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AN ANALYSIS OF THE ECONOMIC BURDEN OF AIR POLLUTION ON POPULATION HEALTH AND ENVIRONMENTAL POLICY IN THE CZECH REPUBLIC

Michelle Juarez



Introduction

As a nation once ruled by a communist regime, the Czech Republic has strongly centered its economy on industrial production and energy intensity. Environmental safety has often been traded for economic gains. However, in recent years there has been increasing concern regarding air pollution, as it is an issue that directly affects the population's health and quality of life. Air pollution kills more than three million people across the world every day and accounts for six percent of deaths in the world (WHO, 2016). A recent study conducted by the National Institutes of Health estimated that more than 5,000 deaths annually are due to air pollution in the Czech Republic and that the number will continue to rise. If sufficient actions are not taken, air pollution is set to become the top environmental cause of premature mortality by the year 2050 (OECD, 2012). Despite long-term declines in pollutant emissions, the air quality in the Czech

Republic is not improving, and a large portion of the population continues to be exposed to excessive levels of air pollutants. These various air pollutants are attributed to the heating, transport, and energy sectors that use inefficient fuels and emit hazardous substances into the environment. These substances are correlated with several health issues, from coughing and wheezing to chronic respiratory and cardiovascular diseases.

The Czech Republic has struggled to remedy the legacy of environmental damage left behind from the communist regime; but in a globalized era, its biggest challenge is to balance economic, health, and environmental priorities. The nation's reliance on the energy sector for economic growth makes these matters even more difficult. In a time when economic gains and health outcomes are of increasing concern, it is important to find a balance between all these priorities. The Czech Republic has made earnest attempts to address these growing concerns, but many of the

policies in place are ineffective for the major environmental issues at hand.

In this article I examine the current state of the Czech environment as it relates to air pollution and the major policies in place to address these concerns. I first describe how the communist regime contributed to the dangerous levels of air pollution and environmental burden in the Czech Republic that continue to plague the nation today as well as the current barriers to improving air quality. I then analyze current environmental policies in the Czech Republic and the complexities of balancing environmental, economic, and social priorities. I conclude by offering recommendations for improving air pollution policies and by underscoring the importance of economic cost analysis of air pollution in establishing a more cohesive sustainable development strategy.

Communist Legacy of Air Pollution

The communist government that existed in the Czech Republic between 1948 and 1989 is the main culprit of the legacy of environmental degradation that still burdens the nation today. The doctrines and ideals intrinsic to the communist regime of the Czech Republic were the driving force behind the environmentally degrading behavior and practices exhibited in this era. The communist belief during this time was that capitalism was the sole contributor to environmental damage and that in a communist society where the public owned the means of production, environmental degradation was merely “accidental” (Andrews, pp. 6–7). Because the government was both the source and regulator of environmental problems, environmental regulation was essentially at a standstill during this era. The communist ideals carried over to the government’s hazardous practices, which emphasized high production and economic power over sustainability. Three main communist practices contributed heavily to the decline of the environment leading up to the Velvet Revolution: heavy industry, pressure for urbanization, and neglect of policy change.

Heavy Industry

The policies of the centralized economy

during the communist regime placed particular focus on heavy industrial production. During this time, industry alone was responsible for more than 60 percent of the country’s net material worth (Andrews, p. 7). Environmental degradation notwithstanding, high industrial output was achieved by any means necessary and included the development of even more heavy industry despite their deleterious effects. The Czech Republic used more energy per capita and 2.5 to 5 times as much energy per dollar of GNP compared to any other Western country except the U.S. during this time (Andrews, p. 8). Many of the machines, metals, chemicals, and energy used in heavy industry relied on low-quality lignite (high sulfur) brown coal and crude oil, both of which are highly damaging to air quality and the environment. Although other Western European countries were beginning to modernize their technologies and facilities for greener production, the economic structure of the Czech Republic during the communist era hindered any incentives or initiatives for resource management and energy efficiency. Industrial production in the Czech Republic was concentrated in few companies that essentially monopolized the sector, creating little to no incentive to improve these facilities to keep up with Western nations.

Urbanization

The communist pressure to urbanize small rural towns, or to move rural populations into more urbanized cities, to increase economic prosperity caused more environmental problems. During the communist era, the government emphasized urbanization for social and economic agendas, so much so that by 1987, 68 percent of the population lived in towns or cities (Andrews, p. 9). Responsibilities of urban municipalities continued to grow, but these municipalities were ill equipped to address the problems of urbanization. A byproduct of this urbanization was the creation of settlements with very poor energy efficiency and low-quality facilities, because efforts to modernize these settlements could not keep up with the high rate of urbanization. The concentrated transportation system that characterized urban cities led to an

increase in automobile usage and consequently air pollution, as many of these vehicles used antiquated exhaust and converter systems that emitted harmful pollutants into the air. Although many issues were apparent in the urban infrastructure, such as the air pollution resulting from heating using lignite coal, these municipalities did not have the political power or resources to address these issues under communism (Andrews, p. 10).

Neglect of Policy Change

Altogether, heavy industry and urbanization worked in unison to bring the state of the environment in the Czech Republic to its nadir. Conditions in the environment, in particular air pollution, were so bad that the Czech Republic became part of Europe's Black Triangle, a region that shared a border with Germany and Poland for the visible smog and high levels of air pollution. By the end of the communist era, the nation's air pollution was one of the worst in the world (Horak, p. 313). Lignite coal used in industry and heating contributed to a three-fold rise in sulfur dioxide levels between 1950 and 1985. By the end of the communist regime, many parts of the Czech Republic had substantially exceeded the World Health Organization (WHO) thresholds for safe exposure to air pollutants. Unsurprisingly, the health effects resulting from these environmental pollutants took a large toll on the population. The incidence of such respiratory diseases as asthma and emphysema was high, the prevalence of allergies rose six-fold for adults and ten-fold for children, rates of infant mortality grew, and life expectancy was three to six years shorter in the Czech Republic than in other European countries (Andrews, pp. 12–13). Overall, over one-fifth of the population in the Czech Republic suffered from health issues caused by poor environmental conditions (Horak, p. 315).

Despite the devastating environmental problems and health effects, the communist government responded to these matters ineffectively. Information about the environment was collected as early as the 1950s, and many studies on the environment were conducted between 1970 and 1980 but

were suppressed to the general public. The communist government made environmental issues a secretive matter and did not disclose them to the general public so as to undermine their importance. The government masked this indifference, portraying a facade of commitment to environmental issues by enforcing ineffective laws and regulations to address these problems. Most of the laws enacted during this time instituted fines for exceeding environmental standards rather than criminal punishment, which addressed only the consequences of environmental damage and not the source itself. Thus, these laws were largely ineffective in discouraging environmental damage because it was often cheaper to pay these fines than to invest in facility modernization. Perhaps the most significant reason why environmental laws were ineffective, however, was that the communist government was both enforcer and regulator of these policies, roles that cannot exist simultaneously without compromising each other. Many big industries found loopholes in the laws and often were not penalized by the government for their damage. This stalemate between law enforcement and economic productivity put environmental regulations on the back burner and left behind decades worth of environmental damage that will continue to plague the nation in the future.

Current State of the Environment and Effects on Human Health

Years after the end of the communist rule, the Czech Republic continues to face pressing environmental issues. The most recent report on the environmental state, conducted by the Ministry of the Environment in 2011, reveals stagnant and even worsening environmental conditions related to air quality. Although there have been considerable decreases in pollution since the 1990s, air quality in various regions of the Czech Republic remains unsatisfactory. The worst of these conditions are in the Ostrava, Prague, and central Bohemia regions, where much of heavy industry was located during the communist regime. The report found that acceptable emission levels of pollutants were exceeded in more than one-third of the nation. The major pollutants that pose a threat to

human health include particulate matter (PM), ozone, and acidifying substances (nitrous and sulfur oxides). As a whole, these pollutants can cause cardiovascular and respiratory illnesses, stress on heart and lungs, loss of lung capacity and function, and shortened life span.

PM is the most common, and the most detrimental, air pollutant. PM is composed of hazardous substances, such as nitrates, ammonia, soot, smoke, dust, and water, in a mixture of particles suspended in the air. PM can be categorized into several classes depending on the diameters of the particles they include, but the most common and destructive are those with a diameter of 10 microns or less, such as PM₁₀ and PM_{2.5} (WHO, 2014). PM can be directly emitted from the solid particles through combustion, or it can form in the environment in reactions with sulfates and nitrates. These particles are small enough to penetrate deep inside lung tissue and contribute to a variety of respiratory and cardiovascular diseases, including lung cancer and arrhythmias. There is a close correlation between high concentrations of PM and high rates of morbidity and mortality, and to date there is no threshold at which PM concentrations do not induce health problems. For this reason, the WHO sets out guidelines for the lowest concentration of PM values that would significantly reduce risks for health problems from these particles (WHO, 2014).

Although not the most common, ground level ozone pollution is just as deleterious because it is the main source of photochemical smog. Ozone is formed when nitrous oxides or other volatile organic compounds react with sunlight and is thus more commonly seen during sunny weather. High levels of ozone can lead to respiratory issues, such as asthma, emphysema, chest pain, reduced lung function and immunity, and other lung diseases (WHO, 2014). The ozone precursors, nitrous oxides and volatile organic compounds, can further exacerbate these health concerns. Nitrogen dioxide in particular is the main source of nitrate aerosols, which comprise a portion of PM_{2.5} as well as ozone. Nitrous oxides can cause airway inflammation, which increases the incidence of bronchitis, coughing, mucus secretion, asthma, and infection and reduces

lung function. Similarly, sulfur dioxide affects respiratory function and also can cause eye irritation (WHO, 2014).

Other pollutants include carbon monoxide, methane, ammonia, and benzopyrenes. Although these compounds are not as common, they are precursors to other more common pollutants; thus, their deleterious effects are still seen. Exposure to high levels of ammonia can cause irritation in various mucous membranes and lead to coughing; carbon dioxide can lead to heart disease as well as cardiovascular damage; and benzopyrenes consist of toxic, mutagenic, and carcinogenic compounds that can lead to various cancers and respiratory diseases. Most of these compounds are formed from manufactured sources, primarily fuel combustion, transportation, agriculture, and the energy sector (WHO, 2014).

Overall, the Czech Republic has seen a decline in the emission of these various air pollutants in the past decade but not an improvement in overall air quality. In fact, air quality appears to be worsening according to the most recent data from the 2011 Report on the Environment of the Czech Republic. In 2011, areas where the target air pollution limit values were surpassed comprised 16.9 percent of the Czech Republic's territory, compared with 14.5 percent in 2010 and in 2013. Compounding the already burdensome environmental legacy from the communist regime are new sources of pollution resulting from globalization and modernization—namely, transportation, industry, and household heating. Heating causes 80 percent of the Czech Republic's benzopyrene emissions and suspended particle matter production. In 2014, the recommended 24-hour values of PM₁₀ and PM_{2.5} were exceeded in virtually the entire area of the Czech Republic (“Report on the Environment...”).

Exacerbating these statistics are the trends in greenhouse gas emissions. Greenhouse gas emissions are directly linked to the economy's performance; and when the nation's economy is booming, so are the resultant greenhouse gas emissions. Greenhouse gas emissions in the Czech Republic are currently ranked as the fifth worst in the EU; the Czech Republic

generates 13 tons of carbon dioxide emissions per inhabitant per year, whereas the average total carbon dioxide gas emissions are approximately nine tons of carbon dioxide per inhabitant per year in the EU (“Report on the Environment...”). Although greenhouse gas emissions do not contribute directly to health problems, they do contribute to climate change and global warming, which consequently have their own health effects. Moreover, greenhouse gas emissions often occur concomitantly with emissions of other pollutants that pose risks to human health.

Although these various air pollutants cannot be seen with the naked eye, they are dramatically visible in their health effects. A study conducted by the Czech National Institute of Public Health reported more than 5,000 deaths annually attributed to air pollution (“Report on the Environment...”). Based on the average PM concentrations found in urban areas, the percentage of premature deaths due to air pollution is up to 12 percent in the most polluted areas. These increases in morbidity and mortality also coincide with a rise of hospital admissions in cardiac and respiratory complaints. Estimated hospital admissions due to air pollution range from 4 to 22 hospital admissions per year due to cardiac issues and between 7 and 35 admissions due to respiratory complaints (“Air Pollution and Associated Health Risks...”).

As the Czech Republic continues to grow as a developed nation and its economy prospers, the environment is taking a toll. Significant improvements are needed to remedy the state of the environment, and the recent environmental trends point toward a need for more effective legislation.

Policies Addressing Air Pollution and Sustainable Development

The Czech Republic has passed many laws regarding environmental protection, but the variety and broad scope of these laws have led to inconsistencies and gaps in regulation. In response to the 2004 EU directive on environmental responsibility that required member states to prevent and ameliorate environmental damage, the Czech Republic passed the Environmental Damage

Act. This act imposed strict penalties for environmental damage and also required responsible parties to fix their environmental damage. Notwithstanding good intentions, this law has never been enforced in the Czech Republic. The Environmental Damage Act also required increased standards for evidence against environmental damage, and these higher standards have led to delays in penalty enforcement and consequently unsuccessful implementation of preventative and restorative measures thereafter (“Environmental Liability 2012”).

Various other laws regarding different environmental sectors were passed to more specifically target different environmental areas and to better enforce liability charges. For example, in 2012, Parliament passed the Air Protection Act, whose purpose was to define and enforce objectives regarding air quality and pollution to protect human health. Under this act, firms in the main polluting sectors (energy, transportation, and industry) are subject to inspections to assure they have met pollution emission standards and are responsible for introducing pollution-reduction mechanisms into their practices. Failure to comply with environmental protection guidelines would require the responsible party to implement both restorative and preventative measures for the damage (“Air Protection Act”). Although it is more specific, the Air Protection Act failed to impose penalties for environmental damage. According to the Czech environmental liability report, between the years 2000 and 2009, 452 people were charged with environmental offenses, although only 175 were sentenced in the same period for these offenses. In comparison, penalties for all other criminal offenses aside from environmental damage have had an 83 percent prosecution rate (“Environmental Liability 2012”). Despite inconsistencies and gaps in policy enforcement, the Air Protection Act has made considerable strides toward improving air quality. One stipulation of this act is the prohibition, by the year 2020, of household heating boilers that cause substantial environmental damage. This would eliminate one of the biggest sources of PM in the environment and lead to substantial improvement in air quality.

The Czech Republic drafted its State Environmental Policy in 2012 detailing the goals and initiatives for environmental protection between the years 2012 and 2020. This comprehensive report provides a framework for policies to mitigate environmental and health damage done by the energy, transportation, and industry sectors. The policy includes many directives aimed at incorporating integrated economic approaches into environmental policy rather than end-of-pipe policies. End-of-pipe policies focus on implementing emission standards to reduce environmental damage and a “polluter pays” principle to discourage environmentally harmful activity. Integrated economic approaches, on the other hand, introduce environmental concerns directly into other policy areas, mainly economic policies. This approach influences the pattern of resource use itself by changing the costs and benefits associated with using particular resources, which can influence broad patterns of overall consumption and are thus more effective.

As the primary sources of air pollution, the energy and transportation sectors are the main targets of the State Environmental Policy. Among the many initiatives in this policy are those that improve technologies within the two sectors to promote safer and more efficient practices. Implementation of the best available technology systems have been a core focus in these sectors as modernized equipment promotes lower pollutant and waste emissions as well as technological efficiency. In the energy sector, the State Environmental Policy has directives in place to reduce energy intensity by requiring energy audits and restructuring the energy infrastructure for more efficient production and distribution. Yet another policy, the State Energy Concept of the Czech Republic, has initiatives paralleling the State Environmental Policy to increase heat efficiency for both public and private consumers and to promote the use of the best available systems for heating and electricity.

One of the main goals detailed in the State Environmental Policy is the reduction of greenhouse gases by focusing on the use of renewable resources. Renewable resources represent the most efficient and

environmentally friendly source of energy and are critical for sustainable development. Several directives have been put in place to promote the use of renewable resources, including taxes on fuels that cause harmful emissions and educational programs advocating for more efficient energy consumption in municipalities, businesses, and households. Since January 2008, the Czech Republic has placed a ten percent excise tax on coal and a one percent tax on electricity to encourage more efficient heating methods (“Report on the Environment...”). The government has also provided subsidies to replace old household boilers for more environmentally friendly heating and for the use of renewable sources. Yet another plan is the National Action Plan for Energy from Renewable Sources, wherein the Czech Republic has set goals for the share of energy from renewable resources in the final consumption of energy. By the year 2020 the Czech Republic aims to have 13 percent of its energy come from renewable resources compared to a six percent share in 2005.

Although some of the Czech Republic’s policies target the individual sectors responsible for pollution, most of the environmental legislation focuses on defining national emission standards for the various types of pollutants. One example is the National Emissions Program, in which the Czech Republic has identified acceptable levels of pollutants and which requires businesses to adhere to these emission standards or face penalties. This program targets the air pollutants that are most harmful to human health, including PM, acidifying substances, and ground level ozone (“Report on the Environment...”). These same emission standards in turn have encouraged business and industries to utilize the best available technologies and renewable resources to keep their emissions in check. The standards are of utmost importance not only to the Czech Republic but also to neighboring nations because air pollution is not a static problem. The Czech Republic has remained committed to preventing transboundary air pollution, and legislation is currently proposed to determine the Czech Republic’s potential for reducing emission standards by 2020 (“Report on the Environment...”).

Environmental Policies and Economic Implications

Despite the many legislative frameworks in place to tackle air pollution, the Czech Republic is struggling to find a balance between environmental policy enforcement and economic prosperity. Increased economic growth is often accompanied by increased industrial production and consumption as well as increased energy and transportation utilization—all factors that greatly contribute to air pollution. The Czech Republic is striving to ensure environmental well-being while not compromising its economic security, but this has proved particularly difficult due to the country's historically high dependence on the energy, industry, and transportation sectors for prosperity.

The energy and industry sectors represent the main sources of GDP growth for the Czech Republic. The industrial sector contributed to more than 28 percent of the country's GDP in 2011, which is among the highest percentages in the EU, where the average is around 18.7 percent ("Report on the Environment..."). Industrial production continues to rise at an annual rate of 6.5 percent, which poses a major threat to environmental health and safety. The policies in place that aim to curtail or limit industrial production result in additional costs to these industries at the expense of decreased production and revenue and, consequently, a decline in economic growth. For example, policies promoting renewable sources of energy have been hindered due to high development costs. In 2011, the Czech Republic spent 2.2 percent, or roughly 83.8 billion koruny (CZK), on environmental cleanup policies. Most of these funds were not allocated to air pollution, however, which represents the greatest risk for human health. Instead, they were allocated to waste and water management, which received nearly eight times more funding (62.6 vs. 8.2 billion CZK) than air protection (OECD, 2014). Many of these expenditures have gone toward replacing antiquated heating, industrial, and energy production with more modern machines, research and development for the creation and implementation of renewable resources and technology, and administrative costs of monitoring environmental conditions.

The funds that have been allocated to air protection seem insufficient. In order to tackle the existing concerns about the environment and the legacy of damage compounded throughout the years, it is projected that billions more will have to be spent annually in the next 20 years (Jůn).

The increased concerns of balancing economic and environmental priorities have underscored the importance of sustainable development in the Czech Republic. The World Bank defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Bank). Sustainable development encompasses economic, environmental, and social priorities and characterizes them as inextricably linked to future prosperity. In the realm of social factors contributing to sustainable development, population health is of utmost importance, especially for the Czech Republic, which has seen its share of health concerns from air pollution. Although health economics is a relatively novel concept, recent research has illustrated its importance in effective sustainable development. For the Czech Republic, this can make a difference in the way it addresses economic losses and gains from environmental protection.

Although environmental protection and economic growth are inversely related, population health and economic prosperity are directly related. As the health of a nation improves, so do labor productivity and labor potential, which directly affect the economy. In addition, better health means lower healthcare expenditures so that the resultant savings can be recycled back into the economy or environment. Key measurements in calculating the economic impacts of health are years lost due to morbidity and mortality and the economic value of each life lost (value of statistical life). The OECD has developed a statistical method for calculating the economic cost of deaths from air pollution: specifically, the number of deaths from air pollution is multiplied by the value of statistical life of each death. In 2010 the economic cost of deaths from air pollution amounted to \$19.6 million (OECD, 2014). It is important for the Czech Republic

to take this value into consideration and incorporate it into future policy development because it could pave the way for substantial savings, not only for the environment but also for the economy. Realizing the lost resources from health impacts, the Czech Republic could reallocate these resources into future sustainable development projects to ensure the protection of both the economy and the environment.

The Next Steps: Recommendations for the Future

As is the case for many developed nations, the Czech Republic continues to struggle in balancing its economic priorities with its environmental and social needs. The Czech economy thrives through the energy, transportation, and industry sectors, but these are the very industries that contribute the most to air pollution. The country has focused on decreasing its energy intensity without compromising the economic benefits from this industry, primarily by continuously monitoring and assessing environmental conditions and setting emission standards for the various pollutants. However, an important energy savings potential lies in the area of energy transformation through the use of renewable resources and efficient technologies. Greater efficiency in existing steam power, boilers, and household appliances could reduce the environmental burden tremendously. Compared with other EU countries, the Czech Republic has one of the lowest proportions of renewable resource use in electricity consumption. The problem lies in the limited capacity of renewable resources that are available. However, the potential for biomass use in the Czech Republic is comparable to that in other Central European countries and is a promising feature for further improvements in energy efficiency (“Report on the Environment...”). To implement these renewable resources and make use of the best available technologies, the Czech Republic must increase its environmental expenditures. Although billions of Czech koruny have already been invested in environmental protection, as noted earlier, billions more will be needed to ensure environmental safety and fulfill the

commitments that the Czech Republic has made in its environmental policies (Jůn).

Many framework policies are already in place to address environmental issues, but they only provide guidelines and goals to be met rather than definitive actions. There needs to be more consistency between transforming environmental policy frameworks into action plans for environmental protection. In addition, the sheer number of environmental policies may actually be a detriment to law enforcement. Many of the policies in place are similar in nature, which leads to confusion about how to approach and interpret various laws in specific situations. Discrepancies in energy tax rates, low levels of taxation on fuels with high environmental damage, and exemptions for fuel used in some sectors impede the transition to a low-energy economy. An extensive review of existing environmental policies needs to be done in order to consolidate and perhaps reduce the number of policies. This would provide a more consistent means of accountability and lead to improved law enforcement for environmental protection.

There are several directions that the Czech Republic can take to improve the cost effectiveness of its environmental policies and ensure economic stability. It can continue to make use of economic instruments, such as pollution charges and taxes, to prevent air pollution, but it should also increase the rate of collection. As mentioned earlier, previous political ideologies focused on end-of-pipe measures, which were ineffective in ameliorating long-term environmental damage. The recent focus on integrated economic approaches, however, has allowed for a more effective mode to promote environmental protection by incentivizing economic gains (OECD, 2005). Moreover, the Czech Republic would also benefit from strengthening environmental reform at the regional and municipal levels to ensure cooperation between public and private initiatives. Most importantly, it should consider the economic costs of health impacts caused by air pollution, as economic analysis could be beneficial in helping the nation to refocus its environmental expenditures. By identifying sector-specific shares of health impacts of air pollution and the economic costs of each, the

Czech Republic could generate substantial improvements in health, environmental, and economic outcomes. To do this, however, it must continue to research methodologies for calculating these measures.

A multifaceted issue such as sustainable development requires an interdisciplinary approach to problem solving, and it is imperative that the Czech Republic focus on integrating the government, municipalities, organizations, and the general public to tackle these issues. Particular focus should be placed on educating the population about the environment because large-scale change begins at the individual level. A broader awareness of the health impacts of air pollution could be the impetus for environmental reform and also pave the way for economic security.

Conclusion

The Czech Republic has seen decades of environmental degradation and has spent just as many decades trying to remedy it. There have been substantial improvements in the state of the environment in recent years, but these improvements are insufficient to

remedy the years of environmental damage passed down from the communist regime. Several areas of the country continue to be exposed to dangerously high levels of air pollution that cause serious health concerns. In an era where economic prosperity shapes a nation's competitiveness, it is often difficult to find a balance between environmental and economic priorities. Now more than ever, the Czech Republic must focus on sustainable development so as to not compromise its economic, environmental, or social well-being. By understanding the intricate interplay between economic, environmental, and health outcomes, the country will be able to see advancement in all three areas. If conditions remain the same, emissions of PM and other air pollutants will only continue to rise. However, if measures from the proposed legislation are met, the Ministry of the Environment predicts that the Czech Republic will be on track to increase its share of renewable resources in the energy sector, decrease air pollutant emissions, increase monetary savings, improve its energy management, and see tangible improvements in air pollution and the environment by 2030.

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