

Our World of Plastic

It is inevitable that plastic has become an essential material to people's life. It contributes much to human efficiency and businesses. One reason is due to its inexpensive price of production and its durability, therefore the levels of plastic production are very high nowadays. Another reason is, it is resistant to many natural processes of degradation which lead to slow to degrade due to chemical structure (Economist, 2018)^[1]. This is good because plastic could be reused many times without it being out of shape. However, since human tend to make mistakes, sometimes we only enjoy the good side of our deed without concerning the side effect of it. This analogy actually has happened to our world regarding the use of plastic. Despite the advantages of using plastic in our daily life, yet without our consciousness, it could actually harm the nature, animals and even humans both socially and environmentally.



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There is no doubt that this action is came for human ourselves. For instance, littering which has become the high prominence of human action towards plastic pollution in the environment. Many side effects have occurred from littering, the major impact is to our nature and animals especially fish, seabirds, sea turtles and marine mammals. They can become entangled in or sometimes can consumed the micro plastic waste unconsciously which can lead to starvation and suffocation (Reddy, 2018)^[2]. Moreover, since plastic is naturally non-degradable, it will stay forever on the land and with constant littering they will turn into a huge plastic landfills which lead to an unhealthy environment. In the meantime, plastic in the canals could clog the waterways and flood pipes which has become the reason of major floods in Jakarta and Depok each year (The Jakarta Post, 2018)^[3]. As we can see, just by littering it could lead to many

harmful situations. Regardless being littered, plastic could pollute on its manufacturing process as well. For example, the compound releases in the process and chemicals leached from plastics into the air and water could be a pollution concern (Oyedele, 2019)^[4].

To get a better idea on our global plastic total production and its waste generated. The history, current and forecast data need to be presented. To start off, it is better to understand the production of global plastic each year from 1950 to 2020.

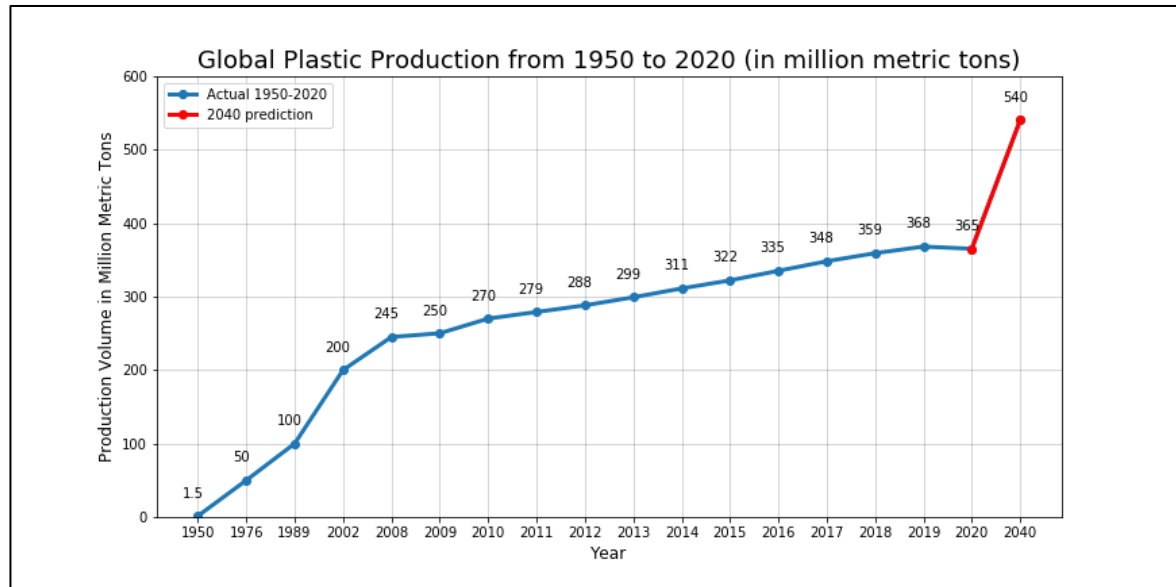


Figure 1. Global Plastic Production from 1950 to 2020 (in million metric tons) and 2040 prediction.

According to the data surveyed by Tiseo (2021)^[5] and published in Statista.com, in 1950 due to lack of plastic manufacturer and technology, the plastic production only reached nearly 1.5 million metric tons. However, it increased deliberately in the next 50 years since more advanced technologies and the realization of how cheap and durable the plastic is with almost 200 million metric tons, which finally it reached around 365 million metric tons in 2020. Moreover, Bassetti (2020)^[6] the author of Foresight in 'The Future of Plastics is uncertain' article forecasted that in 2040 the global plastic production could hit almost 540 million metric tons. The prediction is based on the similar data from Statista.

This is actually bad, since the more plastic produced means the more waste generated in future as well. The waste can be in form of discarded waste on the land which could create an unhealthy environment or harm the animals especially animals that live under the sea. This has been supported by the data obtained from Jambeck et. Al. (2015)^[7] and Eriksen et. Al (2014) which later illustrated by Richie and Roser (2018).

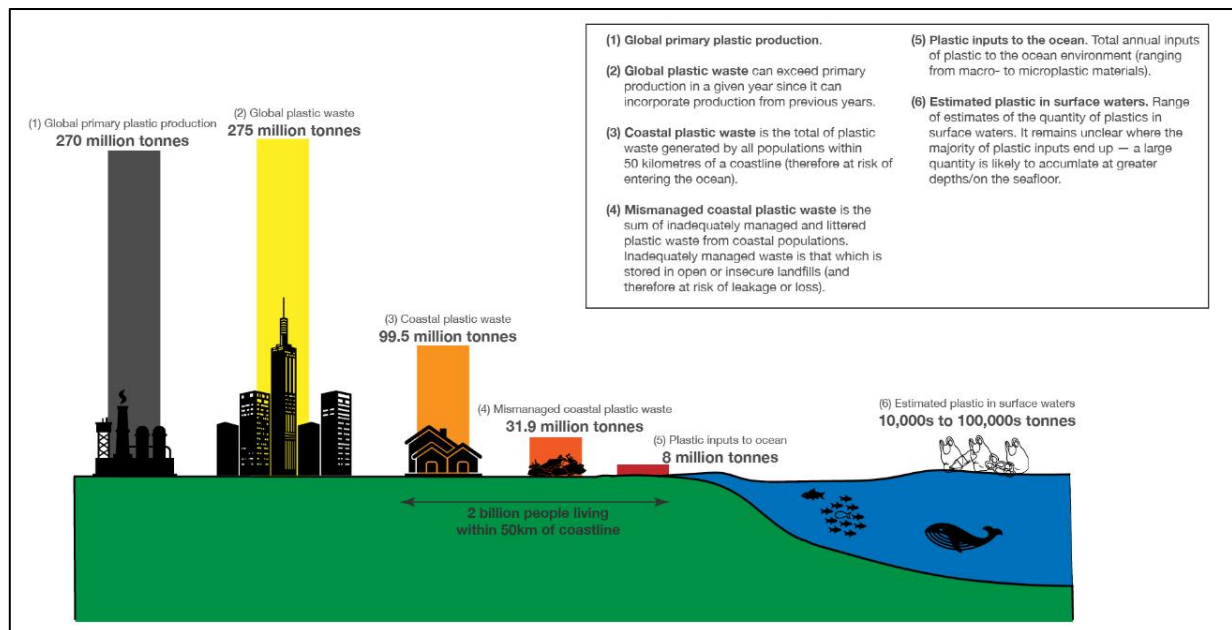


Figure 2. The illustration is going to talk about “where all our 2010 plastics are going to” in 6 steps.

As we can see in **Figure 1**, the global plastic production in 2010 is 270 million metric tons which yield the same amount to the (1)-Grey in Figure 2. Next, (2)-Yellow is the global plastic waste generated which is 275 million metric tons on that time. The reason it did exceed the annual plastic production is because the waste also could be accumulated through the remaining of the previous year. In (3)-Orange, the population that live within 50km of the coastline has generated nearly 99.5 million metric tons of plastic waste. It is crucial since the waste could potentially end up in the sea. Out of the 99.5 million metric tons, there were 31.9 million metric tons of plastic waste are being mismanaged in process (4)-Tango. This mismanaged waste will be thrown and pile up in the landfills which we have discuss above. Next, (5)-Red are all waste near shoreline and enter the ocean which accounts for 3% of total waste produced in that year or 8 million metric tons. Finally, (6)-Blue is the estimation of the plastic waste that floated on the water. The estimation accounted for 10.000 to 100.000 metric tons. This has raised awareness for the remaining missing plastic, which could be consumed or entangled by the marine creatures, sunk to the bottom of the sea and potentially being drag to another part of the ocean or shoreline (Ritchie and Roser, 2018)^[8].

After understanding the trend of the world plastic production every year and its impact towards environment. We would like to see the statistic on how we actually manage this plastic waste. In order to have better idea on current trend, the analysis will be performed in cumulative frequency within years. Using the data from **Figure 1**, we actually can obtain the estimation of cumulative global plastic production within years.

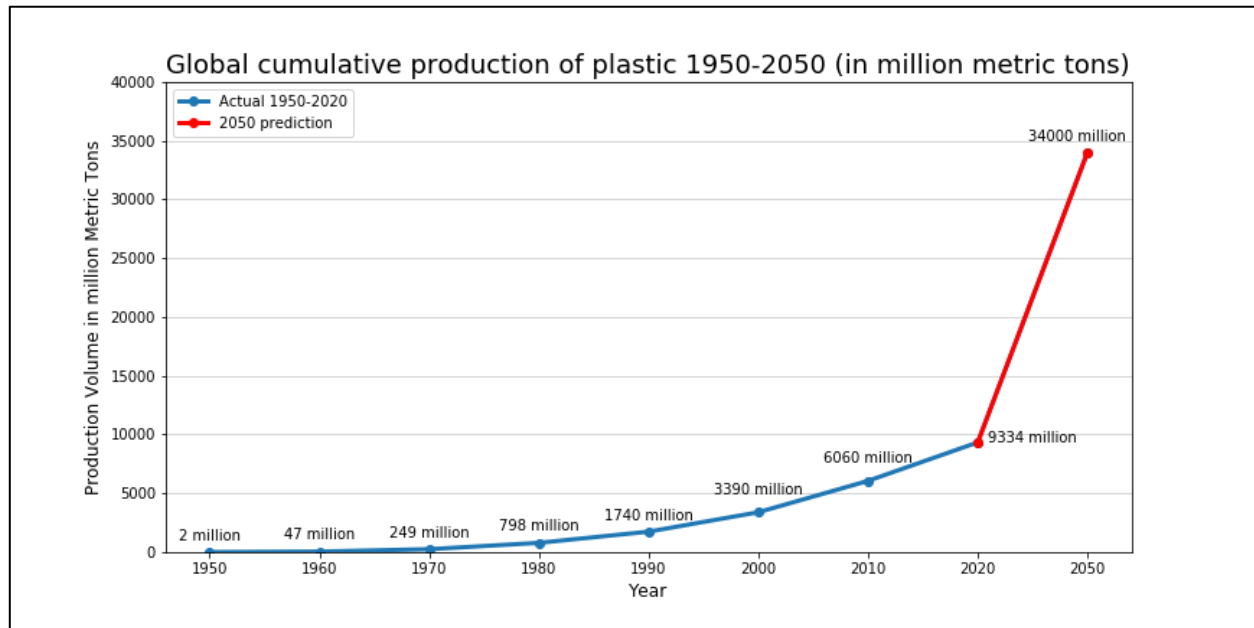


Figure 3. Global Cumulative Production of Plastic 1950-2050 (Our World in Data)

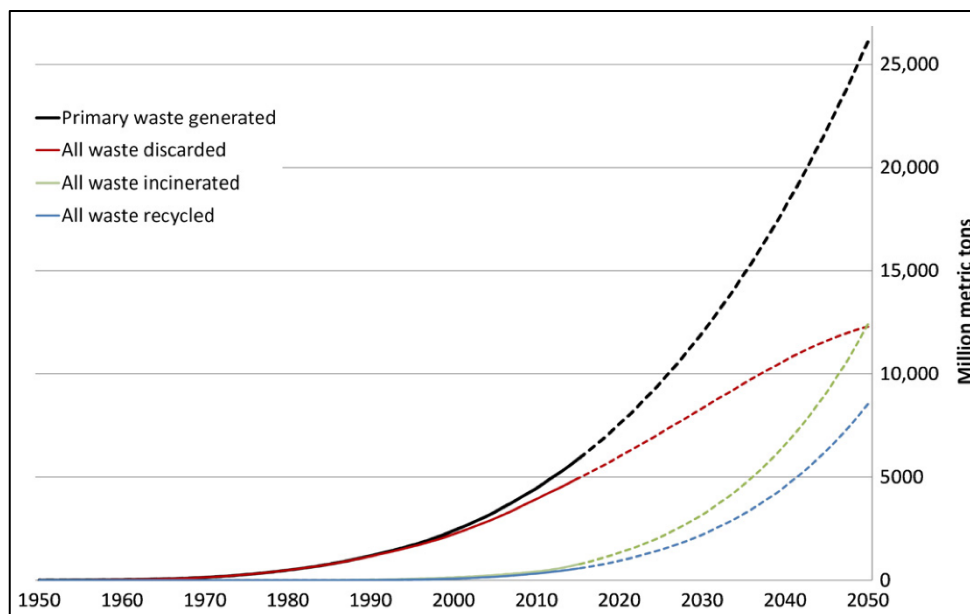


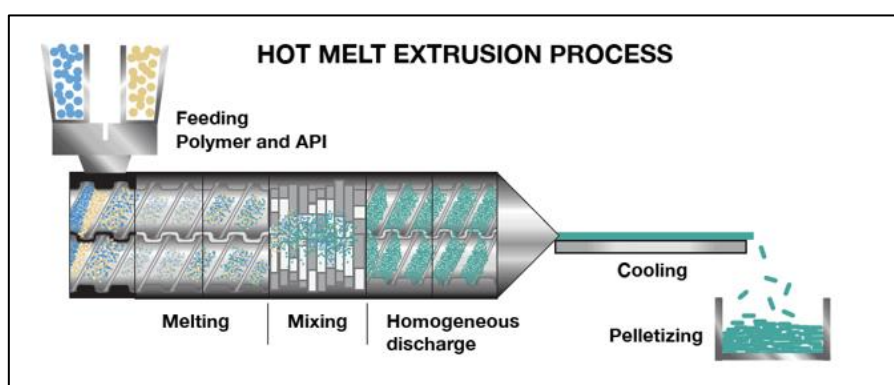
Figure 4. Cumulative plastic waste generation and disposal (in million metric tons). Solid lines show historical data from 1950 to 2015; dashed lines show projections of historical trends to 2050. (Geyer et al., 2017)^[9]

In **Figure 3**, The prediction of 2050 is based on the Tiseo (2021)^[10] research estimation using the global cumulative plastic production historical data. Out of 34,000 million tons plastic, almost 26,000 million have become primary waste according to **Figure 4** (Geyer et al., 2017)^[9]. Moreover, out of the total waste, the amount of waste being discarded reached 5000 million metric tons in 2015 which eventually this neglected

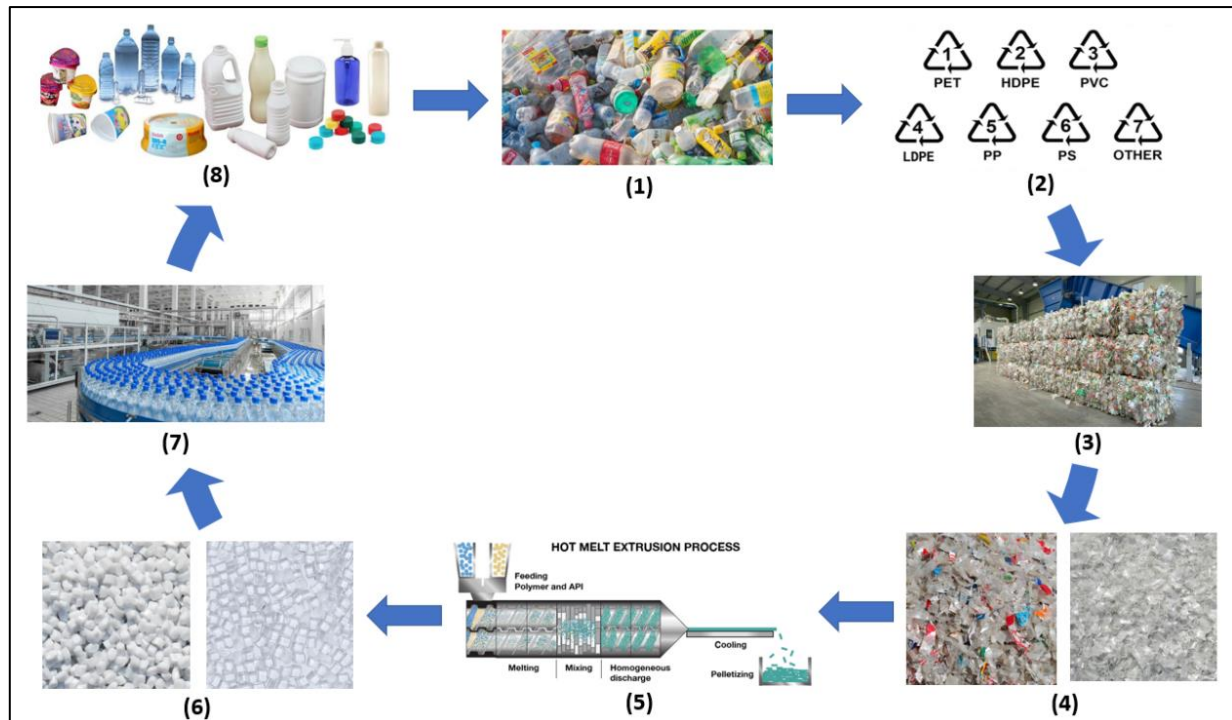
waste will bring harm to the environment if not managed properly. However, starting around 2005, as technology is getting more advanced and people become more aware or concern towards the side effect of huge amount of plastic waste are being generated. Some action such as incineration and recycling have been performed despite it is still low on record with only 2500 million metric tons of total waste for respective action in 2015. They believe that in 2050 the discarded plastic waste will descend, and on top of that the plastic waste that are being incinerated and recycled will rise.

This desirable future is what we are looking for, since it will result in less plastic are being produced and less waste are being dispose on landfills. More importantly, if we could fully recycle the waste instead of burn it, this will result in more resilience solution. One advantage is, recycle could tackle the environment issue by reducing energy usage, water & air pollution, and conventional waste disposal. Another advantage is, it could create a circular economy or green business in the future. Many people think that a sustainable business is not profitable, since the company need to spend more cost on the machines or technology. However, in the long term they will be profitable. First, recycling is a huge reason for savings, beside it does not require many resources overtime to produce the product, it is also cheaper to manufacture goods from recycled materials. Second, recycling also avoids the cost of waste disposal in landfills and incinerators. Finally, with more land available, more option to open new business opportunity or put into economic use in the future.

Due to this reason, the practice on creating a circular economy by recycling plastic has been very famous nowadays. Companies from startup to big corporate race to achieve the most affordable and most sustainable way on this practice especially for packaging and consumer product industry. One technique that has been very efficient and commonly known is by turning the plastic into pellets which later they will be turned into original plastic product again. Below, I created an illustration of plastic recycling process. Use the loop flowchart as the layout and the information data from ecomarketingsolutions.com blog which title "How Do You Convert a Plastic Water Bottle into Recycled Plastic?". The main technology use to create pellets is called the Hot Melt Extruders (HMEs).



Hot Melt Extruders (HMEs) [Lubrizol Life Science](#)



- (1) **Waste collection:** All plastic wastes are collected by waste collector or recycling centre.
- (2) **Material Type allocation:** Since most of the plastic waste on landfills are made of PET, HDPE, PP and PVC. Therefore, separating them is a must. Usually, it is done in a centralized material reclamation facility by either machine or actual people and sometimes both ways.
- (3) **Plastic Bales:** After separated by its material type. The plastic will be compressed into blocks to ease the next step process which is grinding.
- (4) **Grinding, Clean, and Colour Separation:** The plastic bales will be transported to the conveyor belt which lead to a cleaning machine. The cleaning process which functions to remove other liquids, dirt, and paper labels. After that, the cleaned plastic will move to a grinding machine and convert it into small chips or flakes (**picture on the left**). Later, it will move to colour separation machine which this colour separation will ease the melting process in the next step. The result will be plastic chips in group of same colours (**picture on right**).
- (5) **Hot Melt Extrusions Process (HME):** The process consists of Melting, Mixing and Cooling. Using the plastic chips as the main resources, it will generate a long plastic noodle through the melting process (filtered and purified) and mixing process. Finally, the plastic noodles need to be cooled before being cut into pellets.
- (6) **Pellets Grade:** The process for the food-grade pellets (**picture on right**) and non-food grade (**picture on left**) needs to be done separately on HME. Since pellets for food-grade has higher purity compare to the non-food grade pellets with nearly 99% level of purity.

- (7) **Plastic Manufacturer:** Finally, the pellets will be transported to a plastic manufacturer, using extruder to melt the pellets and some other composition to create the recycled products.
- (8) **Final Products:** The recycle products could be 100% recycled or fraction recycled. It also based on the material type to create the similar product. For example, PP material to create a new bottle cap, PET material to create a packaging bottle or fibers for clothing and HDPE material to create detergent containers or milk bottles.

As previously being stated, plastic recycling practice has been globally known. It is inevitable that many people already familiar with this practice. However, people and companies are still racing to achieve the most efficient, sustainable and profitable solution. Particularly, the developed countries where their technology is way more advanced. For example, [Nuosen Plastic Co.](#) is one of the biggest PE/PP plastic pellet manufacturers in China. They already one way ahead with colouring pellets speciality.

Similarly, [Coca Cola China Limited](#) as one of biggest beverage and packaging brand in China also take action in plastic recycling movement. In their sustainable project namely “No Waste in the World”, they manage to recycle PET bottles and officially launch an eco-friendly bottle for IceDew water product which is one of the brand subsidiaries. Not only their product, but they also raise awareness and educate people about environmental protection and promote green life by engaged in some activities such as garbage sorting, beach cleaning and tree planting. Despite it is small movement but this could lead to huge impact in the future.

Another example come from Israel start-up company, [UBQ Materials](#). According to Washington Post (2019)^[11], the idea is come from the eight tons of trash pile up in front of small factory. Using the upcycling mindset, they always look at landfills as a golden opportunity. UBQ aims to keep trash from ever going into landfills. By recycling plastic into pellets, they believe it could create a new life for hard recycle plastic while it helps to reduce landfill production of a powerful greenhouse gases.

Last but not least, start-up company [Tridi Oasis](#) which is based in Indonesia has huge impact on reducing and recycling the Indonesia ocean waste. As an archipelago country, Indonesia is surrounded by ocean. As the fourth biggest population in the world, the trash issues would be very severe. They mainly recycle on PET plastic material as it is the type of plastic usually floating on the ocean. They also convert the waste into pellet before they turn into the original product. However, there is issue on doing recycling business in Indonesia. The problem is the garbage sorting system is not integrated well which result them to mostly manage the waste manually (Kaplan, 2020)^[12].

Beside plastic, the waste also can be turned into another product. For instance, polyester fabric from exact PET waste as they have same composition which is polyester (Guilford of Maine, 2016)^[13]. Another example, Singaporean start-up company namely [Magorium](#) manage to turn plastic waste into road construction

materials. It is believe using the mixture of another component such as recycled asphalt and glass could improve the lifespan of roads while recycling waste (SMU, 2020)^[14].

To sum up, it is expected by 2050, there will be less discarded waste and more plastic being recycled and incinerated. Nevertheless, if we start raise more awareness on how important is plastic recycling include the benefit towards our environment and more companies leading towards sustainable goal as well. I believe in 2030 (**Figure 4**), with more new advance technology to create similar quality between the recycled and original plastic, the total recycled waste (blue line) could overstep the incinerated waste (green line). Moreover, the discarded waste (red line) will plummet to below the recycled waste. This is due to less plastic production since we have embraced the circular economy culture.

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