses.

Mr. GIBBONS. I would like to introduce our first panel. Our first panel is Mr. Shelley Stewart, Tyco International; David Menzie, U.S. Geological Survey; Robyn Storer, Westhouse Securities, LLP; and James Frank, Marathon PGM Corporation.

Ladies and gentlemen, we have a ritual here at the committee where we swear in all of our witnesses, so if you would each rise and raise your right hand.

[Witnesses sworn.]

Let the record reflect that each of our witnesses answered in the affirmative. I turn now to our very first panel member. Shelley, welcome. The floor is yours. We look forward to your testimony.

STATEMENT OF SHELLEY STEWART, VICE PRESIDENT, SUPPLY CHAIN, TYCO INTERNATIONAL (US) INC.

Mr. STEWART. Thank you very much. Mr. Chairman and Members of the Subcommittee, my name is Shelley Stewart. I am the Senior Vice President of Operational Excellence and Chief Procurement Officer for Tyco International. I also serve on the Board of Directors of the ISM, Institute for Supply Chain Management, and I am the Chairman of the Howard University School of Business Supply Chain Management advisory program. I am responsible for $25 billion in global procurement spending. I lead the company's efforts to reduce cost and increase efficiency.

Tyco International is a global, diversified company that provides vital products and services to customers in four business segments: electronics, fire and security, health care, and engineered products and services. With a 2005 revenue of $40 billion, Tyco employs 250,000 people worldwide. Tyco operates in 50 U.S. states and in more than 100 countries worldwide. In the U.S., we employ 85,000 individuals who share an extraordinary commitment to excellence and to the communities in which they live and work.

From the operating room to the boardroom, Tyco offers the products and the services the modern world needs to grow. Tyco fills an incredibly wide range of many diverse needs of businesses and governments, education, medical institutions, and commercial industries ranging from food to automobiles. For example, the connectors in your cell phones and computers, the many security access control systems used throughout Washington, as I look around, in this room as well, and the sprinkler systems installed in the ceiling for fire suppression are likely Tyco products.

On behalf of Tyco International, I would like to extend my appreciation for the opportunity to testify regarding global copper prices and their impact on end users like Tyco, who use this commodity to manufacture goods used by people across the world. We appreciate the committee opening a dialogue on this issue and hope to be a valued resource to you as we continue to examine this activity.

From architecture to telecommunications, copper is in numerous products we rely on each day. Not surprisingly, copper is a vital component to many thousands of Tyco products, sometimes serving as the major cost driver of producing those products. Out of the $10 billion that Tyco spends annually on direct materials, that is, materials that go directly into the products we manufacture, copper now accounts for 7 percent, up from 4.5 percent just last year. Copper wire, cable, and tubing are used in many commercial and residential installations of ADT and Simplex/Grinnell access control, home security, fire suppression and detection devices. These devices are essential to keeping families and businesses safe and secure.

Our engineered products division also uses copper to manufacture industrial, commercial, and residential applications, providing solutions from floor heating, snow melting and de-icing to temperature measurement, wiring, and leak-detection systems. The AFC cable business unit utilizes copper to manufacture electrical distribution products used in construction and modernization of commercial office buildings, institutional facilities, shopping centers, and multifamily dwellings.

Most significantly, Tyco's electronics business uses copper in the millions of electrical connectors that we manufacture. In fact, Tyco's electronics division alone purchases nearly 50 million pounds of copper each year. These connectors are found in many products, including automobiles, computers, televisions, mobile phones, and other consumer electronics.

For our products that require copper, there is no alternative metal. Copper offers unique formability, conductivity, and stress relaxation not available in any other metals.

There is an old adage that "a penny saved is a penny earned," and in today's world of rising metal prices, pennies, or more accurately, copper, is becoming a precious commodity that has a tremendous impact on savings and earnings.

Since 2003, the price of copper has risen more than 350 percent. Prices have risen more than 62 percent since February of this year, and, in all likelihood, they have not peaked yet.

Several factors have contributed to this steady rise in prices. Labor disputes in Chile and Mexico and political unrest in Indonesia that is threatening copper production has caused price increases. Heavy demand and consumption of copper in Europe and China has created shortages, thus driving up costs, and, interestingly, hedge fund investments in the metals markets, including copper, are extremely heavy due to the weak dollar, again driving up the price of these commodities.

Soaring copper prices are also a reflection of a healthy and robust economy driven by increased manufacturing and construction, both domestically and abroad. Congress and the Administration should be applauded for enacting economic policies the fuel such growth, yet this growth, coupled with the other factors I have outlined, has stoked the demand for copper to a point where the increased cost is negatively affecting businesses and consumers.

Drastic changes in the weighted average price of copper, as we have seen recently, disrupt business planning and revenue forecasts. These cost increases are often passed on to customers in the form of surcharges, indexed pricing, and direct-to-customer billing of subcontracted material, and whatever is not passed on to consumers ends up negatively impacting companies' bottom lines, adversely affecting investors, stockholders, and employees.

Early this month, as Tyco reported quarterly profits, we adjusted our full-year earnings forecast. Soaring copper prices contributed greatly to this adjustment. In 2005, Tyco purchased more than $468 million worth of copper on the global market, equaling nearly 280 million pounds. This year, purchasing the same volume of copper at the current price will cost the company $681 million, for an estimated year-over-year increase of $213 million, or 46 percent. Put in perspective, Tyco's copper cost increases above the previous year's average, or as we call them, "head winds," for 2005 was $73 million. In 2006, we will nearly triple that, incurring cost increases amounting to $60 million per quarter. For example, in Tyco Electronics alone, we have nearly reached our $285 million budget for copper spending in the first five months of 2006.

These significant investments in copper cannot be underestimated, and the staggering surge in copper prices impacts Tyco's competitiveness worldwide. Moreover, these high costs put pressure on our medium-to-small suppliers. Therefore, they are turning to Tyco for help by proposing price increases and shorter payment terms to get money in the near term to finance copper or to offset their higher finance costs.

As the Chief Procurement Officer and head of Supply Chain for Tyco, it is my responsibility to manage the total cost of goods and services Tyco needs to manufacture its thousands of products, products that are vital to millions of people in the U.S. and around the world. Though the markets for commodities such as copper and other metals often fluctuate, percents of sustained and substantial increase make it difficult for my organization to manage costs. This impacts our ability to develop overall product and pricing strategy as well as our ability to accurately predict our financial results, which is a strong expectation from our shareholders.

Skyrocketing metal costs also make it difficult to avoid increasing prices for our own products. Eventually, whether these products are for residential, commercial, or industrial uses, it is the consumer who will ultimately end up absorbing these increases.

While there are several contributing factors to the high price of copper, the underlying market issue is more than likely supply and demand. Is there enough copper today to meet demand, and what does the future hold for copper producers and suppliers? Do we have enough copper? Are there enough suppliers to satisfy the potential demand?

I will leave these questions to the experts, but I do know that, as a customer, I am highly dependent upon copper products in virtually every hour of my modern life, from the computer I used to prepare this statement to the car I drove to get here today.

The world cannot afford for companies to be hamstrung with high copper prices, especially when companies like Tyco International are using copper to manufacture products, or components to products, that are so vital to everyone's lives.

As this committee continues to examine the impact of copper prices on consumers and businesses, I hope that you will keep today's testimony in mind. On behalf of Tyco International, I ask that you consider the true impact of copper prices on our company and the thousands of products we make. Thank you for your time, and thank you for providing me with this opportunity.

[The prepared statement of Mr. Stewart follows:]

Statement of Shelley Stewart, Jr., Senior Vice President, Operational Excellence & Chief Procurement Officer, Tyco International (US), Inc.

Introduction

Mr. Chairman, Ranking Member Grijalva and members of the sub-committee, my name is Shelley Stewart, Jr. I am Senior Vice President of Operational Excellence and Chief Procurement Officer for Tyco International, USA. I also serve on the Board of Directors for the Institute of Supply Chain Management and am Chairman of Howard University's School of Business Supply Chain Advisory Board. At Tyco, I am responsible for 25 billion dollars in global procurement spending and I lead the company's efforts to reduce cost and increase efficiency.

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On behalf of Tyco International, I would like to extend my appreciation for the opportunity to testify regarding global copper prices and its impact on "end users," like Tyco, who use this commodity to manufacture goods used by people across the world. We appreciate the committee opening a dialogue on this issue and hope to be a valued resource as you continue to examine it.

Tyco and Copper

From architecture to telecommunications, copper is in numerous products we rely on each day. Not surprisingly, copper is a vital component to literally thousands of Tyco products, sometimes serving as a major cost driver of producing those products. Out of the $10 billion that Tyco spends annually on direct materials—materials that go directly into the products we manufacture—copper now accounts for nearly 7%, up from 4.5% just last year. Copper wire, cable and tubing are used in commercial and residential installations of ADT and Simplex/Grinnell access control, home security, fire suppression and detection devices. These devices are essential to keeping families and businesses safe and secure.

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The Price Problem

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Since 2003 the price of copper has risen more than 350 percent. Prices have risen more than 62 percent since February of this year. And, in all likelihood they haven't peaked yet.

Several factors have contributed to this steady rise in prices. Labor disruptions in Chile and Mexico and political unrest in Indonesia that is threatening copper production has caused price increases. Heavy demand and consumption of copper in Europe and China has created shortages, thus driving up costs. And, interestingly, Hedge Fund investments in the metals market, including copper, are extremely heavy due to the weak dollar, again driving up the price of these commodities.

Soaring copper prices are also a reflection of a healthy and robust economy driven by increased manufacturing and construction both domestically and abroad. However, we believe other factors such as dwindling supplies and speculative buying from Hedge Funds have influenced the copper price. Congress and the Administration should be applauded for enacting economic policies that have fueled such growth.

Yet, this growth coupled with the other factors I have outlined has stoked the demand for copper to a point where the increased cost is negatively affecting businesses and consumers. Drastic changes in the weighted average price of copper, as we have recently seen, disrupt business planning and revenue forecasts. Whenever possible, these cost increases are often passed on to our customers in the form of surcharges, indexed pricing and direct-to-customer billing of subcontracted material. And, whatever is not passed on to consumers ends up negatively impacting companies bottom lines—adversely affecting investors, stock holders and employees.

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Conclusion

While there are several contributing factors to the high price of copper, the underlying market issue is more than likely supply and demand. Is there enough copper today to meet demand and what does the future hold for copper producers and suppliers? Do we have enough copper? Are there enough suppliers to satisfy potential future demand? I will leave these questions to the experts. But I do know that as a consumer, I am highly dependent upon copper products in virtually every hour of my modern life, from the computer I used to prepare this statement to the car I drove to get here to be with you today.

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As this committee continues to examine the impact of copper prices on consumers and business I hope that you will keep today's testimony in mind. On behalf of Tyco International I ask that you consider the true impact of copper prices on our company and the thousands of products we make.

Mr. GIBBONS. Thank you very much, Mr. Stewart. Your testimony is stark and to the point and very informative for us, and I appreciate the fact that you have found the copper to write your statement and the car to get here this morning as well, so thank you very much.

Mr. STEWART. Thank you very much.

Mr. GIBBONS. I turn now to Mr. David Menzie from the U.S. Geological Survey. Mr. Menzie, again, welcome back to the committee. We look forward to hearing from you.

STATEMENT OF W. DAVID MENZIE, CHIEF, MINERALS INFORMATION TEAM, U.S. GEOLOGICAL SURVEY

Mr. MENZIE. Thank you, Mr. Chairman. Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear at this hearing. I am David Menzie, a geologist with the U.S. Geological Survey.

Prices of metals are again rising, raising concerns about future metal supplies. The price of copper has increased from around 70 cents a pound in January of 2003 to $3.80 a pound yesterday. Recently, USGS scientists investigated future mineral scarcity, with an emphasis on copper, in a paper published by Resources for the Future. That study concluded that although global copper resources are abundant, rapid increases in copper consumption could lead to temporary shortages.

A number of factors will affect future supplies of copper, including level of consumption, estimates of copper resources, investment in mineral exploration, the state of the minerals professions, scrutiny and restrictions on mineral extraction, and environmental residuals.

Economic development and rising incomes in some Asian countries have led to rapid increases in mineral consumption. Some have suggested increased consumption of minerals by developing countries is not sustainable, either because resources will be insufficient to meet consumption or because of the environmental consequences of increased production. We estimated the consumption in the 20 most populous countries to 2020. World copper consumption was estimated to increase from about 15 million tons in 2000 to 27 million tons in 2020. Developing countries accounted for most of the increase. Consumption in China was forecasted to increase from 2 million tons in 2000 to 5.6 million tons in 2020.

Currently, 90 percent of copper that is consumed comes from mines and 10 percent from recycled material. Unless recycling can be dramatically increased, escalating demand for copper will have to either be met by increased mine production or substitution. However, development also increased demands for substitute commodities. Therefore, projected consumption is likely to come mainly from mine production.

Reserves of the inventory of mines; as the inventory is reduced, the reserves must be replaced either from identified resources or from discovering new deposits. World copper reserves are currently about 470 million tons. Total [identified and undiscovered] world copper resources are not well known because an assessment of undiscovered world resources has not been made. Current estimates of world copper resources, about 1.6 billion tons, would likely be significantly increased by an assessment of global undiscovered copper resources.

We estimate that about 1.1 billion tons of copper will be needed to meet consumption between 2000 and 2020 and to maintain a proportional reserve. This is more than three times the amount of copper in the five largest deposits currently known. Much of the material will come from undiscovered deposits. Because a very few large deposits typically contain the majority of copper resources, a small number of large, undiscovered deposits will be critical to supplying copper in the future.

Analysis of mineral exploration budgets and changes in mining companies and universities are reasons to question whether sufficient reserves will be available. Exploration budgets increased through the early nineties, but they peaked in 1997 at $5.2 billion and then declined sharply to as low as $1.9 billion in 2002 before rebounding to just over $5 billion in 2005.

During the 1990s, large companies eliminated grassroots exploration. Geologists in these companies either joined junior companies or left the industry. The restructuring has resulted in fewer exploration geologists funded by smaller exploration budgets.

Future resources are likely to be in deposits concealed beneath covering rock or sediments. Such deposits will be more difficult to discover and more costly to mine. Reorganizations in universities have resulted in fewer and smaller academic departments to train the needed scientists and engineers to deal with this problem.

A further cause for concern about society's ability to produce minerals that will be needed by the developing countries is increased scrutiny and restriction of mineral extraction. In the United States, and opened to mineral exploration has declined significantly, and population growth in the mountain west has led to increased scrutiny of mineral development. Scrutiny of projects outside the United States is also increasing.

Increased residuals from mineral production and use will accompany increased consumption. About 350 tons of waste rock and 147 tons of tailings are generated for each ton of copper produced. Assuming that grades of ores do not change, mining and milling of copper will produce about 130 billion tons of waste rock and 56 billion tons of tailings between 2000 and 2020.

To summarize, Mr. Chairman, although the world has abundant resources of copper, rapid increases in copper consumption can lead to temporary shortages of copper. Reasons for these temporary shortages may include reduced investment in mineral exploration, a decline in the number of mineral professionals, increased restriction on mineral extraction, and increased environmental costs for mineral extraction and use, and increased costs of discovering new copper resources. Thank you, Mr. Chairman.

[The prepared statement of Mr. Menzie follows:]

Statement of W. David Menzie, Chief, Minerals Information Team, U.S. Geological Survey

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear at this hearing on energy and mineral requirements for development of renewable and alternative fuels used for transportation and other purposes. My name is David Menzie. I am a geologist with the U.S. Geological Survey (USGS) and serve as Chief of the Mineral Information Team's International Minerals Section, a component of the USGS Mineral Resources Program. The USGS is the primary Federal provider of scientific and economic information for objective resource assessments and unbiased research results on national and international mineral potential, production, trade, consumption, and environmental effects. The USGS provides information to help inform land use and resource planning decisions on specific management units and for national and international economic, foreign policy, and national security decisions.

Rising costs of metals are again heightening concerns about future supplies of these important commodities. Copper is among the metals that have experienced a dramatic increase in price. In January 2003, the price of copper was around $0.70 per pound and it was readily available as copper stocks exceeded 1.2 million metric tons (Mt). At the end of March 2006, copper prices reached $2.46 per pound and stocks were just over 150,000 metric tons (t). Stocks fell to below 50,000 t in July 2004 and some smelters had difficulty in obtaining sources of copper. The recent rise in copper prices is the result of increased copper consumption by developing countries. Some authors suggest that increased consumption of minerals by developing countries is not sustainable either because copper resources are insufficient to meet growing consumption or because the environmental consequences of increased resource production will be too costly.

USGS scientists have addressed the question of future mineral scarcity, with emphasis on copper, in a paper titled "Mineral Resources and Development in the Twenty-first Century" that was published by Resources for the Future in their 2005 book, Scarcity and Growth Revisited. This study concluded that although the world has abundant resources of copper, rapid increases in copper consumption may lead to temporary shortages. The USGS considered a number of factors that will affect future supplies of copper, including: (1) rising consumption related to economic growth in developing countries; (2) estimates of copper availability; (3) investment in mineral exploration; (4) the state of the minerals professions; (5) increased scrutiny of and restrictions on mineral extraction; and, (6) increased environmental residuals (pollutants resulting from mineral production and use). I will discuss each of these factors in turn.

1. Economic Growth and Mineral Consumption

Rapid economic development and rising income levels in a number of countries, especially in Asia, have led to a rapid increase in consumption of mineral commodities following a consistent pattern of increasing per capita consumption with increasing income (per capita GDP). Levels of mineral consumption are low in lesser-developed countries with low income levels; however, mineral consumption increases very rapidly as countries begin to industrialize and incomes pass a threshold level. Per capita mineral consumption then stabilizes at higher levels when countries begin to develop the service and information sectors of their economies. The current rapid increase in mineral consumption is the result of a number of large countries approaching or having reached threshold income levels for consumption.

The USGS used the relation between per capita income and per capita copper consumption to estimate copper consumption in the 20 most populous countries in 2020. The results suggest that world copper consumption will increase an estimated 3.1 percent per year from 14.9 Mt in 2000 (our base year) to 27 Mt in 2020. Most of the increased consumption will take place in developing countries. For example, copper consumption in the United States and Japan will increase from 3 Mt and 1.3 Mt in 2000 to 3.5 Mt and 1.4 Mt respectively in 2020, while copper consumption in China and India will increase from 2 Mt and 400,000 t in 2000 to 5.6 Mt and 1.6 Mt respectively in 2020.

2. Estimates of Copper Availability

Currently, about 90% of all copper consumed comes from mining and processing new ores. About 10% of copper is from recycled sources. Recent studies reported in the *Wall Street Journal*, the *Washington Post*, and trade publications question whether recycling rates can be significantly increased. Unless recycling can be dramatically increased, the escalating demand for copper will either have to be met through increased mine production or through substitution of other commodities that exhibit the same properties and can serve the same functions as copper. Economic development increases the demand for a full suite of industrially useful mineral commodities—not just copper. Therefore, limits may exist to the availability of substitute commodities. Thus, much of projected copper consumption is likely to be mine production of copper from reserves.

Copper reserves represent the working inventory of mines; as that inventory is reduced, the reserves will need to be replenished from other (non-reserve) identified resources and by discovering new deposits of copper. There are about 45 Mt of copper reserves in the United States. Identified copper resources in the United States are estimated to be about 260 Mt. About 290 Mt of copper are estimated to exist in undiscovered deposits in the United States based upon a detailed probabilistic assessment of undiscovered mineral resources. World copper reserves are currently about 470 Mt. Total (identified and undiscovered) world copper resources are less well known. An assessment of undiscovered world resources comparable to that for the United States does not exist. Completion of the probabilistic assessment of undiscovered resources for the United States increased previous estimates of United States' total copper resources significantly. Based upon these results, it is expected that the current estimates of total world copper resources (1.6 billion tons) would be significantly increased by a modern global mineral assessment including an estimate of the amount of copper in undiscovered deposits worldwide.

Our study estimated that approximately 1.1 billion tons of copper will need to be added to reserves if the world is to meet projected copper consumption at present recycling rates and to maintain reserves at the same level relative to copper production. The study concluded that to meet anticipated copper consumption between 2000 and 2020 and to maintain a proportional amount of reserves will require more than three times the amount of copper as is contained in the 5 largest deposits currently known (Chuquicamata, El Teniente, Escondida, and Las Bronces in Chile and Morenci in Arizona). Although some of this material exists in discovered deposits, much of the material will need to come from undiscovered deposits. Because a small number of very large deposits typically contain the majority of copper resources, a small number of large undiscovered deposits will be critical to supplying copper in the future.

Based on available information, it appears that sufficient supplies of copper exist to meet the needs of developing countries; however, the production of these resources will depend upon a number of factors including adequate levels of mineral exploration, the development of new technologies for mineral discovery and production, and social and legal environments that allow for mineral exploration and production.

3. Investment in Mineral Exploration

An analysis of mineral exploration budgets, together with organizational changes within corporations engaged in mineral exploration, and within universities that teach economic geology, mineral economics, and mining engineering illustrates reasons for concern. Although significant resources exist, a ready inventory of copper may not be available to meet the increased demand imposed by developing economies. A strong focus on exploration for gold and diamonds, coupled with declining levels of exploration spending, likely contributed to the temporary shortages of copper last year. Mineral exploration budgets increased throughout the early 1990s, reaching a peak of $5.2 billion in 1997 and then declining sharply after 1997. Exploration budgets reached a low of $1.9 billion in 2002 before rebounding to $5.1 billion in 2005. Prices of most mineral commodities rose sharply in 2004.

4. State of the Minerals Professions

During the late 1990s, many large companies restructured to eliminate grassroots exploration (exploration in untested areas where mineral deposits are not known to exist). In some cases, economic geologists who had been in these companies formed or joined junior companies; in other cases, they left the industry. The restructuring of mineral exploration has most likely resulted in fewer exploration geologists funded by smaller exploration budgets.

Over the next 20 years, an increasing proportion of resources that remain to be discovered are likely to be in concealed deposits that lie beneath significant quantities of covering rock or sediments. Such deposits will be more difficult to discover and will likely be more costly to produce. Reorganization in universities that teach economic geology, mineral economics, and mining engineering has resulted in smaller academic departments to teach scientists and engineers needed to meet the technical challenges that will be presented by future mineral exploration and development.

5. Increased Scrutiny of and Restrictions on Mineral Extraction

Our study concluded that a further cause for concern about society's ability to produce the amount of minerals that will be needed by developing countries is the increasing social scrutiny of and restrictions on mineral resource extraction. In the United States, the amount of land open to mineral exploration has declined significantly since the passage of the original Wilderness Act in 1964. In addition, population growth in urban areas of the mountain west (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming) has led to increased scrutiny of domestic mineral development projects. Scrutiny of mineral projects outside of the United States is also increasing as mineral-producing countries are demanding greater control over their natural resources.

6. Increased Environmental Residuals from Mineral Production and Use

Increased mineral consumption, increased residuals from mineral production and use, and disposal of mineral products that are implicit in the growth of developing economies will require the implementation of new strategies to reduce residuals from resource production and to increase recycling. On average, about 350 t of waste rock and 147 t of tailings are generated for each ton of copper produced. Assuming that grades of ore produced do not change, the model implies that mining and milling of copper ores will produce about 130 billion tons of waste rock and 56 billion tons of tailings between 2000 and 2020. Copper smelting can release both sulfur dioxide and arsenic to the atmosphere and hydrosphere. Amounts of these materials that might be released depend on the proportions of copper and arsenic that are processed by pyrometallurgical methods (using high temperatures to transform metals and their ores) and the technology employed in the smelter. The amount of waste rock and tailings are unlikely to be reduced unless copper ores are leached in place. The amounts of arsenic and sulfur dioxide released into the environment are more likely to be reduced by adoption of new technologies.

In addition to the residuals that are the direct result of producing commodities, there are residuals that enter the environment from use and final disposal of goods manufactured from the commodity. An increase in recycling could reduce the magnitude of these residuals.

To summarize, Mr. Chairman, our study concluded that although the world has abundant resources of copper, rapid increases in copper consumption can lead to temporary shortages of copper. Reasons for these temporary shortages may include: reduced investment in mineral exploration; a decline in the number of exploration geologists, mining engineers, and mineral economists; increased restriction on mineral extraction; increased environmental costs from mineral extraction and use; and increased costs of discovering new copper resources.

Thank you for the opportunity to discuss the growing demand for global mineral resources, such as copper. I am pleased to respond to any questions that you and Members of the Subcommittee may have.

Mr. GIBBONS. Thank you very much, Mr. Menzie. We appreciate your testimony and your presence here as well. Very helpful information for our committee.

I turn now to Ms. Robyn Storer from Westhouse Securities. We welcome you to the committee. The floor is yours. We look forward to your testimony.

STATEMENT OF ROBYN M. STORER, CONSULTING MINING ANALYST, WESTHOUSE SECURITIES, LLP

Ms. STORER. Thank you. Mr. Chairman and Members of the committee, I am Robyn Storer, Consultant Mining Analyst for Westhouse Securities in London. I am pleased to have the opportunity to speak to you today regarding the challenges that the copper mining industry faces to meet the growth in world demand.

Demand for copper is growing worldwide as the emerging economies of China, India, Russia, Brazil, and elsewhere work toward bringing a North American standard of living to their families. To realize the dream of urbanization, industrialization, and consumerism, these economies will need to consume mountains, or, in the mining context, large pits of metals.

However, the growth for demand in copper is not restricted to these fast-growing, emerging economies. The electrical characteristics of copper make it an essential component of our modern world.

For example, the modern family car today contains 50 pounds of copper and over a mile of copper wiring. However, this is not solely the result of the introduction of power windows, GPS systems, and the like. A significant proportion of the increase in copper in vehicles has been in under-the-hood applications, where electrical motors have replaced moving mechanical parts, boosting efficiency and lowering fuel consumption. In this respect, the move to hybrid cars, vehicles containing some 100 pounds of copper, is just an extension of this trend.

Thus, projected growth in demand for copper mine production of some 3.7 percent per annum over the next decade translates into a growth of some 7 million tons per year. Allowing for the inevitable mine closures, this means that within a decade less than half of world demand for copper mine supply can be met from existing mines. The balance will largely need to come from new mine developments.

On current projections, there will not be sufficient new mines in production by the middle of the next decade to meet this projected demand. The world needs the equivalent of 30 new major mines to meet the projected growth in demand. However, new greenfields mining projects are few, following a period of prolonged underinvestment in base metal exploration which has restricted the number of new discoveries to below what is needed to even replace mine production.

The shortage of new projects in the pipeline is a major issue for the industry. The rule-of-thumb is that it takes eight years from discovery to mine development. However, lead times can be significantly longer than this, aggravated by the increased level of regulation and longer permitting times. In addition, the concentration in the mining industry means that major mine development decisions are now in the hands of companies who, by their very nature, tend to be more conservative decision takers. Only nine companies now produce half of the world's copper mine production.

Concentration is not all bad. Given that major mine development costs are in the order of one to $2 billion, only large companies can finance such projects. However, the concentration in the industry is certainly a contributing factor to Chinese concern over future supply and the Chinese moves to acquire international mining companies and invest in new project development in exchange for off-take rights.

Another challenge facing the industry is that it will need to develop mines in new regions of the world. The occurrence of copper deposits is controlled by geology, with large deposits predominantly confined to modern or ancient continental margins.

The USA has a number of known but yet undeveloped major copper deposits, the two largest being Resolution in Arizona and the Pebble copper-gold deposit in Alaska. However, the Safford mine development, still awaiting final permitting, will be the first new, major copper mine in the USA in over 30 years. This lack of new mine development in the U.S. means that today the U.S. produces only half of the copper it consumes.

However, with the difficulties of permitting and the "not in my back yard" approach to new mine development in North America, then the back yards from which future copper mine supply will come increasingly are from Chile, which already produces half of the world's mined copper; Peru; Kazakhstan; China, Tibet, and Mongolia; the Philippines, Pakistan, and the Congo. Exploration will then need to search wider in the lies of the Far East of Russia, Angola, Iran, and Turkey.

In conclusion, there is no easy answer to where the next and subsequent generations of copper mine supply will come from to supply an increasingly copper hungry world. Thank you.

[The prepared statement of Ms. Storer follows:]

Statement of Robyn Storer, Consultant Mining Analyst, Westhouse Securities

Mr. Chairman, members of the Committee, I am Robyn Storer, Consultant Mining Analyst for Westhouse Securities in London.

I am pleased to have the opportunity to speak with you today regarding the Daunting Challenge the Copper Mining Industry Faces to Meet the Growth in World Demand.

DEMAND DRIVERS

Demand for copper, and metals in general, is growing worldwide.

GDP and investment are rising in the emerging economies of China, India, Russia Brazil and elsewhere, and will continue to rise, as people in these countries work towards bringing a North American standard of living to their families. There are over 2.3 billion Chinese and Indians today, nearly 40% of the world's population; by 2050 this figure is forecast to rise to 3.2 billion. (Fig. 1)

This demand for housing, automobiles, telephones, white goods and electronics—and in turn for the commodities that are the building blocks of these products means that these economies will need to consume mountains or, in the mining context, great pits of metals, to realize the dream of urbanization, industrialization and consumerism. (Fig. 2)

However, the growth in demand for copper is not restricted to these fast growing emerging economies.

Copper is what I like to term a "modern metal", a metal with a long past, but a bright future.

The electrical characteristics of copper make it an essential component of modern electronics. Whilst it seems obvious that copper helps runs our televisions and computers, less obvious are some other electrical applications. A modern family car today contains some 50lbs of copper and over a mile of copper wiring. However, it would be a mistake to assume that this is solely the result of the introduction of power windows, GPS systems and video monitors to entertain the children.

A significant proportion of the increase in copper in vehicles has been under the hood applications, where electrical motors have replaced moving mechanical parts, boosting fuel efficiency and lowering fuel consumption. In this respect, the move to hybrid cars, vehicles containing on average 100 lbs of copper, is just an extension of this trend.

MAJOR NEW MINE DEVELOPMENTS NEEDED

Thus projected growth in demand for copper mine production of some 3.7% per annum (Fig. 3) over the next decade, translates into a growth from the current, just under 13 million tonnes per year of mined copper production to a number close to 20 million tonnes per year.

Allowing for the inevitable closure of some mines through reserve depletion, this means that by 2016 less than half of world demand for copper mine supply can be met from production from existing mines. (Fig. 4).

Brownfields expansions at existing operations can meet only a small part of the projected increase in demand.

The balance will need to come from new mine developments.

WILL THERE BE SUFFICIENT NEW MINE DEVELOPMENT TO MEET DEMAND?

Will there be sufficient new mines in production by the middle of the next decade to meet demand?

On current projections, the answer to this is question, is NO.

The world needs the equivalent of 30 new major mines by 2016 to meet the projected growth in demand.

However, new green fields mining projects few.

The reasons for this are: firstly, a period of prolonged underinvestment in exploration which has restricted the number of discoveries. Secondly, the poor allocation of those exploration dollars which, for example, saw almost two thirds of the world's mineral exploration budget in 2004 spent on the search for gold and diamonds.

Not only has the mining industry not kept pace with the growth in demand, it is struggling to hold its ground. Worldwide, significant copper discoveries between 1998 and 2004 fell well short of what was needed to replace mine production. The growth in demand has meant that whilst 10 years ago the Industry needed to find 2.4 Mt of mineable copper to replace daily production; by 2005 this figure had risen to 4 Mt per day. This means that rate of discoveries to replenish daily production needed to increase by about 66%, in reality; it rose by only 25%.

SHORTAGE OF NEW PROJECTS IN THE PIPELINE

This shortage on new projects in the pipeline is a major issue for the Industry.

The rule of thumb is that it takes eight years from discovery to mine development. However, lead times can be significantly longer than this.

Aggravating the speed of new mine development is the increasing concentration in the mining industry, with fewer and larger companies.

This means major mine development decisions are now, by and large, in the hands companies who, by their very nature, tend to be more conservative decision takers. In the case of copper, only nine companies now produce half of the world's copper mine production.

Concentration is not all bad; given that major mine development costs usually run in the order of 1.5 to 2 billion dollars, only large companies can finance such projects.

However, the concentration in the industry is certainly a contributing factor to Chinese concern over future supply, and the consequent Chinese push to acquire companies, for example, MinMetals unsuccessful bid for Noranda last year, and to the growing investments by Chinese companies in new project development, in exchange for off-take rights.

Lead times for mine developments have also increased with the increased level of regulation and time taken over permitting.

INCREASINGLY COPPER MINE PRODUCTION WILL COME FROM NEW MINING AREAS

Another challenge facing the Industry is that it will need to develop mines in new regions of the world.

The occurrence of copper deposits is controlled by geology—with large deposits predominantly confined to modern or ancient continental margins (Fig. 5).

1. The USA has a number of known but a yet undeveloped major copper deposits: the two largest by far being: Resolution in Arizona (which is planned to replace copper mined from Bingham Canyon when that mines begins to runs out of ore resources in 2017) and the large Pebble copper-gold deposit in Alaska.

However, Phelps Dodge's Safford mine development, still contingent on certain permit approvals, will be the first new major copper mine to be opened in the USA in over 30 years.

This lack of new mine development in the USA means that today the USA produces only half of the copper it consumes, a shortfall of 1 million tonnes per year.

2. B.C. in Canada has a number of large, but low grade copper deposits which can be brought on stream

However, with the difficulties and delays of permitting and the worrying trend to a 'not in my backyard' approach to new mine development in North America, then the backyards in which the major copper mine supply growth of the future will increasingly come from are:

1. Expansions of existing operations and some new mine developments in Chile—but to some extent this is only compensate for mine closures and the drop in ore grades;

2. The development of known deposits and yet to be discovered copper deposits in Peru. However, worrying is the recent political rhetoric of nationalization in Peru, coming hard on the heals of the nationalization policies emerging in Venezuela and Bolivia;

3. China, Tibet and Mongolia—the large, slowly developing Oyu Tolgoi copper deposit in Mongolia and the development if a number of mid-sized to large copper deposits in Tibet; will go to help feed the hungry Chinese copper market;

4. The Philippines, although the political situation in the Philippines has been a major source of development delays;

5. Pakistan, with the major Reko Diq copper deposit recently purchased by a consortium of Antofagasta and Barrick; but questions exist about security and stability in this region;

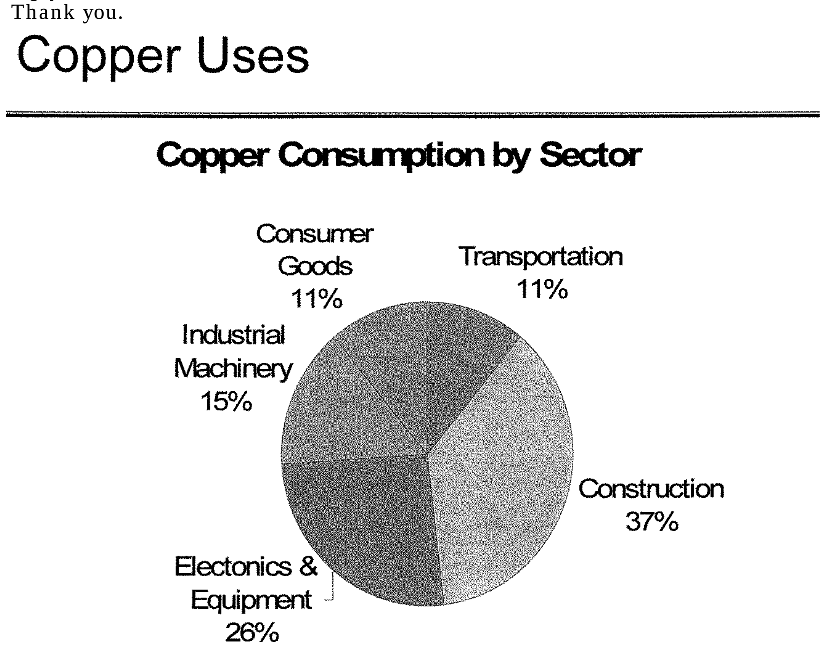
6. And of course the DRC, the Congo where a number of major and junior companies are looking to develop mining operations. However, political considerations, the long, 1500 km transportation distances to the coast and lack of infrastructure such as power generation—will not see the Congo reach anything like its mineral production potential in under several decades, at least.

After these areas, my pick of exploration areas for the next major discoveries are: the Far East of Russia—in similar geological terrain to Nth America, Angola, part of the central African copper belt and across the border from Pakistan, in Iran and along the same belt into Turkey.

CONCLUSION

So, in conclusion, there is no easy answer to where the next and subsequent generations of copper mine supply will come from, to supply an increasingly copper hungry world.

Thank you.



Copper in Construction

- An average family home contains more than 90 kg of copper
    - 88 lbs of electrical wire
    - 66 lbs of plumbing
    - 33 lbs of builders hardware
    - 20 lbs inside electrical appliances-11 lbs of brass goods
  - An example of Longevity in Construction Uses
    - The Statue of Liberty contains more than 37,000 tonnes (81.5 million lbs) of copper

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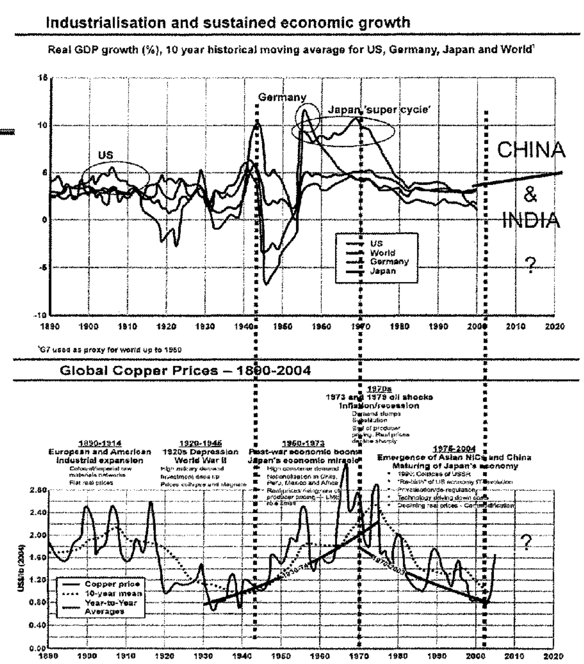
Copper in Transportation

- Vehicles, the Average family sedan contains:
    - on average 50 lbs of Copper
    - over 1 mile of copper wiring:
        - 50% electrical distribution systems and wiring harnesses,
        - 20% generators, starter motors and other electromechanical components
- Hybrid Cars contain 100 lbs of copper
- A Boeing 747-200 jet plane contains:
    - approximately 1.8 tonnes of copper

Copper — Environmentally Friendly

- Copper is environmentally friendly and recyclable
    - over 80 % of copper ever mined is still in use
    - alloyed with tin = bronze
    - alloyed with zinc = brass
- Copper is essential to the metabolism of all living things
- Copper is vital to humans
    - Adults need 2-3 mg in their diet daily

Copper Prices to Continue Strong

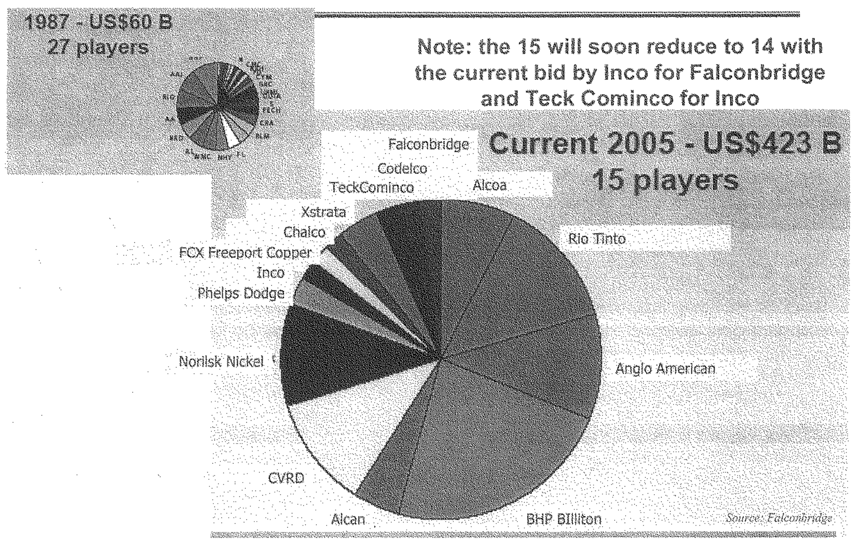


Source: BHP Billiton, Westhouse Securities

Impact of Industry Consolidation

- Fewer players
  - Nine companies now control over half the world's copper production
  - Increasing number of possible developments now held in fewer hands
- Larger companies tend to be:
  - Better capitalized
  - More cautious investors
  - More focused on projects with a material impact on the overall company
  - Sequential Developers—Not Simultaneous

Consolidation: Base Metals Industry



Top Copper Producers

World Mine Production	000s metric tonnes 2005	Companies	000s metric tonnes 2005
Chile	**5,320**	**Codelco**	**1,832**
USA	**1,150**	**BHP Billiton**	**1,148**
Indonesia	**1,050**	**Phelps Dodge**	**945**
Peru	**1,000**	**Grupo Mexico**	**868**
Australia	**930**	**Rio Tinto**	**691**
Russia	**675**	**Southern Peru Copper ***	**690**
China	**640**	**Freeport McMoRan Copper**	**660**
Canada	**580**	**Anglo American**	**635**
Poland	**530**	**KGHM Polska**	**550**
Zambia	**450**	**Flaconbridge**	**544**
Mexcio	**420**	**Xstrata**	**494**
Kazakstan	**400**		

*** 75.1% owned by Grupo Mexico**

Mr. GIBBONS. Well, as they always say, on every committee, there is a woman who always sets the pace. You have done a remarkable job in giving your five-minute speech within the five-minute timeframe, and I think the other guys ought to learn from your experience as well. Thank you very much. The committee truly appreciates the fact that you have flown from England all the way here to meet with this committee, and thank you for the trouble and effort that you went to get here. We are very pleased.

Before I turn to Mr. Frank, let me explain that the ugly buzzers that you heard in the middle of your testimony is an indication that we have a series of votes on the Floor of the House. The first vote is 15 minutes, and that was about three and a half minutes ago, so I believe I can get the testimony of Mr. Frank in before I have to leave to go vote. We will take a brief recess at that point in time, come back, and we will continue. I do apologize for this interruption, but it is something that I have no control over, and I certainly hope you will understand and forgive us for the fact that we do have other things going on, including votes on the Floor.

Mr. Frank, welcome, Marathon PGM Corporation. We look forward to your testimony. The floor is yours.

STATEMENT OF JAMES D. FRANK, CHAIRMAN, MARATHON PGM CORPORATION

Mr. FRANK. Mr. Chairman, Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the status of future mine development in the U.S.

My name is James D. Frank, and I am the Chairman of Marathon PGM Corporation, a Canadian company. I was born and raised in Kellogg, Idaho, in the Silver Valley mining district. I worked my way through college by working at the Bunker Hill lead smelter. After graduating from the University of Idaho, I went to work in the mining industry in Idaho. In 1996, I went to work for Summo Minerals Corporation in Denver, Colorado. In 2001, I was laid off from Summo and started to work on my own. In September of 2003, I founded Marathon, a small, exploration/development company in Canada, although I still live and work in Centennial, Colorado.

Marathon has a mining property in northern Ontario with a resource containing 1.5 million ounces of palladium, 400,000 ounces of platinum, and 348 million pounds of copper. In the last three years, I also helped form a copper company with properties in the Philippines, which now also has two additional properties in Africa.

I have been involved in mining in the United States all of my life until 2003. Actually, my father started mining in Idaho in 1932, and I started to work at the Bunker Hill smelter in 1966.

Why am I now running a Canadian company with a Canadian mining property? The answer is risk. This is a picture that I keep in my office. This was the 19th century "mine finder." He was an opportunist. He had to assess his risks, not unlike today. He had to get his first "grub stake." In other words, he had to convince other people he could find a mine so he could get enough supplies to search for the mine. His odds of success were something on the order of 10,000 to one, not unlike today.

If he was lucky enough to find mineralization, he or someone else came back for a second grub stake, more financing to develop the property further. Now his odds were maybe 1,000 to one, not unlike today.

Then he or someone else would come back and get a third grub stake to develop the mine. He also had to hope that the price of the commodity did not drop, or everything he was working for was for naught. His odds now were probably something on the order of 10 to one, not unlike today.

An added risk we have today is permitting. With all of the risks, this risk has made it almost impossible to find financing for early stage projects in the United States.

The last risk of permitting is not "can you get a mine permitted with good environmental standards," but "can you get it permitted at all?"

No one wants to go back to what we had before 1972. I remember growing up in Kellogg, where the air was filled with smelter smoke so thick you could cut it with a knife, and the South Fork of the Coeur d'Alene River was gray from mine tailings being dumped directly into the mine. These are unacceptable practices today, but the current permitting process is also unacceptable.

To illustrate this additional risk, I would like to explain my experience at Summo. Schedule A here shows the line of permitting events for Summo's Lisbon Valley Copper Project in Moab, Utah. Summo's permitting started in January 1991. By February of 1996, when I joined Summo, they had already filed their preliminary draft EIS. One year later, in 1997, Summo had a record of decision from the BLM approving the construction of the project.

By March of 1997, Greg Hahn, the President of Summo, and I had put together $62 million in financing to construct the project. This financing consisted of bank loans, supplier loans, and common stock sales. Summo started construction in April 1997. In May 1997, an environmental group organized by the National Wildlife Federation and the Mineral Policy Center filed an appeal and petition for stay. In June 1997, the Interior Board of Land Appeals granted a stay. Summo was told it could build the mine, but it could not mine it until the stay was removed.

Under the stay, of course, Summo could not complete the bank loan and, therefore, could not build the facility. Finally, in March 1999, the IBLA ruled entirely in Summo's favor, the stay was removed, and Summo could proceed. However, the price of copper had dropped from $1.20 to less than 60 cents. Summo stock had dropped from over $1.50 to only a few pennies.

Greg Hahn was forced in 2001 to lay off most of this employees, including me, and hold on as best he could. Finally, in 2003, as metals prices started to recover, Greg was able to finally build Lisbon Valley is now operating. But the capital cost to build the project had increased by more than 50 percent. Lisbon Valley Project is today a success story, with over 130 people employed and producing at a rate of 60 million pounds a year. However, the original investors lost most of their investment because it took almost 10 years from the record of decision to a producing mine. There were no good arguments against building the mine in 1997.

The two environmental groups routinely challenge every significant new mining project in the U.S. They have very competent lawyers, and their strategy is simply to delay each project as long as they can and hope that the investors will throw in the towel.

This is a personal story, but it has been repeated hundreds of times over the last 15 years. It is now very difficult, if not impossible, to raise money for exploration/development projects in the U.S. Canada has a very strong, environmental permitting process, but the problem in the U.S. is that anyone can slow or stop the process for the price of a stamp, even if they have no valid concerns.

This is why I can get a grub stake for projects in the Philippines and Canada but not in most places in the U.S. Nevada is one of the exceptions to this rule. We hope to be able to start construction on Marathon's PGM project in the next few years, a timeframe that is very difficult to match in the U.S.

As others today have explained, we need minerals—copper, PGMs—in order to produce fuel cells and smog-free cars. We have to be able to mine these minerals—platinum, palladium, and copper—in the U.S. as well as other places. Thank you, Mr. Chairman.

[The prepared statement of Mr. Frank follows:]

Statement of James D. Frank, Chairman, Marathon PGM Corporation

Mr. Chairman, Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the status of future mine development in the US.

My name is James D. Frank and I am the Chairman of Marathon PGM Corporation (Marathon), a Canadian company. I was born and raised in Kellogg Idaho in the Silver Valley mining district. I worked my way though college by working at the Bunker Hill Lead Smelter. After graduating from the University of Idaho, I went to work in mining industry in Idaho. In 1996, I went to work for Summo Minerals Corp (now Constellation Copper Corp.) in Denver, Colorado. In 2001, I was laid off from Summo and started to work on my own. In September of 2003 I founded Marathon, a small exploration/development company in Canada, although I still live and work in Centennial, Colorado.

Marathon has a mining project in northern Ontario with a resource containing 1.5 million ounces of palladium, 400,000 ounces of platinum and 348 million pounds of copper. In the last three years I also helped form a copper company with a property in the Philippines, which now also has two additional projects in Africa.

I have been involved in mining in the United States all of my life, until 2003. Actually, my father started mining in Idaho in 1932, and I started work at the Bunker Hill Smelter in 1966.

Why am I now running a Canadian company with a Canadian mining property? The answer is RISK.

This is a picture that I keep in office. This was the 19th century "mine finder", he was an opportunist. He had to assess his many "RISKS", not unlike today:

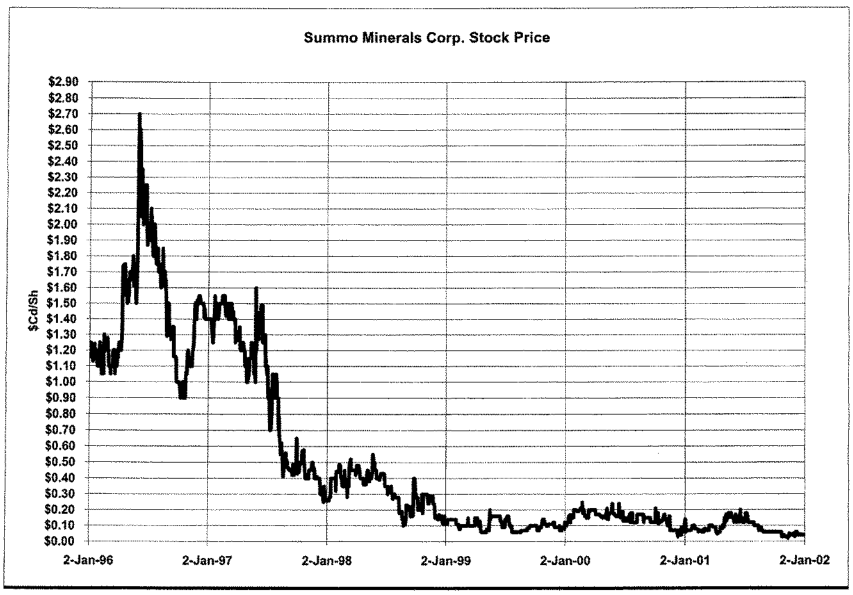
1. He had to get his 1st "grub stake". In other words, he had to convince others that he could find a mine so that he could get enough supplies to search for a mine. His odds of success were something in the order of 10,000 to 1, not unlike today.
2. If he was lucky enough to find mineralization, he, or someone else, would come back to get a 2nd "grub stake", more financing to develop the property. Now his odds were reduced to maybe 1 in 1,000, not unlike today.
3. Then he (or someone else) would get a 3rd "grub stake" to develop the mine. He also had to hope the price of his commodity did not drop, or everything he had worked for was for "not". His odds were now in the order of 10 to 1, not unlike today.
4. The added "RISK" we have today, is permitting. With all of the other "RISKS", this risk has made it almost impossible to find financing for early stage projects in the US.

This last "RISK" of permitting is not "can you get a mine permitted with good environmental standards" but "can you get it permitted at ALL".

No one wants to go back to what it was before 1972. I remember growing up in Kellogg where the air was filled with smelter smoke so thick at times "you could cut it with a knife" and the South Fork of the Coeur d'Alene River was gray from mine tailings being dumped directly into it. These are unacceptable practices today, but the current permitting process is also unacceptable.

To illustrate this additional risk, I would like to explain my experience at Summo. Schedule A shows a time line of permitting events for Summo's Lisbon Valley Copper Project out of Moab, Utah. Summo's permitting started in January 1991. By February 1996, when I joint Summo, they had already filed their Preliminary Draft EIS. One year later in March 1997, Summo had a Record of Decision from the BLM approving the construction of the project.

By March of 1997, Greg Hahn, the President of Summo, and I had put together a $62 million financing ("3rd Grub Stake") to construct the project. This financing consisted of; bank loans, supplier loans and common stock sales. Summo started construction of the mine in April 1997. In May 1997 an environmental group organized by the National Wildlife Federation and the Mineral Policy Center filed an Appeal and Petition for Stay. In June 1997 the Interior Board of Land Appeals (IBLA) granted a stay on "mining". Summo was told it could "build the mine" but it could "not mine it" until the stay was removed.



Under the "stay", Summo could not complete the bank loan and Summo eventually lost the bank loan facility. Finally in March 1999, the IBLA ruled entirely in Summo's favor, the stay was removed, and Summo could proceed. However, the price of copper had dropped from over $1.20/ lb to less than $0.60, and Summo stock had dropped from over Cd$1.50/share to only a few pennies (see price chart).

Greg Hahn was forced in 2001 lay off most of his remaining employees, including me, and hold on as best he could. Finally in 2003, metal prices started to recover and Greg has been able to finally build Lisbon Valley and is now operating. But, the capital cost to build the project had increased by more than 50%. Lisbon Valley Project is a success story today with over 130 people employed and producing copper at a rate of 60 million pounds a year However, the original investors lost most of their investment because it took almost ten years from the Record of Decision to a producing mine. There were no good arguments against building the mine in 1997. The two environmental organizations routinely challenge nearly every significant new mining project that is proposed in the US. They use very competent lawyers, and their strategy is simply to delay each project for as long as they can in hope that the investors will give up and "throw in the towel".

This is a personal story but it has been repeated 100's of times over the last 15 years. It is now very difficult, if not impossible, to raise money for exploration/development projects in the US. Canada has a very strong environmental permitting process. The problem in the U.S. is that anyone can slow or stop the process for the price of a stamp, even if they have no valid concern.

This is why I can get "grub staked" for projects in the Philippines and in Canada but not in most places in the US. Nevada is one exception to this rule. We hope to be able to start construction on the Marathon PGM project in the next few years, a time frame that would be very difficult to match in most of the US.

As others have explain today, if we want fuel cell cars and smog free cars, we have to be able to mine the platinum, palladium and even copper to make them.

Thank you

Mr. GIBBONS. Thank you very much, Mr. Frank. Again, I apologize for the delay here that is going to take place. We have a series of three votes. There are about five minutes remaining on the first one, so I have about enough time to run over there and make that vote. There will be a second series, two five-minute votes, so give me about 20 minutes to complete this process, and then we will come back. So as that goes, this committee is now in recess.

[Recess.]

Mrs. DRAKE [presiding]. Thank you for your patience with us while we are voting. Chairman Gibbons sends his apologies, that he has another conflict.

I am Thelma Drake from Virginia, and I welcome you here. Sorry that I was unable to hear your testimony, but I know we are going to move into questions now for you. The first question that Chairman Gibbons and I both have for any of you who would like to answer it is, always in the past, there seems to have been discussion about the technology, the need for the resource versus the environment, and with the changes in technology today, do you see a way where those two things could be brought together and that we can stop having the debate that pits one side against the other and develop a way that technology could accomplish the protection of the environment, like we all want, along with being able to use the resource? I would like to ask all of you that question, if you would like to weigh in on it.

Mr. FRANK. Well, I will start a little bit. One thing we need to do is maybe have some realism. Mining, the nature of the business is to dig into the dirt, take out rocks, crush them up, and stack them. So we are always going to have some scarring on the earth. It is not unlike what we do when we build a housing development. We tear up the trees, put in roads and put in houses. Those houses may only last 40 years or 60 years, and then they become an eyesore.

In mining, we do somewhat the same. We dig it up, we process the ore. So what we can do, and have done, for someone that has been in the mining business all of my life and have seen the really bad and where we have come to, it is remarkably different now where we do use technology and do not put mine tailings directly into the rivers, which we used to do. By the way, automobile industry and furniture manufacturers did the same thing, but we have not stopped those industries as we have in mining. We, for some reason, have really focused on mining. Even though they have stopped doing these things, we will go back because the old mine tailings are on the hillside or something.

So we have made big strides. We take the tailings ponds that are left and cover them with soil and plant trees on them. Now, does it look just like the mountains? No, it is different, but that is where we are. The same thing in a housing development: When a housing development stops being useful, you can tear it down, but it will never go back to the same state it was in.

Mrs. DRAKE. But, still, it can be very nice in the end. I have seen it in Pennsylvania where they have reclaimed mine land, and a phenomenal difference over the pictures of what had been there before.

Mr. FRANK. Absolutely. One problem we have is that there are mines that that did not happen to, and so they are still there as an eyesore, and people look at those that may have been shut down for 40 years, and they are still there. They are still an eyesore.

Mrs. DRAKE. Thank you.

Ms. STORER. Speaking as a geologist, and often talking with other geologists, we are the people at the forefront. We are out in the environment. We are out in these remote places. We consider ourselves to be environmentalists. We appreciate the remote areas we are working in, but, again, conceding the need for mine development, I think technology today does provide the ability to protect the environment, to return the water quality, to not pollute the local environment. But, as pointed out, if you dig something out, you are going to make a mark on the landscape, but I think we all in the industry are conscious that we want to minimize that impact, both for our own benefit as environmentalists and for the future generations.

Mrs. DRAKE. Thank you.

Mr. MENZIE. I think, a lot of times when we talk about the environmental problems, we focus on the production end of the cycle, and I think we also have to be mindful of the use of the manufactured products and the environmental problems that those cause when they reach end of use cycle and have to go into landfills.

One of the ways that we could limit that part of the environmental impact of minerals use is through increased recycling. The biggest problem with recycling is the cost of collection. It is possible that information technology in the form of things like radio chips, which could be applied to parts of manufactured goods, could reduce the cost of recycling by allowing automated separation of parts. So I think there are things that could be done that would address that part of the materials cycle as well.

Mr. STEWART. I think I am the only nongeologist sitting at this table. I would just tell you, from the supply side end, that, you know, the environment is very important to us, and we have taken to making sure that everything we do in our plants and our factories are in favor of the environment, recycling as much as we can, particularly copper. We try to make sure we use it as efficiently as possible because the supply piece of it is not very good for us. So from that standpoint, on the other side, we are trying to do our best around managing it from an environmental standpoint.

Mrs. DRAKE. Well, thank you for that. I do agree with you. I think that even though we see the need to take the resources from the ground that we would all consider ourselves conservationists and that we want it done in the best manner possible. I appreciate your answers.

I have read all of your testimony, just before we go to questions, and I truly had not thought about the tremendous pressure that is going to be put on platinum and copper now as we move into these new alternative methods of transportation, so it was an eye opener for me.

Mr. Stewart, do you think that the activities of hedge funds should be subject to increased levels of regulation by the Federal government or, as the Chairman of the Federal Reserve has suggested, by the banks?

Mr. STEWART. I can tell you, and I commented on it in my statement, that we believe that hedge funds are impacting the price of copper. So if that is the case, and they need to have some oversight, I think the answer is yes. I am not educated enough on the subject to really articulate whether they are going to continue to drive the cost up, but right now someone needs to pay attention to them because they are impacting our prices significantly, which, by the way, end up in the cost to the consumer.

Mrs. DRAKE. Thank you. That was an interesting sideline on that, that we may need to look at that as well as the environmental issues.

Dr. Menzie, your title says you are the Chief of International Minerals Section of the Minerals Information Team. What role do you and the employees in your section play within the minerals information team?

Mr. MENZIE. Madam Chairman, our group of about 16 employees collects information on production and use of minerals worldwide, so in about 180 countries for about 90 mineral commodities, we collect the information, publish it, analyze it, and report on it for both the public and for private interests.

We also act as specialists on different issues to other parts of the government. For example, we provide expertise to the State Department with regard to production and trade in diamonds in support of the Kimberly process.

Mrs. DRAKE. And, Dr. Menzie, this may be a little bit of an uncomfortable question for you, but I think it is very important that we get the answer, and that is, would you and your section be able to continue to perform your current duties and functions if the President's Fiscal Year 2007 budget were to be enacted by the Congress? What would the minerals team be able to tell us about foreign mineral markets, consumption, production, and all of that?

Mr. MENZIE. My understanding of the 2007 budget is that it would eliminate minerals reporting by the section, so that function would not be available in the future.

Mrs. DRAKE. And you would not be able to do your job properly.

Mr. MENZIE. I would not be able to do it at all.

Mrs. DRAKE. Right. Thank you very, very much. Thank you for an honest answer.

Ms. Storer, are the recent copper prices above $3 per pound copper justified, in your view, and where do you see the long-term prices of copper going?

Ms. STORER. I think we in the industry see above $3 copper prices as a bit of a speculative bubble. However, the copper prices needed to maintain all existing mines in production today are something on the order of $1.50 a pound of copper. This increase has come as wages have risen and, in particular, the price of energy has risen. Energy is used both to mine the rock, to crush it, to grind it, to process it, and then to transport it to the markets.

In addition, the long-term price is going to have to stay at a reasonable level to provide a return to investors if we are going to see new investment in new mine production. As I have pointed out, the new mines are likely to come from areas that carry political risk. It is all about risk and reward. If we are going to make an investment, we are going to have to see a reasonable return on our investment, and that means long-term higher copper prices than we have seen historically.

Mrs. DRAKE. Thank you. I also wanted to ask you, because you have pointed out the need to ramp up the levels of exploration, but one thing we always talk about here in Congress is our workforce, and I wondered if the companies have access to a sufficient number of trained geologists to succeed in a ramp up. Where are we as far as workforce goes?

Ms. STORER. I think there is a critical shortage of trained and skilled geoscientists worldwide. We have lost a lot of mining schools. In the years when metal prices were low, companies cut their exploration budgets, people left the industry, and we just have not seen the younger generation coming through to replace those geoscientists.

Mrs. DRAKE. When they left, we lost them. We lost the workforce.

Ms. STORER. When they left, we lost them, and they are certainly not coming back.

Mrs. DRAKE. Thank you. Do you think that state-owned companies have a material or financial advantage over privately held companies, and do you see any evidence that state-owned companies are increasing their participation in exploration? Have you thought about that?

Ms. STORER. Well, historically, state-owned companies have not been successful. Where we have seen the success in a lot of countries around the world is in the privatization, which has revitalized their mineral sectors. So, no, I do not think state-run companies are the way to run exploration in the future. No, I do not see them going in to exploration, nor do I see the major private companies ramping up to the extent that I think that we need to see to make the discoveries needed to find mines for the future.

Mrs. DRAKE. Thank you.

And, Mr. Frank, in your testimony, you present a rather stark tale of a junior company being severely damaged by an attack by national-level interest groups, leading to the near bankruptcy of your employer. During the permitting process, what was the attitude of the local population about the development of the mine, and were they supportive of the development?

Mr. FRANK. Yes. The local communities typically, and this is very typical, welcome this type of activity because the wages tend to be four to six times higher than the average wage in the community, so they were quite supportive. We did have several town hall meetings in different cities, so I think we had a total—it is back 10 years, so it has been a while, but in the order of 12 different local meetings, very supportive. But we did receive letters from places like Florida—these are meetings in Utah—and New York, et cetera, complaining about the activities that we were going to have in the district, but the local people were very supportive and still are. There are 150 jobs there now that are very highly paid, and the mining company becomes a very active part of the communities.

Mrs. DRAKE. Thank you. I would like to thank the witnesses for your valuable testimony and also for the extra time you had to take for us and for the questions that you have answered. Members may have additional questions for the witnesses, and we will ask you to respond to these in writing if some of our colleagues who could not be here today may have questions that they would like to present to you based on the testimony.

The hearing record will be held open for 10 days for these responses, and I would like to thank you very much and recognize the second panel. So thank you.

[Pause.]

Mrs. DRAKE. If I could ask the panel to please stand and raise your right hand and then respond after I read the oath.

[Witnesses sworn.]

Mrs. DRAKE. Thank you very much. I would like to recognize our second panel: Chris Guzy with Ballard Power Systems, Robert Rose with U.S. Fuel Cell Council, Eric Carlson, TIAX; and Milt Copulos, National Defense Council Foundation.

The Chairman now recognizes Chris Guzy to testify for five minutes. You probably saw that the timing lights on the table will indicate when your time has concluded. All witness statements will be submitted in the hearing record. Mr. Guzy, welcome. Thank you.

STATEMENT OF CHRIS GUZY, CHIEF TECHNOLOGY OFFICER, BALLARD POWER SYSTEMS

Mr. GUZY. Madam Chairman, Members of the Subcommittee, my name is Chris Guzy, and I am the Chief Technology Officer of Ballard Power Systems. Thank you for the opportunity to speak to you today on the subjects of platinum and fuel cell commercialization.

The purpose of my testimony is to provide the Subcommittee with an understanding of the use of platinum in fuel cells, outline Ballard's Technology Road Map for achieving key technical targets that underpin the commercialization of automotive fuel cells, and to review the important role that platinum plays within that framework. I will also offer a set of steps the government can take to support fuel cell commercialization in the context of the technology's platinum use.

Ballard is recognized as a world leader in developing and manufacturing proton exchange membrane, or PEM, fuel cells. We have been developing PEM fuel cells since 1983 and hold nearly 1,000 patents, issued and pending, on some of the most fundamental fuel cell intellectual property.

We are the exclusive supplier to Ford and DaimlerChrysler and have supplied fuel cells to many of the world's other major automotive manufacturers. Today, Ballard powers more customer demonstration vehicles than all other fuel cell developers combined.

In addition to automotive applications, Ballard is actively working with partners and lead customers to develop fuel cell-powered products for residential cogeneration, forklifts, and backup power. Each of the applications presents less challenging cost requirements than automotive and are on a nearer term path to commercialization. These early markets will help facilitate the transition to fuel cell vehicles by, among other contributions, growing the PEM supply base and establishing early hydrogen infrastructure.

It is interesting to note that the relative contribution of platinum to cost in these applications is less significant than in automotive, a function of the fact that lower production volumes generate higher costs in other areas, such as stack assembly. However, given that the largest potential fuel cell application is the automotive market and that the relative contribution of platinum to cost is higher in automotive fuel cell applications, that is where I will focus my remarks today.

In 2004, we began publishing a Technology Road Map, a public commitment to demonstrate commercially viable automotive fuel cell technology by 2010. This Technology Road Map is aligned with the DOE's commercial targets for automotive fuel cells and addresses the key factors of durability, freeze-start, and power density.

My comments here center on the interplay of platinum with cost and durability. However, for the record, our submitted testimony discusses progress toward each of the four goals.

Meeting the DOE's 2010 high-volume stack cost target of $30 per kilowatt is required for fuel cells to compete with today's internal combustion engines. Over the past four years, we have consistently achieved significant cost-reduction targets and are confident we will meet this important goal. Between 2002 and 2005, the projected high-volume cost of Ballard's automotive stack technology has been reduced from $125 per kilowatt down to $73 per kilowatt. In 2006, our target is to reduce the cost to less than $65 per kilowatt.

The impact of platinum catalyst on overall fuel cell stack cost is significant. A fuel cell consists of bipolar plates that carry the reactant gases, an electrolyte membrane, and two catalyst-coated electrodes. Platinum is required on both electrodes and is core to achieving the required levels of fuel cell performance.

A major thrust of our cost-reduction strategy has been to lower the platinum loading. Between 1994 and 1999, Ballard achieved a tenfold reduction by switching from non-supported pure platinum catalysts to carbon-supported catalysts with increased platinum surface area to provide more accessible sites for the fuel cell electrochemical reactions. We improved fuel cell performance over this same period, despite the lower amounts of platinum, through improved catalyst utilization, optimized cell design, and implementation of better materials.

Since 1999, we have achieved a further 40 percent reduction in catalyst loading while continuing to improve fuel cell performance. The path to meeting 2010 cost targets requires an additional 50 percent reduction in catalyst loading from where we are today. Early laboratory demonstrations give us confidence that we will achieve this goal.

To get a sense of the relative contribution of platinum to the overall cost of the fuel cell, we should note that even with low catalyst loadings targeted for 2010, a fuel cell capable of delivering the required power will contain on the order of $1,000 of platinum at today's prices, or about 30 percent of the total stack high-volume cost. This is five to ten times higher than the amount of catalyst found in conventional gasoline or diesel catalytic converters today.

Last year, while aggressively pursuing lower platinum loadings, we were able to achieve automotive fuel cell stack lifetimes of 2,000 hours and are confident that by 2010 we will deliver to the DOE target. To put this in perspective, our cogeneration system for residential use in Japan operates under less rigorous duty cycles and achieved more than 10,000 hours of operation.

To summarize, we know what the technical challenges are, we are pursuing multiple paths to resolution, and we are confident we will demonstrate commercially viable technology by 2010. Platinum will continue to play a pivotal role in the commercialization of fuel cell technology. That said, we agree with our colleagues at TIAX that the availability of platinum at a stable price should not be a barrier to fuel cell vehicle commercialization.

In closing, I would like to recommend three important steps Congress can take to support fuel cell commercialization as it relates to platinum.

First, Congress should provide fuel cell R&D funding at levels authorized in the Energy Policy Act of 2005 to increase public and private research efforts to reduce platinum loadings and investigate nonprecious metal catalysts that may someday replace platinum.

Second, Congress should investigate whether and what government actions may be necessary to ensure a proper platinum recycling framework is in place.

Third, Congress should legislate a meaningful set of tax credits for fuel cell vehicles for a 10-year period beginning early in the next decade. These tax credits, which should be phased, will help mitigate the short-term increase in platinum prices that can be expected to occur as supply adjusts to the new demand.

Thank you for the opportunity to appear before you today. I look forward to any questions you may have.

[The prepared statement of Mr. Guzy follows:]

Statement of Dr. Chris Guzy, Chief Technology Officer, Ballard Power Systems

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We are the exclusive supplier to Ford and DaimlerChrysler and have supplied fuel cells to many of the world's other major automotive manufacturers. Today, Ballard fuel cells power more customer demonstration vehicles than all other fuel cell developers combined. As well, our state of the art manufacturing facility provides volume production capability that is unmatched in the industry.

It is from this leading position that we join with many others in the firm belief that hydrogen fuel cells will be the powertrain of the 21st Century. Fuel cells have the power to transform our world because they offer a comprehensive solution to some of the most pressing problems of our time: energy security, global climate change, urban air quality, and long-term energy supply.

In addition to automotive applications, Ballard is actively working with partners and lead customers to develop fuel cell powered products for residential cogeneration, forklifts, and back-up power. Each of the applications present less challenging cost requirements than automotive and are on a nearer term path to commercialization. These early markets will help facilitate the transition to fuel cell vehicles by, among other contributions, growing the PEM supply base and establishing early hydrogen infrastructure. It is interesting to note that the relative contribution of platinum to cost in these applications is less significant than in automotive—a function of the fact that lower production volumes generate higher costs in other areas, such as stack assembly. However, given that the largest potential fuel cell application is the automotive market, and that the relative contribution of platinum to cost is higher in automotive fuel cell applications, that is where I will focus my remarks today.

To help guide and communicate our progress toward the demonstration of commercially viable automotive fuel cell technology by 2010, two years ago Ballard began publishing a Technology Road Map. This Technology Road Map is fully aligned with the Department of Energy's (DOE) published commercial targets for automotive fuel cells and focuses on the key factors of cost, durability, freeze-start, and power density.

Let me first address cost. Meeting the DOE's 2010 high volume[1] stack cost target of $30 per kW is required for fuel cells to compete with today's internal combustion engines. Over the past 4 years, we've consistently achieved significant cost-reduction targets and are confident we will meet this important goal. Between 2002 and 2005, the projected high volume cost of Ballard's automotive stack technology has been reduced from $125/kW down to $73/kW. In 2006, our target is to reduce the cost to <$65/kW.

The impact of the platinum catalyst on overall fuel cell stack cost is significant. A fuel cell consists of bipolar plates to carry the reactant gases, an electrolyte membrane, and two catalyst-coated electrodes. Platinum is required on both electrodes, and is core to achieving the required levels of fuel cell performance.

Accordingly, a major thrust of our cost reduction strategy has been to lower the platinum loading in our fuel cells. Between 1994 and 1999, Ballard achieved a tenfold reduction in platinum loading. We did so by switching from non-supported pure platinum catalysts to carbon-supported catalysts with increased platinum surface area to provide more accessible active sites for the fuel cell electrochemical reaction. We improved fuel cell performance over this same period, despite the lower amounts of platinum, through improved catalyst utilization, optimized cell design, and implementation of better materials.

Since 1999, we've achieved a further 40% reduction in catalyst loading while continuing to improve fuel cell performance. The path to meeting the 2010 cost target requires an additional 50% reduction in catalyst loading from where we are today. Early laboratory demonstrations give us confidence that we will achieve this goal.

To get a sense of the relative contribution of platinum to the overall cost of the fuel cell, one should note that even with the low catalyst loadings targeted for 2010—about 30 grams—a fuel cell capable of delivering 100 kW gross power (or roughly 130 horsepower) will still contain up to $1,000 of platinum at today's prices, representing approximately 30% of the total stack high volume cost. This is 5-10 times higher than the amount of catalyst that is found in a conventional autocatalyst today.

As we work to lower platinum catalyst loadings, we must be careful to balance this objective against durability requirements, another key commercialization parameter. Last year, while aggressively pursuing lower platinum loadings, we were still able to achieve an automotive fuel cell stack lifetime of 2,100 hours and are confident that by 2010 we will deliver on the DOE target of 5,000 hours—which is equivalent to the lifetime of today's internal combustion engine. To put this goal in perspective, our cogeneration system for residential use in Japan—while operating under less rigorous duty cycles than the automotive application—has achieved more than 10,000 hours of lifetime.

In addition to our progress toward cost and durability objectives, we are improving the ability of our fuel cells to start in freezing temperatures and are on track to exceed the DOE target for 2010. The electrochemical reaction within a fuel cell

[1] Defined as 500,000 units.

produces water and heat. Managing that water in sub-zero temperatures is essential to a successful start-up. Last year, we demonstrated technology that was able to start at -25° Celsius, reaching 50% of the rated power within 90 seconds, which represented a much faster time than our 2005 goal of 150 seconds. Our goal for 2010—which is more stringent than the DOE target—is to demonstrate start-up from -30° Celsius, reaching 50% of the rated power in 30 seconds.

Lastly, power density is an important criterion to ensure that fuel cells can be packaged within the limited vehicle space available. Last year, we demonstrated fuel cell technology at 1470 watts net per litre. The DOE's 2010 commercial target is 2000 watts net per litre. As with freeze-start capability, Ballard has set a more stringent target based on our customers' requirements of 2500 watts net per litre and we're confident we can achieve this target through improved stack polarization performance and advanced cell designs.

To summarize: we know what the technical challenges are, we have multiple technology paths that we are pursuing, and we are confident that we will demonstrate commercially-viable automotive fuel cell technology by 2010. As discussed, platinum will continue to play a pivotal role in the commercialization of automotive fuel cell technology. That said, we are in agreement with the conclusion that our colleagues at TIAX have reached in their DOE-commissioned analysis "Platinum Availability and Economics for August 4, 2006 PEMFC Commercialization"—the availability of platinum at a stable price should not be a barrier to fuel cell vehicle commercialization.

In closing, I'd like to recommend three important steps Congress can take to support fuel cell commercialization as it relates to platinum.

First, Congress should provide fuel cell R&D funding at levels authorized in the Energy Policy Act of 2005 to: (a) increase public-private research efforts to reduce platinum loadings while simultaneously improving fuel cell performance; and (b) increase public-private research efforts aimed at the development of non-precious metal catalysts to replace platinum. With respect to the latter, many of the alternative catalysts being investigated today are cobalt based, which offer a lower cost catalyst, but to date require a tradeoff of reduced performance and durability. Accordingly, we believe that while the substitution strategy is a good approach for the long-term, we do not see non-precious metal catalysts offering a viable alternative at the point when fuel cells begin the transition to market.

Second, Congress should investigate whether and what government actions may be necessary to ensure a proper platinum recycling framework is in place to support fuel cell vehicle commercialization.

Third, Congress should legislate a meaningful set of tax credits for fuel cell vehicles for a 10-year period beginning early in the next decade. These tax credits—which should be phased (decreasing in value over time—will help to mitigate the short-term increase in platinum prices that can be expected to occur as supply adjusts to new demand.

Thank you for the opportunity to appear before you today. I look forward to any questions you may have.

Mrs. DRAKE. Thank you, Mr. Guzy. Next is Mr. Rose.

STATEMENT OF ROBERT ROSE, EXECUTIVE DIRECTOR, U.S. FUEL CELL COUNCIL

Mr. ROSE. Thank you, Madam Chairman. My name is Bob Rose. I am the founding Executive Director of the U.S. Fuel Cell Council, the 120-member trade association of the fuel cell industry. Today's comments are my own, although I think they are fully consistent with the USFCC's policies, and, indeed, I hope they are.

Fuel cells generate electricity electrochemistry without combustion. They typically harness the attraction that hydrogen or a hydrogen-rich fuel has for oxygen. In effect, they redirect a stream of electrons during the course of a chemical reaction, thus producing a current that can be put to work. This process is inherently clean and inherently efficient, so fuel cells have inherent advantages over conventional systems.

Fuel cells are a family of technologies, and in the context of this hearing, it is important to recognize that different technologies use different materials. Generally speaking, the lower-temperature fuel cells use platinum group metals; fuel cells that operate at higher temperatures tend to use other materials.

Fuel cells are being developed for virtually every power need, from consumer electronics and defense to power generation systems, industrial equipment, off-road vehicles, cars, trucks, buses, and so on.

They do require high-tech materials, fuel cells do, and some materials are common to virtually all fuel cells, but there are significant differences. Chart 1 lists the key fuel cell materials other than platinum group metals, which are being addressed separately at the hearing. Some of the fuel cells use platinum group metals, some use base metal catalysts, and others rely primarily on heat. Materials on this list often are used in combination. Thus, molten carbonate fuel cells use lithiated aluminum oxide, and certain other solid oxide fuel cells use yttria stabilized Zirconia, but given my technical depth, I just say "ceramics and rare earths."

The fuel cell industry does face substantial materials challenges, but these relate to characteristics like expansion and contraction, heat resistance, purity, their suitability for mass manufacture, the close tolerances to which they must be manufactured, their resistance to contamination, and so on. The industry is working hard on these issues, and an incredible variety of materials are under active review, ranging from metals to microbes.

Any concern over supply in fuel cells generally has focused on the platinum group metals, and I think the PGM concern personally has been answered, but we will wait until the next witness as well.

The U.S. does rely on imports at present for several materials on the list, but I think there are several reasons to be optimistic that materials demand will not be a barrier to commercialization.

Firstly, we do not need the supply all at once. We will need significant material infrastructure eventually, but the market ought to have time to adjust, assuming that resource markets are functioning normally.

Second, materials costs are such an important part of the system cost, as Mr. Guzy mentioned, that there is going to be relentless pressure to use as little as possible of these materials.

Third, fuel cells are highly recyclable.

Fourthly, fuel cell developers and researchers are evaluating new materials, driven largely by cost reduction, although also by performance. The list today may not be the list we will see in 20 or 30 years.

Use of more benign fuels may also provide some relief on the materials front. Research to date has already allowed a substantial reduction in the anticipated volume cost of fuel cells, and that translates into smaller, lighter, better systems, and that also means more efficient use of component materials.

I would like to echo Mr. Guzy's recommendations on behalf of the Fuel Cell Council. Congress took a significant step to assist our industry in the Energy Policy Act of 2005. Fully funding it would bring more resources to bear on the search for materials.

Second, Congress approved an installation tax credit for fuel cells, but it is scheduled to expire at the end of next year. We support the pending legislation to extend the credit for an additional eight years.

Third, I think this Subcommittee may wish to examine materials recycling a little more closely, with emphasis on platinum group metals certainly in the short term, to identify areas where Federal intervention might be helpful or appropriate. An estimated 2,000 tons of platinum group metals are on the road worldwide on vehicles. That is more than 50 million ounces, according to International Platinum Association. Governments in Asia and Europe have implemented various recycling requirements and incentives that may be worth examining here in the United States.

The U.S. Fuel Cell Council has established a sustainability working group and is examining recycling issues on its own.

I would be happy to answer questions at the appropriate time, and I thank you for the opportunity to testify.

[The prepared statement of Mr. Rose follows:]

Statement of Robert Rose, Executive Director, U.S. Fuel Cell Council

My name is Robert Rose. I am founding Executive Director of the U.S. Fuel Cell Council, the 120-member trade association of the fuel cell industry. I began my work in fuel cells in 1991, and in 1993 established the nonprofit Fuel Cells 2000 education program at the Breakthrough Technologies Institute. The U.S. Fuel Cell Council followed in 1998. Thank you for this opportunity to participate in the discussion of materials and fuel cells.

I must say at the outset that I am presenting my personal views today, although I am confident that nothing in my remarks runs counter to the Council's stated positions.

Fuel cells generate electricity electrochemically, without combustion. Fuel cells have inherent advantages over conventional energy production systems, including greater efficiency, lower environmental impact, and enhanced design flexibility. The only byproducts of using a fuel cell fueled by hydrogen generally are water and heat; both can serve useful purposes in particular fuel cell applications.

Fuel cells are being developed for virtually every power need, including remote sensors; consumer electronics; defense applications; emergency and backup power systems; heat and electricity for homes, businesses and factories; industrial equipment; locomotives and other off-road vehicles; trucks, buses and the family car.

The primary public excitement—and the largest potential market—lies in fuel cell passenger vehicles. Fuel cells offer the greatest potential to reduce and ultimately eliminate our reliance upon foreign oil, enhance our national security, and reduce the environmental impact of fossil fuel combustion. Fuel cells are fuel flexible. They use conventional fuels efficiently, and can bring solar, wind power and other forms of renewable energy to the transportation sector.

Fuel cell vehicles can even serve as electricity generators. It is literally possible for a fuel cell car parked in the driveway to generate enough power for the home, and to supply a significant amount of additional energy to the grid.

Charts 1 and 2 list fuel cell types and explain their operation.

The subcommittee is evaluating whether an adequate supply of raw materials will be available to produce fuel cells and hydrogen in a cost-effective manner. To answer that question we must look inside the box.

While some materials are common to virtually all fuel cells, there are significant differences. Some fuel cells, for example, use platinum group metals (PGM) to stimulate the electrochemical activity. Others use base metal catalysts. Still others rely primarily on heat. Other speakers will address the PGM. Chart 3 lists the key fuel cell materials other than platinum group metals. These materials often are used in combination. Thus molten carbonate fuel cells use lithiated aluminum oxide. Some solid oxide cells contain Yttria stabilized Zirconia; given my technical depth I just say, "ceramics and rare earths."

The fuel cell industry faces substantial materials challenges. But these challenges relate to characteristics such as expansion and contraction, heat resistance, their purity, their suitability for mass manufacture, the close tolerances to which they must be manufactured, their resistance to contamination and so on. The industry is working hard on these issues, and a wide variety of materials are under active review, ranging from metals to microbes.

All these issues occupy the attention of the fuel cell industry; to date, any concern over supply of the materials has focused on the Platinum Group Metals, even though the U.S. relies on imports at present for most or all the supply of several materials on the list. There are a number of reasons for this confidence, I believe.

1. We will need a significant materials infrastructure eventually, but not right away and not all at once. Suppliers ought to have time to adjust to demand, assuming the resource markets are functioning normally. In the case of some materials there are plentiful supplies already.
2. Anticipated worldwide economic expansion will require additional materials of all kinds, and there is nothing exceptional about fuel cell materials that suggests they should be treated as a special case. The auto industry, for example, anticipates that the total number of vehicles on the road worldwide may reach 3.5 billion units by 2050—compared to fewer than a billion today. That suggests expanding demand for everything.
3. Fuel cells are highly recyclable. Whether motivated by economics or sustainability principles, recycling will play an increasing role in the economy in general. Here, there may be a role for government in helping stimulate recycling; governments in Japan and Europe have implemented various recycling requirements and incentives. The U.S. Fuel Cell Council has established a Sustainability Working Group, and recycling issues are high on its agenda. On the PGM front, the U.S. Geological Survey estimates that 70 tons of PGM is recycled annually in the US, primarily from auto catalysts.
4. Fuel cell developers and researchers all over the world are evaluating new materials, and searching for ways to use critical materials more efficiently; they are driven by cost reduction. Thus, the list we put together today may not be—indeed, likely will not be—the critical list in 20 or 30 years. It also means that today's catalyst formulations will certainly be replaced by supported catalysts and catalyst alloys that work better, and cheaper.
5. Research achievements to date have already allowed a substantial reduction in anticipated volume cost for fuel cells. And that translates into smaller, lighter, better systems and more efficient use of component materials.

The fuel cell industry is investing heavily in this research because, while fuel cells are meeting customer needs in some niche markets today, full commercialization depends on cost reduction. And thus, harvesting the benefits that fuel cells can bring to our energy and environmental priorities also depends on it.

Congress has already taken significant steps to assure a strong public-private partnership toward this end. The Energy Policy Act of 2005 commits us to a 15 year development effort that covers not only research, but also demonstration, technology validation, federal purchases and market entry support. Building on this beginning, I would suggest the following.

1. The Administration's budget request for 2007 does not fully reflect the Congressional will as expressed by the authorizations in EPACT. Fully funding EPACT, including the fuel cell purchase programs, will be a significant boost for the industry, although I should emphasize that even at these levels the industry's own investment is far larger than the federal share, as it should be.
2. Congress approved an installation tax credit for fuel cells, but with a two-year time line. We support legislation proposed in both House and Senate to extend the credit for an additional eight years.
3. This Subcommittee may also wish to examine the issues related to materials recycling, with particular emphasis on platinum group metals, to identify any areas where federal intervention might improve the process or stimulate additional recycling activity. An estimated 2000 tons are "on the road" worldwide, according to the International Platinum Association.

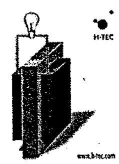
I want to thank the Subcommittee, and you, Mr. Chairman, for this opportunity to testify. I would be happy to answer any questions, to the best of my ability.

Slide 1

Fuel Cells - Defined

Fuel (H_2) + O_2 / Catalyst → (H_2)O + Heat

Fuel cells harness the chemical energy of a fuel to produce electricity. The only by-products are water and useful heat.



Slide 2

A Family of Technologies

Type	Efficiency	Operating Temp.
Solid Oxide	45-65%	800°C
Molten Carbonate	50%	650°C
Phosphoric Acid	40%	200°C
Alkaline	50-60%	80°C
Direct Methanol	40%	80°C
Polymer (PEM)	40%	50°C

Regenerative, Metal-Air, Organic

Slide 3

Fuel Cell Materials

- Carbon/graphite
- Ceramic materials/rare earths
- Stainless steel
- Various polymers
- Nickel
- Silicon/glass
- Lithium
- Sodium, Potassium
- Zinc / Aluminum

Slide 4

No Supply Limitations Anticipated

- Demand will increase gradually
- Materials must be used sparingly to meet aggressive cost targets
- Fuel cells are highly recyclable
- Systems will evolve; today's list may not be tomorrow's
- Research already paying off in smaller, lighter, better systems

Slide 5

Next Steps

- Fully fund EPACT research, demonstration, technology validation, federal purchases
- Extend installation tax credits
- Evaluate incentives for recycling

Mrs. DRAKE. Thank you, Mr. Rose. Mr. Carlson?

STATEMENT OF ERIC J. CARLSON, PRINCIPAL, TIAX, LLC

Mr. CARLSON. Thank you, Madam Chairman, Members of the Subcommittee, and guests. I want to thank you for the opportunity to appear here today to discuss with you the study that TIAX conducted for the Department of Energy in 2003, and the purpose was to understand the potential impact of fuel cell vehicle commercialization on the availability and price of platinum.

TIAX LLC is a technology development company founded in 2002 by Dr. Kenan Sahin when it acquired the R&D laboratories of the former Arthur D. Little Company, which was founded in 1886. TIAX is located in Cambridge, Mass., has a broad range of technology expertise and experience in various end-use markets, particularly those associated with energy and power, including portable, stationary, and transportation markets.

The use of fuel cells in transportation could play a critical role in developing a hydrogen economy, which could, in turn, lead to a greatly reduced reliance on foreign oil. Platinum is an essential element in fuel cell performance as it catalyzes the electrode reactions and consequently determines the power density and efficiency of the fuel cell. It is also the largest cost component of the fuel cell system, accounting for approximately 50 percent of the fuel cell system. We have estimated this at a high-volume cost projected out in the future. For this reason, the DOE has invested significantly in R&D to reduce platinum loadings, increase activity of platinum catalysts, and develop platinum-free catalysts in the long term. The DOE commissioned our investigation as part of this effort.

We agree that the committee's question concerning platinum availability is a timely one, given the recent highs in platinum price, China's commodity needs, higher platinum requirements in fuel cell vehicles than today's cars, and the critical role that platinum plays in PEM fuel cell technology. Even though this study was conducted in 2003, we believe that the findings are still very relevant to the committee's inquiry.

Before discussing the project findings, I would like to summarize the scope of the assessment. The timeframe of the projection which we made in the study went from 2005 to 2050, a long time for a projection. Platinum markets considered included jewelry, transportation, industrial, and stationary fuel cells. Vehicle projections were done for five regions, including North America, Western Europe, Japan, India, and China, and the price behavior of platinum, we looked back retrospectively to 1880. Market penetration scenarios for fuel cell vehicles by 2050, we considered 50 percent and 80 percent market penetration.

In developing our findings, we could not account for the impact of political instability in major platinum-producing countries, control of platinum production by a limited number of companies in the major producing countries, future growth or decline in the world economy, or significant increases in platinum demand from new applications other than fuel cells.

Because of the complexity of this topic, our primary objectives were to develop insights into key factors and interactions that would influence platinum price and availability, identify what factors might limit adoption of fuel cell powertrains for transportation.

The study focused on answering whether the successful introduction of fuel cells in transportation could be threatened by platinum price increases and limitations in platinum supply in the long term. Specifically, can long-term primary platinum resources accommodate the new demand from fuel cell markets, including transportation, stationary, and portable? How will supply operations [mining and refining] respond to increases in market demand, and what role will recycling play in the supply chain as fuel cell markets develop? Will the relationship between supply, demand, and price of platinum change as fuel cell markets develop?

Key findings of the study were fundamental availability of platinum resources, in of itself, should not be a barrier to mass commercialization of fuel cell vehicles. However, efficient recycling of platinum from fuel cell stacks will be necessary to minimize the demands on primary platinum production.

The platinum industry indicated that it could ramp up production rates to approximately 14 megagrams per year. This would allow market penetrations of 50 percent but not the 80 percent scenario. Consequently, the ability to ramp up production capacity could limit fuel cell commercialization, depending on the rate of fuel cell vehicle adoption. For comparison, during the introduction of catalytic converters, production capacity increased at a rate of three and a half megagrams per year, or about one-third the rate of fuel cell vehicle adoption.

Analysis of historical price data showed a constant mean real price of $550 per troy ounce in 2003 dollars. Since 1880, the price of platinum has shown periods of volatility, but it has always returned to a long-term mean, indicating a stationary price. Interviews with the platinum industry confirmed this observation of a stationary, real platinum price driven by the desire of the industry to keep end users from substituting other metals for platinum.

Mass commercialization of fuel cell vehicles could dramatically change the balance of platinum markets from today's roughly 40/40/20 split between transportation, jewelry, and industrial applications to a market dominated by transportation.

Those are the key findings, and I would like to thank Madam Chairman for the opportunity to discuss this important subject. This concludes my testimony, and I would be happy to answer any questions. Thank you.

[The prepared statement of Mr. Carlson follows:]

Statement of Eric J. Carlson, Principal, TIAX LLC

Mr. Chairman, Members of the Subcommittee, and guests, thank you for the opportunity to appear here today to discuss with you the study that TIAX conducted for the DOE in 2003 to understand the potential impact of fuel cell vehicle commercialization on the availability and price of platinum.

TIAX LLC is a technology development company founded in 2002 by Dr. Kenan Sahin, when it acquired the R&D laboratories of the former Arthur D. Little, Inc., which was founded in 1886. TIAX, located in Cambridge, MA, has a broad range of technology expertise and experience in various end-use markets, particularly those associated with energy and power (portable, stationary, and transportation).

The use of fuel cells in transportation could play a critical role in developing a hydrogen economy, which could in turn lead to a greatly reduced reliance on foreign oil. Platinum is an essential element in fuel cell performance as it catalyzes the electrode reactions and consequently determines the power density and efficiency of the fuel cell. It is also the largest cost component of the fuel cell system, accounting for approximately 50% to the projected high volume manufacturing cost for systems with today's performance. For this reason, the DOE has invested significantly in R&D to reduce platinum loadings, increase activity of platinum catalysts, and develop platinum-free catalysts in the long term. The DOE commissioned our investigation as part of this effort.

We agree that the Committee's question concerning platinum availability is a timely one given the recent highs in platinum price, China's commodity needs, higher platinum requirements in fuel cell vehicles than today's cars, and the critical role that platinum plays in PEM fuel cell technology. Even though this study was conducted in 2003, we believe the findings are still very relevant to the committee's enquiry.

Scope of Platinum Project

Before beginning the discussion of the project findings, I'd like to summarize the scope of the assessment:

- Timeframe of the projection—2005 to 2050
- Platinum markets—jewelry, transportation, industrial, and stationary fuel cells
- Vehicle projections for five regions—North America, Western Europe, Japan, India, and China
- Price behavior of platinum—1880 to 2002
- Market penetration scenarios of fuel cell vehicles by 2050—50% and 80%

In developing our findings, we could not account for the impact of:

- Political instability in major platinum producing countries
- Control of platinum production by a limited number of companies in the major producing countries
- Future growth/decline in the world economy
- Significant increases in platinum demand from new applications other than fuel cells

Because of the complexity of this topic, our primary objectives were to:

- Develop insights into key factors and interactions that would influence platinum price and availability
- Identify what factors might limit adoption of fuel cell powertrains for transportation.

The study focused on answering whether the successful introduction of fuel cells in transportation could be threatened by platinum price increases and limitations in platinum supply in the long term. Specifically:

- Can long-term, primary platinum resources accommodate the new demand from fuel cell markets (transportation, stationary, and portable)?
- How will supply operations (mining and refining) respond to increases in market demand?
- What role will recycling play in the supply chain as fuel cell markets develop?
- Will the relationship between supply, demand, and price of platinum change as fuel cell markets develop?

Key Findings

- Fundamental availability of platinum resources in of itself should not be a barrier to mass commercialization of fuel cell vehicles. However, efficient recycling of platinum from the fuel cell stacks will be necessary to minimize the demands on primary platinum production.
- The platinum industry indicated that it could ramp up production rates to approximately 14 Mg/year. This would allow a market penetration scenario of 50% (11 Mg/year) but not the 80% scenario. Consequently, the ability to ramp up production capacity could limit fuel cell commercialization depending on the rate of fuel cell vehicle adoption. For comparison, during the introduction of catalytic converters, production capacity increased at a rate of 3.5 Mg/year.
- Analysis of historical price data showed a constant mean real price of $550/tr.oz. in 2003 dollars. Since 1880, the price of platinum has shown periods of volatility, but it has always returned to its long-term mean, indicating a stationary price. Interviews with the platinum industry confirmed this observation of a stationary real platinum price driven by the desire of the industry to keep end-users from substituting other metals for platinum.
- Mass commercialization of fuel cell vehicles would dramatically change the balance of platinum markets from today's rough 40/40/20 split between transportation, jewelry, and industrial applications to a market dominated by transportation (e.g., 75-90%).

Basis for the Study

Platinum Supply and Markets

As part of the study we delved into the background of platinum and PGM materials. Aside from their unique chemical properties, platinum group metals (PGMs) have their own geology, supply, and markets. Due to the unique geology of the Bushveld Complex, South Africa dominates the supply and projected resource of platinum, accounting for roughly 70-80% of both. Russia is the next major supplier of platinum, with about 10-20%. The rest of the world, including the U.S. accounts for the balance, about 10%. The geographic concentration of supply and resources naturally raises concerns.

In 2003, markets were largely driven by the demand for autocatalysts and jewelry (40% each). Industrial (glass, chemical, petroleum) and electrical applications consumed the remaining 20%. However, since the study was conducted, several factors have led to steadily increasing demand from the transportation sector: increasingly stringent auto emissions regulations on both gasoline and diesel vehicles, the unique ability of PGMs to catalyze auto exhaust clean-up, and rising auto markets in China.

Project Methodology

In addition to the technology capabilities within TIAX (e.g., fuel cells, catalysis, and automotive powertrains) we retained two university professors to assist with economic modeling (Professor Walter Thurman, Department of Agriculture and Resource Economics, North Carolina University) and PGM mineralogy (Professor Grant Cawthorn, Platinum Industry's Professor of Igneous Petrology, University of the Witwatersrand, South Africa). During the project, we obtained inputs and feedback from the car companies and the platinum industry.

To develop projections of platinum demand arising from fuel cell vehicle introduction, we had to:

- Estimate how much platinum would be required per vehicle and created a timeline for the technology evolution (amount of platinum per kilowatt of stack power)
- Estimate vehicle sales in the considered regions
- Define scenarios for fuel cell vehicle market introduction and penetration with assumptions for vehicle life and platinum recovery rates
- Assess the sufficiency of platinum resources. The primary platinum production over the period of the projection was integrated and compared with available resource projections

For the purposes of this study we assumed a 75 kW fuel cell power plant hybridized with batteries would be representative of a mid-size vehicle. Starting in 2005, we assumed that platinum requirements would decrease from 60 grams per vehicle to15 grams per vehicle in 2025 and then remain constant until 2050.

We based our vehicle projections on estimates of population growth and vehicles per capita in the five regions. In the mature automotive markets in the United States, Western Europe, and Japan, we assumed high per capita vehicle populations (i.e., 0.7 to 0.84) in 2050. For China and India, with values on the order of 0.01 vehicles per capita today, we considered future scenarios ranging from 0.1 to as high as 0.25 vehicles per capita. With these assumptions, the world vehicle fleet was projected to approximately double by 2050 driven by markets in the U.S., India, and China. In 2050, our assumptions led to annual vehicle sales of 72 million for the five regions. For comparison, in 2000, 41 million vehicles were sold worldwide with the five regions representing 75% of this value.

The next step in projecting platinum demand was the definition of fuel cell vehicle market penetration scenarios. Two scenarios were defined with market penetrations of 50% and 80% by 2050. For the 50% scenario, the production of vehicles for the selected regions was projected to be 72 million in 2050. In the Developed Countries, fuel cell production volumes were projected to be 20 million per year in 2050 for this scenario with annual increases of 1 million vehicles per year during the ramp up to 50% market penetration.

Based on the 50% scenario, we then integrated the cumulative primary platinum production over the time of the projection for all applications. The cumulative primary production (20,000 Mg) was less than the platinum resource base of 76,000 Mg projected by experts in the field.

Our conclusion that prices will return to historic mean prices depends on demand staying in balance with supply. Recycling will be critical to limiting the increases in primary platinum production.

Thank you, Mr. Chairman, for the opportunity to discuss this important subject. This concludes my testimony. I would be happy to answer any questions you may have.

Exhibit 1 **Historic price behavior indicates that as long as supply and demand remains in balance, the long-term real price of platinum will be stable.**

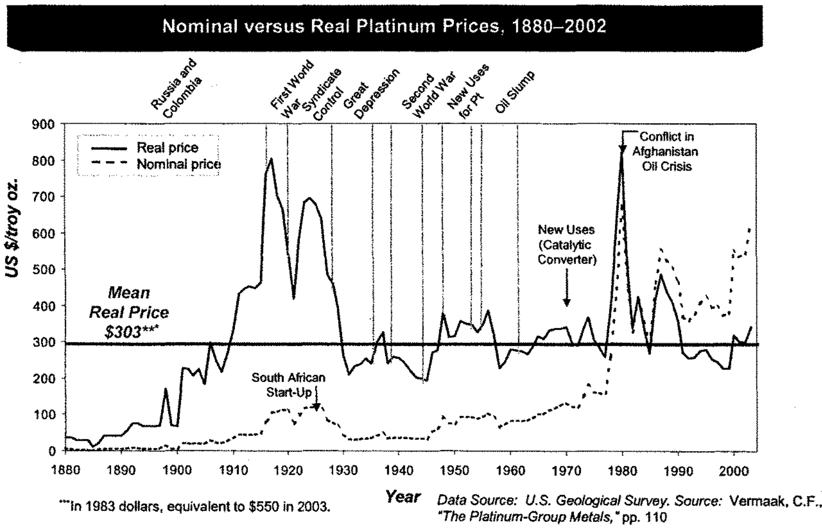
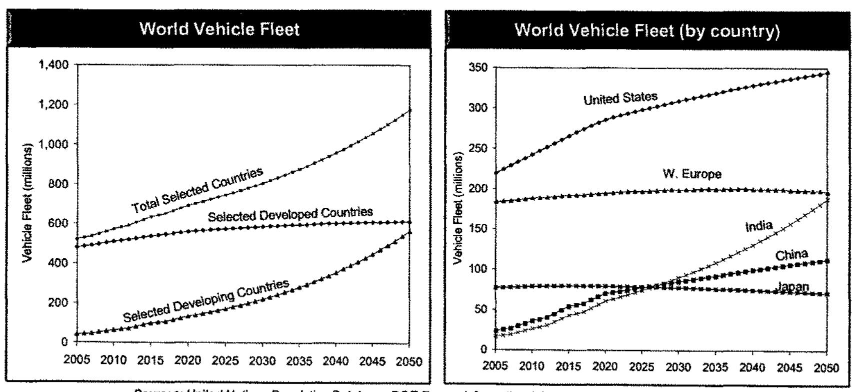


Exhibit 2 **Growth in the world vehicle fleet will be driven by markets in the U.S., India and China.**



Sources: United Nations Population Database, DOE Energy Information Administration Annual Energy Outlook 2003.
Rest of world may add 20% to vehicle sales based on 2000 statistics (Ward's).
Assumed 0.25 veh/cap and 0.15 veh/cap (Moderate Scenario) for China and India respectively in 2050.

Exhibit 3 **We used two market penetration curves to estimate the impact of fuel cell vehicles on platinum demand.**

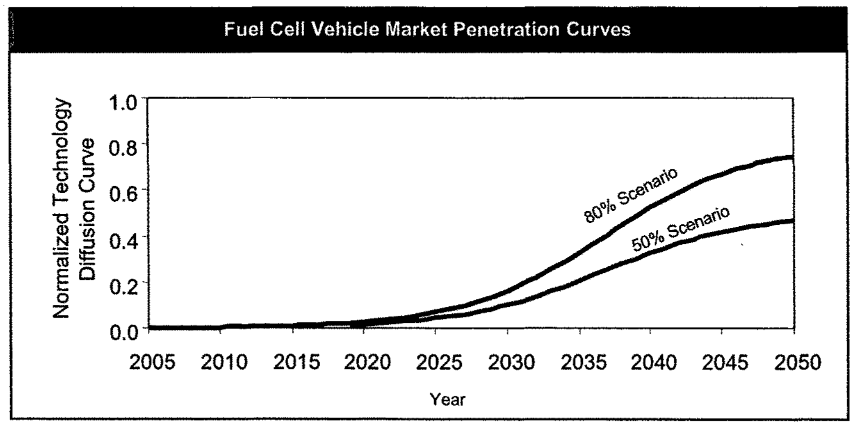


Exhibit 4 **Introduction of fuel cell vehicles would require increased rates of annual production. Discussions with the platinum industry suggested that production growth rates needed for the 80% scenario could not be met.**

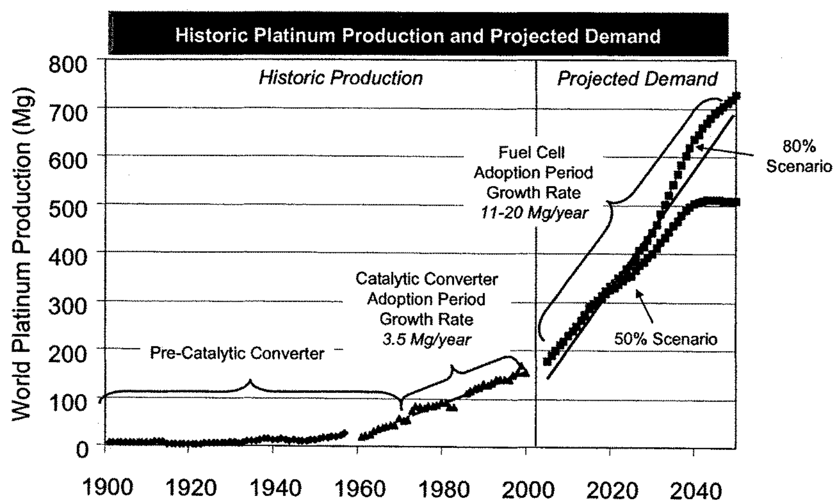


Exhibit 5 **The complex interplay between recycling, fuel cell vehicle market penetration, and Developing Country market dynamics leads to steep increases in platinum demand in China and India after demand peaks in the developed countries. The latter due to recycling.**

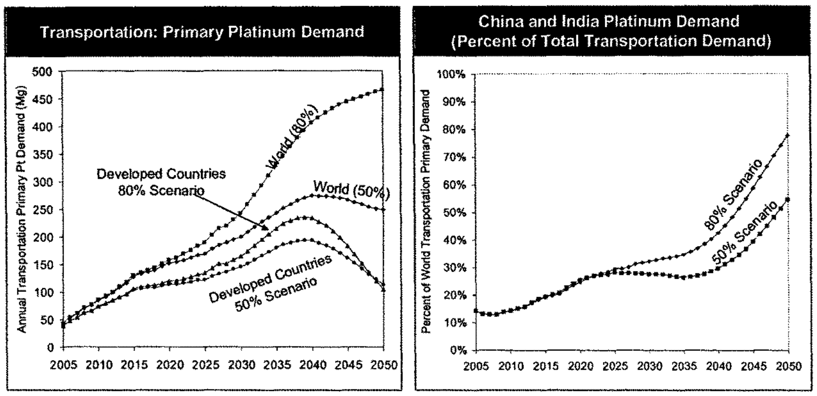
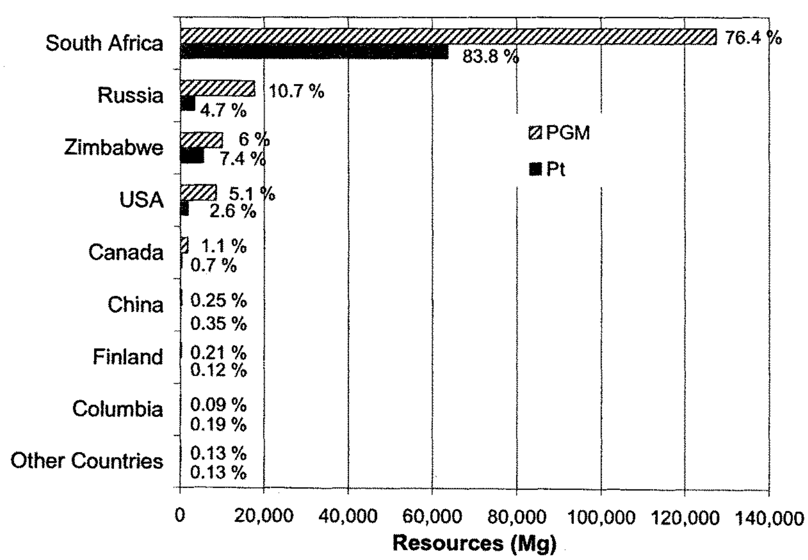


Exhibit 6 **The projected demand of 20,000 Mg would be less than the currently estimated resource of 76,000 Mg.**



Compiled from a variety of sources, including Cawthorn, Vermaak, Page, Mining Weekly, and Stribyn

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Mrs. DRAKE. Thank you, Mr. Carlson. And, Mr. Copulos, you made an impression on me a few weeks ago when you made your comment about we face economic collapse or a resource war. So welcome back.

STATEMENT OF MILTON R. COPULOS, PRESIDENT, NATIONAL DEFENSE COUNCIL FOUNDATION

Mr. COPULOS. Thank you, Madam Chairman, and like Yogi Berra, it is sort of deja vu all over again. Two weeks ago, as you noted, when I was here we said that we face this potential for a Hobson's choice between economic collapse and a global resource war, and it is just as true about minerals as it is about energy, the major difference being, I think, that you go up to a gasoline pump periodically and fill your tank, so you are aware of what has been happening with energy prices, but people do not do the same with copper or platinum or any of the other host of minerals that we rely on. Yet if you take a look at what the numbers show, the increase, in some cases, has been even higher.

We are looking at a platinum price, I was just informed this morning, of $3.80 a pound. That is over a fivefold increase since 2001. We are looking at platinum running about 1315. We are looking at the price per ton of nickel increasing almost three times the last four years. All of these things are having an impact on us and on our economy and bode ill for the future.

But what makes this even more of a sort of deja vu experience for me was that in the late 1980s I had the great privilege of serving in the Reagan White House, at their request, to author the first, and what, unfortunately, was the last, National Critical Materials Report, and in that report, our Chairman, in introducing it, Don Hodel, who was interior Secretary at the time and also served as chairman of the council, said something that I think is quite important for us to bear in mind. He said, Perhaps one way to visualize the U.S. economy is it is a pyramid in which service and commercial sectors are at the apex, the high tech sector is the next layer down, and those sectors are followed by light industrial and heavy industrial sectors, and I will submit, at the very bottom of the period, its foundation, if you will, are energy and minerals extraction and processing industries and agriculture.

He continued to say, Our economic strength is vital to our ability to defend ourselves against foreign attack upon the United States and its allies. Our capability to defend this nation is weakened if there is peril to the foundation of the economic pyramid, which is integral to our national strength. In other words, if our energy and minerals production is jeopardized, or if our supplies are short, our nation's security is threatened, and I think no truer words could be spoken.

You know, we have talked a lot over at the Department of Defense about the new battlefield, the electronic battlefield. Excuse me. One of the signs of old age is the barber spends more time trimming the hair on your ears and on the top of your head. The other is you need two pairs of glasses.

At any rate, as we take a look at the electronic battlefield of the future where there all of these different things, in the end they get down, in a large degree, to communications, and for communications we need things like copper, we need platinum, we need rare earth, things that are in short supply and, in some cases, that we do not produce here.

One of the things that strikes me: We are concerned about importing 65.3 percent of our oil supplies, and yet there are 33 minerals, important minerals, which we are more dependent upon for imports than oil. We import more than 65 percent of them, and they do include things like platinum and chromium and cobalt and things that are absolutely essential defense commodities. Indeed, there are 16 minerals we have to support 100 percent of. We are completely dependent on imports, and what is worse, in some of the cases, one reason we are as dependent as we are is that we are unable to access supplies that are right here in our own borders that we could be using.

One other point that I do want to make as well is the importance of information. It was mentioned earlier, and I will tell you that in the experience of doing the National Critical Materials Report and in doing some classified work in the area of minerals at the behest of the Director of Central Intelligence, one of the things that I found absolutely essential was the ability to obtain information from people at the then-Bureau of Mines, Minerals Management Service. It was absolutely essential to have that, and one of the other things I witnessed was how easily conclusions get skewed by internal agendas, misconceptions, or people that refuse to face the facts.

So I would say that in addition to focusing on the very, very great importance of utilizing our domestic minerals, recycling, and so on, we also need to focus very, very much on the importance of having good information because without good information, you cannot make good decisions, and, quite frankly, this is an area so vital to our national security, we cannot afford to make bad decisions.

[The prepared statement of Mr. Copulos follows:]

Statement of Milton R. Copulos, President,
National Defense Council Foundation

Good Morning

My name is Milton R. Copulos and I am President of the National Defense Council Foundation.

Two weeks ago I appeared before this Subcommittee to address the grave danger oil imports pose to our economy and our nation's security. This issue has been a dominant topic in the news over the past two years, gaining renewed attention with each increase in the pump price of gasoline. Yet, I am here to say today, that we face an even greater danger from our dependence on imported nonfuel minerals.

Consider this, if you will.

We are deeply concerned about the fact that we currently depend on foreign sources of supply for 65.3% of our crude oil and refined petroleum product supplies. Yet, we rely on an even greater proportion of imports for 33 different minerals and 100% dependent on foreign supplies for 16 mineral commodities. Included among those we upon which we are entirely import-dependent are such critical commodities as columbium which is essential to the manufacture of jet engines and rocket subassemblies; manganese, which is essential to iron and steel production; yttrium, which is essential to the manufacture of microwave communications equipment, rubidium which is essential to the manufacture of vacuum tubes and photocells, and vanadium which is essential to the manufacture of superconductors.

We also rely on imports for 91% of our platinum and tantalum, 78% of our palladium and 70% of our tungsten.

The vulnerability this dependence creates cannot be overstated, and, like the vulnerability that has accompanied our dependence on imported oil, it is a problem that has persisted over time.

Indeed, the problem first came prominently to my attention nearly two decades ago when I had the great privilege of serving in the Reagan White House as a consultant to the National Critical Materials Council. I had been brought in to author the nation's first, and unfortunately last, National Critical Materials Report. That report included a quote from congressional testimony presented on March 31, 1987, by the Council's Chairman, Interior Secretary Donald P. Hodel in which he stated:

> "Perhaps one way to visualize the U.S. economy is as a pyramid in which the service and commercial sectors are at the apex, the 'high-tech' sector is the next layer down, and those sectors are followed by the light industrial and heavy industrial sectors. And, I will submit, at the very bottom of the pyramid—its foundation if you will—are our energy and minerals extraction and processing industries and agriculture."

What Secretary Hodel said nineteen years ago is just as valid today. Our energy and minerals extraction and processing industries are, indeed, an essential element of the foundation upon which all other economic activity rests. If these sectors are in any way threatened, then our entire economic well being is threatened as well.

Secretary Hodel made another point in his statement that also has relevance to our present condition. He said:

> "...our economic strength is vital to our ability to defend ourselves against foreign attack upon the United States and its allies. Our capability to defend this Nation is weakened if there is peril to the foundation of the economic pyramid, which is integral to our national strength."

Despite the fundamental truth of the warning contained in Secretary Hodel's statement, it has been ignored over the ensuing years. Indeed, over the past fifty-odd years, we have witnessed a dramatic reversal of the our nation's long-standing tradition of encouraging development of domestic energy and minerals resources, to the point that such development has become close to impossible in many cases. In so doing we ignored the lessons of recent history. But perhaps this was inevitable.

In a letter President Dwight D. Eisenhower sent to Senator Clifford P. Case in 1963, three years after leaving office the former Supreme Allied Commander described the difficulties mineral shortages posed in World War II, and how the lessons of those shortages remained unlearned in the period that immediately followed:

"You will recall that when we became involved in World War II our lack of an adequate stockpile of strategic and critical materials gravely impeded our military operations. We were therefore forced into costly and disruptive expansion programs. The Nation was compelled to divert, at the most critical time, scarce equipment and machinery and manpower to obtain such necessary materials. However, the need for such a program was recognized and theoretical objective established on a predicted 5-year war."

> "But even after this experience we had not fully learned our lesson. After World War II stockpiling was confined too much to mere talk, it neglected implementation. After we became involved in Korea, we went through experiences almost identical with those of World War II—only then did realistic stockpiling begin."

What makes today's import dependence an even more serious threat than it was in the last century is the dramatic change that has taken place on the world economic stage. The exploding economies of China, India and parts of Eastern Europe have created unprecedented competition for scarce mineral supplies. As a consequence, although largely unnoticed by the public, these prices for these commodities have experienced price increases similar to those that have shaken the world oil market.

For example, in 2001, a pound of copper sold for $0.76 cents. Today it costs $3.19. In that year a pound of aluminum sold for $0.68. Today it costs $1.31. In 2001 an ounce of platinum cost $533, today it costs $1,315. Since 2001, Nickel has gone from $5,945 per ton, to $17,921—an increase that matches that of crude oil.

But it is not just the increase in price that is a concern—there is also grave cause for concern over availability. This concern is even greater in relation to certain strategic and critical materials. This month, it was reported that shortages of U.S. stocks of specialty metals was jeopardizing our ability to keep helicopters flying in Iraq. The shortages included such things as titanium and specialty steel used in the aircraft's bearings.

But the concern over mineral shortages should not be limited to exotic or specialty materials. One of the most important defense commodities is copper. In fact, during World War II, copper shortages led to the minting of zinc-coated steel pennies so that the copper otherwise used for coinage could be diverted to war production. Today, copper is even more important to defense production than it was in the 1940s.

For example, in addition to its use as a jacket for small arms ammunition and as a component of the brass used for cartridge and artillery casings, copper also is used for the core of shaped anti-armor charges. Moreover, with the advent of the electronic battlefield, the need for copper wire for a whole range of electronic equipment has grown exponentially.

What is perhaps most disturbing about our growing mineral dependence is that, like our dependence on imported oil, it is largely unnecessary. In all too many instances, our dependence is at least in part, the consequence of restrictions on access to federal lands where domestic sources of the minerals so important to our economy and national security can be found.

Platinum, cobalt and chromium provide useful examples.

We currently import 91% of our platinum requirements, with the balance primarily obtained through recycling. We import 69% of our chromium requirements, with the balance obtained through recycling. Yet, the Absaroka-Beartooth Wilderness in Montana contains reserves of both chromium and platinum-palladium ores. As a consequence we cannot access these critical resources. In the case of cobalt, we rely on imports for 78% of our needs with the balance coming from so-called secondary production such as recycling scrap and some releases from strategic stockpiles. As with chromium and the platinum group metals, we have domestic deposits near the Blackbird mine in Idaho, but they extend into the River of No Return Wilderness, and therefore cannot be accessed.

In other words, as in the case of domestic energy production, we suffer more from a lack of will than of resources.

This is not to say, however, that we can be self-sufficient in terms of mineral resources. There are some minerals that do not naturally occur within our borders and others that are not available in quantities sufficient to meet domestic needs. This is why it is necessary to maintain strategic stockpiles. Here again, however, we are falling short of the mark. Unfortunately, our strategic stockpiles have too often been viewed as sources of quick cash for federal coffers. As a consequence, there is continual pressure to sell them off, or to fail to maintain them at adequate levels. Failing to maintain adequate strategic stockpiles, however, may seem to offer some short term economic gains, but in the long run will only lead to enormous economic penalties.

In the process of writing the National Strategic Minerals Report, as well as designing the Advanced Materials Program Plan for the National Critical Materials Council, we examined the costs of not stockpiling essential minerals and materials. We determined that it cost eight times as much to obtain them after the fact than it did to stockpile them in advance. In short, failure to make adequate preparations was a classic case of being penny wise and pound foolish.

Moreover, our mineral dependence also threatens efforts to become energy independent.

Take the hybrid electric vehicle as an example.

A conventional automobile contains around 50 pounds of copper. A Toyota Prius contains 100 pounds, and larger hybrids can contain 150 or even 200 pounds. If we are to expand the fleet of these fuel-efficient automobiles and trucks, we are going to need a lot more copper.

What about fuel cells?

At present fuel cells require platinum group metal catalysts—about 3 and a half ounces for each unit. If we are to greatly expand the use of fuel cells, we are going to need a lot of these minerals. But we will not be the only nation seeking them. China has indicated it plans to add 120 million new vehicles to its fleet, all of which will use western-style pollution control technology—that is catalytic converters.

Biofuels and Ethanol are also mineral dependent.

The fueling system modifications needed to make vehicles capable of using high concentrations of ethanol such as E-85 require brass and chrome fittings due to the corrosive nature of the fuel. Moreover, if we are to significantly expand our production of alternative fuels, we will need conventional minerals and materials such as steel, concrete and aluminum to build their manufacturing facilities.

Given our perilous dependence on nonfuel minerals, the logical question is what must we do? Where is our greatest deficiency?

The answer is simple: our greatest deficiency is leadership. It is time for someone to sound an urgent alarm about our mineral dependency and the threat it poses to our nation. I believe that this committee can provide that leadership.

The members of this committee have been at the forefront of attempts to expand access to our domestic mineral resources and to bring some sanity to the regulation that has so hindered the ability of mineral producers to operate within our borders. It is more urgent than ever for that message to be communicated to the public and to your colleagues in the halls of Congress.

Two weeks ago I told this committee that our nation faces a Hobson's choice between economic collapse and global resource war if nothing is done about our dependence on foreign oil supplies. The same statement could as easily be made about our dependence on imported supplies of minerals. The same nations that are competing with us for energy are competing for minerals as well, and the consequences of that competition are just as potentially explosive.

Therefore, I urge the committee to voice its concern in the strongest possible way, and to make every effort to educate their colleagues about the dangers inherent in our current dependence.

Mrs. DRAKE. Thank you very much. That is very important: We cannot afford to make bad decisions. Thank you for being here with your testimony and your information.

Mr. Guzy, I am going to start with you. When do you see fuel cell vehicles being commercially available, and when do you expect them to represent a sizable percentage of the market?

Mr. GUZY. Most OEMs have announced first commercial launch for fuel cell vehicles in the 2014-to-2016 timeframe, and in that timeframe there would be tens of thousands of vehicles available. Many of them are planning more than one demonstration fleet generation of products between now and then.

In terms of significant amounts of vehicles, in 2014 to 2015, we expect at Ballard about 50,000 vehicles to be deployed worldwide. We agree with TIAX's conclusion that in the 2050 timeframe, somewhere between 50 to 80 percent of vehicles worldwide will be fuel cell powered.

Mrs. DRAKE. Now, this next question, all of you may want to weigh in, but I will start with Mr. Guzy. I did hear we do need to fully fund and extend tax credits. What do you think would be the most effective measures that government could do today to support fuel cell commercialization?

Mr. GUZY. In addition to the tax credits, they recognize that full funding on the R&D side, in particular, is important. Also, it would be useful in the industry if government became a purchaser of fuel cell products. The procurement side of things could help drive early volume and early adoption.

Mrs. DRAKE. Very good. Thank you. Did anyone else want to comment on that question? Mr. Rose?

Mr. ROSE. I would agree with that. The Energy Policy Act recognized that commercializing this technology is a process. It is a process that really has already begun because there are some fuel cell units in customer hands today in specialty applications in areas where the current cost of the fuel cell is not a barrier to the market. This industry needs to find ways to reduce its costs. Volume is certainly one piece of it, and a design based on the experience of initial customers is another.

So not just the research, which is extremely important, but also that early market experience is extremely important.

The Defense Department loves fuel cells, loves the potential of fuel cells, because they have the potential to save soldiers' lives. They operate very quietly and with a low heat signature typically. That is another area where I think there is an opportunity to get units, providing customer needs and building those volumes that we need.

Mrs. DRAKE. Mr. Carlson?

Mr. CARLSON. As a technology development company, one thing we would say is that in terms of encouraging young people to enter into these fields and provide that knowledge base and that experience base to develop the technologies would be important going forward also.

Mrs. DRAKE. Thank you. Mr. Copulos, did you want to weigh in? OK.

Mr. Rose, obviously, recycling facilities will need to be developed to foster reuse of fuel cell materials. Do you think that our Federal recycling policies need to be reviewed? Is there work we need to do on that and make them more recycling friendly?

Mr. ROSE. Recognizing that this is not my field, I certainly would not object to that, and it may well provide some useful information and experience. I think if you look around the world, Europe and Japan have, in particular, taken pretty aggressive steps to, in some cases, require the recycling of major consumer goods. Now, in this country, we do not tend to do that, but I think perhaps we can learn something from the experience of those countries in how the industry responded to those mandates and perhaps in some way, either by stimulating interest or developing voluntary programs perhaps short of regulation, we might be able to do some things in the short term.

There is a worldwide interest that is both economic and also, I think, a sense around the world that sustainable systems are what we are going to need in the long term. So I think there is some work that could be done there, and there are people and experiences that we can learn from.

Mrs. DRAKE. Thank you, and I would also like to ask you, and the rest of the panel may also want to jump in on this one, and that is, if the fuel cells are commercialized, what changes in the infrastructure of transportation systems will be required? In particular, how do you get it? What happens to your corner gas station?

Mr. ROSE. I am going to resist a flippant answer.

Mrs. DRAKE. You can do flippant. It is OK.

Mr. ROSE. We would like to have these problems. That would mean that there were sufficient products on the street and sufficient demand so that we would need to concern ourselves with a substantial uptick in infrastructure investment.

I would like to make a couple of observations, if I could, on this issue. As is the case with the materials that go into the fuel cell, the supporting infrastructure is going to be necessary, but it is not going to be needed all at once. The figure of perhaps 50 percent penetration in 2050 implies a great deal of vehicles, but it also is a 45-year ramp-up period. So we are going to have some time, and my view is that the fuels industry and perhaps some competitors, when they see an opportunity to make money supplying fuel and the supporting infrastructure for fuel cells, they will come in, and they will do that. That is the way our system works. There is no reason, neither technical nor practical, why one could not convert gas stations into fuel stations. Several oil industry members of the Fuel Cell Council who are actually pursuing this marketplace are hoping that the marketplace will develop, keeping an eye on it, if you will.

Finally, you know, the gasoline infrastructure is not free. It has been estimated that meeting a new gasoline demand worldwide is going to cost something like three trillion dollars over the next couple of decades, and, to some extent, it is just an allocation of resources, that some of that, in my view, ought to be going to fuel cell fuels, hydrogen-rich fuels. You may have to pay a little bit of a premium in the short term. The concern for kind of the need for an instantaneous national infrastructure, I think, may be a little bit overblown.

Mrs. DRAKE. Did anyone else want to weigh in?

Mr. COPULOS. I think one of the other things we have to bear in mind is when we talk about a fuel cell infrastructure, we are really talking about a fueling infrastructure, and it begins with determining what is your source material. What is a fuel cell going to use as a power source? Is there going to be an onboard converter to turn something into hydrogen? Are you going to be using methanol pumped in that then gets turned into it? Are you going to use natural gas that you convert at the gas station?

There is a whole host of questions, but just to give some perspective, we have something on the order of 1.5 to 1.6 trillion dollars already invested in the existing infrastructure, and, over time, if we do make this transition to fuel cells, that is the kind of money we are looking at spending. And, again, it kind of gets back to information. We need to know as soon as is practical, and I do not think that will be within the next decade, frankly, what our source of fuel for the fuel cells is going to be. Are we going to be mining coal, digging natural gas? What are we going to do, and then how are we going to convert it? Until you have those questions, you cannot really get started on the infrastructure, and that could prove to be a bottleneck.

Mrs. DRAKE. Mr. Rose?

Mr. ROSE. May I respond briefly to that?

Mrs. DRAKE. Absolutely.

Mr. ROSE. Thanks. In the short term, there is not an absolute consensus, but there is a virtual consensus that gaseous hydrogen will be the choice of fuel for fuel cell vehicles. The derivation of the hydrogen will depend on local resources, kind of like we generate electricity today from a variety of fuels, depending on what is available locally.

The third is that it will take us a while to get to kind of a tipping point where we choose to utilize large-scale systems to supply the hydrogen. In the short term, there are a number of options, utilizing everything from electrolysis of water to the use of natural gas that is already at perhaps a third of the gas stations in the United States and so on.

So, again, I think these are important questions, and it is good to be visiting them, but I do not think they will be show stoppers, and I do not think that the oil or auto industry sees them as show stoppers either, not anymore.

Mrs. DRAKE. Thank you. Mr. Carlson, would you comment on the degree of success that the industry has had in recycling platinum for the automotive catalytic converters?

Mr. CARLSON. As part of the study, we did talk to the platinum industry, and we also talked to the car companies, and they did not provide exact numbers, but in talking to the car companies, our sense was that recycling on catalytic converters is greater than 90 percent, maybe even higher, and that is driven by the fact that platinum group metals are a valuable material, and so a value chain, collection chain, has been set up because of that value, and it has been established.

Earlier, you asked a question about whether there might be regulations that encourage recycling, and I think that would be very important because when you look at a fuel cell vehicle, not only will there be the platinum metal, but you will have batteries, and you will have the electric motors, and there will be a lot of other metals that would be very valuable in terms of being recovered.

Mrs. DRAKE. Thank you. Mr. Copulos, are you familiar with the Land Warrior system and the Future Force Warrior system currently being developed by the Defense Department, and would you comment on the metal and materials that are going to be needed to achieve success in these systems, which, of course, will keep our 65,000 infantrymen safer on the battlefield? Are you familiar with that?

Mr. COPULOS. Yes, ma'am. It is the result of a progression that has taken us from the Vietnam War to today. In World War II, the only protection you had was a steel helmet, which was sort of questionable. By Vietnam, you had flak vests, which most of us would discard sooner or later because they were hot and uncomfortable, as well as the old steel pot. But now we have flak vests and body armor and so on.

During that period, we have also seen an evolution in communications. Where we had the old PRC-25 radios in the field, which worked most of the time if we were lucky, and that was the extent of our communications really other than the occasional flare, now you have a much more sophisticated, what they call the "electronic battlefield," which will become even more so with the introduction of the Stryker Brigade combat teams, which is the model of the future.

I think one other point that is important to understand is that with the modern armed forces, yes, we have 65,000 infantrymen, and ultimately it is the man with the rifle who holds the territory. The ultimate goal of everything else is to get the infantryman there. But with the changing nature of the battlefield, everybody, at one point or another, is going to want to essentially function as an infantryman because you do not have defined lines.

So just as used to happen in special operations, where we would see a piece of equipment adopted or introduced, eventually it expanded out to where everybody had it. MREs are an example of that. You are going to see that happen with these new innovations for the Land Warrior system, which basically is built around a couple of things. It is built around communications. It is built around interoperability. Whereas we had one radio for a squad if we were lucky, now everybody has their own radio that ultimately links into the Stryker combat vehicle and will not only provide you with communications, but then you have night vision systems. You have all of these very sophisticated electronic elements. You also have the X-8 personal weapon, a new weapon which has a higher rate of fire and is much more accurate with its sites.

But in the end, what do you need to make all of these things? Well, one of the things you are going to need is a whole lot of copper because guess what, they have wires. That is not the only military application of copper. Ammunition is copper jacketed, and the cases are brass. The antitank weapons we use that are shape charged, the armor-piercing shells, have a copper core because what basically happens is the explosive heats the copper up, super heats it really, so you get a jet of hot copper that burns through the armor. You are going to have copper and brass in all of the components of almost everything you are using in the Land Warrior system, and you are going to need platinum as a catalyst.

They are looking at fuel cells in military vehicles not just to power the vehicle, but one of the other things they are looking to use the fuel cell for is to power a lot of the electronic equipment within the vehicle when it is at rest so you do not have to run the engine. Well, that means you are going to use platinum for that. You need yttrium. You need a whole bunch of rare earths in order to make the night vision goggles, to make the electronic sights and components.

So the bottom line to it is we are going to have a huge requirement for minerals, many sophisticated minerals, especially platinum group metals, copper, and rare earths.

Mrs. DRAKE. Thank you for that because we certainly want to make sure they are as safe as possible and that we move into the use of these fuel cells rather than all of these batteries, and you have covered that.

But, Mr. Copulos, also, and this may be an uncomfortable question, or you may not mind because you have been very straightforward about the risk to our nation, but do you believe that the proposed Department of the Interior budget for 2007, which cuts the mineral commodity information that we just talked about, virtually eliminates the collection of international mineral commodity information, is a wise public policy that enhances the nation's security?

Mr. COPULOS. Well, Congresswoman, you will excuse me if I am extremely blunt——

Mrs. DRAKE. Be blunt.

Mr. COPULOS.—but the third idiot from the left could have figured out that we need these people, so apparently the policy was put together by the fourth. It is obscenely stupid, and I can tell you from personal experience, as I noted earlier, I authored the White House Critical Materials Report in 1988. At the time, I was doing classified work at the direct request of the Director of Central Intelligence in these areas, and I learned two things, one of which was the most reliable source of information on mineral commodities there was in Washington, D.C., were these people working at then the Bureau of Mines. Now they are over at the U.S. Geological Survey. They were absolutely world-class experts who knew their stuff and could be relied on to give you the accurate information you needed to make very important decisions.

The other thing that I discovered was that every time we tried to use them, individual political agendas, pet projects, and just plain misconceptions entered into the process and tried to influence their conclusions. Now, these people withstood it pretty vigorously.

In fact, Secretary Hodel had me go around to each of the commodity specialists, explain what was going on, and elicit answers, to the point where I was visiting one of them who I had not seen before who said, "Are you the shrink the Secretary is sending around?" They thought that things had gotten so bad that they required a counselor to go out and talk to the people about why they were not being believed.

We cannot afford to have that kind of stuff go on. We need independent sources of information. One of the things that happened as a result of my work being second guessed in one of the classified reports is that we missed by two years a warning that the Soviet Union was going to collapse, which would have been quite evident had those conclusions been acted on and not been dismissed because of someone else's biases and prejudices.

I would hate to see us make similar, very important strategic mistakes or have bad decisions made because we did not have information on an area that is as important as energy and, quite frankly, needs this even more because it does not get the attention that energy gets.

Mrs. DRAKE. Thank you. I would like to thank all of our witnesses for their valuable testimony, and as I said before, we may have additional questions from other Subcommittee members that we would ask you to respond to in writing. Our hearing record will be held open for 10 days for these responses, and if there is no further business before the Subcommittee, the Chairman, again, thanks the members and the witnesses, and the Subcommittee stands adjourned.

[Whereupon, at 1:15 p.m., the Subcommittee was adjourned.]