Energy and the End of Growth

By Michael Edesess
January 8, 2013

Is economic growth coming to an end? That's been a hot topic of discussion recently (including in this publication), thanks to a paper by Northwestern University economist Robert J. Gordon, Is U.S. Economic Growth Over? It had a simple but striking thesis: "There was virtually no growth before 1750, and thus there is no guarantee that growth will continue indefinitely."

But before 1750 there were no fossil fuels either. Only once humans tapped the large deposits of coal and oil beneath us did economic growth truly awaken. Every technological innovation since then has depended on fossil fuels. The history of economic growth is, so far, the history of fossil fuels.

This gives us cause to wonder whether economic growth will end when it is no longer powered by fossil fuels. Civilization as we know it is – and has been – fossil-fueled; where society is not energized by fossil fuels, people live in abject poverty, much as most of the world did in 1750.

Hence, there is endless discussion about what will take the place of fossil fuels when they are gone or become too expensive or damaging – and what kind of civilization will use these alternative forms of energy. This is not idle speculation – it is a very practical conversation to have. Long lead times will be necessary to make a transition. Two hundred and fifty years of fossil-fuel based growth and infrastructure development will not be cast aside quickly or easily.

It is also an important conversation for those who study investment opportunity. The biggest opportunities arise when new technologies are born, creating a new social and industrial infrastructure in the process. A major energy transition could entail as great an upheaval in infrastructure as any that our civilization has experienced since 1750. It will not be merely a question of what energy systems to invest in; it will be a question of what the entire global social infrastructure will look like, depending on what energy technologies are used.

The cloistered economics profession

Of course, most economists fail to ask the right questions to be a useful part of this discussion – and Gordon is the latest example.

Gordon's describes the goal of his article this way:

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.

> This paper raises basic questions about the process of economic growth. It questions the assumption, nearly universal since Solow's seminal contributions of the 1950s, that economic growth is a continuous process that will persist forever.

This opening reveals how cloistered the thinking in the economics field is. MIT professor Robert Solow posited, in a 1956 paper, a very simple model of economic growth based on capital, labor, and a third factor presumed to be technological advances.

The mathematical statement of Solow's model expresses GDP, or total production, as Solow's three factors multiplied together – capital, labor, and technology – with two of them raised to an exponent. This appears to be the reason why, as Gordon states, the assumption has been nearly universal among economists since then that economic growth will continue forever – indeed that it will be exponential growth. But there is nothing in Solow's theory *itself* that implies – or even offers an argument for the proposition – that economic growth will continue forever.

In spite of Gordon's statement that the assumption of unlimited growth is "nearly universal," it has been questioned vigorously many times – not just by individuals but by entire intellectual movements – for example, the "limits to growth" and "peak oil" movements – not to mention the field of ecological economics. In the 1970s, Herman Daly, a founder of ecological economics, published widely read articles and books arguing that the economy must transition to a steady state – one without growth. Daly was not, and is not, a fringe commentator, but a respected academic economist who served as chief economist of the World Bank.

More recently, the journalist Richard Heinberg published The End of Growth, a book that argued that growth is impeded by resource depletion, environmental impacts, and debt.

The problem, I believe, is that Gordon is using the economist's esoteric meaning of "economic growth" – a technical term of art whose definition can be comprehended only with the aid of a Ph.D. in economics. Hence, when people who are not in the economics mainstream – resource pessimists for example – speak of economic growth, economists ignore them, or assume they are talking about something else.

The economists' model of economic growth does not include natural resources as something on which the level of economic production explicitly depends. For this omission, ecological economists have roundly criticized their mainstream counterparts. Nevertheless, natural resource limitations – particularly limitations on the quantity of, and access to, fossil fuels – could well challenge, sooner or later, the possibility of unlimited economic growth.

The enormity of energy use

After reading economists debating their inscrutable definitions of "economic growth," it was, for me, a breath of fresh air to read recently a work by a scientist who speaks not in

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.

jargon but in more or less plain English: Energy for Future Presidents by Richard A. Muller, a physics professor at the University of California, Berkeley.

The book lists almost every energy source and technology we know of today that might be used in the future. It presents a simple evaluation of each – its risks, its costs, its energy output, its energy density (how much energy it provides or stores per pound or per unit volume), and so on.

One thing the book makes clear is the sheer enormity of our fossil fuel use. The United States alone uses the equivalent of a cubic mile of oil a year (with coal and gas converted to their energy equivalents in oil).And that's only what's used in the United States, with one-twentieth of the world's population.

You might have thought the U.S. trade deficit comes from imports of consumer goods from China, but in the 2000s half the U.S. trade deficit represented oil imports (much of them from Canada). Half of rail transport in both China and the U.S. is used for shipping coal. China builds a new one-gigawatt coal-fired electric power plant every week – that's enough energy to power a million homes.

This massive fossil fuel consumption will be difficult to replace. Furthermore, the future looks worse. China's current per-capita energy use is only one-fourth that of the U.S. The Chinese have been under-spending for decades while piling up savings from exports. With their U.S. and European consumer markets flagging due to economic difficulties, China's latest five-year plan calls for tapping its citizenry's own accumulated savings by selling into the internal market.

Suppose the Chinese follow the Western model, purchasing automobiles (China is already the world's largest buyer of automobiles), air conditioners, clothes washers and dryers, electric water heaters, home appliances, and so on. U.S. electricity use grew by 7% per year in the 1960s and 70s as purchases of these energy-intensive consumer durables became widespread. China has only just begun that phase of its development.

If and when climate change caused mainly by fossil fuel emissions becomes an urgent matter – it's not yet, in my opinion, but it's getting there – the challenge will become even more awesome. Think of the phase-out of nuclear energy and the general disfavor cast upon it following the saturation media coverage of the Fukushima nuclear accident. (Muller thinks that reaction is a mistake, and I agree; more about this shortly.) Even if a cataclysmic event – such as Hurricane Sandy but more so – that could be linked to climate change occurs that, like the Fukushima accident, is more symbolic than certifiably calamitous, it could turn popular opinion strongly against fossil fuels. If protests prevent coal plants and perhaps even gas from being built, what then?

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.

The chief competitors

Among the possible alternative sources of energy known to us now, the chief contenders – although none are mutually exclusive – are various forms of renewable energy (e.g., solar, wind, biomass and hydroelectricity) and nuclear energy.

Renewable energy's candidacy seems dubious because the sun, the wind, rivers – these have always been readily available. Human inventiveness and ingenuity is not some new phenomenon that began in 1750 – the thriving civilizations of the ancient Greeks and Romans make that clear.

Why, then, did it take the discovery of fossil fuels to untether that ingenuity and inventiveness and uncork the modern miracle of economic growth? Why couldn't it have been done using solar and wind and renewable biomass energy alone a thousand years ago? If we can rebuild modern civilization using only renewable energy now, why couldn't earlier geniuses have built a civilization using it then? One possibility is that fossil fuels were needed as a kick-starter, just as an electric charge is needed to start an internal combustion engine. Can renewable energy take over now that the economic engine is already humming?

Perhaps. Still, I believe that in public perceptions a nagging sense lingers that renewable energy is not powerful enough.

Nuclear energy, on the other hand, has only recently been discovered, much more recently than fossil fuels. Its problem in the public imagination is the exact opposite – it is too powerful. We worry that something, somehow, could go disastrously wrong; it may not even be possible to predict beforehand just what that will be.

Muller does a good job of demystifying – and minimizing – nuclear threats. He also touts the benefits of small, underground nuclear reactors, though it is disappointing that he does not address their costs (but it may be impossible to do so with any accuracy at this point in their development).

The public concern about nuclear energy is, I believe, largely a product of misinformation and misunderstanding – and, as a result, as Muller points out in the case of small reactors, rigid regulation designed to make it safer could wind up making it less safe instead, or unusable.

But that is the problem with a technology that seems too powerful – people will quite reasonably demand strong and perhaps rigid restrictions.

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.

In the interim

Between where we are now and those two choices there are two way stations, either or both of which could carry us for a hundred years or more.

First, there is energy efficiency. Muller recommends that a future president rechristen it "energy productivity," to escape the unwarranted pooh-poohing that has ensued ever since Jimmy Carter called for energy conservation in his so-called malaise speech in 1979. Energy efficiency – or energy productivity if you prefer – can mean technical fixes or structural societal changes (homes situated closer to workplaces, for example) that reduce the consumption of energy without altering or impairing the quality of life. Many energy efficiency opportunities offer high returns on investment.

Second, there is natural gas, much more of which is expected to become available with the spectacular success of hydraulic fracturing. Muller says that while "fracking" has negative environmental consequences, and regulation must require it to be done in an environmentally sensitive manner, its cost, even with regulation, remains attractive.

What's missing

Though overall I'm quite impressed with what Muller's book achieves, I have a few quibbles that must be noted.

First, not every scientist agrees with all of Muller's analyses. Two comments strongly dissented from his calculations about electric automobile batteries. These calculations were crucial to his conclusion that electric cars, and even plug-in hybrids, will never be economical.

However, if those were the only dissensions based on technology alone – and they appear to be – then that's a pretty strong endorsement. I don't see how Muller could have checked up on the latest facts and figures about every single technology he analyzes and still had time to write the book, unless he had an army of research assistants at his beck and call.

Second, I wish he had said more about methanol. Muller makes a good argument that the best alternative fuel for automobiles will be compressed natural gas – especially in the United States, where the cost of natural gas has come way down due to the fracking boom.

And yet, there are others who claim that methanol – which can be made from natural gas or coal – is the best alternative to gasoline. I would have liked to know Muller's analysis of this fuel. The energy analysts Gal Luft and Anne Korin, who also authored the 2009 book Turning Oil Into Salt, argued that if all automobiles made in the U.S. could be turned into flex-fuel vehicles at a cost of $100 each (some already are), then drivers could switch to methanol or other fuels if the price of oil skyrockets.

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.

How can economic growth continue if fossil fuels are phased out?

Assuming that a misinformed or misled public does not get in the way, the future of energy is fairly clear. It should include both nuclear and renewables, as well as radically more efficient use of the energy we do produce. Natural gas will be important for a long time, and all fossil fuels could be acceptable if “carbon capture and sequestration” (the capturing of carbon dioxide from the emissions stream and storing it underground) becomes economical and its risks are adequately mitigated. (Muller is more sanguine about that last prospect than I am.)

As I pointed out in a previous article, politicians who aspire to national office treat nuclear energy as the third rail, while renewables get enshrined alongside apple pie and motherhood. This unequal treatment will have to change. It may seem ludicrous to suggest such a thing in the present day, but I’m with Muller in believing that politicians should be educators not panderers – and a good deal of education is needed on the energy issue.

Michael Edesess is an accomplished mathematician and economist with experience in the investment, energy, environment and sustainable development fields. He is a senior research fellow with the Centre for Systems Informatics Engineering at City University of Hong Kong and a project consultant at the Fung Global Institute, as well as a partner and chief investment officer of Denver-based Fair Advisors. In 2007, he authored a book about the investment services industry titled The Big Investment Lie, published by Berrett-Koehler.

www.advisorperspectives.com

For a free subscription to the Advisor Perspectives newsletter, visit:
http://www.advisorperspectives.com/subscribers/subscribe.php

© Copyright 2013, Advisor Perspectives, Inc. All rights reserved.