Chicago- Journey to a sustainable city

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Abstract: **Urbanization and increase in population have triggered the rise of pollution in the city of Chicago. A lot of her residents grew up on polluted lands and impoverished neighborhoods. And many believe it is solely the government job to help mitigate these problems. How can the city government channel her funds in curbing hunger, unemployment rate, and combat air pollution? This paper examines the social and environmental impact of assessment in Chicago and effective ways to mitigate it. Investments in the city will help provide the government with more funds to resolving some of the issues reviewed in this paper. However, what strategies can the city of Chicago use in raising investors within and outside its city's walls?**

***Keywords*: Impact Assessment; Green- Infrastructure; Renewable Energy; Recycling; Chicago**

I. INTRODUCTION

Urban cities have had a steady increase in air pollution over the last decades due to industrialization, deforestation, and pollutant emission. The effects of populated cities on environmental and social levels have resulted in the need to researching lasting solutions to improve the affected cities. Often, disastrous effects are what forces decision-makers to provide viable strategies to mitigate these challenges.

Chicago is the largest metropolitan city in the Midwest and the third most populated city in the United States with a population size of about 2.8 million residents (U.S. Census Bureau QuickFacts: Chicago City, Illinois; United States, n.d.). In 2019, the city exceeded 3.4 calendar days of air pollution more than 5 times by the US EPA. And exceeded an average unhealthy ozone day of 19.2 per year (Chicago Air Quality Index (AQI) and Illinois Air Pollution | AirVisual, 2021). For a city that is richly populated to have that level of toxicity in the air is unhealthy for the country. If no sustainable solution is achieved, it will eventually lead to a generation with hereditary respiratory diseases that may then be passed to millions of others across the country via migration.

Chicago has a history of toxic air pollution that dates all the way back to the city's industrialization in the late 19th century (Chicago Air Quality Index (AQI) and Illinois Air Pollution | AirVisual, 2021). This was because of the refineries, and industries that moved to that region. Coal is one of the biggest natural resources in the state of Illinois and has helped the state improve its economy greatly over the last two centuries. Coal was the primary source of energy during the industrialization of Chicago, and due to its high demand, little to no thought was put into its impact on future generations. Coal was used to power motor engines, steel mills, heat buildings. The impact of burning coal has caused devastating damage to the health of the city of Chicago (The Chicago Center for Health and Environment, n.d.). It is, therefore, the objective of this paper to examine the existing infrastructure for combating pollution in Chicago and provide solutions for improvement.

II. METHODOLOGY

1. Environmental Impact

For the past 6 years, Chicago's water supply has been contaminated with lead. The researchers at the US Environmental Protection Agency (US EPA) found alarming levels of the brain- damaging metal that is caused by service lines that connect buildings to the city's water system. Since nearly 80 percent of the buildings run on service lines made of lead, there is an increasing risk of exposure to dangerous levels of lead (The Chicago Center for Health and Environment, n.d.).

Coal tar is still used on driveways and parking lots as an ingredient for pavement sealants despite recommendations provided by the American Medical Association. When it heavily rains, the coal tar is washed off which runs into various water bodies. This toxic substance contaminates the city's water supply making it unsafe for everyday living (Environmental Protection Agency [EPA], 2020).

Furthermore, less than 9% of Chicago's household waste is recycled according to the 2019 Environmental Platform for the city of Chicago (Figure 1). Plastic and litter often end up in rivers, lake Michigan, and other areas in quantities that can harm people and wildlife. This poorly handled waste often clogs and prevents the normal flow of these water bodies which in turn results into flooding and erosion when it rains. In addition, untreated sewage also runs off into the rivers and lakes during days of increasing rainfall which overwhelms Chicago's combined sewer system.

Figure 1: Waste Dump in Chicago (Brackett, 2017)

Due to the city's water supply being heavily polluted, there has been an increase in gastrointestinal illnesses, nervous system disorders, fertility issues, and some chronic diseases such as cancer.

Air Quality and its impact on Health

The American Lung Association's 2019 report titled "State of the Air" reported that the city of Chicago ranked 18th amongst the most polluted Ozone cities in the United States.

Ozone is a harmful gas pollutant created by a chemical reaction between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) (Figure 2). It occurs when pollutants emitted by power plants, refineries, cars, chemical plants, etc. react chemically in the presence of sunlight. In cities like Chicago, ozone levels are most likely to reach dangerous levels on summer days.

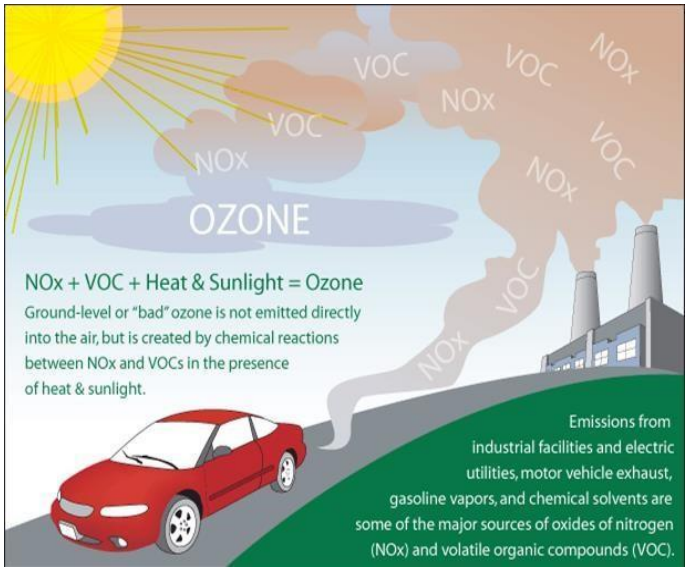

Figure 2: Ozone creation DHEC

Chicago has a long history of unhealthy air pollution dating back to the city's industrialization in the late nineteenth century. Coal was the primary heat source in Chicago at the time and it was used to run motor engines and heat buildings (The Chicago Center for Health and Environment, n.d.).

The soot emitted from burning coal is toxic and can lead to various health complications such as: asthma, cancer, heart and lung diseases, pneumonia, and so on. This toxic compound can also cause acid rain and global warming. Coal plants have a particularly strong impact on asthma rates in Chicago, with the city having an average of about 41 premature deaths, 550 additional emergency room visits, and 2,800 additional asthma attacks yearly (Lydersen, 2008).

Figure 3: Air pollution in Chicago (Reyes, A. (n.d.))

The image above is a cloud of dust that is a result of developers in Chicago demolishing a giant smokestack at a coal power plant in the southwest side of the city. The cloud of dust was suspected to contain toxic substances like lead and silica. This cloud however, engulfed surrounding neighborhoods while residents were sheltering in their homes during the COVID- 19 crisis (Air Quality and Health). Research has shown that the inhalation of lead could cause lead poisoning which could affect mental and physical development in children as well as adults,

Alongside the emission of coal, other factors- such as diesel particulate, traffic proximity, toxic waste emitted by industries and winter wood also significantly contribute to Chicago's poor air quality.

2. Social Impact

i) Food Scarcity

The amount of viable land available in Chicago is not enough for adequate food production which has led to food insecurity in certain areas of the city particularly the low-income neighborhoods. This is partly due to the large number of trash and toxic substance dump sites located in these neighborhoods.

Nearly 284,000 Chicago residents live in communities where they must travel farther to buy a fresh apple than they do to get a bag processed food.

ii) Health Care

Improved health is beneficial to the Chicago economy. However, due to the spike in health risks, the demand for proper health care has also increased without a simultaneous increase in low- income health benefits despite these neighborhoods being the most affected. Most of these families could barely afford to keep their homes that getting an air purifier or relocating is not an option.

III. SOLUTIONS

Upon research, four different solution methods can be implemented to create a stable and sustainable city.

i. Green Infrastructure

This a cost- effective approach to combating flooding, erosion, and air pollution. Certain trees such as silver birch, yew, pines, and cypresses are very effective air purifiers and can help remove toxic particulates from the air (Traverso, 2020). Another advantage of these trees is its ability to prevent flooding and erosion which would help curb the yearly budget on stormwater.

Moreover, an increase in tree canopies and parks in a city will improve the health of the communities in the city. People will be more encouraged to ride bikes instead of driving, to go jogging in the morning, or go on evening walks. This will also reduce the rate of obesity and high blood pressure in the city.

Green Infrastructure is very advantageous due to its environmental, social, and economic advantages which will attract external investors to the city.

ii. Renewable Energy

This is clean energy that comes from natural sources such as the sun and wind that are naturally replenished. There are five major sources of renewable energy:

- Solar energy from the sun
- Geothermal energy from heat in the earth
- Wind energy
- Hydropower from flowing water
- Biomass from plants

Renewable energy generates energy that produces zero greenhouse gas emission (*results from burning fossil fuel*) which will lead to the decline of air pollution that will cause a decrease in the rate of health challenges amongst Chicagoans.

Subsequently, renewable energy will create job opportunities in the manufacturing industries. This will help to improve the social and economic life of Chicago. Also, its residents will have a better chance at a better life with the opportunities created by the introduction of renewable energy to the city.

iii. Reduce and Reuse

This declines pollution rate by reducing the need to harvest raw materials by encouraging reuse of materials and products.

Reduce and reuse protects the land from waste dump which clogs drainage systems and changes the flow of water in water bodies which leads to erosion and flooding. This solution maximizes the use of products to its maximum capacity and reduces the amount of waste that requires incineration thereby curbing carbon footprint.

In addition, this opens the city for friendly- living which gives an opportunity for donations that can assist low-income neighborhoods and improve the welfare of the communities.

iv. 5- way Recycling

This is the process of having 5 compartments or bins in a recycling chain which would reduce the chances of recycling contamination. These 5 compartments or bins include a bin for paper and cardboards, glass, metals, plastic, and food compost.

Recycling contamination is the result of recyclable materials being mixed with non- recyclable ones such as food compost. Recycling contamination increases the cost of recycling through sorting and sometimes, results in loss of materials due to contaminations from substances such as, food, fluid, chemicals, etc.

The 5- way recycling will help curb the cost of sorting in the recycling process. The purpose of recycling is to conserve and optimization of natural resources such as water, timber, rubber which can only be achieved by effective recycling methods such as this.

The importance of having a bin for food compost is it could save local farmers the cost of buying manure for their farms. These food compost could be sold back to these farmers at very low cost which would also improve the health of crops and livestock in the city.

IV. STAKEHOLDERS

These are groups of people needed to establish a green, sustainable Chicago. Each stakeholder is needed to promote and uphold the city of Chicago to the standard she attains to reach and surpass.

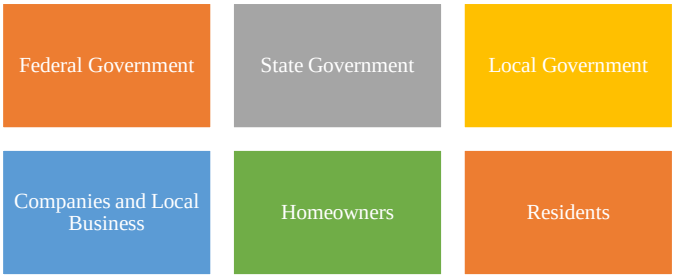

Figure 4: Stakeholders of Chicago

The Federal, State and Local government are needed to pass bills to put some of these solutions like renewable energy in place. In addition, their support is needed to promote ads using government channels to encourage the education of residents on these solutions.

Also, companies and local business can be taxed with the responsibility of proper disposal of their waste as well as compliance to the city's waste regulations.

Furthermore, homeowners are also needed in the of implementation of these solutions. Many homeowners are either unaware or unconcerned about the effects of stormwater outside their homes considering the existence of stormwater outside private properties causes roads to flood and crack, thereby creating potholes.

Therefore, embracing green buildings and planting of trees on private properties will greatly reduce the risk of flooding in a lot of neighborhoods across the city.

Moreover, full adoption of clean energy in residential areas begins with homeowners and leasing companies and agencies. If the option of renewable energy is available to tenants, it will be easy for them to opt for it upon education of the benefits.

V. IMPLEMENTATION

The involvement of every stakeholder is necessary because the effort in promoting a clean, safe, and sustainable city lies in each group. Every resident and worker in the city can be educated on the benefits of these solutions by utilizing schools, community outreaches, non- profiting organizations, and commercials on mediums such as the water bill.

The cost of the 5- way recycling can be gotten from investments, industrial companies, and refineries in the city. Industrial companies and refineries can be taxed by the city of Chicago for air pollution and waste released in the environment even after the incentives and waste laws. Also, citizens of Chicago can be fined when they violate the regulation of keeping a clean, and sustainable city.

Figure 5: Implementation

VI. CONCLUSION

President Joe Biden called for a net- zero emission economy by year 2050. With these solutions, a net- zero emission Chicago can be achieved between 10- 15 years which will encourage investments in the city. A city with an achievable growth plan is one investors will visit because they know the value of the city will increase as each measure is put in place. Another keynote, land appreciation will be beneficial to homeowners and local business which would be a ripple-effect of more investments in the city.

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