Renewable Energy and the Maryland Renewable Energy Portfolio Standards – A Critique

Frank R. Lewis, MD

Introduction

Senate Bill 0931 is an effort to assume total zoning control of Maryland land by the Public Service Commission when considering renewable energy generating facilities, rather than continuing to allow the governmental apparatus of each county to do so. It would also prohibit counties from taxing renewable power facilities and would establish maximal landscaping requirements which could be placed on them. The PSC already has the ability to force counties to accept generating facilities and power lines, but the counties retain the ability to tax them and ensure compliance with Comprehensive Zoning Plans. SB0931 would remove those powers.

This represents an unprecedented transfer of power over land use from the citizens of a county to a five member governmental board, but its presumed beneficial intent is to promote more rapid implementation of renewable energy and energy storage with the ultimate goal of increasing in-state energy generation and reducing CO2 emissions, and meeting the goals of the Maryland Renewable Energy Portfolio Standards, or RPS.

My testimony will therefore be directed to the question of whether renewable energy is an effective way to provide energy and reduce CO2 emissions, and whether the RPS, as currently defined, is an achievable goal. I would like to clearly state that my arguments apply only to industrial scale solar and renewable energy, not small solar installations by individuals or farmers, which have completely different issues.

Current Status of Maryland Energy Generation and RPS Mandates

In Maryland currently in-state electricity generation is provided from 7 sources: 41% from nuclear, 41% from natural gas, 6.5% from coal, 5.2% from hydroelectric, 3.2% from solar, 1.5% from wind and 0.9% from biomass (**Fig 1**). The last four---hydro, solar, wind, and biomass are all considered renewable, so the renewable total is just over 10%. **(Fig 2)** Of these four, two are stable year to year---hydro, because you can't make more rivers, and biomass, because the amount of waste, wood chips, and switchgrass are not likely to increase. Both of these have been unchanged for the last 15 years.

That leaves wind and solar, but wind is currently only 1.5% and not likely to increase much because in most of Maryland wind is too weak and inconsistent to be useful. The RPS recognizes this and does not have any requirements for onshore wind but does assume that offshore wind can meet a substantial fraction of the renewable energy requirements by 2030---specifically 13.2%---but the current amount available is zero and President Trump just mandated by edict that no new offshore wind leases will be issued during his term in office, which will extend to 2029. **(Fig 3)**

In addition, offshore wind is dying on its own merits. Shell, BP, and Equinor---all large energy companies which have offshore leases and have planned to build major offshore wind installations, have announced that they are discontinuing their efforts. Gov. Phil Murphy of New Jersey, who has been a strong proponent of offshore wind, has recently discontinued all state financial support for it, which will effectively stop all implementation. Orstead, one of the two largest wind turbine makers in the world, recently announced that they are cancelling the leases they already hold for Ocean Wind 1 and Ocean Wind 2, two large projects off the East Coast, even though it meant they incurred a multimillion dollar penalty for doing so.

Offshore wind is a victim of its own prohibitive cost, and seems destined to disappear soon. It's unlikely to be available to meet any part of the RPS requirements. That means that when the RPS requirements say "renewable" the only source left that can increase is solar—there is nothing else. How likely is that to happen?

Solar Power---Realistic Issues

As already noted, solar currently accounts for 3.2% of Maryland's in-state energy, but has taken 15 years to get to that point from zero, and during the last four years is increasing at a rate of only 0.4% per year.
The RPS mandate for solar in 2030 is 14.5%. At the recent rate of increase it would take 28 years to go from 3.2% to 14.5%, not five..

What's more significant is the unfilled gap between the state's mandate of 50% renewable energy by 2030 and current reality. As we've already said, offshore wind is likely to remain at zero, and none of the other in-state sources of renewable energy can be increased significantly except for solar. But at its present rate of increase solar would only reach 5.2% by 2030. The total renewable energy available in-state from hydro, onshore wind, solar, and biomass would then be only 12.8%, one quarter of the RPS mandate, leaving a gap of 37.2%, or about 13,000,000 megawatt hours per year, to reach the 50% mandate. If solar can't do that, then the RPS is unachievable except by buying renewable energy from out of state, which the legislators profess to want to eliminate. Their policies are therefore internally contradictory.

The intent of SB0931 is to accelerate the rate of solar energy generation to help fill this gap and meet RPS goals. How realistic is it that SB0931 could accomplish this?

The amount of electricity generated from a solar installation today is estimated by the National Renewable Energy Laboratory (NREL) at 300 MwH per acre per year. To meet the gap stated above for reaching 50% renewable energy, we would therefore need 13,000,000/300 = 43,300 acres of land. Solar farms require large expanses of fairly flat land, and in Maryland that's mostly on the Eastern Shore, so the impact of SB0931 would disproportionally fall there. There are 900,000 acres of agriculturally zoned land on the Shore, so 43,300 acres would represent 5% of all farmland on the Shore. That would severely disrupt the agricultural economy.

What about the characteristics of solar itself – how useful is it as a source of power?

The most essential characteristic of solar is that it has a capacity factor of 20%. Capacity factor is the amount of power you get in actual use in a year divided by the nameplate capacity of the solar panel. The nameplate capacity is the amount of power the panel would generate if placed at the equator at high noon on a sunny day. That's not the real world. There are six factors which reduce the efficiency of solar panels in actual use:

1. It's dark half the time, so that reduces the power by 50%.
2. Even when it's daylight the power for two hours after sunrise and two hours before sunset is low-that reduces it another 33%.
3. The power decreases as you move north or south of the equator. Maryland, at 39 degrees latitude, has an average sun angle of 39 degrees from the vertical, which reduces power 18%.
4. The sun also moves 23.5 degrees north and south of the equator with the seasons. On December 21, the angle of the sun from the vertical in Maryland is 62 degrees, not 39, and the energy available is reduced by another 30%. That also means the capacity factor in December is only about 10%, not 20%, so it's hard to generate electricity in the winter months, when you need it most for heating.
5. In the middle of December the hours of daylight are only about 9.5, not 12, reducing it another 20%.
6. About 1/3 of the days in Maryland are cloudy, and output will be only 30-60% of sunny weather.

Put all of these together and you get a maximum of 20% as a yearly average - you can't improve on that, because it depends primarily on the motions of the sun.

That makes solar the least efficient method of energy generation there is. By comparison nuclear has a capacity factor of 93%, 4.6 times as great.

There are three other consequences of the 20% capacity factor. Because solar panels don't generate electricity 80% of the time, you have to have a complete backup system to substitute for it during the time it's not producing electricity. The only alternative available is natural gas or coal. But the 80% of the time you use natural gas or coal, you're producing CO2, so the entire thesis on which solar energy is based is false. Whenever you make solar power a substantial part of your system, you have to provide reliable power 80% of the time from fossil fuels, and the maximal reduction of CO2 emissions that can ever be achieved is 20% of the nameplate capacity—you could build a million acres of solar panels, and the system would still be generating CO2 80% of the time. No solar installation ever built can lower emissions more than 20% from the amount a fossil fuel plant would generate.

The second effect of the 20% efficiency is that you must pay for two complete systems to produce one stream of reliable power. The grid has to meet 100% of demand 100% of the time, otherwise you get blackouts and brownouts. Traditional sources of energy generation – coal, natural gas, nuclear, and hydro, all can stand on their own and and do that---you need only one system. Wind and solar always require two. The obvious question which arises is that if you need a fully competent system to backup solar, then why not use that all the time. Why do you need solar? The answer is you don't; it exists only because of the promise of lowering CO2 emissions and the mandates of legislatures that it has to exist and receive financial benefits to incentivize it.

Since you have to provide two systems, the cost of a system that includes solar power will always be at least twice as expensive as standalone systems. Proponents of solar power advertise that it's the cheapest, but that's a lie, and it's quite easy to prove with real world experience. The retail cost of electric power in Maryland today is about 16 cents per kilowatt hour, which is typical for most of the US. The current price of electricity in California, which gets 22% of its power from solar averages 35 cents per kilowatt hour. In Germany, which gets 50% of its power from renewable sources, the price is 40 cents per kilowatt hour and it's the highest in the world---that's two and a half times what we pay in Maryland.

In summary, the 20% capacity factor means that you only reduce emissions by 20% from a fully fossil fuel system, you need 2 complete systems to provide one energy stream, and the price of electricity generated is 2-2.5 times as great as fossil fuel or nuclear systems.

CO2 Emissions

Finally, you have to look at the global impact of CO2 emissions reduction in the entire US, not just Maryland, to judge the effectiveness of renewable energy. The emissions from a single country don't matter much in lowering CO2 emissions; it's only the total emissions of the world which is relevant, because the emissions from all countries constantly mix in the atmosphere---it's only the total which can affect global warming, so you have to examine how much the efforts in all of the US have affected the world.

If you examine the total impact of renewable energy in the United States during the last 23 years to determine its impact on global CO2 emissions and global warming, it's negligible **(Fig 4)**. From 2000 to 2023, the CO2 emissions of the United States decreased from 6000 million metric tons of CO2 per year (MMT) to 4800 MMTs. That's a 22% reduction in 23 years, or 1% per year. Of that total the majority was due to the substitution of natural gas for coal in energy generation, which has been ongoing for 20 years; the actual reduction due to renewable energy is only about 22 MMT per year, or 0.4% of the total per year **(Fig 5)**. During that same period, China and India alone were increasing their CO_2 emissions by 220 MMT per year, and the world totally was increasing at 650 MMT per year. The total world CO_2 emissions in 2024 was 37,000 MMT, so the percentage effect that the US reductions had was 22/37,000 = 0.073%, less than one-tenth of one percent. That cannot possibly have had any impact on global warming. Maryland is only 0.6% of the US total, so it's contribution to CO_2 reduction was what accountants refer to as "decimal dust", meaning it's completely insignificant. All the money we are spending on renewable energy ---both in Maryland and nationally---has had no meaningful impact on global CO_2 production or global warming; what is even more important--it cannot possibly have any meaningful impact going forward. It represents nothing more than virtue signalling. The urgency which the Maryland legislature seems to feel to do something quickly to reduce CO_2 emissions is misplaced. Nothing we are going to do will have any meaningful impact worldwide now or in the foreseeable future.

Battery Storage

Storage of renewable energy is also one of the objectives of this bill – building large battery facilities to store energy during peak production periods for solar, and then drawing on it when its dark. Unfortunately battery storage can't solve the problem, because it has inadequate capacity to store the large amounts of energy needed to sustain the grid for very long and it's prohibitively expensive. Battery backup is essential to smooth out short term fluctuations in wind and solar energy - the minutes to hours fluctuations, but it has nowhere near the capacity to provide sufficient power to make wind and solar single-source systems which can supply total power for a week or two. The capacity of the largest storage systems in the world can provide full grid power for only a few hours, and no system ever built can get you through one night, let alone a week or two of cloudy weather.

Some examples will suffice to prove this: The largest storage facility in the world is at Moss Landing, California. It has a capacity of 3000 MwH and a power rate of 750 Mw. Divide those two numbers and you see that it can supply full power for only 4 hours. The Hornsdale Power Reserve, built by Tesla a few years ago in Australia, and touted for its size, has a capacity of 193 MwH and can supply power at 150 Mw, lasting only 1.3 hours. There are several more examples, but all are the same, and none can come close to providing power for a sufficient time to make solar panels work as a sole system.

The second problem is that battery storage is prohibitively expensive and in practice unaffordable. The cost of storage is estimated at $300,000- $400,000 per MwH. Moss Landing, the largest, with a capacity Of 3000 MwH, cost between $900,000,000 and $1,500,000,000. Using a low estimate of $1 billion, that calculates to $333,333 per KwH. Maryland, which consumes about 4,000 KwH per hour on average, would therefore incur a cost of 4,000 x $333,333 = $1,333,000,000 to provide full grid power for one hour from batteries. If you only needed to backup renewable power, at 50% of the total, it would cost $666,666,000 per hour, and roughly $4 billion per night. Battery backup is a pipe dream.

Summary

1. Solar energy is the most inefficient form of energy there is, with a capacity factor of only 20%, compared to nuclear at 93%

2. It requires an entire second system to back it up, since it's unavailable for full power 80% of the time

3. It's the most expensive of all power sources, and costs 2 to 2.5 times as much as energy from fossil fuel or nuclear sources. The myth that it is cheap is based on the levelized cost of energy (LCOE) calculations. But LCOE is an artificial construct looking at solar power in isolation, not in a real system which has to provide power 100% of the time. It has no relevance to the real world.

4. Both solar and wind energy require huge tracts of land. We have already examined this in detail for solar – the requirements for wind are even greater.

5. Both wind and solar are intermittent, variable, and unpredictable – and tend to destabilize the grid as they approach 50% of total power because of their variability. Achieving total renewable energy power has never been possible in any demonstration system in the world – the maximum that can be achieved is about 50%, and then only with gas turbines, which can be ramped up and down quickly.

6. Finally, and most importantly, the only rationale for utilizing solar power, with all its disadvantages, is to lower CO2 emissions and their impact on global warming. If renewable energy does not do this, and it does not, then it has no reason to exist. Germany since 2011 has expended more than $500 billion on implementing Energiewende, and provides 50% of its power from renewable energy. The total reduction in emissions which that has provided is a decrease of 8.7 MMT per year. By comparison, the increase in emissions from the rest of the world is 650 MMT per year. The German yearly reduction is even smaller than the US reduction, and therefore completely insignificant.

Implications for Maryland's RPS and Conclusions

The goals stated in the RPS for 2030 – 50% renewable energy, a substantial contribution from offshore wind, and net zero by 2045---are not remotely possible, and these goals are misleading the public regarding the minimal amount of wind and solar energy actually delivered in Maryland despite 20 years of RECs, the ineffectiveness of solar energy in reducing CO2 emissions, and the true costs on their electricity rates of pursuing this course of action. Solar RECs are one of the principal reasons electricity costs are going up, because they require energy producers to generate 35% of their electricity from renewable sources in 2025. Most producers can't do this, so they purchase RECs to meet the requirement. The price of a REC is about the same as the wholesale price of a megawatt hour of electricity, so this requirement essentially doubles the wholesale price of electricity for the 35% of electricity that is required to be renewable. These costs are paid by the non-renewa,ble energy producers, but they are immediately passed on to ratepayers, raising their cost of electricity. In reality it is a hidden tax on ratepayers which is paid to those who generate renewable energy, doubling the income they get per megawatt hour of electricity.

Renewable energy in its entirety in the United States since 2000 has had a negligible effect on global CO2 emissions, could not possibly have had any effect on global warming or climate change, nor could it possibly have any effect in the foreseeable future. The principal rationale for the existence of renewable energy---reducing CO2 emissions---is a fraudulent promise.

The only reason renewable energy still exists is because of subsidies provided by states in the form of renewable energy certificates (RECS) and by tax credits and accelerated income tax depreciation at the Federal level. These subsidies provide developers of renewable energy with 2 to 3 times the income per kilowatt hour that conventional energy producers receive. This results in massive profits which continue to fuel the industry, and the lobbying and PR that sustain it. If the subsidies and tax benefits were to disappear, renewable energy would also disappear fairly quickly, because it cannot stand alone on its merits.

This is already happening with offshore wind, even before the subsidies are withdrawn.

The legislature is trying currently to deal with a two pronged crisis: scarce energy and higher prices. They don't realize that the policies they have implemented for the last decade in the RPS are the cause of the crisis, so they are trying to double down on the same plan. That is the sole purpose of SB0931. They should instead heed Albert Einstein's observation: "Insanity is doing the same thing over and over and expecting a different result."

Renewable energy began as an idealistic effort to counter CO2 emissions and their potential effect on climate change and has evolved into a fixed ideology that ignores reality. It long ago morphed into a massive scam that efficiently transfers money from taxpayers and ratepayers to renewable energy developers without providing a product that has any value. The Secretary of Energy of the United States, Chris Wright, who has been an energy executive all his life and knows the field exhaustively, recently commented that the pursuit of renewable energy was "lunacy" and is impoverishing our citizens. He is correct.

For those who think that CO2 emissions from energy generation should still be reduced, there are viable and affordable ways to do that, but renewable energy is not one of them. SB 0931 even if fully implemented, would do nothing to promote affordable or reliable energy, and in fact would do the opposite. What it also would do is inflict irreparable damage on agriculture, one of Maryland's most important industries.

Fig 1
MD Electricity Generation by Source
2008-2024

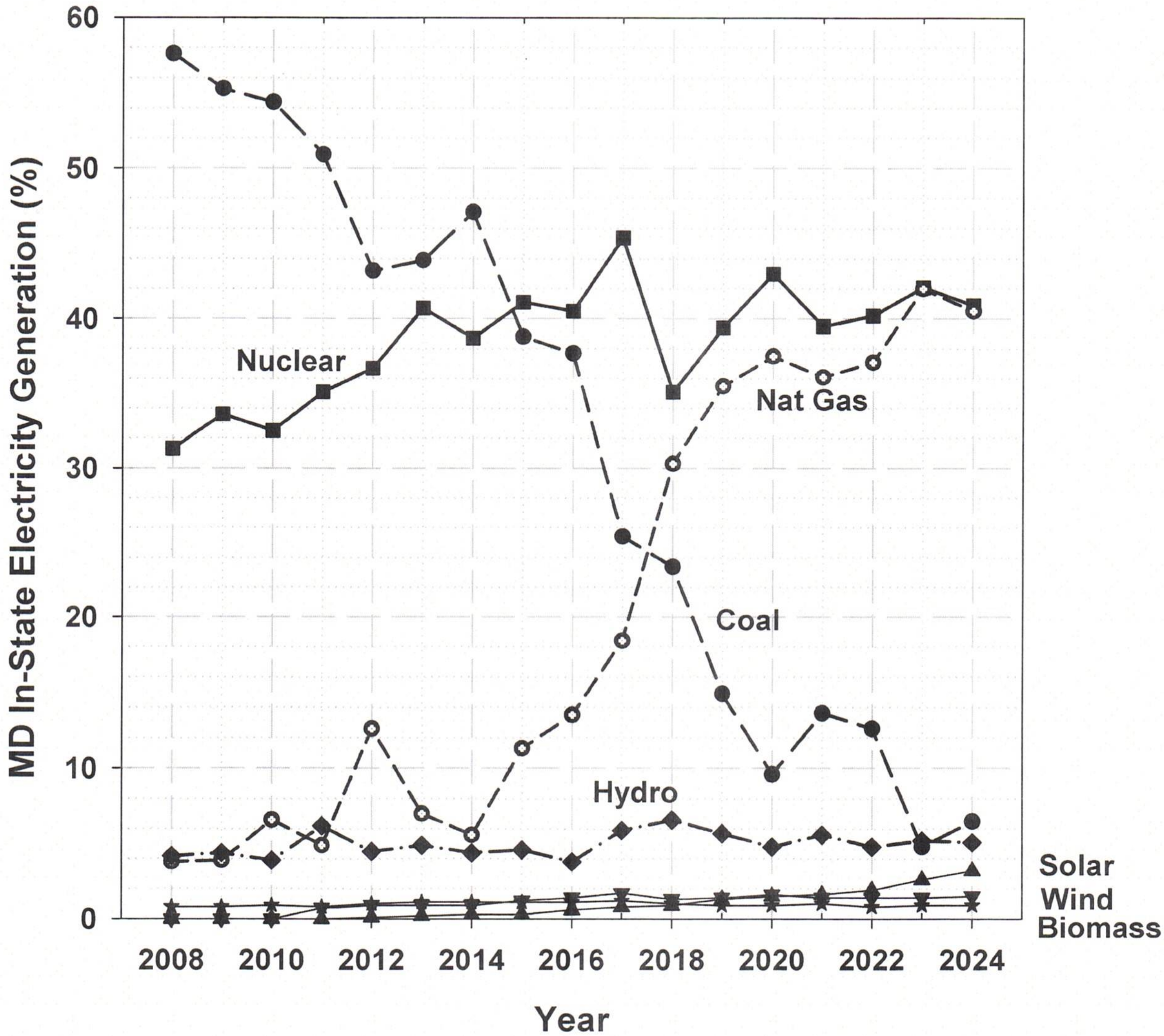


Fig 2
MD Renewable Electricity Generation by Source 2008-2024

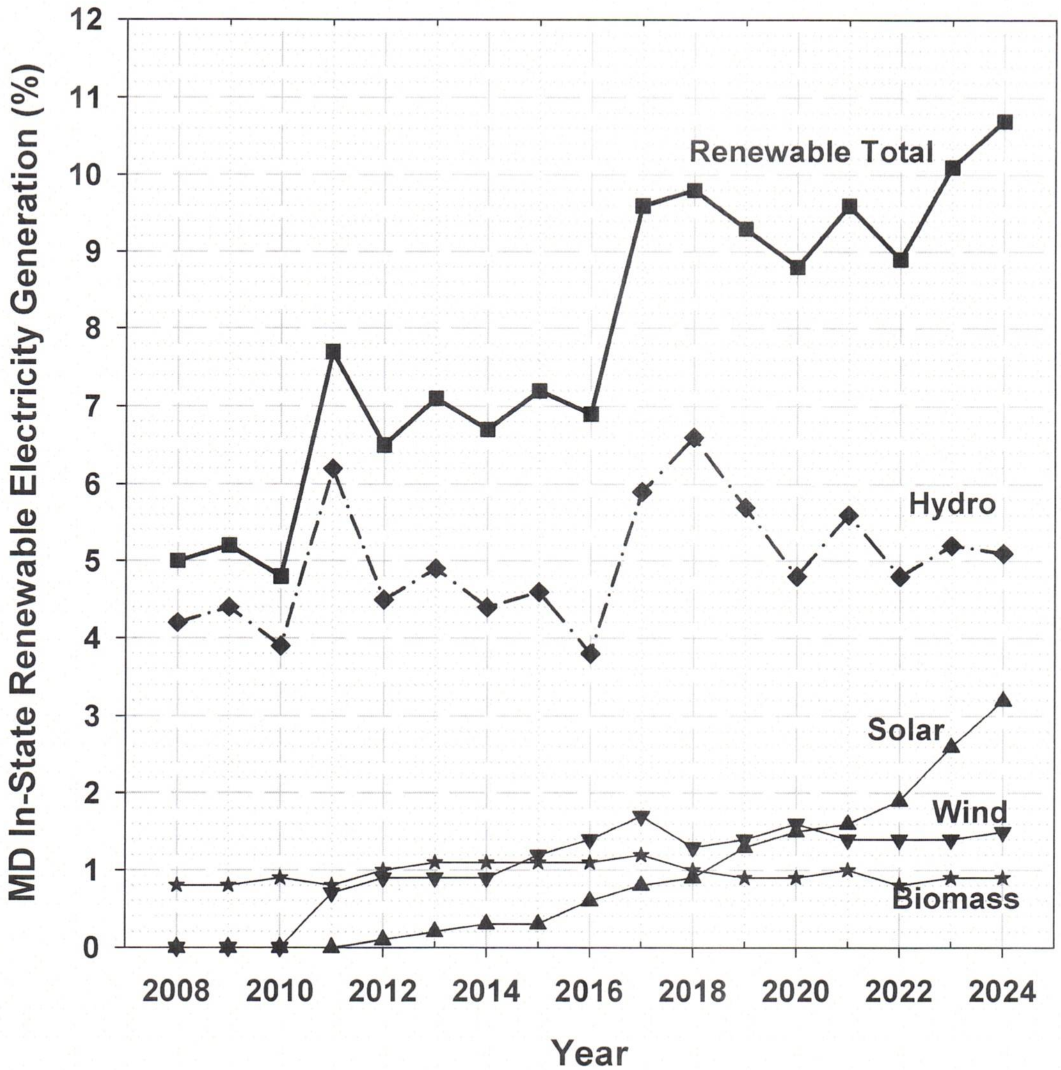
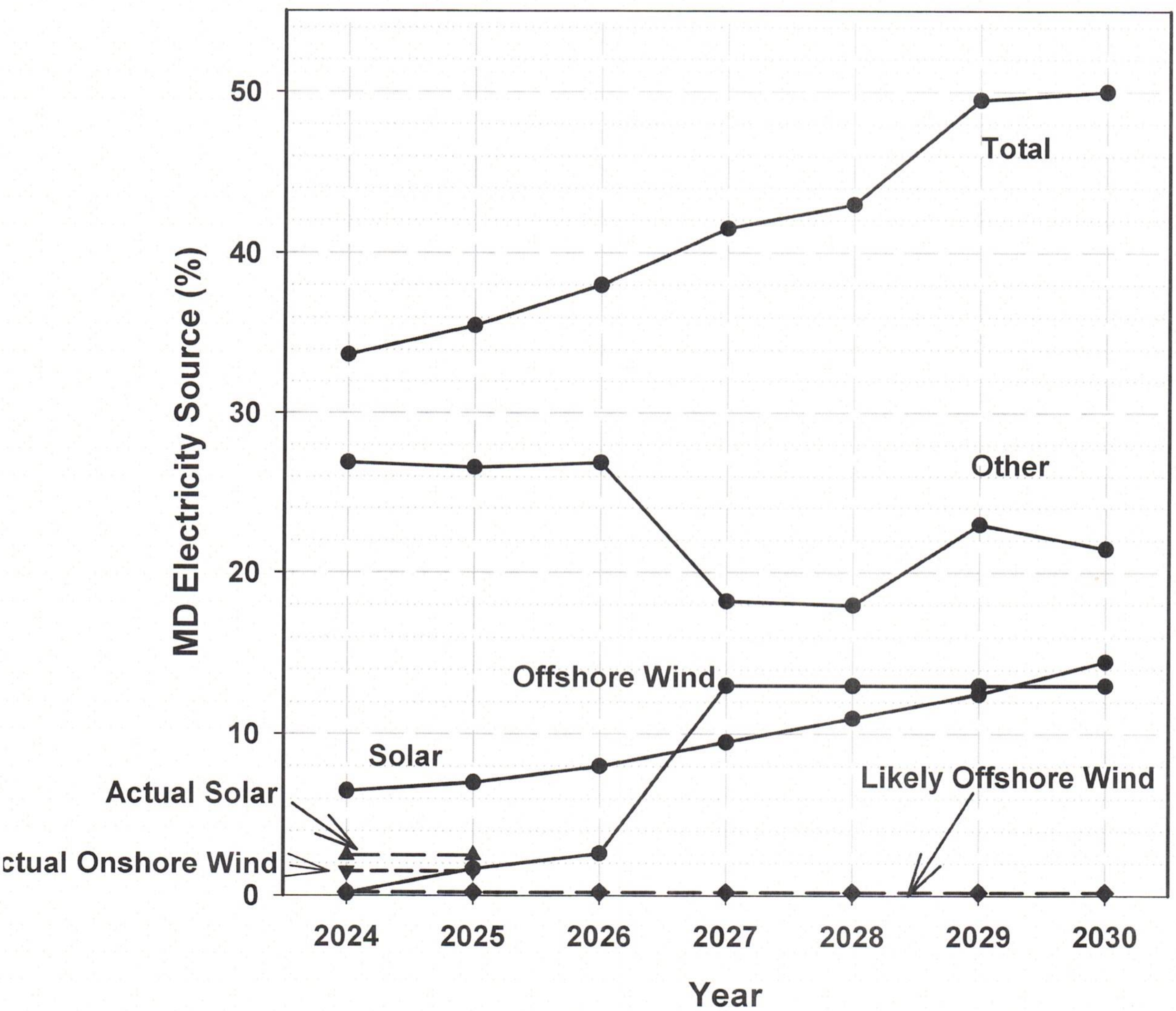


Fig 3
MD RPS Standards*
2024-2030



* Biomass and Geothermal are each less than 1% and have little chance of increase, so are not shown.

Fig 4
CO^2 Emissions Yearly
US, China, and India

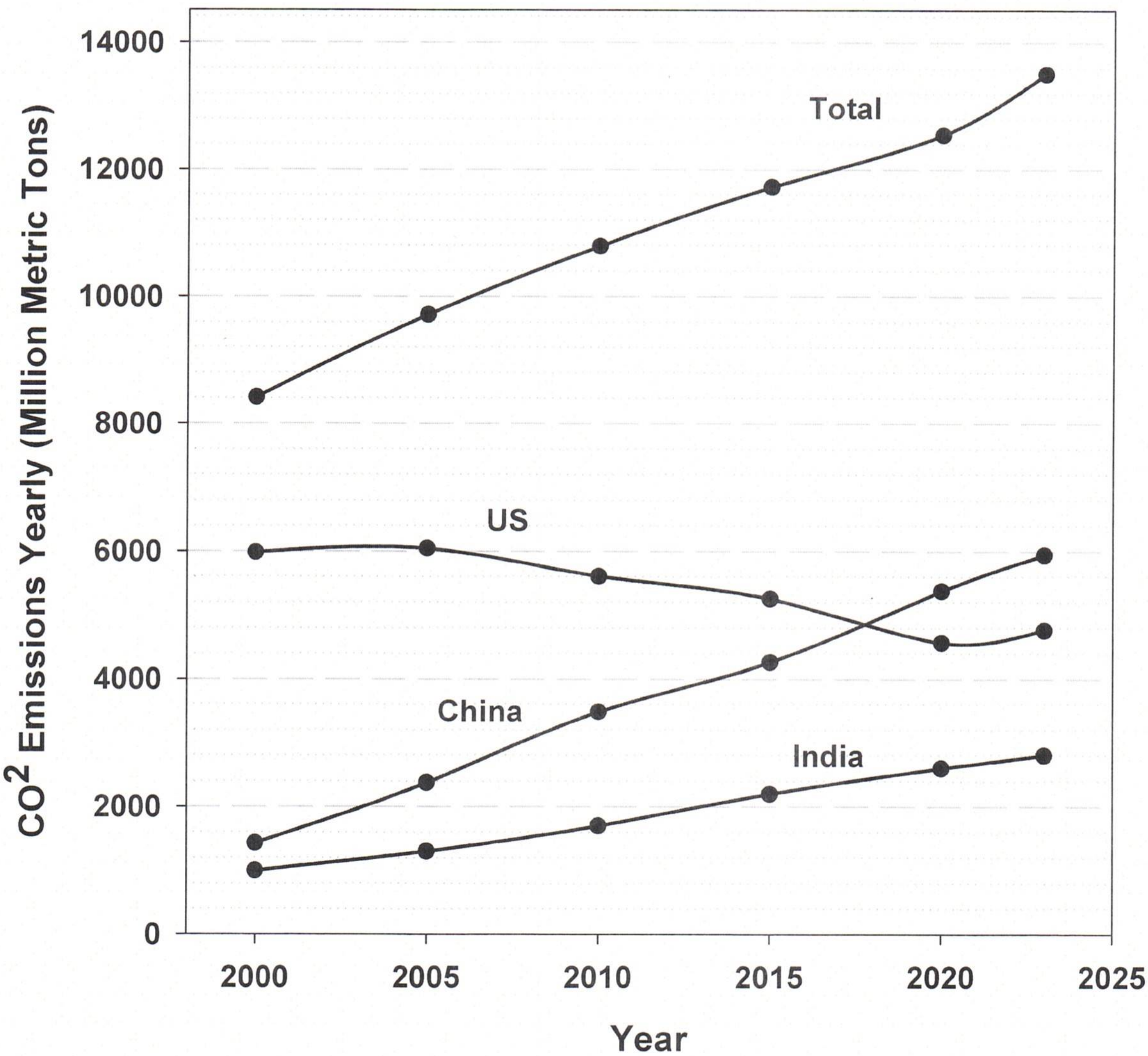
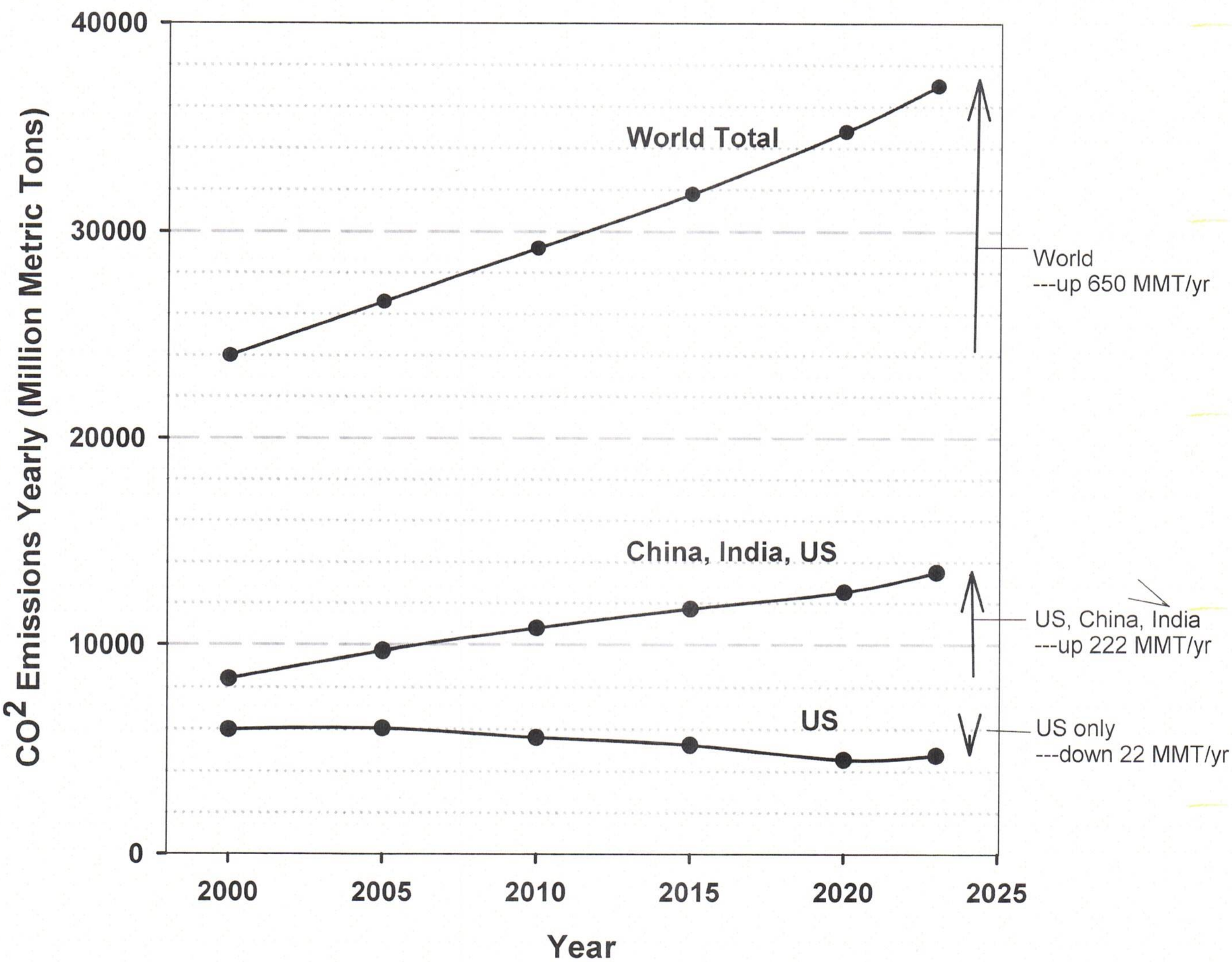


Fig 5
CO^2 Emissions Yearly
World Total



Conclusion - For whole world, CO^2 emissions 2000-2023 go up 30x more each year than US emissions come down from renewable energy use