A Rebuttal of “The Short List” by Michael Barnard

Introduction

A friend sent me the article “The Short List” by writer Michael Barnard. I read the article, and as I am an electrical engineer with more than forty years experience in the generation, transmission, distribution, and utilization of electricity I was more than a little interested in the facile and simplistic treatment of some very complex issues. Interested enough to write this rebuttal which uses the same section titles as written by Mr. Barnard in his article.

Electrify everything

Ignoring for the moment the outright mistakes and over-simplifications in this section, the most egregious error comes from the statement that “the US throws away two thirds of all primary energy”. The article goes on to say that “We only have to replace a third” making it sound like that is an easy thing to do, implying, why not?

The reality is that the US used about 2,400,000 ktoe (a very large unit of energy) in 2018 according to the International Energy Agency. Now, that same agency for that same year reports that biofuels and waste accounted for 107,251 ktoe, nuclear accounted for 219,216 ktoe, and solar and wind combined accounted for 44,915 ktoe.

The remainder, about 2,000,000 ktoe, is produced from oil, gas and coal. Well, since, according to Mr. Barnard, we only need to replace a third of that, we only need an additional 650,000 ktoe of solar and wind power to replace that. Which of course means that we would need to increase the existing solar and wind capacity by a mere 1,400 %, yes, fourteen times, what it is currently. Such an increase would force the relocation of tens of millions of people from Florida to California and would destroy the agricultural capacity of much of that area as well since using land for solar power prevents all other uses. Good luck with that!

Even if a substantial portion of the increase was to come from windmills, such an accumulation of windmills would undoubtedly alter normal wind patterns resulting in unknown but not likely benign climate changes elsewhere and comes with its own seeds of environmental disaster in the disposal of worn out windmill parts.

Overbuild renewable generation

Other forms of generation were indeed overbuilt, for the good and valid reason that the overbuilding created redundancy which lead to nearly perfect reliability of supply. There have been rare, very rare, instances of power outages affecting some parts of North America and Europe, for example, but in no case has a whole country suffered a complete blackout for a material time duration and indeed, in North America no country has ever been completely blacked out.

That redundancy was achieved with a mix of power generation that includes hydro, nuclear, coal, and gas, networked together over large areas virtually eliminating single points of failure that could affect large areas for long periods.

Wind and solar do not offer that same redundancy since for at least half the time there is no sun shining, and for some or all of that time the wind may not blow. The last major power outage that affected almost all of Germany and Denmark was in fact related to a cloudy day and the wind stopped blowing. Germany has since restarted some coal plants and is re-examining nuclear generation.

So simply overbuilding solar and wind, putting all your eggs in the same basket, is not a recipe for success in the power generation business.

As for the cost estimate proposed for this monumental undertaking, considering the very low energy density possible with solar or wind, it is unlikely that a significant part of the vast amount of real estate required could be obtained for that amount of money, never mind the cost of connecting all that low density generation to the remaining load concentrations. Rose colored glasses are not appropriate wear for power engineers.

Build continent-scale electrical grids and markets

HVDC, high voltage direct current, transmission is definitely a real thing done daily in many places for very valid reasons. It is not, however, magic, and is subject to the same physical laws as the alternating current power lines in common use. The physical laws, while exactly the same, apply in different ways not necessarily as benign as Mr. Barnard seems to think.

A recently completed conceptual design for such a continent-spanning line used an estimated length of 2,500 kilometers. The line design was specifically modified to take the most advantage of the direct current character and was sized to deliver sufficient power to replace two or three typical coal fired generating units. In spite of the specific optimization, over the continent-scale, the line losses (waste heat mainly) amounted to eighteen percent (18%), of the input power. Based on real-world input power costs, the delivered power would have been too highly priced to be viable and replaced at most

only a few coal fired generators. Adding more lines will not improve the physics or the price of delivered power.

Build a fair amount of hydro storage

Mr. Barnard states pumped hydro storage is efficient. If we ignore the losses in the transmission line bringing energy to be stored in a hydro dam, we can estimate the efficiency of the process simply as follows:

ITEM	REQUIRED EQUIPMENT DESCRIPTION	EFFICIENCY %
1	Power transmission to distribution voltage change	95
2	Power distribution to utilization voltage change	95
3	Pump motor and control	95
4	Pump gear reducer	95
5	Pump	90
6	Generator control valve	98
7	Turbine	95
8	Generator gear box	95
9	Generator	95
10	Generator voltage to transmission voltage	95
	Overall Storage Efficiency	**58***

* the estimated efficiencies are for industrial or utility sized equipment and are compounded, multiplied together, to evaluate the systemic efficiency

In other words, for every 10 megawatts of excess generation we want to store using pumped hydro, more than 4 megawatts will disappear as waste heat in the process, so we can supply 10, but we only get back 6 out of storage, and that's only if we ignore the transmission line losses, that apply in and out.

As a business model, imagine you want to save $10 in your local bank. Now imagine if it costs you $1 to get to the bank, so you need $11 starting out. You put your $10 in the bank after you get it there. When you want to get it out, guess what, they only give you $6 back. And then they charge you another $1 to get out of the bank. So, you end up with $5. Why would you not want to do this every day?

With respect to battery storage, if the world is trying to electrify transportation, requiring huge numbers of large and larger batteries, the price competition for the supplies of lithium and cobalt, the most widely used elements in batteries, will become untenable given their very few sources in the world.

In other words, the diversity and reliability of the current electrical generation system will not be equaled by simply increasing wind and solar sources.

by Kent Zehr: A Rebuttal of "The Short List" by Michael Barnard

Plant a lot of trees

Sounds easy, until you remember that mankind cut down those trees Mr. Barnard so blithely wants to replace so that we could grow food and build travel ways and towns. So, no, planting a trillion trees will not happen unless we stop food production and living on the surface of the planet.

Change agricultural practices

Only subsistence level farmers practice high-tillage agriculture. The farms that feed the bulk of humanity have been progressing to, not minimum tillage as is advocated, but to zero tillage in a process that began at least 30 years ago in North America. However, the difference this makes to how much carbon is sequestered over long enough time frames is debatable. Sooner or later all the organic material that can be stored in the soil, is, and some is broken down for nutrients every crop cycle, releasing store carbon.

Zero tillage is much more energy efficient though, so there was a definite gain, but it is mainly in the past and not helpful going forward.

Fix concrete and steel

The process of making Portland cement was invented by the Romans and the process has not changed except for the process machinery used. Limestone or gypsum is heated to first drive out the moisture inherent in any natural substance, and then to drive the carbonates apart freeing them up for future re-bonding to make concrete. It sounds simple until the tonnage made around the world every day is considered. Adding heat in the quantities required is easily done with larger burners blowing into rotating kilns and the exhaust gases are sucked out by a large fan. The blower, the rotator, and the exhaust fan are all normally electrically driven in conventional practice. What is not electric is the heat source, usually oil, coal, or gas, and the usual electric heating elements everyone is familiar with are not capable of the necessary input volume at the required temperature, even scaled up many times. Large plasma heaters have been built that turn electricity into super hot plasma which can then be blown/sucked into the kiln.

But, in the large quantity of air sucked into the kiln to absorb the intense heat of the plasma, the nitrogen will inevitably be combined with the oxygen present producing nitrous oxides which will then be able to combine with the moisture as it is driven off and be evacuated as nitrous acid. Acid rain anyone?

Reworking the process machinery to reduce the plasma temperature so these normal reactions do not take place will be very expensive and not simple at all.

Making steel is a different prospect completely. Yes, there are many electric minimills around, as stated by Mr. Barnard, that turn scrap recovered steel into new steel products. That process will simply not work for the smelting of iron ore as those ores are normally good to excellent electrical insulators as opposed to scrap steel, (and in fact, are applied as insulators in some electrical services).

But, again a but, the installed weight of steel around the world grows more-or-less constantly, requiring new steel to be made from iron ore, not only for new work, but also for critical applications where the contaminants from scrap steel are not acceptable. The process of making the millions of tonnes of so-called virgin steel is not a new process but requires two steps, first to melt the iron ore and burn out most of the impurities by heating them in a blast furnace where the ore must be supported on top of the fuel for the heat. That fuel is coke, manufactured from coal, carefully made, such that it retains its necessary strength and resistance to crushing, even while burning at white hot temperatures, so that it can support the weight of the ore and the flux materials above it in the furnace. World wide trade in “coking” coal runs to hundreds of millions of tonnes every year to support this process. No one has succeeded in remaking this process to use anything else in spite of many years of driven research.

There is no simple or easy answer to electrifying more of the steel making process.

Price carbon aggressively

Taxing carbon dioxide production, and make no mistake, it is a tax, not a “price” affects the base costs of almost all modern day activities. The farmer raising your food pays it for fuel, the trucker hauling your food to the city you live in pays another tax for his fuel, everything that interacts with your food pays the tax unless completely electric and all the electricity used is from carbon free sources, very unlikely in most of the world, first and third. So, unlike a value-added tax with rebates for taxes paid on inputs, the carbon taxes as-implemented result in a compounding of input costs. Governments often start out by rebating taxes to people who did not pay them as a way to say they did not harm lower-income families, but the eventual reality usually has been that the taxes become just another income stream.

If increasing input costs, diminishing investment opportunities, and reducing employment levels are the desired outcomes, then pricing carbon aggressively is the way to get there.

Shut down coal and gas generation aggressively

If you still believe that everything can be electrified as easily as Mr. Barnard stated in his opening paragraphs, then there will be no need to shut down coal and gas generation because they will be priced out of business. But of course, that nonsense has already been dismissed. Aggressively shutting down coal and gas generation will result in many people freezing in the dark.

As a final note, biologically sourced methane produces exactly the same amount of carbon dioxide when burned as does natural gas. So, it might signal virtue while burning, but does nothing to reduce carbon dioxide output.

Stop financing and subsidies for fossil fuel

People, such as Mr. Barnard, cannot point to a single piece of legislation anywhere that was proclaimed as a subsidy to fossil fuel, but quite the contrary, fossil fuels are generally taxed for production (known as royalties) and get only the usual blessings for making the required investments. In addition to being allowed to earn their own money back, if they are successful, they also get to depreciate production assets, like every other business, and if they are in a particularly risky investment, they may get the benefits of an accelerated capital return schedule. But if the business fails, they lose their investment.

None of the list of financial treatments above is in anyway a subsidy, it is not a subsidy to allow people to recover their investment, if successful.

On the other hand, especially for electricity produced by renewables, with the exception of hydro, few investments made sense without substantial government intervention, sometimes in the form of guaranteed purchase agreements, generally for very high and uncompetitive prices. No advocate of green electricity ever mentions those subsidies though.

Eliminate HFCs in refrigeration

One thing Mr. Barnard has right is that business as usual around the planet does produce millions of tonnes of carbon dioxide annually. Therefore, the escape of some few tonnes of HFC is not even a drop in the bucket, not even a drop in a swimming pool, so this whole idea is merely virtue signalling.

There are some mildly controversial things left out of this list

That is the heading of the final section. Mr. Barnard goes on with generally the same level of accuracy and truth as the foregoing headings displayed, but I think by now most readers will have a sufficiently informed opinion such that I do not need to continue.

Conclusion

The facile ideas proposed by Mr. Barnard as improvements and as necessary for the future are all simply unfounded in reality. Physical laws are not subject to court rulings or the approval of public opinion. Gravity is gravity, thing always fall down, and always will here on the planet. Thermodynamics always operates, and always operates by the same three laws.

If the ideas espoused by Mr. Barnard are adopted, I feel very sorry for the people who will be trying to eke out their existence after about 2050. I will not likely be around but hopefully some of the brilliant people I have mentored will be willing to help. Because the need for change will be obvious to everyone by then.

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