Ten Reasons Intermittent Renewables (Wind and Solar PV) are a Problem

Posted on January 21, 2014

Intermittent renewables–wind and solar photovoltaic panels–have been hailed as an answer to all our energy problems. Certainly, politicians need something to provide hope, especially in countries that are obviously losing their supply of oil, such as the United Kingdom. Unfortunately, the more I look into the situation, the less intermittent renewables have to offer. (Please note that I am not talking about solar hot water heaters. I am talking about intermittent renewables added to the electric grid.)

1. It is doubtful that intermittent renewables actually reduce carbon dioxide emissions.

It is devilishly difficult to figure out whether on not any particular energy source has a favorable impact on carbon dioxide emissions. The obvious first way of looking at emissions is to look at the fuel burned on a day-to-day basis. Intermittent renewables don't seem to burn fossil fuel on day-to-day basis, while those using fossil fuels do, so wind and solar PV seem to be the winners.

The catch is that there are many direct and indirect ways that fossil fuels come into play in making the devices that create the renewable energy and in their operation on the grid. The researcher must choose "boundaries" for any analysis. In a sense, we need our whole fossil fuel powered system of schools, roads, airports, hospitals, and electricity transmission lines to make any of type of energy product work, whether oil, natural gas, wind, or solar electric–but it is difficult to make boundaries wide enough to cover everything.

The exercise becomes one of trying to guess how much carbon emissions are saved by looking at tops of icebergs, given that the whole rest of the system is needed to support the new additions. The thing that makes the problem more difficult is the fact that intermittent renewables have more energy-related costs that are not easy to measure than fossil fuel powered energy does. For example, there may be land rental costs, salaries of consultants, and (higher) financing costs because of the front-ended nature of the investment. There are also costs for mitigating intermittency and extra long-distance grid connections.

Many intermittent renewables costs seem to be left out of CO_2 analyses under the theory that, say, land rental doesn't really use energy. But the payment for land rental means that the owner can now go and buy more "stuff," so it acts to raise fossil fuel energy consumption.

Normally the cost of making an energy-related product gives an indication as to how much fossil fuel energy is involved in the process. A high-priced energy product gives an expectation of high fossil fuel use, since *true renewable energy use is free*. If the true source of renewable energy were only wind or solar, there would be no cost at all! The fact that wind and solar PV tends to be more expensive than other electricity generation gives an initial expectation that the fossil fuel energy requirements for creating this energy source are high, rather than low, if a wide boundary analysis were to be done.

There are some studies based on narrow boundary studies of various types (Energy Return on Energy Invested, Life Cycle Analysis, and Energy Payback Periods) that suggest that there are some savings (from the top of the icebergs) if intermittent renewables are used. But more broadly based studies show that the overall amount of fossil fuel energy used by intermittent renewables is really so high that we don't come out ahead by its use. One such study is Weissbach et al.'s study in *Energy* called [Energy intensities, EROIs (energy returned on invested), and energy payback times of electricity generating power plants]. Another is an analysis of Spanish installed solar power by Pedro Prieto and Charles Hall called [Spain's Photovoltaic Revolution: The Energy Return on Energy Invested].

I tend to use an even wider boundary approach: what happens to world CO_2 emissions when we ramp up intermittent renewables? As far as I can tell, it tends to raise CO_2 emissions. One way this happens is by ramping up China's economy, through the additional business it generates in the making of wind turbines, solar panels, and the mining of rare earth minerals used in these devices. The benefit China gets from its renewable sales is leveraged several times, as it allows the country to build new homes, roads, and schools, and businesses to service the new manufacturing. In China, the vast majority of manufacturing is with coal.

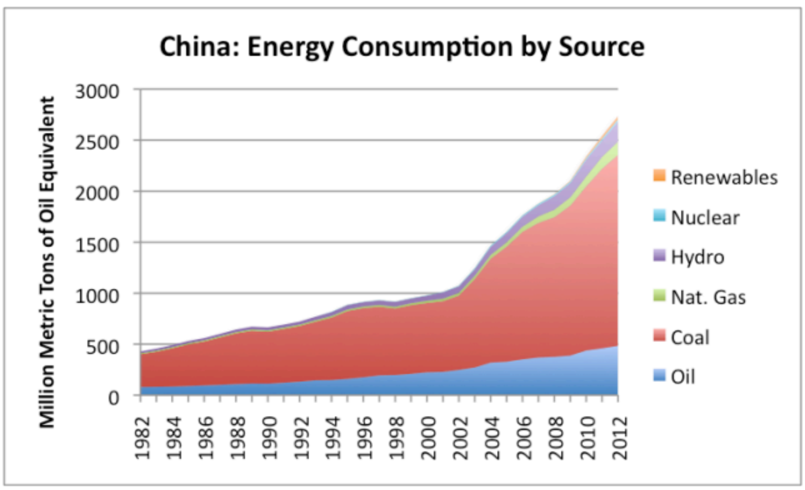

Figure 1. Energy consumption by source for China based on BP 2013 Statistical Review of World Energy.

Another way intermittent renewables raise world CO_2 emissions indirectly is by making the country using intermittent renewables less competitive in the world market-place, because the higher electricity cost raises the price of manufactured goods. This tends to send manufacturing to countries that use lower-priced energy sources for electricity, such as China.

A third way that intermittent renewables can raise world CO_2 emissions relates to affordability. Consumers cannot afford high-priced electricity without their standards of living dropping. Governments may be pressured to change their overall electricity mix to include more very low-cost energy sources, such as lignite (a very low grade of coal), in their electricity mix to keep the overall price in an affordable range. This seems to be at least part of the problem behind [Germany's difficulties with renewables].

If there is any savings at all in CO_2 emissions, it would seem to be from inexpensive intermittent renewables– ones that don't really need subsidies. If renewables need a subsidy or feed in tariff, a red danger light should be flashing. Somewhere the process is using a lot of fossil fuels in its production.

2. Wind and Solar PV do not fix our *oil* problem.

Wind and solar PV both are used to make electricity. Our big problem is with *oil*. Oil and electricity are used for different things. For example, electricity won't run today's cars, and it won't run tractors, or construction equipment, or aircraft. So even if we have more electricity, it doesn't fix our oil problem.

Wind and solar PV have been billed as solutions to our CO2 problem. Unfortunately, as we just saw in (1) above, it doesn't really do this either. The combination of (1) and (2) leaves wind and solar PV with relatively few purposes.

I should mention that there is one small niche where intermittent renewables can substitute for oil. While oil is not generally burned to produce electricity, it is used for this purpose on some islands because of its convenience. These island communities do little manufacturing because their high cost of electricity makes them not competitive in the world market. On these islands, intermittent renewables can be used to reduce the amount of oil used for electricity production, without driving up the cost of electricity, since electric costs are already very high.

3. The high cost of wind and solar PV doubles our energy problems, rather than solving them.

The big issue with oil is its high cost of production. We extracted the easy-to-extract oil first, and now we are getting to the more-difficult to extract oil. Adding high priced electricity to our fuel mix means we have price problems with both oil and electricity, instead of only one of the two. Consumers' wages don't rise to pay for these high-priced fuels, so disposable income is adversely impacted by both. The two high-priced fuels also combine to make exported goods even less competitive in the world marketplace.

4. Even if wind is "renewable," it isn't necessarily long lived.

Manufacturers of wind turbines claim lives of 20 to 25 years. This compares to life spans of 40 years or more for coal, gas, and nuclear. One recent study suggests that because of degraded performance, it may not be economic to operate wind turbines for more than 12 to 15 years.

If we are expecting substantial changes in the years ahead, there are also issues with whether necessary repairs will really be available. Wind turbines are especially repair prone. These repairs can't be made by just anyone, using local materials. They need the specialized world supply chain that we have today. Offshore wind turbines sometimes need helicopters for repairs. If oil is a problem, such repairs may not be available.

5. Wind and solar PV don't ramp up quickly.

After many years of trying to ramp up wind and solar PV, in 2012, wind amounted to a bit under 1% of world energy supply. Solar amounted to even less than that–about 0.2% of world energy supply. It would take huge effort to ramp up production to even 5% of the world's energy supply.

6. Wind and solar PV create serious pollution problems.

Both wind turbines and solar PV use rare earth minerals, mostly from China, in their manufacture. Mining and processing these rare earths generates a tremendous amount of "hazardous and radioactive byproducts." In the part of China where rare earth minerals are mined, soil and water are saturated with toxic substances, making farming impossible.

If we were to try to increase wind and solar by a factor of 10 (so that they together amount to 12% of world energy supply, instead of 1.2%) we would need huge amounts of rare earth minerals and other polluting minerals, such as gallium arsenide, copper-indium-gallium-diselenide, and cadmium-telluride, used in making thin-film photovoltaics. We could not expect China to take on all of this pollution itself. Instead, the rest of the world would need to produce these toxic materials as well. Presumably, many countries would require stringent pollution controls to do this extraction. These pollution controls would likely require greater use of fossil fuel energy. While pollution problems might be kept in check, the greater use of fossil fuels would likely raise both CO2 emissions and the prices of the wind and solar PV.

There are many other pollution issues. China is a major center for renewables production, using coal as it primary fuel. Silicon-based solar cells require heating silica rock to high temperatures in 3000 F ovens, something that which can be done cheaply with coal. Wind is known for its noise pollution issues and for killing birds. Solar panels on the desert floor interfere with the local ecosystem.

A major reason why wind and solar PV are considered clean is because it is hard to measure their true pollution costs, whether CO2 or other types. Electric cars have some of the same issues, because they also use rare earth minerals and have heavy up-front costs.

7. There is a danger that wind and solar PV will make the electric grid less long-lived, rather than more long-lived. This tends to happen because current laws overcompensate owners of intermittent renewables relative to the value they provide to the grid.

One point of confusion is what wind and solar PV really replace. Do they replace electricity, or do they replace the fuel that makes electricity? There is a huge difference, in terms of when an intermittent renewable achieves "grid-parity" in costs. Fuel costs are typically only a small share of retail electricity costs, so reaching grid parity is extremely difficult if intermittent renewables only replace fuel costs. In the US fuel costs average about 3 cents per kWh. For residential users, the retail price averages about 12 cents per kWh, or four times as much as the fuel cost.

What we are interested in is the value of intermittent electricity to the companies that make and sell electricity–utilities or similar companies. In my view, the typical value of intermittent electricity is the value of the fuel the intermittent electricity replaces–in other words, the cost of coal, natural gas, or uranium replaced. This is the case because using intermittent electricity doesn't generally reduce any costs for an electric utility, other than its fuel costs. It still needs to provide backup power around the clock to customers with solar panels. Because of the variability in production, it still needs pretty much the same capacity as in the past, and it needs the same staffing for each of the units, even though some of them might be operating for a smaller percentage of time.

The value of the intermittent electricity to the utility may be greater or less than the first estimate of the fuel savings. In some instances, particularly if there is a lot of solar PV in a part of the world where maximum energy use is during the summer, peak capacity needs may be reduced a bit. This would be a savings above fuel costs. Offsetting such savings would be increased costs for new transmission lines to try to even out spikes in electricity production and to bring wind from sources where it is strongest to locations where its energy is truly needed.

The problem that occurs is the fact that most plans reimburse users of wind and solar PV at a far higher rate than the cost of the fuel they replace. Often "net metering' is used, so the user is in effect given credit for the full retail price of electricity for the electricity generated by solar panels. This higher reimbursements leaves a revenue shortfall for the companies involved in producing electricity for the grid. The danger is that some companies will go bankrupt, or will leave the system, endangering the ability of the electric grid to provide a stable electric supply for consumers. This is a potentially much more dangerous problem than any benefit that intermittent renewables provide.

Also, funding for the additional electric transmission lines is likely to become a problem, because neither the electricity companies nor governments have sufficient revenue to fund them. The reason the electric companies cannot afford them should be clear–they are being asked to subsidize the costs through overly high reimbursement of the value of the intermittent renewables. I discuss the reason for the government lack of funds in (8), below.

8. Adding more wind and solar PV tends to make government finances less sound, rather than more sound.

Around the world, extraction of inexpensive oil and gas has historically strengthened the finances of governments. This happens because governments have been able to tax the oil and gas companies heavily, and use the tax revenue to fund government programs.

Unfortunately, the addition of wind and solar tends to act in precisely the opposite direction. In some cases, the reduction in governments revenue comes directly through subsidies for wind and solar. In other instances, the reduction in government revenue is more indirect. If the high price of intermittent electricity causes a country to become less competitive in the world market, this indirectly reduces government tax revenue because it leads to fewer people having jobs, and thus less taxable income. Even if the issue is "only" a reduction in discretionary income of consumers, this still cuts back on the ability of governments to raise taxes.

9. My analysis indicates that the bottleneck we are reaching is not simply oil. Instead, a major problem is inadequate investment capital and too much debt. Ramping up wind and solar PV tends to make those problems worse, not better.

As I described in my post Why EIA, IEA, and Randers' 2052 Energy Forecasts are Wrong, we are reaching an investment capital and debt bottleneck, because of the higher extraction costs of oil. Adding intermittent renewables, in which huge costs are paid out in advance, adds to this problem. Because of this, ramping up intermittent renewables tends to make collapse come sooner, rather than later, to the countries trying to ramp up these energy sources.

10. Wind and Solar PV come nowhere near fulfilling the promises made for them.

Trying to substitute expensive energy for cheap is like trying to make water run uphill. It is virtually impossible to make such a system work. It makes everyone from governments to businesses to citizens poorer in the process. Promises that are made regarding future payments for electricity often need to be reneged on.

If there really were benefits from the program–other than making government officials look like they are doing something–it might make sense to expand the programs. As it is, it is hard to see much benefit to expanding intermittent renewables. Even if we wanted to, there would be no way we could expand intermittent renewables to cover our entire electricity program–they are just too expensive, too polluting, and don't provide the liquid fuels we need.

Summary

While many people would like us to believe that wind and solar PV will solve all of our problems, the more a person looks at the question, the clearer it becomes that wind and solar PV added to the electric grid are part of the problem, not part of the solution.

If capital is one of the limits we are up against, we need to spend that capital as wisely as possible. Because solar PV is relatively long-lived, it is possible it may be a tiny part of the path ahead, but not as part of the electric grid. Individual citizens may want to buy a panel or two, as a way of providing some electricity, if we should have problems with electricity at a later date. But there is no reason the government should subsidize these purchases.

We might better off spending our capital in more productive ways–for example, figuring out what path we will follow in the very near future, if we find we are reaching a financial bottle neck brought on the high cost of oil extraction. Do we need to be doing more in the direction of local agriculture, with seeds chosen for each area? Should we even be thinking about buying up farmland and resettling potential workers to different areas? Are there ways we can make soil more productive for the long term?

The primary reason for intermittent renewables was supposedly to reduce CO_2 emissions to prevent climate change. If we seem to be reaching *Limits to Growth* in the near term, the amount of carbon burned will be far lower than the climate models assume–even the "peak oil" model for future CO_2. So perhaps from that point of view, our inability to make intermittent renewables work doesn't really matter. We are already reaching the goal the intermittent renewables were trying to reach, in another, not very fortunate, way.

We are now faced with the task of trying to figure out what we can do, in the world Nature gives us. The previous plan didn't work. Perhaps we need to find a Plan B that will put us in a better position.

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About Gail Tverberg

My name is Gail Tverberg. I am an actuary interested in finite world issues - oil depletion, natural gas depletion, water shortages, and climate change. Oil limits look very different from what most expect, with high prices leading to recession, and low prices leading to inadequate supply.

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653 Responses to *Ten Reasons Intermittent Renewables (Wind and Solar PV) are a Problem*

ricst *says:*

January 21, 2014 at 11:59 pm

One of the best things the federal and state governments could do – if they were serious about the bottlenecks we face – is to use eminent domain and acquire tens of millions of acres that could be used for small scale, low energy consumption, agriculture. Then start training millions of out of work adults and young people in how to become subsistence farmers based on organic farming techniques. Maybe small scale windmills and solar PV can help power these farms for a while, until the new farmers learn to live without them, or develop ways to support a low tech wind industry.

If nothing more, such an effort would limit the possibility of starvation when industrial agricultural systems start to become unaffordable.

Reply

Joe Clarkson *says:*

January 22, 2014 at 2:23 am

Aloha ricst,

I have often pondered the two options available to government when things start to fall apart; will we move city folks to the land where they can grow their own food or will we warehouse them in their city homes and bring food to them?

I really do think that the latter option will be the one chosen. Until the falling apart process is upon us, very few city people would even consider leaving their homes, even if they have no work. Even if it becomes difficult to support the unemployed, moving city people to the land would require an enormous new housing and utility infrastructure. The vast tracts of land now devoted to industrial agriculture are nearly empty and there will be no resources available to convert it all to "forty acres and a mule" farms.

Now add all the extra people that have been born into urban life since we moved off the land and giant tractors moved in. Now add in the ignorance factor…most urbanites wouldn't have the slightest idea how to garden, not even if their lives depended on it. Now add in the fact that even if a potential subsistence farmer knew what he was doing, most farm land is worthless without huge outside inputs of fertilizer and water.

I don't think there really is a solution. Many, many people will indeed face starvation. And they will do it in their existing homes.