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Our Electric Future

By Andy Grove From the July/August 2008 Issue

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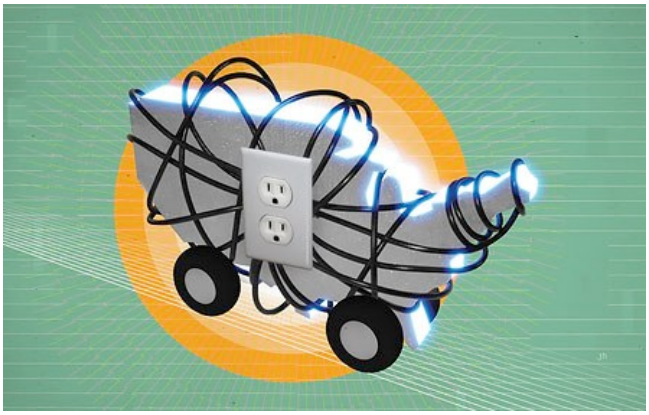
Energy independence is the wrong goal. Here is a plan Americans can stick to.



Twenty-five years ago, when I was CEO of Intel, I had an unusual experience while visiting a customer. It was during a period of tight availability of microprocessors, our main product. This was not an unusual state of affairs. Supply and demand ebbed and flowed as the computer business had its ups and downs. Sometimes we had too many chips sitting in inventory; other times, like this one, we had too few. My main purpose in visiting was to reassure the customer that we were working hard to boost production and that relief was on the way.

A strange sight greeted me as I entered the lobby. A large group of employees was waiting, standing around in a semicircle, with the CEO, an old friend, in the center—on his knees. The employees behind him held up a sign that said, "Please feed the chip monster. He is very hungry."

As flashbulbs popped, I realized the purpose of this setup. We were the sole supplier of the microprocessor this customer needed, and my promises and apologies were not going to help much. The staging was done in good spirit, but I felt deeply embarrassed—which may be why I remember the scene so vividly, even after all these years.

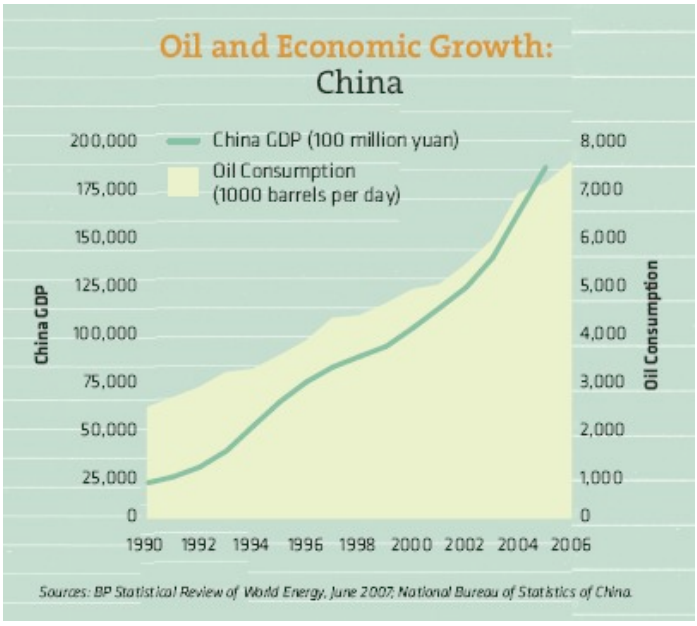
After Nixon, many presidents set similar goals for energy independence. Every target was missed.

The episode came to mind earlier this year when I read about President Bush's visit to Saudi Arabia. His main mission was to ask the Saudis for greater petroleum output. According to press reports, his request was unceremoniously rejected by the oil minister, who did not even appear to be embarrassed. Such an exchange would have been inconceivable as recently as a decade ago. Our standing in the world of oil has fallen a long way in a short time.

In fact, we may be at a critical juncture, the kind that can creep up, in a gradual and insidious way, on companies and industries, and even on societies. Invariably, the actions that are needed to change course at such times are painful. Leaders rarely appreciate the gravity of their situation, and even when they do, they are loath to take appropriate action.

Our Electric Future-1.jpgAfter World War II, the United States was the global leader in the production and distribution of energy. In time, other countries rebuilt their war-ravaged economies. As their oil consumption increased, our prominence, both on the demand and the supply side, was gradually diluted. Our relative decline accelerated in the 1970s, after the Organization of Petroleum Exporting Countries (OPEC) was formed and then again when it flexed its muscles by precipitating the oil shock. Later, in the early 1990s, some of the developing Asian economies started to grow at a rapid rate, requiring a prodigious amount of petroleum. Consequently, our significance as a customer started to decline in the same manner as our significance as a supplier did earlier.

Let's put this situation in perspective. Google's share of the U.S search market is more than half. This allows the firm to wield tremendous influence over the very nature of the American advertising market. Google may even have the power to transform and redefine how advertising is carried out. OPEC has a similarly dominant share of the worldwide oil market, and it may have a correspondingly large influence on its customers.

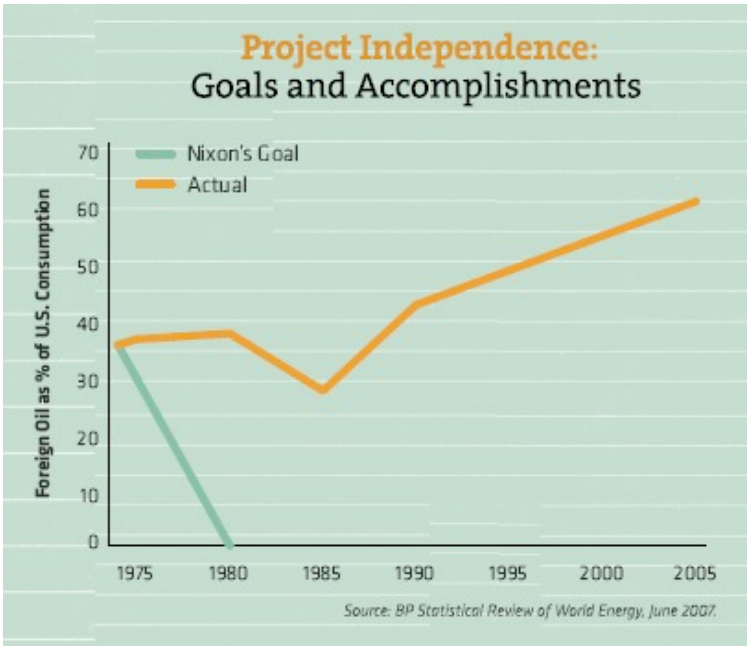


The availability of petroleum can determine employment levels; for a nation like China, this can determine national political stability.

But the stages on which Google and OPEC play are dramatically different. Advertising is a big and important business, but energy is the lifeblood of all economies. Like drinking water or oxygen, we simply cannot be without it. So a supplier of energy can have significant control over customers—even nations.

The availability of petroleum may well determine whether an economy grows or declines. You can see this striking relationship by comparing the rise of China's economy with the rise in its demand for petroleum. The availability of petroleum can determine employment levels, which, in turn, for a nation like China, can determine national political stability.

The Goal That Failed



As America's energy situation began to change, so did our official energy strategy. In the early 1970s, President Nixon kicked off Project Independence, defining a national goal in his State of the Union address: "At the end of this decade, in the year 1980, the United States will not be dependent on any other country for the energy we need to provide our jobs, to heat our homes, and to keep our transportation moving."

The failure to meet that goal was dramatic.

After Nixon, president after president set similar goals. Every target was missed. We became more and more dependent on imported petroleum. Net energy imports doubled between 1970 and 1980, and then again by 1990.

Not only did America fail to meet the goals, but the goals themselves were unwise. A faulty goal leads to the wrong actions; so even if we execute flawlessly, we fail.

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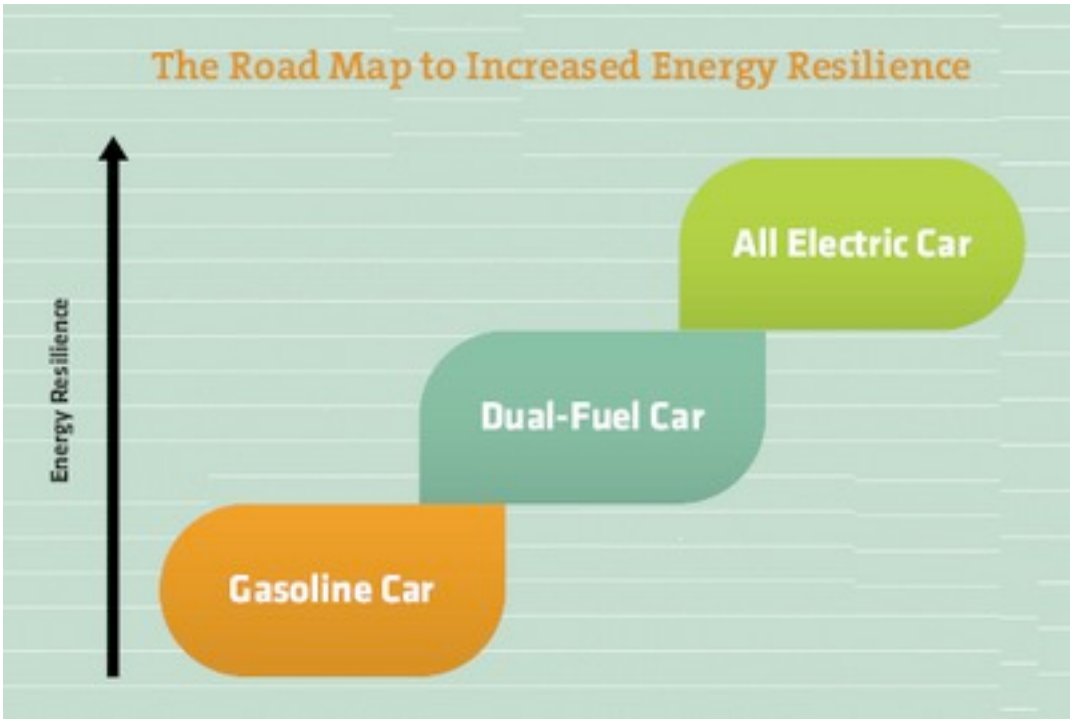
What was wrong with energy independence? As the decades progressed, the United States became more and more integrated into a global economy, where goods, information, and oil move unimpeded across national boundaries. Countries around the world produce energy if they can, and buy on the world market what they need beyond their own production. Oil flows toward the highest bidder, just like all other goods. Consequently, talking about "independence" in terms of one product in an otherwise seamless global economy is a contradiction. As national policy, we must protect the U.S. economy from interruptions in the supply of such a critical commodity—whether those interruptions are related to natural or political causes. I believe that the appropriate aim is to strengthen our ability to adjust to such changes—to strengthen our energy resilience.

We can do that by increasing our reliance on electricity.

Electricity: Energy That Sticks



Oil moves to the highest bidder. Fleets of tankers carry it across oceans day and night. Natural gas can also move around, but with extra difficulties. On land, it can be transported in pipelines, but to carry it across oceans requires liquefaction and expensive, high-tech ships that can carry this liquid in strong, deeply cooled containers.

Electricity can be transported only over land. In other words, it is "sticky": it stays in the continent where it is produced.

Equally important is the fact that electricity can be produced using multiple sources of energy. Petroleum, yes—but also coal, which is abundant in the United States, wind, hydroelectric, nuclear, and solar. Electricity is a multi-sourced form of energy. If one source suffers a shortage, we can produce electricity from another.

Because electricity is the stickiest form of energy, and because it is multi-sourced, it will give us the greatest degree of energy resilience. Our nation will be best served if we dedicate ourselves to increasing the amount of our energy that we use in the form of electricity.

Transportation: The Hardest Nut to Crack

We live in a world where just about everything—from a hairdryer to the Internet—runs on electricity. A big exception is the transportation sector, critical to the movement of people, production materials, food, and even fuel. Transportation uses more than half of all the petroleum consumed in this country. If we don't convert a large portion of the transportation sector to electricity, we cannot make real progress toward energy resilience.

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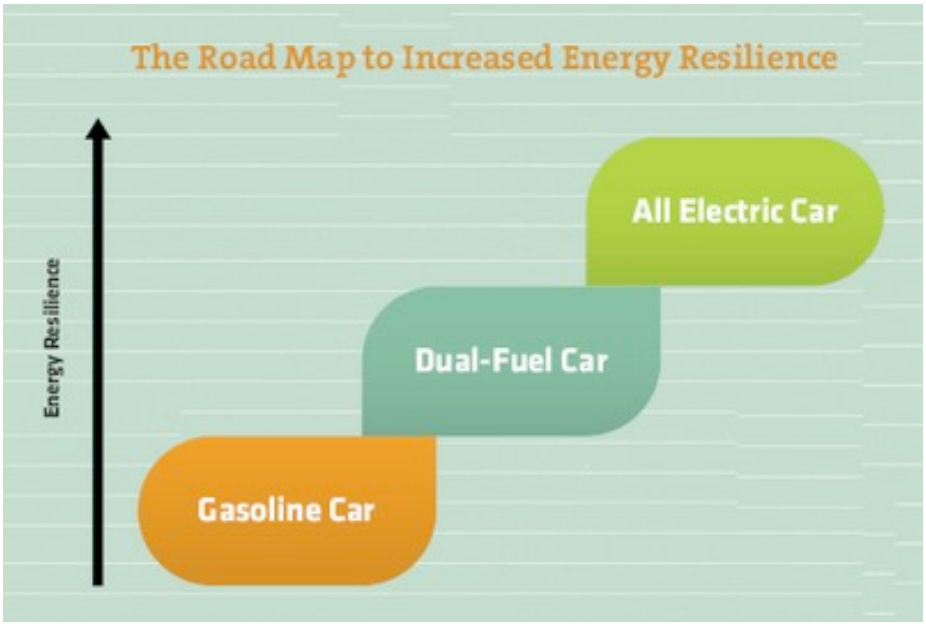
This conversion will not be easy. It requires substantial growth in generation capacity as well as in the capacity and reach of the transmission infrastructure. Most importantly, it requires that vehicles be able to run on electric power.

This is a very difficult technical task. With the size and weight of ordinary automobiles, current technology allows electric cars to run only 100 miles or so before their batteries need to be recharged—the way we recharge our laptop computers or cell phones, by plugging them into the national electric grid. Many drivers can live with this limitation most of the time, but few will find the condition satisfactory all of the time. Still, the capabilities that we have today can get us off to a good start.

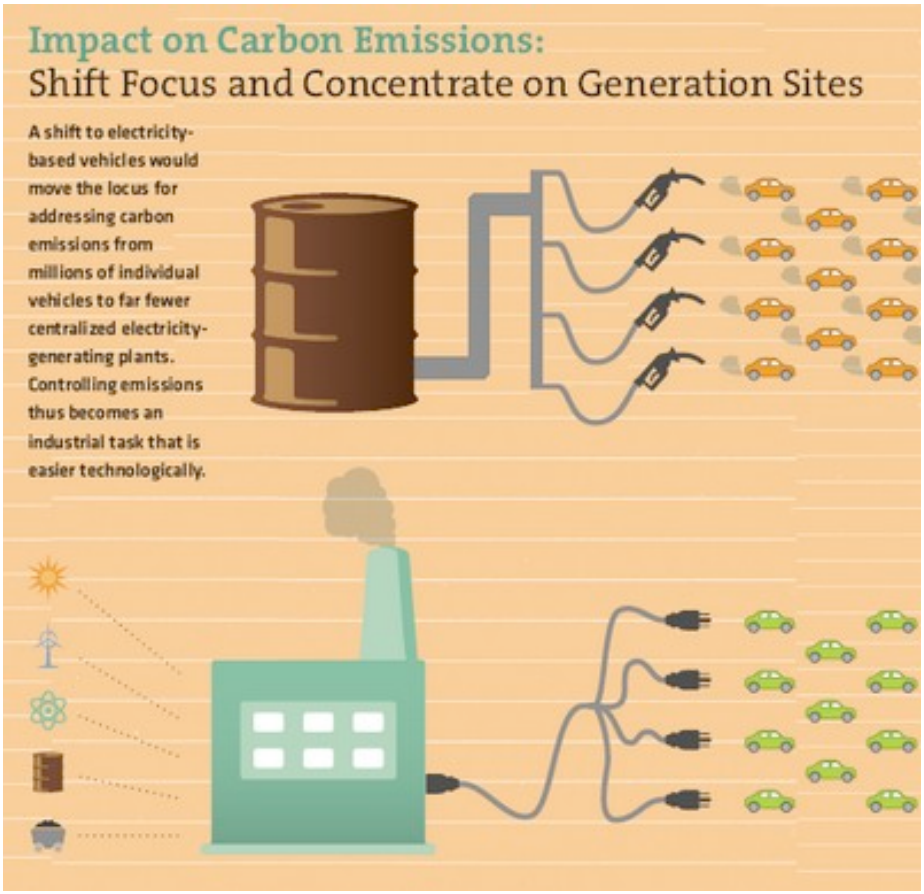


New technology often shows up in this manner: it is not completely satisfactory in the beginning, but good enough to get going. The first personal computers, for example, were little more than toys. They fascinated cognoscenti and hobbyists, but compared to the mainframe computers that were the workhorses of that time, they were limited. PCs quickly grew in capability and eventually reached parity with mainframes and then surpassed them in efficiency and computing power. Such approaches, of starting low and moving up, have been named "disruptive technologies."

The automobile industry, in the main, has not embraced disruptive technology. It has been waiting instead for batteries to improve until they can allow electric cars to enter the marketplace with the same driving range as gasoline-fueled cars. Battery developers, in turn, have been waiting for demand from the automobile industry to develop before fully committing the resources required to do the job. The generation and transmission infrastructures have not been built up to service the potentially explosive demand from transportation. The wait has gone on for some time.

To be sure, this situation is starting to change. Startups like Tesla Motors and Project Better Place have begun to experiment with all-electric cars, and important developments are underway at Nissan and General Motors. But our exposure to the vagaries of oil supply is growing by the month.

We must accelerate conversion to electricity in a major way.



Dual Fuels

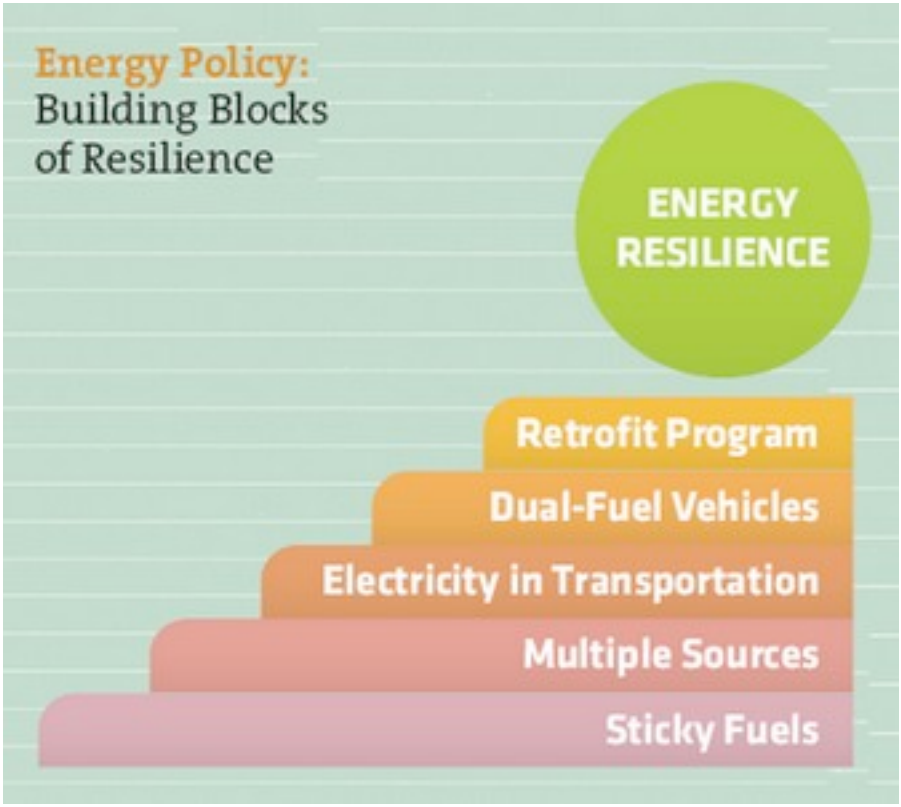
To start with, the U.S. government should lead the way by requiring that a growing percentage of new cars be built with dual-fuel capability. These dual-fuel cars would have both an electric engine and an auxiliary gasoline engine to augment it. The car would run on electricity, and after the batteries were depleted, it would switch to running on the gasoline engine.

Such dual capabilities are often built into machines to help with technology transitions. When DVD players first came to market, they were often combined with a VCR tape player so the consumer could choose if he wanted to watch a movie in VCR or DVD form. Eventually the DVD player became the default standard, but only after a period of time that allowed consumers and the broader market time to adapt.

Laptop computers today come with both wireless and wired Internet connections. If you are in a hotel, you can choose to use wireless service or plug in to the hotel's wired connection. I expect wireless connectivity eventually will be sufficiently powerful and accessible to obviate the wired alternative.

The same would happen to cars. The forces of disruptive technology would eventually bring about improvements in battery technology, ultimately allowing the production of an all-electric car with satisfactory driving range.

This process, however, won't happen quickly enough on its own. No matter how fast the production of dual-fuel cars is ramped, replacing the bulk of the approximately 250 million cars on the roads in the United States with new cars will take a decade or more. As with PCs, the work of advocates and hobbyists shows the way out of this dilemma. There are enterprising folks who have experimented with converting existing gasoline cars into electric cars by removing the gasoline engine and replacing it with an electric engine. Some are working to devise ways in which existing gasoline cars would be converted to dual-fuel cars. As with the new dual-fuel cars, these cars would give first priority to the electric power stored on board, and switch to gasoline only after the electric power is exhausted.



Not all vehicles have the space and design that allow this process to happen easily. Luckily, it is the most gasoline-hungry cars that do. Pickups, SUVs, vans, and the like represent about 80 million vehicles, with mileage of perhaps 13 to 16 miles per gallon. Converting these should be our first priority. The instincts of conservationists have been to improve what is already pretty good—compact cars with decent fuel efficiency. Our national priority to decrease the amount of oil-based energy dictates that we go after the low-mileage part of the fleet first.

Estimates show that converting these vehicles to dual-fuel operation, even with electricity providing no more than 50 miles of driving range between daily recharging, could cut petroleum imports by 50 to 60 percent—a stunning opportunity.

A task of this magnitude requires major effort and investment. We may need to apply tax incentives to offset the cost of the retrofit and couple them with deep discounts on the cost of electricity used by the vehicle over some initial period, such as one to two years.

Shifting to electricity has the added advantage of helping to mitigate a major environmental threat. A shift from petroleum-based vehicles to electricity-based ones would move the locus for addressing carbon emissions from millions of individual vehicles to far fewer centralized electricity-generating plants. Controlling emissions thus becomes an industrial task, easier technologically. Estimates indicate a potential reduction of carbon emissions of around 50 percent through such a shift.

Are government mandates and incentives really necessary to drive these processes? Can't we rely on market forces?

Automobile manufacturing, battery production, and the generation and transmission of electricity are all represented by different industries—each with its own financial aims. The absence of common interests is a major obstacle to action, requiring the coordinated commitment of several industries.

In his seminal study, the business historian Alfred Chandler found that the growth of new industries is often limited unless appropriate adjustments in their structure take place and the boundaries are redrawn to remove obstacles to growth. Chandler also recognized that the necessary changes are unlikely to happen if we have to count on the incumbent managers to bring them about.

Of course, startups and new ventures, not limited by the economic rules of established industries, can break the gridlock in time. But we don't have the time.

There Could Be Blood

Oil-producing countries flex their muscles more and more openly. The elections in Ukraine led Russia to threaten to cut off natural gas supplies. The need to secure oil seems to have influenced China's attitude toward the genocide in Darfur. In Venezuela, Hugo Chávez is using oil to gain political influence in the hemisphere. "The politics of energy is warping diplomacy in certain parts of the world," said Secretary of State Condoleezza Rice in recent Senate testimony.

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And it could get worse. Scratch the surface, and you find that oil has been a major factor in many wars. And it could be again. Today's relationship between China and the United States, says Henry Kissinger, "is very similar to that of Germany, a rising country at the turn of the 20th century, and Britain, an established one." Their conflict over resources "eventually led to war." Listen to Lieutenant General William Caldwell, who heads the Army's schools and training centers: "We are in a period of time in the world today where there is a shortage of resources." Because of this, over the next 10 to 15 years, Army Chief of Staff General George W. Casey Jr. says we will face "an era of persisting conflict."

We have an urgent need for a strategy that can deflect our march toward this "persisting conflict" by strengthening our energy resilience. A policy that favors sticky energy with multiple sources and that aggressively moves vehicles first toward dual-fuel mode and ultimately to running on just electricity provides the answer.

Andy Grove was chairman and chief executive officer of Intel Corporation, the world's largest producer of microchips, from 1987 to 1998. He now serves as senior advisor. He has written five books, including "Only the Paranoid Survive," and is a co-author (with Robert Burgelman) of a sixth, "Strategic Dynamics." Burgelman, who is a professor at the Stanford Graduate School of Business, collaborated with Grove on this article.

Illustrations by John Hersey.