

REDEFINING ENERGY SECURITY

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According to George Shultz, there are two key factors in negotiating a successful outcome in any endeavor. The first is to engage from a position of strength, when the timing is on your side. The second is to define and pursue your own current agenda, and not let your actions be driven by either your past or your opponent, lest you end up negotiating against yourself.

Today in the United States, for perhaps the first time in modern history, we find ourselves in a position of strength with respect to our energy system. Now is the optimal time for shaping and pursuing, both domestically and internationally, our energy goals. But we have grown so accustomed to domestic energy shortfall, with no alternative but to simply respond to external events, that we find ourselves with no energy agenda of our own.

It is time to redefine energy security and to define a comprehensive national energy security strategy. We need to understand and employ our new-found energy largesse in a framework that will guide our domestic and global engagement into the future. The next century of American energy will not be like the last.

Secretary Shultz often relates the story of meeting with President Eisenhower as a young member of his Council of Economic

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Advisers. Eisenhower had warned that if the country were to rely on imports for more than a fifth of its petroleum needs, it would be in trouble. His prognostication alerted Shultz to the role of energy in our nation's vitality and also presaged the energy crises of the following decades. In 1969, Shultz led a cabinet-level task force on the growing energy security issue: a report was issued, hearings were held, but very little was done. The 1973 Arab Oil Boycott that followed—more or less what had been predicted—altered the energy landscape. By 1977, net energy imports hit 24 percent and imports from OPEC alone exceeded one-third of petroleum demand and over 18 percent of all US energy needs. But by that time, it was too late for a proactive strategic energy policy—the forced events of the energy crisis had already put the country on its back foot.

Since then, however, the situation has changed dramatically, largely due to three things: the deployment of a variety of better power generation technologies; hydraulic fracturing and horizontal drilling of domestic oil and gas; and improved efficiency throughout the economy. In 2014, just 16 percent of our country's net petroleum use was imported from OPEC. That is now less than 6 percent of our total energy consumption, putting OPEC behind the total energy supplied by, for example, the state of Pennsylvania (7 percent) and just ahead of Colorado (4 percent). It is also less than the share of our energy that comes from nuclear power (8 percent). Saudi Arabia, for its part, is responsible for about 2 percent of total US energy supply—on par with Arkansas, or just the growth alone in crude production from North Dakota over the past five years and equal to about what the United States produced from wind turbines last year.

The US energy situation today is by almost all accounts better than it has been for decades. So far, we have been the first and only country to successfully combine technology, business entrepreneurship, and our supportive legal and regulatory regimes to exploit abundant shale gas and shale oil resources: US overall

petroleum production overtook Russia and Saudi Arabia in 2014 to become number one globally. Our fuel markets, refining, and trade infrastructure (even while currently challenged by a global environment of continued low prices) make us a lean and competitive supplier. Our energy business across sectors and fuels has a profound global reach. We lead on innovation in forms of energy both new and old. And as anyone who experienced Los Angeles basin smog in the 1980s can attest, the energy efficiency of our economy and improvements in environmental performance of our vehicles and power plants is breathtaking. We operate the largest carbon-free power generation fleet in the world, adding to it daily through new technologies. In sum, our newfound energy abundance offers the incoming administration a chance for something that no others in recent history have had: the opportunity to pause, absent the clamoring pressures of an energy crisis, and dispassionately reflect on our country's longer-term energy priorities.

It is tempting to ignore the opportunity, to relax after decades of lurching from crisis to crisis. But the fact is that our country today does not have a true energy strategy, and we have not had one for years. Even omnibus efforts such as the 2005 Energy Policy Act are more a collection of broad philosophies, loose ends, and pet interests than a comprehensive national posture on a defining issue.

We have taken a haphazard approach to energy, tilting from one issue-of-the-day to the next: from price controls to reducing "petro-state" import dependency, from domestic energy industry jobs to the environment. As each issue comes to the fore, it dominates the others at the expense of a comprehensive and systematic long-term energy strategy. Many of our greatest energy successes have, arguably, come in spite of our attempts at national policy, or at least as unintended consequences.

Early government investment in research and development (R&D) helped to seed the market, and was an absolutely necessary precursor, but fracking ultimately became economical and

widespread largely due to the commendably dogged pursuits in the field by one businessman trying to improve the value of his cheaply acquired acreage. Many reasonable compromise efforts at improving energy-using products have borne fruit—vehicle fuel economy standards and emission standards, for example—but no one in the newly created Federal Energy Administration, itself a reaction to the 1973 oil crisis, foresaw the abrupt flattening of nationwide energy demand growth as industry adjusted production practices in creative and unexpected ways to reduce energy input needs. (According to energy economist Jim Sweeney, today our economy uses just six thousand BTUs of energy to create one dollar of GDP, versus fourteen thousand BTUs for that same dollar in 1973, an improvement of 57 percent.)

Meanwhile, ends-oriented federal programs to champion the deployment of certain energy technologies over others have had a spotty record at best. Some have produced new energy supplies (the subsidy of renewables and starch-based biofuels, for example) and some have not (the coal-to-liquid fuels program, carbon capture and sequestration, and cellulosic biofuels), but all have been expensive. Moreover, these government efforts have been far surpassed in scale and impact by the market responding to state-by-state power sector deregulation through the widespread deployment of natural gas turbine generation facilities.

Technological improvement through R&D has been the one clear bright spot, and an area in which federal research dollars have helped leverage similar private funding. But even those policies have been boom-and-bust, closely linked to the similarly volatile energy commodity prices that technology in itself has yet to solve.

Our passivity toward taking control of our energy destiny is not reflective of how America generally creates and conducts policy in other areas. Today, there is an unprecedented opportunity to do better. But this is not a call for an energy Apollo Program—an attractive conceit on the surface but ultimately irrelevant to the nature of our broader energy goals. Instead, we must recognize that we have been granted new global opportunities for engage-

ment—as a reliable and competitive energy power—and that, as a result, we already are beginning to shoulder new responsibilities, many still indistinct.

So, what must be considered in defining a proactive, domestically beneficial, internationally competitive, and geopolitically effective energy security strategy for the next hundred years?

DOMESTIC ENERGY NEEDS

Our first priority in energy seems obvious, as it has heretofore dominated our thinking about energy. Energy supply security means that energy is always available (even in times of duress), that it is reliable (not prone to sudden disruption, whether intentional or accidental), resilient (able to recover quickly when it is interrupted), and affordable (both in the personal and macroeconomic sense, including price shocks).

Domestic or North American regional energy independence, a goal espoused by many, helpfully contributes to some of these elements of energy security. Our combined North American energy relationships in particular should be explicitly recognized and supported as a global model of competitiveness, diversity, dependability, and constructive regulation. Moreover, that shared competitiveness improves the broader economic viability of our closely linked economies against trade bloc competitors abroad. But “independence” in itself is limited in effectiveness and counterproductive to many other national goals. Energy independence means that US factories and homes would stay supplied if all borders were to be shut down during a conflict, but it does not mean that our expeditionary military forces—or our allies and trading partners—would be similarly taken care of. Energy independence helps with one side of our balance of trade but, given global fuel markets, it does not always mean lower prices for US consumers, nor does it optimize the value of local energy resource types or the refining and generation infrastructure on which the viability of our nation’s energy companies depends.

For example, energy-independent Norwegian consumers to-

day pay just as much more for gasoline when oil prices rise as we always have, despite their position as significant net oil exporters. And at an economy-wide scale, our energy industry is actually a significant beneficiary of petroleum trade—with Mexico, for instance, where crude is imported, refined here using our more advanced infrastructure, and then exported back to Mexican consumers as diesel and gasoline, an export worth over \$20 billion annually and employing American workers in the meantime. Moreover, independence does little for reliability or resiliency. A winter storm can shut down power to the US Northeast no matter where the coal or natural gas comes from, and cyber-attacks do not discriminate on the national origin of electrons. One could argue that a broad-based web of domestic and international supply could be designed such that more, not fewer, points of energy trade and infrastructure connection would improve system-wide reliability and flexibility and make it easier to withstand shocks, be they geopolitical, meteorological, technical, or human.

Rather than seeking strict energy independence, it is far more prudent to invest our current energy dividend into creating a robust, diverse, competitive, redundant, and resilient generation and distribution system in order to improve our nation's energy security over the long term. All else equal, being able to trade among a portfolio of fuels, power generation technologies, private firms, regional suppliers, and resource bases ultimately increases our flexibility when we need it. Healthy domestic energy production is a valuable part of preserving our options because it reduces absolute reliance on any single trading partner.

When correctly managed against fragility, a network is more robust the more nodes that connect within it. It is just as important therefore that we continue to build strong and diverse global energy trading relationships—and maintain the markets, institutions, and infrastructure needed to support them—so that we do not end up isolating ourselves and becoming the ones at risk of being disrupted. We must think of ourselves as market-makers,

and not merely as price-takers. The pursuit of energy independence, when expressed through efforts at energy isolationism, including the restriction of exports, actually serves to reduce our influence and options and hold us back, through “self-imposed sanctions” (to use Alaska Senator Lisa Murkowski’s phrase).

Another step we would take toward long-term domestic energy security is to step up investment in energy technology, both those inventions that seem promisingly near at hand (but are not quite ready to deliver on their own) and the very risky but potentially game-changing options on the horizon. This is not a call for a blank check, or for the government to get directly involved in commercialization. But it is an acknowledgement that the breathing space afforded to us now by the investments in R&D of yesterday—hydraulic fracturing, for example, or efficient vehicles and LED light bulbs—gives us an opportunity to think over a longer time horizon to support what will come next. Much of what we put our research money into will ultimately not become viable, but there is intrinsic value in improving the stock of available technology options so that those we do eventually use are the most economical and highest performance ones possible. Long term R&D investment in generation, distribution, and utilization is essential for our continued energy leadership, innovative achievement, and economic success.

GLOBAL ENGAGEMENT

While the domestic energy security implications of our energy dividend will take time to flower, new avenues for US global engagement are already available to us. Energy-exporting superpowers have throughout their history been tempted to use their dominance as a weapon. For us, energy is instead a tool to support allies and positively influence newly diversified markets with global effect. Now that we are no longer relegated to defining ourselves simply as victims of the global energy regime, what will be the US energy doctrine?

First, with our own domestic needs largely accounted for, we should use our energy to help our partners and allies. This does not mean, for example, that everyone in Europe needs to be buying American LNG. Russia is a major low-cost supplier and it would not be in our long-term interest to use natural gas as leverage to kick Russia while it is down economically, especially in a perceived tit-for-tat response to Russia's past actions with its own neighbors. But a diversified market, with US participation, does allow us to be a credible energy alternative in parts of the world where we have previously had little to offer.

The plight of the Baltic States in relying on Russian natural gas and electric grids is well-known. Less known is that when Lithuania recently began operation of the region's first small floating LNG import facility, even with only a portion of the terminal's capacity contracted, the country's Russian-negotiated wholesale natural gas prices dropped by 23 percent overnight. The difference between monopoly and choice is a significant one. Ukraine has reduced its own reliance on Russian natural gas by half and Bulgaria is similarly interested in access to US supplies. We cannot supply the world, but even a marginal contribution can make a difference in shaping market forces and national behaviors. It gives us an option to neutralize an existing geopolitical weapon without needing to use military force. We should therefore seek to establish relationships, redefine markets, and create the trading infrastructure in regions around the world where we might be able to make a difference—focusing on those areas where we can use energy to deter rather than encourage conflict.

Our ability to engage constructively with allies and trading partners is not limited to those parts of the world facing sovereign threats. Japan and South Korea, apart from their domestic nuclear power industries, are both almost completely reliant on imports for their energy supplies, a fact for which they pay dearly. Closer to home, Mexico is undergoing a surge in demand for electricity and natural gas as recent substantial reforms take hold and its

manufacturing economy surges. We already supply over a quarter of Mexico's natural gas and that figure will rise with the development of new pipelines and power plants to use it. Our existing energy commerce with Canada, across oil, gas, coal, biomass, and electricity, is already one of the largest global energy trades, worth over \$100 billion annually. United States energy exports present a fresh opportunity to deepen our mutually beneficial relationships with these friends and neighbors, and deserves far more than perfunctory treatment.

Of course, additional global engagement on energy is not entirely selfless. There are clear economic benefits at home. Beyond the obvious examples of increased petroleum fuel exports, a US global energy doctrine should also recognize the fundamental role of our energy technology and operational know-how. Our world-leading oil production majors and field service companies already act as ad hoc ambassadors in regions where their influence may well run ahead of that of the state itself in the value of the innovation and performance they offer. American power plant technology vendors occupy a similar industry-leading position. The International Energy Agency estimates that global power sector investment alone through 2040 will exceed \$21 trillion, increasing global capacity by 80 percent. New breakthroughs in adjacent technologies in the renewable energy sector, grid-scale storage, and grid operational or cyber-defense technologies will be similarly sought after. The United States—through both multinational firms and concerted government efforts—can claim credit for successfully spreading civilian nuclear power technologies, and contracts, across the globe. As other new generation sources, including promising nuclear technologies, gradually emerge, how will the United States continue to maintain a competitive and influential international energy role?

In any such calculus, there are two questions to answer: (1) do we have the capability to competitively engage? and (2) do we choose to do anything about it? As the answer to the former

increasingly becomes affirmative, across a range of energy forms and technologies, the second question also demands a formulated response. What should be the role of the state in each of these realms? We are not China, strongly coordinating outward investment and tying it closely to geopolitical aims, nor are we a *laissez faire* libertarian utopia. The recent debates over the reauthorization of the US Export-Import Bank speak to the difficulty in articulating a meaningful and economically beneficial response to these new opportunities.

There are illuminating models from other sectors worth considering. In information technology, for example, early US dominance in software, chips, servers, and networking equipment and architecture led to its technologies being adopted globally as *de facto* and, later, negotiated standards. Sometimes controversially, that dominance has also allowed the country to exploit those technologies for national security purposes. Similarly, in banking, the strength of American financial institutions and the centrality of the US dollar itself have helped give us an advantaged role in the global financial sphere. Today, when the United States wishes to apply economic sanctions, for example, those actions are animated not just by the reach of our trade ties, but also by our ability to effectively monitor and control financial asset transfers that almost ubiquitously clear through American organs—peace through our strengths, with or without force.

With energy, the United States has already shown a values-oriented appetite to use its influence in that sector to help define norms for safety and responsible environmental performance. Again, in nuclear power, we effectively used our primacy in the international supply and technology chain to improve global standards not only in design, licensing, and operational safety, but also in oversight of the nuclear fuel cycle and related fissile material counter-proliferation efforts. Today, consider the Arctic, an area whose strategic importance to the United States will only grow. Shell has, for a variety of reasons, recently announced a

withdrawal from its multiyear and multibillion-dollar efforts to explore for oil off the coast of Alaska. Many in the environmental community saw this as a victory. The sad truth is that Shell's withdrawal means that the United States has lost an opportunity to use its vast experience and high standards to help avoid catastrophe in the precarious Arctic environment. Gazprom recently announced the 10 millionth barrel of production from its Arctic Prirazlomnoye field off the Russian north shore. These efforts continue, without the "compare and contrast" opportunity that would be offered by a modern, safe, and environmentally secure American initiative.

A final opportunity for redoubled US international engagement on the back of our energy dividend is our ability to substantively revisit our ethical stance toward energy poverty. Twenty percent of people globally have no access to electricity; for a billion more, what access they have is erratic. This means that a farmer cannot reliably run a pump to irrigate crops, medical personnel cannot keep life-saving hospital equipment on line, and an entrepreneur cannot keep computers running in an office without relying on an expensive generator.

At the low end of the economic development spectrum, even given improvement in energy efficiency, the statistics are clear: if a country wants to increase its GDP per capita from \$100 to \$1,000, it needs a ten-fold increase in the supply of energy. As we consider the next American energy century, it is worth looking back at our own energy development. Historian and commentator Vaclav Smil in a 2004 essay noted that the typical American household at the turn of the twenty-first century had access to more than sixty times the energy capacity than it did in 1900, and at a small fraction of the cost. If you include cars, the numbers are even more remarkable, with that same suburban household wielding the power equivalent of "a 19th century landlord employing 3,000 workers and 400 large draft horses." Yet today, the richest 10 percent of the world's population claims 45 percent of all energy,

while the poorest half are left with just 10 percent. The opportunity for improvement in global energy access is staggering.

At a time of uncertain public support, energy can also help give new meaning to our international aid efforts. In Africa and Asia, many women not only spend hours each day collecting firewood, their use of those primitive fuels actually harms them and their families. The World Health Organization estimates that indoor air pollution from cooking results in nearly two million deaths annually, which could be avoided through the use of much cleaner commercial fuels such as LPG or natural gas. Though not a perfect analogy, the robust American agriculture industry—including both the export of surplus US crops to famine regions and the spread of American agricultural and seed technologies to improve crop yields—offers one model on how to leverage a competitive US advantage into formation of a domestic constituency to support durable aid policies. Though there is no easy answer to this issue, it is important enough that we should explore how our broad energy strengths could be applied here as well.

The United States is exceptional for how its powerful economy, its national security assurances, and its very democratic values have long been tools to create and sustain a web of strong relationships across the globe. It is time to add energy to that mix.

ENERGY PRIORITIES

Finally, we have to acknowledge that abundance changes the nature of our domestic conversations on energy—our collective priorities and values around energy affordability, equity, and the environment. As has been the theme of these thoughts, new choices give us new space to maneuver; but we have to define the basic course. Much of the current domestic discourse over energy priorities has taken the tone of a political campaign. But as Shultz has noted, campaigning is fundamentally an act of division. We have unfortunately grown used to unending campaigns and wide and deep divides. Strategy, on the other hand, is the act of making

things nonpartisan (as distinct from bipartisan). Energy strategy must be an inclusive act of governance.

The elephant in the room today is carbon dioxide emissions, contributing to global warming. This is an issue with broad consequences, one that offers no clear or painless path to success. As we consider how our collective values around global warming should influence our energy choices, any trade-offs against our other central energy objectives should be supported by elucidating relative social priorities. At the core, to what degree do we accept higher prices, or potentially reduced reliability, in order to achieve an increased measure of decarbonization? This is a judgment call. But it can be informed by honest and largely objective evaluations of the question.

One example helps illustrate the potential risk of a single issue—or any single favored technological solution—dominating what should be a comprehensive approach. As global warming has animated the minds of many (though not all) Americans, wind and solar power have been held out by advocates as particularly desirable solutions, resulting in a number of targeted subsidies and regulations. Renewables have quickly grown, though their share of domestic power generation remains in the low single digits. Meanwhile, existing nuclear power plants, which represent nearly 20 percent of American electricity needs, are suddenly at risk of closure due in part to electricity market distortions brought on by renewables policies. Something is wrong here. If our social priority is to reduce greenhouse gases or air pollution, and the result of our actions is to threaten the viability of our largest source of zero-emission power, we have not delivered a comprehensive agenda.

A similar strain of current domestic energy politics seeks to restrict the use of the hydraulic fracturing and horizontal drilling responsible for delivering much of our current energy abundance, driven by a concern that air or water pollution from elements of the process risk harming human health. This is a valid concern.

But a comprehensive judgment should evaluate it against both our social priorities and our real-world alternatives.

One objective truth here is that cheap natural gas, the result of domestic fracking, has led US power generators to switch to it over coal in droves. More power is now generated in this country by (relatively cleaner burning) natural gas than by our traditional coal mainstay. Another relevant fact is that domestic air pollution from coal-fired power plants, by multiple estimates, kills more than ten thousand Americans annually. There is, as yet, no such data showing commensurate direct harm to human health from fracking. When exploring and assessing values-based energy priorities, we as a society have yet to create satisfactory tools or processes to fairly evaluate and pursue them, especially where our best options may not be immediately apparent.

To this end, an overarching uncertainty is the ability of the existing institutional framework for energy in this country to optimally deliver on comprehensive technological, societal, and environmental priorities, given that the framework itself is an organic and largely ad hoc outgrowth of our country's regional energy history.

States dominate some realms of energy policy through their traditional role as regulators of monopoly power utilities, though their powers are not evenly distributed. California, for example, has been able to be the de facto regulatory body for national vehicle pollution and even fuel efficiency standards due in part to its market size. Elsewhere, groups of states have banded together to form regulatory compacts and interstate agreements on issues ranging from oil pipeline safety to carbon dioxide trading. A host of federal bodies engages with the states in sometimes poorly defined ways that rely on drawn-out court cases or negotiations to resolve, be it esoteric terms of interstate wholesale power transfers or far-reaching subsidies and mandates to rebuild trillions of dollars in power generation infrastructure. Institutional relationships are adversarial by design and seem to be incapable of producing even collaborative, much less consensual, outcomes.

Energy policy and management in the federal government itself are hardly straightforward. The Department of Energy (DOE) handles energy statistics, funds energy research and a network of national labs, and sets the tone for the nation's energy posture, but its budget reflects its main job: to secure and manage the country's nuclear weapons stockpile facilities. A collection of federal regulatory agencies, from across departments, sets important energy performance and safety standards. In recent years, an increasingly athletic Environmental Protection Agency has emerged as perhaps the most influential, and contested, federal energy body through its expansive employment of congressionally granted jurisdiction over the nation's air and water.

Meanwhile, the nascent task of global energy engagement is shared between DOE and the State Department. The problem here is not that this Pythagorean arrangement does not keep the trains running on time, but that overall responsibility is diffused. No one body is in charge, which helps explain why we lack any comprehensive agenda. As the system stands today, it is unclear which entities would be able to deliver the domestic energy supply or outward-looking global energy security strategies described above. Delivering on a new American energy doctrine may well involve goals that are broader than any one agency. Getting there would require not just the identification and articulation of priorities, but also a responsibility-identifying road map—including any necessary structural reforms.

As to road maps, it is important to recognize that a grandiose goal or pledge is not the same thing as a strategy. A numerical target, by itself, is a sort of binding ideology—it can be used to justify choices that otherwise would not make sense. Instead, it is more useful to focus on agreeing on what worthwhile concrete actions can be undertaken today so that they can be prototyped, tested, and improved. Statistics are a useful way to help evaluate progress; actions are what effect change, so they should remain the focus of negotiation.

Given these challenges of governance, it is viscerally enticing

to appeal to the free market for answers. It is the correct starting principle. Many economists, for example, have advocated eloquently for a revenue-neutral carbon tax as the ideal tool to address the negative externalities of carbon dioxide emissions: incorporate the real social costs of pollution across the economy, and let the market (i.e., individual choices) decide the cheapest way to deliver results, all the while returning any new government revenues back to the American people to reduce household costs and avoid the unnecessary side effect of an enlarged public bureaucracy. According to analysts, it would “level the playing field” for energy as far as global warming is concerned, and with less pain than the alternatives.

Surprisingly, the idea has failed to catch on politically, despite being embraced by some of the nation’s largest energy firms. One tension may be the reality that energy is not a completely free market in the United States to begin with. Government interventions are the bedrock of some sectors—the monopoly regulated utility model, for example—or have otherwise become ingrained in the continued viability of others. Leveling the playing field—while a reasonable goal and therefore worth pursuing—will change the status quo in potentially unpredictable ways, even if the overall situation is improved in the end. The other challenge facing the carbon tax is that it has not been given a neutral airing before the electorate. Interest groups from all sides have hijacked the climate issue as a vehicle for ulterior interests. People need to feel trust that the same would not happen here. But these are solvable problems. More optimistic recent opinion polls do suggest that the public is embracing the concept faster than their political representatives, so there may be catching up to do in Washington and the state capitols.

To the extent that governance is about “how to get things on people’s minds,” the revenue-neutral carbon tax, like many other potentially attractive energy policies, demands leadership if it is to be embraced by the industries and people who would ultimately have to pay it. Though the challenges here are real, a motivated

leader should not use that as a reason to shirk from them but rather to ask, “If not this, then what?” A decision not to act, or to maintain a flawed status quo—where a current vacuum of leadership on the issue is rapidly filling with the detritus of others’ policy agendas—is still a decision. The climate issue is housed firmly in American minds and in geophysical realities. It will not fade away.

However we choose to articulate and prioritize our national energy priorities, the process must be seen as fair and reasonable. When we are dealing with decisions and investments that are long-term in nature, it is essential that our chosen course transcend politics and survive across administrations. Our long-term interest is not served by one faction exerting a temporary position of strength over another, only to be later reversed. Leadership will require integrity, something that underlies our scientific, academic, corporate, and governmental processes when they are at their best. Underlying integrity is openness, honesty, and the ability to have those crucial conversations—and confrontations—that must be a part of this continuing journey.

In addressing our energy circumstances, we as Americans find ourselves in a place we have never been with opportunities we have never had and choices we have never before been offered. We have a fleeting window to redefine energy security in terms beyond our own domestic needs and embrace the leadership possibilities and imperatives in creating a global framework within which we and our partners can prosper economically, progress societally, and participate in shared energy security. It is breathtaking how far we have come (as is the nature of the challenges to which we have risen) over the past century of American energy history. It is our good fortune in this century to now find ourselves with the strength to be able to redefine energy security for the next.

Editor's Comment

It seems that Jim Ellis is onto a big idea: the time is right for finding a path to a new national energy strategy. As I see it, what we ultimately want is something that gives us three things: plentiful, low-cost energy for our economy; secure energy so that we don't face the risk of hostile cut-offs from abroad (think of the Arab Oil Boycott of 1973); and energy that does as little damage as possible to our environment—the air we breathe and the environment we help create. Against these objectives, the current moment presents relatively new and outstanding possibilities.

So within that neutral strategic framework, let me use my editorial privilege to fill in two key concrete policy measures that I am convinced need to populate it—both of which should be carried out narrowly, and neither of which need be ideological.

The first is strong and sustained support for energy R&D. New technologies and methods, in considerable part from past energy R&D investments (an overused word in politics, but appropriate here), have given us a plentiful and secure supply of oil and gas, particularly when buttressed by our energy connections with our neighbors, Canada and Mexico. And with cheap natural gas replacing coal, the overall effect on our environment is quite positive. All of this is within our borders, so we have a positive economy, positive national security, and a positive contribution to the environment. What's not to like?

But more advancements are needed—some of which are nearer at hand, others on the horizon. As Jim alluded, I have spent considerable time on the energy issue since my time in office up to the present in my roles with the research programs at Stanford and MIT. So I am fortunate to see first-hand the creative work that goes on at universities and elsewhere. Over the last few years, with high oil and gas prices, the largest-ever scientific and engineering effort has gone into energy research—with visible and important results. Solar and wind energy are now competitive on a cost basis and, with the prospect of large-scale storage, their intermittency problems could diminish. Storage developments also mean there

will be some insurance against cyber or other attacks on our grid. On that count, I'm also optimistic on the prospect for small modular nuclear reactors, which could be revolutionary in every way.

Always in the past, these energy R&D efforts surged when oil and gas prices were high and subsided when prices came down. This time, we need a policy that keeps R&D efforts strong, and that policy needs to be accompanied by something that levels the playing field in terms of deployment.

This brings me to my second point.

Right now, we see a wide variety of subsidies, mandates, and special arrangements across the energy spectrum. They will not get us where we want to go. There is a simple and attractive alternative, and one that also gets at the carbon emission free-rider problem among countries.

A revenue-neutral carbon tax could accompany the repeal of all subsidies (as is practically feasible) and simply make every source of energy take on its full cost, including the cost of putting carbon into the atmosphere. It could be made revenue-neutral by having all the funds put into an easily identifiable pool—perhaps one administered by an existing trusted agency such as the Social Security Administration—and then distributed to individuals.

I speak with economists on the pros and cons of various potential policy design details, and their positions vary; the option favored by both the late Gary Becker and myself is simply to refund every cent collected in an even amount to everyone with a Social Security number. Meanwhile, a border tax on imported goods, commensurate with their embedded carbon content and feeding into that same carbon fund for use by US citizens, would protect our competitiveness and give other countries a reason to sign on with a similar measure of their own—which is, after all, the whole point. The key principle with such an economically impactful measure would be to keep it simple, so that everyone understands what they are signing on to and so that it is harder to tinker with over time (just as Alaska has managed to do with its straightforward oil fund dividend, but at which the various complex car-

bon cap-and-trade systems around the world have consistently failed). Energy requires enormous investments, and investment needs predictability. So I'm not surprised that even our major energy producers tend to like the revenue-neutral carbon tax. Something is happening here.

As Jim Ellis wrote, the climate issue is not going away—far better to be equipped with a respectable policy agenda of one's own to work from than negotiating against another's playbook.

GPS