The Challenges Facing Comprehensive Energy Policy

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ABSTRACT

World leaders have long grappled with the challenges of comprehensive energy policy, and with little success. The United States has been no more successful in adopting energy policy than our counterparts. But, as challenging as the development of comprehensive energy policy is, those efforts must be aligned with broader policies that impact health, safety and economic prosperity for all people. Energy policies must be compatible with policies on land use, access to water, environmental stewardship, economic growth and national security.

Decisions made in one part of the world potentially pose significant negative impacts to others. Our global population is expected to continue to grow at a healthy rate, resource shortages are noticeable in parts of the world (and expected to worsen), and the natural interest of nation-states to keep their economies growing will continue to put pressure on energy feedstocks and other critical resources. As non-renewable resources dwindle, shortages will inevitably lead to tension and conflict between nations. In the worst case, these conflicts manifest themselves in military engagement. It is within this context of an uncertain world and multiple competing priorities that comprehensive global energy policy must find its place, and in some way co-exist with these competing priorities.

A complete discussion of energy policy, how it relates to other major global initiatives, financial health, quality of life, and the environment would take volumes. This article is intended to simply scratch the surface of the issues and provide insight for those engaging in the debate.

SETTING THE STAGE

Our planet is now home to more than 7 billion people. The United Nations projects that the global population will grow by more than 1 billion by 2025. In 2050, world population is expected to be 9.6 billion. The most rapid population growth is expected in lesser-developed countries where shortages in available power, food and water are most severe. Increases in population will continue to exacerbate that situation. (1)

This planet is already energy poor. International Energy Agency projections suggest that over the next two decades 1.7 billion people will gain access to electricity, but these gains are offset largely by population growth. As we struggle to provide access to modern energy to the world, we face the reality that more than 800 million people (approximately 1 in 8) suffer from chronic undernourishment. (2)

The sad reality is that in 2030, 1 billion people will still have no access to electricity, and 2.5 billion people will lack access to clean cooking facilities. (3) To keep pace with population growth and make up for current deficits, the United Nations estimates that by 2030 the world will require 50 percent more food, 45 percent more energy and 30 percent more clean water than is available today. (4)

As the world struggles to provide modern conveniences to all, growth in certain areas in the global economy is triggering skyrocketing demand for energy. Strong economic growth in China, for example, will more than double electricity consumption in that country by 2030, reaching a level equal to that of the European Union of today. In fact, in the entirety of non-OECD Asia (led by China and India) it is expected that energy use will increase by 112 percent between 2010 and 2040. (5)

While certain parts of the world struggle to secure required energy feedstocks to power growing economies, other areas with an abundance of natural resources are challenged with converting them to reliable energy sources. For example, much of Africa is resource rich…with ample reserves of coal and oil. In addition, hydro and wind on that continent offer significant potential. However, many African nations have yet to effectively exploit their natural bounty domestically. So, some countries rich in energy resources find their populations woefully poor in terms of availability of modern energy.

What Does All this Mean to Future Energy Demand?

In its 2013 International Energy Outlook, the U.S. Energy Information Administration lays out its projections for global energy requirements through 2040. In spite of significant efforts to build awareness and improve energy efficiency worldwide, economic growth and a booming population will drive significant increases in demand for all fuel types over at least the next quarter century. Total energy demand is expected to increase on average at 1.5 percent per year over the period. Nuclear and renewable generation capacity is projected to grow 2.5 percent annually…greater than fossil…but not keeping up with increasing demand. The net result is that fossil fuels will continue to supply most of the world's energy even in 2040—or about three quarters of the world's energy consumption.

World coal consumption will increase 1.3 percent per year from 2010 to 2040…with non-OECD Asia fueling the largest percentage of that.

WHAT DOES ALL THIS HAVE TO DO WITH COMPREHENSIVE ENERGY POLICY?

Above, you see a mind numbing set of facts, figures and projections. What do they have to do with the development of a comprehensive energy policy, either at the national or global level? Everything. Energy policy will have an impact on other national and global priorities. National comprehensive energy policy not aligned with the policies of other countries runs the risk of being ineffective, and even counterproductive.

Optimizing on a set of national or global energy goals could, in fact, have a serious negative effect on other critical policy initiatives. As an example, there has been much debate on whether grown energy feedstocks could have a negative effect on food production…with much

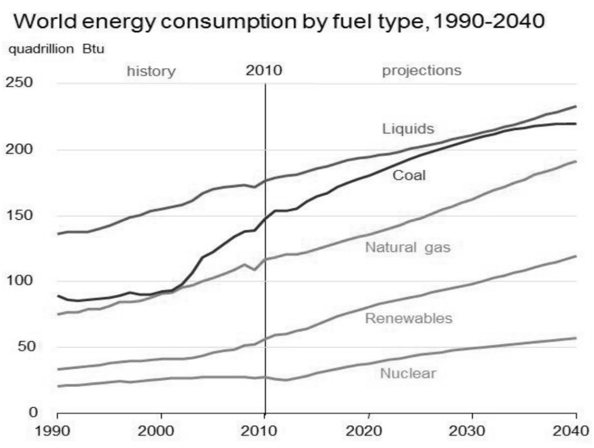

Figure 1: World Energy Consumption by Fuel Type, International Energy Outlook 2013, U.S. Energy Information Administration

effort expended to focus on field waste and marginal land as the source for bio-energy feedstocks. But, as the data detailed above illustrate, we are not currently capable of feeding more than 10 percent of the current world population. So, either the current production and/or supply chain is not operating efficiently enough, or we do not have enough acreage in production to meet required output. Too, dwindling natural areas like rainforests and the habitats they support further limit the availability of critical resources to grow feed and bio-energy feedstocks. Food, energy and water demand is expected to skyrocket over the next 15 years. Competition will be intense for the same land and water resources. Unless demand from each desired use is carefully calculated and overlaid against available natural resources to meet each need, the risk is significant that poor decisions will be made, resulting in unintended consequences.

UNDERSTANDING THE LIFE CYCLE AND THE HOLISTIC ENVIRONMENT

The effectiveness of any comprehensive policy requires the establishment of goals and metrics. Careful development of metrics goes a long way to ensuring successful policy implementation. Improper metrics can drive behavior contrary to intended results and could actually make matters worse. One glaring case in point: The biofuels revolution is providing incredible business opportunities for the world agricultural communities. The prospect of replacing hydrocarbon fuels with renewable alternatives is compelling, but what about the unintended consequences? It was well documented a few years ago that the biofuels boom triggered massive development of palm oil plantations in Indonesia. Business opportunities for local farmers were significant, but those opportunities resulted in a significant destruction of pristine rain forests in that country, threatening endangered species, displacing indigenous people and releasing massive amounts of CO_2. (6) The devastating environmental impact, overall, had the opposite effect as was intended.

Each individual set of actions that makes up a complex system intended to support policy that will fundamentally change the way we operate carries the potential of unintended consequences. There is obviously no way to anticipate each one. However, rigorous review, based on careful analyses of the life cycle effects of any decision, would assist in uncovering the unexpected. The new technologies that will drive the renewable energy revolution will require the harvesting or extraction of key raw materials, manufacturing processes, transportation, installation, operation/maintenance, and finally end-of-life disposition. Each costly step carries an environmental footprint, each step likely displaces some other activity, and most importantly, each step will drive specific human behavior to compete. On the whole, the life cycle impact will help guide decision makers in rewarding certain behaviors and discouraging others. Failure to understand life cycle impact risks outcomes with the same catastrophic effect as seen in the Indonesian rain forest.

As important as comprehensive energy policy is at the global scale to the future economic and environmental well-being of the planet, energy policy cannot be considered in a vacuum. Many resources must be managed in parallel. This means that tradeoffs will occur. It is not rational to think that energy policy can be optimized at the expense of equally important efforts. The best holistic solution will be one where no individual initiative is optimized, but rather on balance the whole is operated in the most efficient state, with individual initiatives sub-optimized to achieve the best overall result. Nothing is truly sustainable if it is not also financially sustainable. To sustain themselves, governments must provide opportunities to improve quality of life. People want to advance economically and provide better lives for their children. Infrastructure will be built, resources will be exploited, and economies will grow, while demand for energy and other resources will grow as well.

THE PROS AND CONS OF ENERGY INDEPENDENCE

Individual nations have the responsibility to provide for the well-being and protection of their citizenry. Ideally, there would be an absence of conflict among nations, and decisions as to where resources are acquired would be simple comparisons on cost, quality and availability. The system would be at its most efficient, financially, and using our limited resources effectively. But, the world will most likely continue to be a very uncertain and volatile place. Therefore individual nation states will find it necessary to secure access to adequate supplies of energy feedstocks that are not susceptible to disruption from political unrest.

Logically, feedstocks safely inside national boundaries or within the control of trusted allies provide the best path to energy independence. But what if those resources are more expensive than alternatives found in more volatile parts of the world…or maybe the environmental footprint of locally sourced feedstocks is less favorable? Well, the goal of energy independence could certainly be achieved, but at a net cost to the overall efficient and effective use of the world's valuable resources.

Nations can be naturally expected to incorporate some degree of energy independence in their energy policies in an effort to address national security concerns well outside the bounds of energy policy. Inefficient from a pure energy perspective? Sure. Critical from a national security perspective? Absolutely.

PROVIDING FOR ENERGY SURETY

Energy independence is one thing; energy surety and the risks to our energy distribution infrastructure (which question the reliability of getting needed energy to the point of use) stands as the proverbial elephant in the room. Make no mistake…energy independence in no way assures energy surety. Energy independence normally refers to a sovereign's control over the source of supply of energy feedstocks…avoiding the risk that adversaries or rogue organizations could restrict a nation's access to needed energy feedstocks. Energy surety, on the other hand, addresses the ability to reliably and efficiently deliver energy to a user. So, energy surety focuses on the assets that refine, generate and distribute energy resources. Therefore, it is possible that a nation could achieve a high level of energy independence, but have a vulnerable distribution system that makes it unable to deliver energy to the point of use.

Electrical grid, pipeline and supply chain transportation assets are vulnerable to natural and manmade events that threaten long-term and wide ranging disruptions to refining, generation and distribution infrastructure. These vulnerabilities raise the possibility of very-long-term grid outages and fuel delivery delays. The impacts are greater than local fuel storage and backup power generation assets are designed to address.

Energy surety risk can come from either natural or manmade events. On the natural side, the northeastern United States experienced the effects of such occurrences in October 2012 with the arrival of Superstorm Sandy. Grid outages and fuel delivery delays went from days to weeks, stressing backup systems beyond designed capacity. The aftermath of that storm has given us a glimpse of the challenges a nation can face from long-term widespread disruptions. Storm events are only one of the natural occurrences that could impact delivery of energy. Solar flares, for example, present significant risks, and those risks are in many ways quite similar to the impacts of manmade events discussed below.

Every day, the world becomes more dependent on high-tech electronic equipment to run almost every aspect of our lives. As this equipment becomes more critical, interest it as strategic military targets becomes more intense. Any event that could disrupt the operation of critical electronic equipment could be potentially devastating to a developed nation. We rely on sophisticated electronic equipment to insure the delivery of power, and to integrate intermittent renewable resources onto a very complex and far-reaching grid. We call this capability the "smart grid," and we are more and more dependent every day on the smart grid to provide efficiency and reliability. But, what happens if the smart grid suddenly goes "dumb?" What if those sophisticated electronic systems cease to function? The backbone of the system would be broken, so widespread and long-term outages are a real and present risk. Could something like this really happen? Yes! The source could be a cyber-attack, or the effects of an electromagnetic pulse (EMP) event.

The effects of either event are essentially the same. They would cripple the sophisticated electronic devices that control generation assets and distribution systems, taking the entire system down, possibly for extended periods of time. The extent of expected damage is so wide ranging that recovery efforts would be extensive and significantly time-consuming. Work-arounds are considered almost impossible after an attack…therefore proactive measures need to be taken now to address risks and incorporate resiliency into vulnerable systems.

As nations grapple with the development of comprehensive energy policy, they cannot ignore the risks to grid and fuel delivery infrastructure. Investments in hardening of assets, resiliency and redundancy must be part of the debate and the solutions, if these policies have any chance of addressing the most important component of the entire exercise…reliable availability of energy to the end user.

ROLE OF THE MILITARY

The US Department of Defense is one of the world's largest single consumers of energy. Military activities are inherently energy intensive, so other world militaries also use more than their equitable share of energy resources to conduct operations. Recent studies indicate that American war fighters consume more energy per capita than any other fighting force in history. With these facts as the backdrop, what is the appropriate role for the military in the world of energy policy, development of renewable energy technologies and energy efficiency initiatives?

Starting with the stated mission of the military, military organizations have a very distinct and unique mission. They are charged with the protection of national interests at home and abroad, coming to the aid of allies in distress and providing humanitarian assistance at any point on the globe in rapid fashion. The successful execution of their mission requires significant energy resources. We want those who go into harm's way on our behalf to have the best equipment, intelligence and situational awareness possible, to give them an overwhelming tactical advantage against adversaries. By definition, that capability requires mechanical equipment and electronic devices that consume vast amounts of energy.

So, should military organizations be saddled with the additional burden of pushing new energy technologies and being the standard bearer of national and/or global energy policy? On its face, that task seems well beyond reasonable. Certainly, as big users of energy, military installations and units are perfect as early adopters of new, commercially available technologies. In recent years the US military has been quite willing to sponsor demonstration projects of emerging energy technologies and has enthusiastically embraced performance-based energy efficiency efforts. This willingness appears quite in line with the military's past participation in development of emerging technologies that have military application as well as civilian applicability.

Finally, the military's thirst for energy does pose significant supply chain challenges, as well illustrated during coalition activities in Operations Enduring and Iraqi Freedom. Significant life and national treasure was expended to protect fuel convoys moving to and from forward-operating locations. Protecting the supply lines proved to be a very costly proposition. The military has moved out aggressively on battlefield energy efficiency and alternative energy sources. The lives and limbs of our brightest and best who serve the nation with valor deserve nothing less.

So, there is certainly a role for military organizations in the development of energy technologies and in the pursuit of a comprehensive energy strategy. But, that role is best limited to activities that augment military capability and allow our war fighters to more effectively do the mission to which they are tasked.

SUMMARY AND CONCLUSIONS

The challenges associated with the development of a comprehensive end-to-end energy policy are enormous. Constituencies and priorities are many and varied. There will be no lack of individual zealots intent on driving their agendas at the expense of the optimal holistic approach. Any successful policy development and implementation must be grounded in the realities and requirements of the real world. The march of progress will continue. Billions of people will move from poverty to middle class and beyond. They will consume more and use energy at ever-increasing rates. Effective energy policy will take all these realities into consideration. It will recognize that dramatic change is slow and that multiple transitional steps are necessary to reach a desired end state. Finally, success requires collaboration and cooperation between all constituencies. Ignoring the realities of the environment or key constituencies would be done at the peril of the overall effort.

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