Energy Issues of the Future

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Begin with an anecdote from the People's Climate March in New York City this past September. At that time some of you may have seen a small news story about one young reporter's contretemps with Robert Kennedy Jr. who was amongst many celebrities there demanding an end to the age of hydrocarbons. The reporter asked Mr. Kennedy if he planned to give up his car *and* his iPhone to demonstrate personal leadership in cutting his carbon footprint. Kennedy, to use the inelegant phrase, flipped out, grabbed the reporter's microphone and accused her of asking an inane question.

It was actually a revealing question, not so much Kennedy's reaction, but about the magical thinking in play about how energy is used and produced. Kennedy thought the reporter's question about his iPhone was particularly nutty. It wasn't. It was a question that says much about energy demand, and supply, both today and in the future.

The smartphone gets its smarts from a vast and largely invisible infrastructure that consumes energy. It is the energy consumed in that network that means you could reasonably call a smartphone the SUV of the information superhighway.

Watching a Major League baseball game on your smartphone or iPad uses about as much energy as driving about 30 miles in a Prius. Overall, a single smartphone used the way most of us use it consumes as much electricity each year as the refrigerator in your home. I'm not talking about what it takes to charge the battery in your iPhone. That doesn't take any more energy than a nightlight. I am referring instead to your *pro rata* use of the massive, but hidden electricity-intensive infrastructure that hums in the background 24x7 and invisibly makes smartphones possible. Unlike a car where nearly all the energy used is visible to you in the on-board fuel tank, most of a smartphone's energy consumption is consumed remotely in the Cloud and networks.

In fact, globally, information hardware and software in all its various forms and functions now consume more electricity than the generating capacity of Japan and Germany combined.

This shouldn't be totally surprising when you consider the scale of how many transistors the world produces and uses today. Transistors in all their various forms are used of course to process, store and transport information. Transistors consume electricity, and only electricity; individually not much, but collectively a lot. And the "collectively" is quite amazing. The world manufactures more transistors each year than we grow grains of wheat – not tons or bushels of wheat, but ***grains***.

In America, 70 percent of our electricity today and for the foreseeable future comes from coal and fracked natural gas. For the world, coal supplied 60 percent of all the growth in electric supply over the past two decades during the ascent of the smart mobile ecosystem – and is forecast to supply at least 50 percent for the next two decades even under the most optimistic—or pessimistic, for the anti-hydrocarbon crowd—scenarios.

Put another way -- the ascendant defining energy-consuming technologies of our time, smartphones, Apps, and big data, are increasingly powered by the ascendant defining energy-producing technology of our times, fracking. The 400,000 marching in New York last month, given how they likely Tweeted and "YouTubed" (to create a new verb) were responsible for directly consuming about 150 tons of coal that one day.

The future of energy demand is driven, literally, by everything because *every* thing, not just iPhones, depends on energy – that is, everything that makes life and society possible, always and everywhere. It is precisely this fact that renders what is being proffered as an 'alternative' energy future so fundamentally misguided, even silly. Consider that the energy equivalent of 100 pounds of coal or ten gallons of oil is needed whenever we:

- consume 100 GB on a smartphone
- manufacture the computer chips in one iPhone
- fly or drive about 300 miles
- produce beef for 15 hamburgers
- power a conference room like this for an hour

The annual consumption of these kinds of things is growing globally and is measured in astronomical numbers: trillions of gigabytes of data, trillions of air and road miles, hundreds of billions of tech products, hundreds of millions of cars, billions of tons of food, billions of conference hours.

Such scale of demand in the real world tells us that an anti-hydrocarbon agenda cannot prevail in the foreseeable future. We know what the future of energy looks like because of clear and immutable laws – laws of nature, economics, politics and technology. In order to illuminate reality, I'll briefly highlight the central law in each of these four domains.

Let's start with physics: I'll mention just one relevant and immutable law that promises greater, not less, global energy demand. If I may, with apologies to any physicists in the room, summarize the law of physics I'm referring to here in this way: Nature, naturally, wants to create disorder. Things, to put it another way, naturally fall apart. Possibly many of you here have noticed that we usually become aware of this law when we buy our first home, or hit our 40th birthday or so. In order to fight disorder, to create order -- to perform the magic of adding beauty, structure, speed and logic to our world – we always and everywhere have to use energy. What this means is not just that more wealth creates more energy demand because more people consume more stuff, but that with rising wealth, people increasingly want more access to things that create beauty, comfort, safety, convenience and speed – all such attributes in everything from art to transportation and from entertainment to information increase energy consumption.

Which brings us to the second domain, economics. Here, one of the immutable laws is to put it simply: cheaper is better. Economies, businesses, political systems and politicians can't long survive by making more expensive, instead of cheaper, the products and services that people want. All of human history has been a drive towards getting more of what we like—comfort, beauty, convenience, speed, safety—by using less of what we cherish – our time and money. In the energy world, and in the domain of things that energy depends on, which is everything, cheaper is better. And all, not some, of the alternatives to hydrocarbons are far more expensive.

This brings me naturally to the third domain of reality, politics. Here I propose there are two immutable laws of political behavior -- money matters, and world government will never happen.

I say world governance because as President Obama said at his U.N. climate speech this year, and as many committed environmentalists have said as well, the challenge that the U.N.s climate computer models put before us cannot be met unless everyone in the world gets on board with the same plan. China fueled its two decades of astonishing growth with a rise in hydrocarbon consumption equal to adding a United States to the world. India is about to follow the same path. Africa, and then South America, will be next. Global agreement on what amounts to something more fundamental than industrial policy—energy policy—is simply never going to happen. And any simulacrum of any such global agreement is, at best, a paper thin plan with hidden, limited and usually counter-productive agendas.

Then there's the money *and* politics – I don't mean money *in* politics. According to the International Energy Agency, the world has spent over the past two decades $1 trillion subsidizing non-hydrocarbon energy alternatives. Yet over that period coal still supplied 70 percent of all new electricity generated. The IEA forecasts that at least another $3 trillion in subsidies will be needed in the coming two decades to achieve an outcome not much different. I doubt the world will spend that. I predict that we're entering a new era, one of intolerance for such massive subsidy spending – call it peak subsidies.

Finally, let me turn to the core law of the fourth domain, technology. Here, the relevant law is that supplying energy to society is fundamentally about technology, not resources. Energy resources are immense in scale and ubiquitous and have been available for all of geophysical time, whether sunlight, wind, waves, coal, shale or uranium. It is technology that enables humans to convert the abundant energy extant in nature into a form useful to us, at a price and in a way we can afford. Deep sea oil always existed but was unavailable until engineers could build deep-water rigs. Shale oil and gas similarly has been unlocked not by a new "discovery"—the U.S. shale fields were mapped by the U.S. Geological Survey a century ago—but by developing and deploying new technologies.

While brings us to a critical collateral law, that technology always gets better and does so agnostically. It's not just that batteries are better today than a decade ago, making a Prius and a Tesla possible, but that internal combustion engines are getting better too. And while solar cells get better, so do oil rigs. The information revolution that permits new capabilities in modeling, materials, processes and operations isn't available only to engineers who build solar panels. It's available to petroleum engineers too.

As has been widely reported, technology (ignoring the subsidies) has driven down the cost of solar panels. Measured in ways that matter, productivity in terms of energy delivered per unit of capital expended, solar is nearly 350% cheaper now than 15 years ago. Measured the same way – CapEx per unit of energy delivered – oil rigs in the shale fields have improved 350% in less than five years.

The newfound hydrocarbon abundance comes in large measure from information technology and not just hydraulic fracturing, or horizontal drilling – but a combination of all three. Using sensors and super-computer-class computation on desktops, drillers not only know where to drill but how to steer drills horizontally in real time in order to follow hydrocarbon-rich seams, how to design the hardware and rigs, how to undertake exploration. Call all this smart drilling.

Still, there is a rising chorus, as many of you probably know, claiming that the shale boom is a bubble. That peak oil is still coming, just delayed. But this view requires one to believe the untenable idea that technology progress has now ended: Or that the underlying resource is very limited. The quantity of the resource is countable in the thousands of billions of barrels. The U.S. consumes annually about 12 billion barrels of oil and natural gas. The economically extractable quantities are of course entirely a function of today's technology, not tomorrow's; in those terms the available supply is countable in hundreds of billions of barrels. The words Bakken, Barnett, Eagle

Ford and Marcellus are now in the common lexicon. There are many other shales, and in the future some of their names will become better known, such as the Wolfcamp, Springer and Green River. All of the geophysical resources of shales in America are countable in the thousands of billions of barrels.

In today's America, over the past half-dozen years—without incentives, special subsidies, grants or stimulus—we find ourselves the world's fastest growing oil and natural gas producer. And the biggest producer of the latter, on track to move from second to first place on the former. The boom has returned oil production to levels last seen 40 years ago, and cut U.S. imports by 60 percent.

What does it mean?

This boom has single handedly propped up the entire U.S. economy in the tepid recovery from the Great Recession. Absent the roughly $300 billion added annually to the GDP each year from just the oil & gas sector, the U.S. would have been in a recession in nearly every year since 2008. The boom has also attracted a flood of foreign direct investment in this sector, already past $300 billion cumulatively in the past half-dozen years, with more to come. While the U.S. is not now, nor will it become, a resource-centric economy, the abundance has been a gift.

The newly established and permanent surplus of natural gas is stimulating a manufacturing revival. There is over $120 billion in private investments in 200 new energy-centric manufacturing operations scheduled to come on line in the U.S. in a few years that will generate a million-plus new jobs and add yet another $300 billion to the GDP. In due course, we can expect to see an associated expansion of manufacturing in the entire supply chain beyond that which is chemical-based and energy-centric.

The decades of hand-wringing, political wrangling and serially goofy ideas about how to end import dependency is over. The political system, and especially our policies and regulations, have not caught up with this stunning change. We no longer need to talk about how to minimize our economic and strategic import dependencies, but rather we can talk about how to maximize our influence and export power.

It is not enough that we import less though. It is critical that American firms become sellers to the world. Our European allies fully appreciate the potential geopolitical benefits of having America as an energy supplier in order to reduce dependence on Russia. A leaked European Union memo from this past summer's bilateral trade negotiations with the U.S. contained an explicit plea for America to eliminate constraints on shipping crude and natural gas to Europe. And nearly everyone that buys from the Middle East would welcome a more secure source.

All of this is on track to disrupting global geopolitics—in fact it is arguable that these trends have already reset the landscape. The future used to look like a world in which nearly all of the global trade in fuel would be dominated by two players, Russia and the Middle East. Now the U.S., especially by partnering with our two North American neighbors, Mexico and Canada, can become not just the third major player but conceivably the dominant player.

Unlocking all this will require a complete rethinking of energy and economic policies that are nearly a half-century old and anchored in defunct, old-think. What American policymakers can do now to capitalize on the new reality is easy to summarize in just four steps – four R's.

One, Ramp Up: Policies should encourage yet more production on private and state lands. This could be done with regulatory relief in many cases, especially as it relates to building out the essential infrastructures from pipelines to refineries and ports.

Two, Repeal: We need to completely repeal the antiquated federal constraints on exporting natural gas and crude oil. The former was made de facto illegal by virtue of the mother-may-I federal approval requirements, and the latter is affirmatively illegal to export. These anti-competitive and trade-violating rules were put in place eons ago when people thought we were running out of energy. American companies shouldn't be asking for permission to sell to overseas buyers, the federal government should be helping them do it. Congress should repeal the antiquated rules, and re-purpose and re-name the relevant agencies as offices of export assistance (much as we have in the Department of Agriculture). This no-cost move would by itself stimulate more production.

Three, Reduce & Repatriate: Reduce corporate taxes not just to create more production and jobs, but also to accelerate the trend of foreign investment across the entire U.S. energy sector. It is worth keeping in mind that the shale boom was not created by "big oil" but almost entirely by thousands of small and mid-sized businesses in America, precisely the kinds of businesses hardest hit because they don't have the legal and financial resources to, put it unkindly, 'game' the tax rules as do mega-firms. And, again, seriousness would suggest creating a tax holiday for the repatriation of foreign profits of American firms, provided the money supports the strategy.

Four, Reform: The shale boom has happened entirely on private and state lands, so let's open up federal lands for expanded oil and gas production where current policies have actually yielded a decline in output. The federal government controls half of America's land and nearly all of the off-shore domains and leases under two and six percent respectively of those controlled territories. Imagine a bold policy to foster *growth* in production on federal lands to match what's happening on private and state lands by two simple steps: expand the land available for lease by, say, two-fold, and rationalize approval and permits policies to emulate the states fast and sensible processes.

The seriousness of the times calls for bold strategies. America is at a pivot point in history. The power of American hydrocarbon technology has the potential to finally staunch the flow of money that has been distorting geopolitics for decades, and stimulate—for free, without taxpayer subsidies—a boom in manufacturing, exports, jobs and GDP the likes of which the U.S. has not seen in decades.

All we need do is abandon magical thinking, and embrace a future that is already happening.

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