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Solutions to Pollution Resulting from Manufacturing in China



Sebastian Fleschner

SUBMITTED TO MICHAEL LUCAS FOR WRI 227

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Abstract

Manufacturing in China is a major contributor to carbon emissions and pollution of our planet. There are many outdated policies that cause a lot of this pollution that could be adjusted to match other countries that have addressed their own pollution issues. This report will discuss the specific problems in depth and suggest solutions implemented by other countries, as well as how you can affect the change that needs to happen.

The amount of pollution is a danger to not only China, but the whole world. One study stated that over one year China dumped 200 million cubic meters of waste into their coastal waters. The same study described how they were spending over 7 billion yuan a year to clean up their coast. This calls for policy changes on the part of manufacturers, not just the government.

The energy China uses to power all of its industry is also incredibly pollutive. Being mostly fossil fuels, and coal at that, it accounts for the most CO₂ emissions out of every country on the planet. It's making the shift towards renewables, but at the same time increasing its coal power to keep up with its ever-growing economy and production. While going green is good, increasing coal, the most pollutive fossil fuels, as well negates any good that might be happening.

Through a joined effort corroborated by successes in other countries, manufacturers, China's government, and their citizens can fix a lot of these problems and work towards a greener, less polluted future. This can only happen if all they are all involved and work together, which must be prompted by individuals and executives in companies.

1.0 Introduction

1.1 Overview of Problem

China has made leaps and bounds in the manufacturing sector and is currently the world's largest source of cheap manufacturing. But this development has been severely lacking in some very crucial areas. They are the highest producer of carbon emissions in the world, which when coupled with them being the highest exporter of goods may not seem the biggest problem, but there are many other countries that when scaled have a much better per capita ratio of carbon emissions. Most of these emissions are due to their energy production, as they rely on mostly coal and other fossil fuels in order to support their decades of incredibly rapid economic and industrial growth. A lot of their technology also remains outdated or inefficient, causing them to pollute a lot more than is necessary and forcing them to source a good portion of higher value products and components from other countries. All of these contributors have caused China to become incredibly polluted, contributing to 1.42 million deaths in 2019, as well as causing overall decreases in environment, quality of life, and living conditions.

1.2 Introduction to Solutions

All of this pollution calls for some major changes. While there isn't one miracle solution that can magically fix everything, there are many solutions employed by other countries that China has implemented yet that may gradually fix the problem. For example, their energy production is mostly coal, a quick and easy solution to energy that produces more CO₂ than any other fossil fuel. They also have very loose regulations for recycling and waste management due to the rapid growth and transition to a capitalist, industrial economy. Many of these problems have been addressed by other countries with similar environmental issues, and these solutions will be evaluated later in this report.

2.0 Background of Problem

2.1 Energy Production and Air Quality

One of the biggest problems relating to pollution in China is energy production. They currently account for 27% of the world's total emissions. The US at second highest only makes up 11%. This number doesn't look quite as bad when you factor in the scale of how much production is happening in China compared to every other country including the US, but it's still bad. Figure 1 is an excellent demonstration of the distribution of power sources in both China and the US. China currently uses coal as its primary fuel, making up 60% of its total energy production. That also contributes to its dismal 87% fossil fuel of its energy sources. The US isn't that much better, with 80% being from fossil fuels, but 36% of that is natural gas, and only 11% is coal. Natural gas emits only half as much CO₂ as coal burning does, making this an even bigger gap. [1] This isn't to say China isn't working on their renewable energy. They currently are operating at about 10% renewable energy out of the total, which is about the same as the US. However, the US is far ahead in their nuclear development, about 20% of total power, while China has less than 5%. There are of course other considerations with nuclear power, but it does produce almost no carbon. Overall, China is relying too much on incredibly pollutive power sources because most

renewable sources take time and money to establish. The rapid industrialization hasn't left as much room for long term planning, leading to inefficient systems both in the power sector and elsewhere [2].

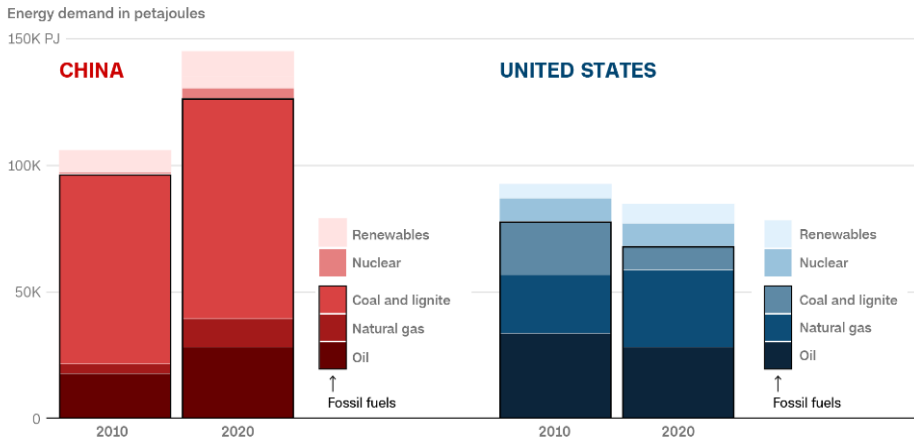


Figure 1. Energy Production: China vs US. Adapted from: [2]

2.2 Marine Pollution

Another huge pollution problem in China is ocean and river pollution. They are the single largest consumer and exporter of virgin plastics. Virgin plastics refers to plastics not made from any recycled materials. Unfortunately, this high consumption and production leads to an enormous amount of pollution. Because of the rapid industrialization and change to consumerism, they didn't have enough time to establish a good or enough infrastructure for a recycling system. As you can see in figure 2 below, China is one of the biggest contributors to mismanaged waste. A lot of this comes from dumping trash, waste plastics, and chemicals into the rivers. In the entire world, there are 10 rivers that contribute to 95% of all waste, 5 of which flow through China. The Yangtze River alone, the largest river in China, accounts for more than half of all marine pollution [3]. Granted China isn't the only country the Yangtze River runs through, but it is still a major contributor to its pollution, as you can see.

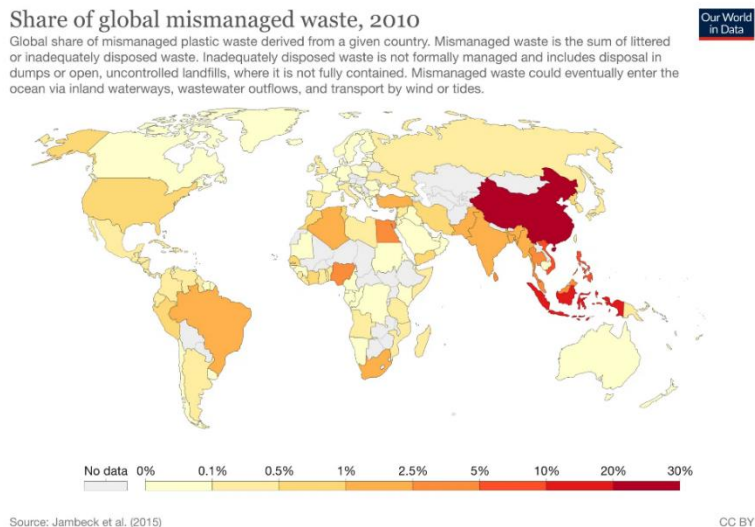


Figure 2: Mismanaged Waste in the World. Source: Our World in Data

One study observed plastic in 21 sea fish and 6 freshwater fish from China. Every single one they studied had ingested either meso- or microplastics* [4]. Microplastics and small fragments <5mm, and mesoplastics are fragments between 5-10mm. With fish and other seafood being one of China's main, this is a huge problem. All of these plastics and other chemical pollutants also cause problems with drinking water. In 2012, a government survey doing tests of 5000 groundwater sites found that 57.3% were heavily polluted. An estimated 60,000 people die every year from water pollution [3].

3.0 Possible Solutions

3.1 Power Solutions

As demonstrated in the figures below, coal is the worst energy type when it comes to CO2 production and pollution. The figure is also scaled for energy production, so not only is coal the most popular source of energy in the world, but it is also the most pollutive per terawatt-hour (TWh) produced. This is why China needs to transition from coal power to renewable sources, or even just better fossil fuels. China is making big strides in this area, building around 175 gigawatts (GW) of solar and wind energy generation. However, Beijing also authorized 106(GW) of new coal generation to be constructed, 4 times as much as the previous year [5]. This is why I believe China needs to expand into other sources of renewable and less polluting energy rather than just wind and solar. Nuclear energy is a big investment of both time and money but in the end, it is a higher producing energy source. While there is a stigma about nuclear energy due to the disasters in the past and its ability to be weaponized, it's actually one of the least deadly options for power out there. The initial construction cost makes it more expensive than other energy sources, but planning for a long-term energy production option can make it worth it, especially if you have a good system for dealing with the radioactive waste. Hydropower is another huge mostly untapped resource in China. One recent study found that China has the potential capacity to generate 30% of its energy through hydroelectric plants [6]. Hydropower is another more long-term energy solution. The fact that it's less expensive than nuclear, and produces no waste makes it seem like the ideal long term power solution to China's coal pollution problem.

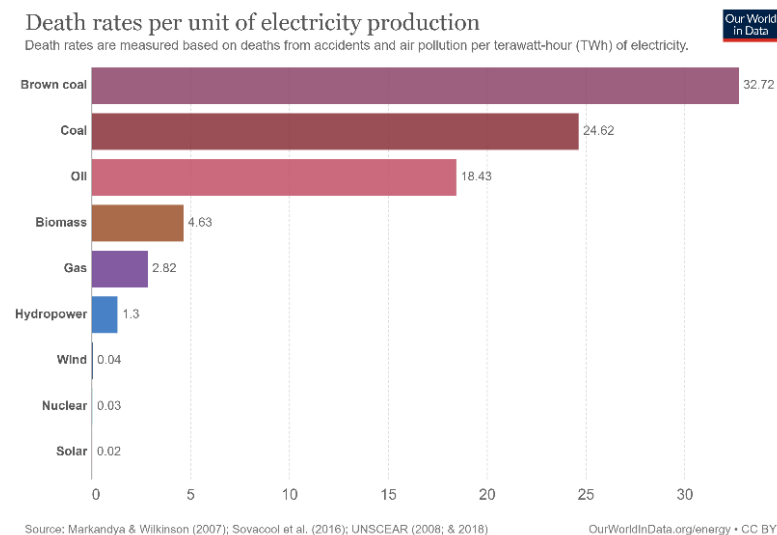


Figure 3: Deaths per Energy Source. Source: Markandya & Wilkinson (2007); Sovacool et al. (2016)

3.2 Waste Solutions

Similar to the power solutions, in order to decrease the amount of waste, China has to stop certain policies and become stricter in other areas. Currently China produces deals with 249 million tons of garbage every year. This isn't all due to manufacturing, but a good portion is. China doesn't have a lot of space for landfill, so they have started burning more and more of their trash. This does decrease the number of plastics on the shores and in water, but releases nitrogen oxides, sulfur dioxide, volatile organic chemicals (VOC's), and polycyclic organic matter (POMs), as well as other cancerous substances [7]. This is why more investment in recycling is needed. One study estimated that over 85% of the trash could be recycled if done properly, compared to the current 9% recycled rate [8]. There are many innovative solutions in this are, at all levels from rewarding individuals for recycling to redesigning products to be easier to recycle and/or reuse for other products, and it will probably take more than just one. Products made from recycled products are becoming more popular as well. Notebooks made with recycled paper, bike tires, backpacks, even glass products are some of the common things made using recycled materials. With more cooperations between businesses and governments, even more products could be made using recycled materials, the connection just isn't quite there yet. Through a bit of investment, China and other governments could hit that 85% recycling mark and we could start making progress on the amount of trash in the world instead of producing more and more every year.

4.0 Evaluating Solutions

4.1 Effectiveness of Solutions in Other Countries

Common sense tells us that moving away from fossil fuels energy generation will be better for the environment and the population. An ideal goal to work towards would be 100% sustainable energy, but that isn't realistic given the massive energy demands in China. A more realistic solution would be to continue to advance renewable energy, while transitioning away from coal to other fossil fuels. As you can see in the graph, the US has been continuously phasing out coal power, while continuously building up renewable energy. The interesting thing is that we haven't decreased fossil fuels that much. But because we moved towards more efficient, less polluting fossil fuels, while at the same time increasing our renewables, deaths due to pollution and pollution itself has seen a steady decrease. Because China's main energy source is coal, they could implement a similar solution. Steadily phasing out coal, replacing it with natural gas and other less pollutive fossil fuels, while continuing their massive investments in renewable energy could show similar results as the US in pollution declination.

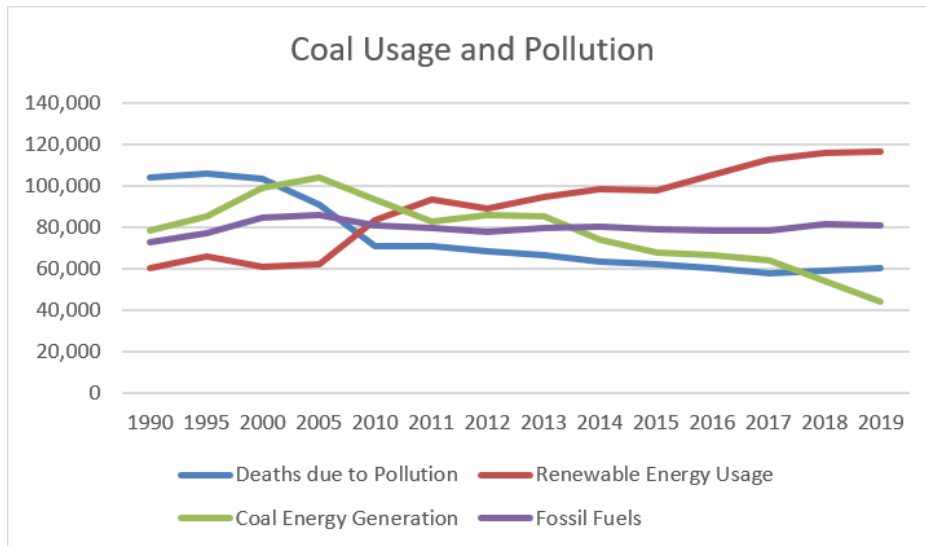


Figure 4: Coal Usage and Deaths to Pollution.

On the waste side of things, looking at countries like Germany who already have a 56% recycling rate give us some inspiration. In 1990, they implemented a policy that made the producers of waste plastics responsible for the waste. This caused manufacturers to create a program called Green Dot [9]. In essence, the more waste you produce as a manufacturer, the more you will be taxed. It also means that recycling is done by both households and the manufacturers themselves in joint. A similar solution could be effective in China. Through a combination of government taxes and a combined effort from manufacturers, individuals, and the government, China can also work towards having over half of their waste being recycled.

4.2 Issues with Solutions

Despite all of these concrete successes in other countries and solid foundations for improvements, China is still in a unique position compared to many of the other countries that have already made improvements. China is responsible for a vast majority of its manufacturing because it is incredibly cheap compared to other places that use more advanced facilities and expensive electricity with stricter regulations. These solutions have to be implemented by both businesses and governments together, otherwise companies looking for cheap manufacturing will simply go to other countries sitting at China's current state and continue to pollute just as much. A similar problem needs to be considered for the waste solution. Most of the other countries that have implemented that same partnership-style for recycling were nowhere near China's level of production and manufacturing. However, the concept is still proven and solid, so while some of their specific methods may not apply, the overall idea of partnering to fix the problem works.

Conclusions

China has a lot of problems with pollution that need to be solved. However, these problems have been dealt with in many other countries successfully, albeit on a smaller scale. Replacing coal power with other less pollutive fossil fuels, while increasing renewable and non-fossil fuel energy sources has been shown to be effective in the US, the second largest country in terms of manufacturing and power usage in the world. This will help with the massive amounts of pollution from energy production that China has right now. The various recycling and waste management solutions splitting the burden between manufacturers, government, and citizens has also been shown to be effective in many other countries. While they may not transfer perfectly as these are all solutions shown to be effective on smaller scales, they are in principle the same.

You can help bring about these changes in a variety of ways, depending on who you are and what influence you have. If you are an engineer, try to design products that are more easily recyclable, or use recycled materials for your designs, if possible. If you are an executive or someone with more influence, make the policy changes in your business that can bring about these necessary changes. If nothing else, make your voice heard and advocate for these changes to the government and manufacturers so they can make the changes together. The only way we will solve any of these problems is if we work together and find some agreement so that the bulk of the cost for change isn't carried by just one.

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