The Economics Behind the Regulation of Ambient Pollution

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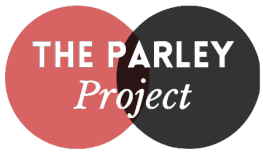


INTRODUCTION

Environmental damage resulting from emissions by factories and industrial units isn't very new. The brink of the industrial revolution in the 1850s saw increasing health problems due to acid rains caused by emissions of coal-powered industries. A few years later, in 1948, severe industrial air pollution created a deadly smog that asphyxiated 20 people in Donora, Pennsylvania, and made 7,000 more sick. Several movements lead to legislative victories in the U.S., followed by numerous international regulations to make sure the future generations are not under threat. Sustainable development has been a topic of discussion by many economists who believe inclusive growth is the only long term solution to a prosperous global economy. Inclusive growth takes into account the consumption requirements of future generations, in addition to the current population. The other side of economists believe that consumption smoothing can occur even if we use resources less sustainably. This concept follows the assumption that with the trend of increasing income (and consumption) with time, future generations are likely to have a higher income even though resources will be more scarce. This, however, is a very meek and unpopular opinion. Therefore, with the rising threat of global warming, regulations have been put in place at the national and international levels.

This research paper has been divided into three sections. The first section deals with the international level regulations and treaties by organisations, ensuring that countries emit optimal levels of pollutants depending on the stage of its development. The second section talks about the economics behind regulations at the national level and how effective they are empirical. The last section focuses on the adaptation of environmental policies by the corporate sector and how the business environment will shift with effective regulations in place.

I
INTERNATIONAL MEASURES FOR LIMITING GREENHOUSE GASES

Green taxes come from taking an externalities approach to taxation. Externalities are the impacts of economic activity (either at the production or consumption end) that impact a third party who did not opt into that impact. The environment frequently tends to bear many externalities, and residents need to undertake the indirect costs themselves, instead of the producers or consumers. This allows for people to continue producing and consuming in their previous ways since most do not have to pay the cost of the outside impacts that the production or consumption process is doing. Many consider this approach to be irresponsible from a moral perspective but also an economic outlook. In a business as usual manner, since the externalities of their activity isn't impacting them on a financial level.

Air pollution is one of the most significant externalities since borders cannot control it. One heavily polluting industry can have an impact on an entire region, not just people who live near it. Governments across the world are aiming to internalise these externalities within the industries to help reduce their impact. By taxing companies who produce in an unsustainable manner, or consumers who consume irresponsibly (by placing the cost in the form of a more expensive finished good) it encourages them to behave sustainably instead of being reliant on their good intentions to stop polluting. As of recently, social pressure from consumers who are becoming increasingly aware of their production chains has also been a reason why companies are internalising these externalities. Hardin's seminal paper exploring the Tragedy of the Commons goes further into how a shared resource like atmosphere is likely to be abused by those who can afford it, and put those who can't afford it at risk without tight regulation and control. If we examine the level of emissions emitted by the country as a form of "using" the atmosphere, we see that the industrialised world has used an overwhelming amount of it, primarily from regulation and internalisation of air quality within the production and consumption cycles.

When we understand this on a global scale, we can observe a similar pattern historically, where more developed countries while industrialising have contributed to over 3/4th of all carbon dioxide produced over the last two centuries. If we divide the amount of carbon emissions per capita equally, we can see from the graph below that the industrialised world has emitted significantly more than it "should" for the sake of development.

The moral argument here remains that for the rest of the world to develop a decent standard of living, they should be allowed to emit carbon dioxide (in a sustainable manner). The United Nations has adopted this policy as a framework for its global financial initiatives under the concept of Common But Differentiated Responsibilities (CBDR). In essence, it states that

industrialised countries must take the brunt of developing more sustainable technology and ways of living and give grants to industrialising countries to promote their development sustainably. In 2019, the European Union donated € 72 billion along the lines of this principle.

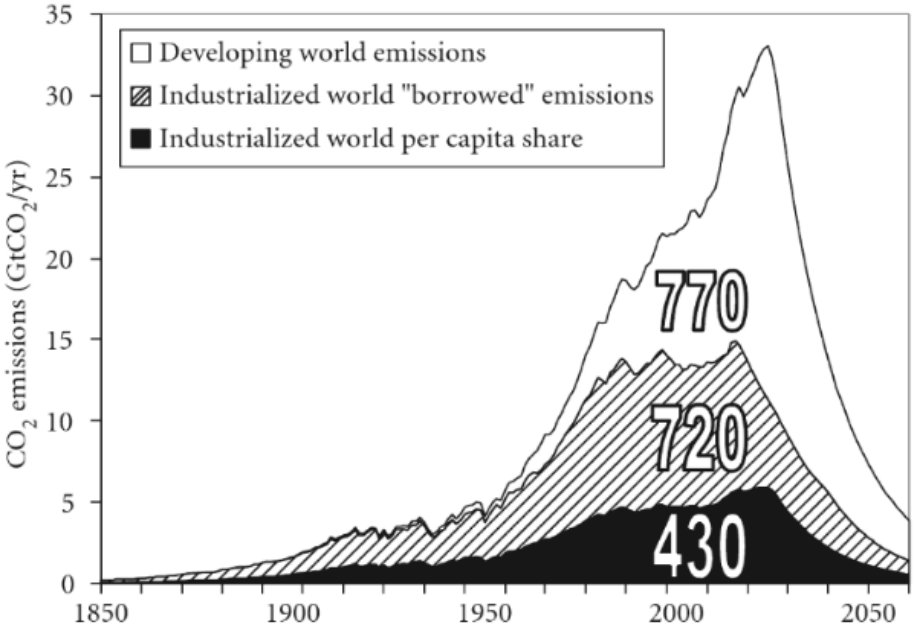


Figure (2): CO2 emissions per year since the 1850s, which shows how much the industrialised world should have emitted based on equal allocation (black section), has actually emitted (striped and black section) and how much the industrialising world has actually emitted (white section only). These estimates are based on per-capita emissions within these groupings.

In line with the Common But Differentiated Responsibility policy, the IMF has proposed that the countries that emit the most greenhouse gases (mainly in the developed world) should establish a tax on CO2 emissions of roughly $75 per tonne as an economic measure to drive down the cost of environmental bads, like fossil fuels. As discussed in the business section, a carbon tax on unsustainable production and consumption practices, along with a subsidy on more sustainable practices, help make the environment economically viable and thus more likely to work.

The idea of a carbon tax (also known as a green tax) is the most effective economic measure (when coupled with others) to make countries financially responsible for their emissions and influence decarbonisation on a global scale. The $70 tax is not uniformly applied, as evidenced by the CBDR policy principles since it would prevent citizens in certain countries from being able to afford a decent standard of living. For these situations, the IMF suggests a lower tax rate of around $35, possibly selectively applied to specific communities or businesses. Environmental

economists favour carbon taxes since they are easy to administer on a quantifiable externality (carbon dioxide) and generate positive revenue for individual countries,

The overall aim of a green tax is to attempt to "flatten" the Environmental Kuznets curve (see section two), by allowing countries to develop, but do so by emitting as few emissions as possible. The IMF has proposed that the countries that emit the most greenhouse gases establish a tax on CO2 emissions.

Carbon offsetting has been used extensively by developed countries to get the rights to emit beyond the limit they have been permitted. The industrialised countries provide a greener and cleaner energy to the developing countries for activities which have easier alternatives. For example, a firm in the U.S. could provide electricity needs to small towns and villages in India through setting up of solar panels in exchange for buying the rights to pollute in their own country beyond their permits. This way, the pollution level on the international scale remained unchanged with cleaner energy used in one part of the world, offsetting the increased carbon emissions in the other part.
Offsets may be cheaper or more convenient alternatives to reducing one's own fossil-fuel consumption. However, some critics object to carbon offsets and question the benefits of certain types of offsets. Due diligence is recommended to help businesses in the assessment and identification of "good quality" offsets to ensure offsetting provides the desired additional environmental benefits, and to avoid the reputational risk associated with poor quality offsets. This is mildly differentiated from the emission trading (discussed in the next two sections), where firms buy the emitting rights in exchange for money.

II
MACROECONOMIC PROSPECTS TO EMISSION CONTROL

Why is it important to differentiate the actual pollutants that are emitted and the damage from ambient concentrations? Regulators often only aim at reducing the overall level of emission. Efficiency calls for balancing the cost of emission control with the destruction by ambient pollution, taking into account the complexities relating to the emission damage. On the other hand, setting an emission target or ambient targets usually comprises the efficiency in pollution control.

Long term prospects of environment damage

Environment Kuznets curve hypothesis follows the lines of the Kuznets curve of inequality by Simon Kuznets (1950s). The inverse U shaped Kuznets curve shows that income inequality first increases with economic growth and eventually falls after reaching a maximum. The same theory has been used by economists to explain the effects of pollution and environmental degradation on economic growth.

Environmental pressure increases faster than GDP during the first stage of economic development. This is identified as the first phase of the EKC. The second phase is characterized by an increase in environmental pressure but at a lower rate than the rise in GDP. In other words, during the second phase, pollution increases at a decreasing rate until the curve reaches a maximum. The third phase starts at the maximum point of environmental pressure. In this phase, the EKC starts to decrease, and if it continues to decline when income levels tend to infinity, then economic growth is not linked anymore to environmental pressure. In this case, there is an authentic environmental Kuznets curve, in which the pattern of environmental pressure follows an inverted U-shaped curve.

If we observe a certain level of income at which environmental pressure starts to increase again, then we are in the presence of the fourth phase, where there is a period of relinking between income and environmental pressure. Some authors have called the environmental pressure-economic growth relationship an N-shaped curve when this phase is observed.
They argue that at higher income levels, one may observe behavioral changes and changes in preferences that are related to a cleaner environment.

After China banned imports of most plastic waste in 2018, developing countries, particularly in Southeast Asia, have received a considerable influx of contaminated and mixed plastic wastes that are difficult or even impossible to recycle. Norway's proposed amendments to the Basel Convention provides countries the right to refuse unwanted or unmanageable plastic waste.

This waste dumping by developed countries into developing countries was used to reduce the waste and the pollution generated because of it in the former. This is one example of how the data could have been hampered to show an inverse U shaped EKC, illustrating a reduction in environmental damage as a country becomes more developed.

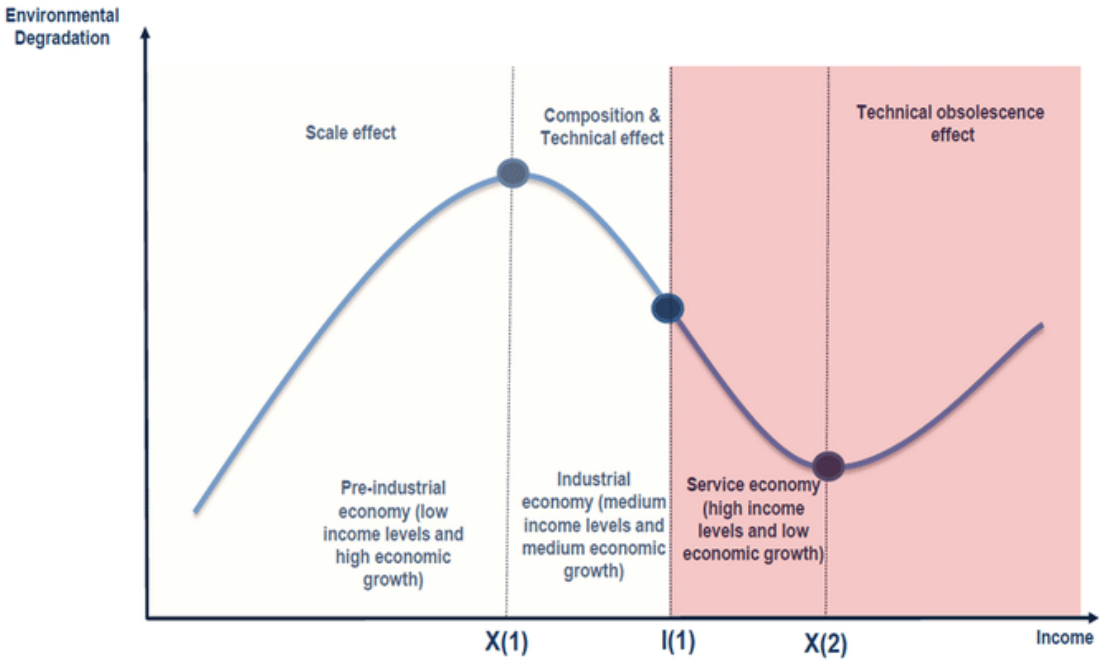


Figure 3: The near N-shaped Environmental Kuznets curve, illustrating the effect of development (income generation) on the environment. The results can be segregated into the four industrial stages of an economy, the lowest damage to the environment being in the service economic development era.

Economic incentive-based regulations for keeping pollution in control

In his book, Intermediate Environmental Economics, Charles D. Kolstad analyzes ways of calculating the efficient level of pollution that a firm can produce and the ways governments can regulate the pollution of the economy as a whole. CBDR policy (discussed in section-1) derives pollution levels by developing and industrial countries to ensure emissions are within controllable limits.

Economic incentive-based regulations go a long way toward ensuring that only the optimal level of pollution enters the atmosphere. The following are few such measures which in theory can are considered most efficient in controlling the emission levels:

1. **Carbon trading (emission trading)**

When a product does not have a very well-established market, this product will most likely be underpriced. This is the case with natural systems such as air or water. The lack of property rights for these natural inputs and the absence of environmental regulation or legal protection to pollution receptors make a firm perceive atmosphere as an input that can be freely used, like a shared resource, thus neglecting all external costs imposed on other agents of the economy. If there were well-defined property rights for air, firms would have to buy the right to pollute it, and

emissions could be internalized through a market mechanism. When buyers and sellers do not take into account the external costs of their actions while deciding how much to consume or produce, the market equilibrium is inefficient, and the price of a good does not necessarily reflect its social value. Carbon trading is discussed in detail under section-3.

2. **Market permit for pollution (carbon credit)**

This solves the problem of increased pollution by firms by creating a market for buying and selling the right to emit. It is an economic incentive given to the firms to ensure that only the optimal pollutants enter the atmosphere. This trading induces a price on the permit, which makes pollution an expensive activity. Supposing that there are only two polluting firms who are given a specific number of permits by the government, thus there is an opportunity cost attached to the pollution, less pollution by a firm means more permits sold to the other firm. Firms will minimise the level emitted, calculated by the intersection of the marginal savings curve by issuing by two firms. The firms' negligible savings decreases as the pollution level increases (more permits need to be purchased), which explains the downward sloping MS curves. The intersection shows the efficient level of polluting by both, and the right to pollute has to be bought by both at the equilibrium price of permits. The problem occurs at the stage of regulating and monitoring to ensure that firms don't exceed the levels that are permitted to them at the prevailing price.

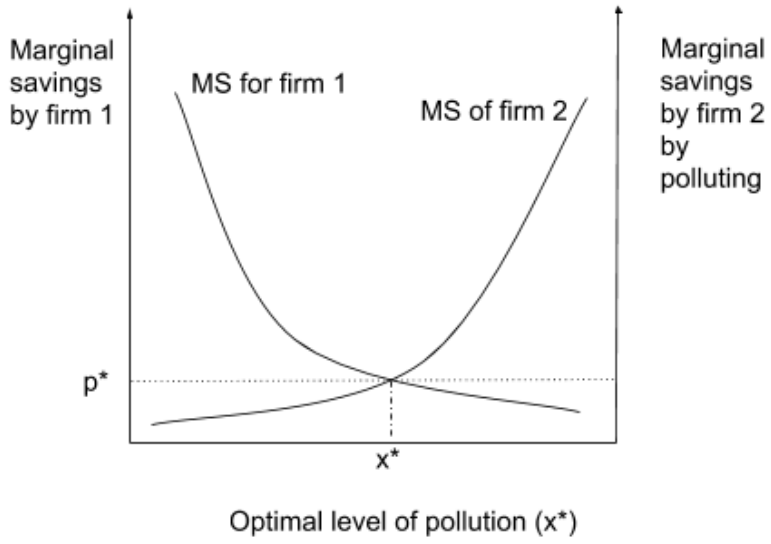


Figure 4: The marginal savings curve of the two firms have been used to show the savings done by firms as emission is reduced

3. **Pollution fee by governments**

Green tax is an example of a pollution fee charged by the government, as discussed in section-1. It is a form of Pian tax on the externality caused by pollution, where the tax is collected per unit

of emission. This form of regulation is not free from limitations as the per-unit emission is hard to monitor. This makes it ineffective in reducing the total level of pollution.

4. Compensating for the externality

The idea behind compensation is that the costs to the ones who are at a loss can be reimbursed by the ones who gain out of emitting. This suggests that it is more cost-effective for firms to pollute and take limited precautions in doing so. However, the costs can not be calculated since everything isn't in quantitative terms. Such charges may include things that have spiritual/ emotional meaning to the loser. Therefore, the compensation usually has to be much larger than what ends up getting transferred. Even though the compensation level can never be accurate about the actual loss, this can be used to ensure lower pollution.

There are two costs to a firm, which can cause substantial damage to the environment. For illustrating this, we take the example of a hazardous waste storage facility. This dumb has costs while undertaking a precaution to avoid any mishaps. On the other hand, there is another cost to the environment which the dump has to compensate for ultimately. This could be in the form of an accident like leakage from waste storage. The expected value of an accident reduces as the care is taken increases. The optimal level of caution is calculated by taking the costs of both into account. The maximum difference between the two costs, represented by the highest vertical distance between the two curves, shows the optimum.

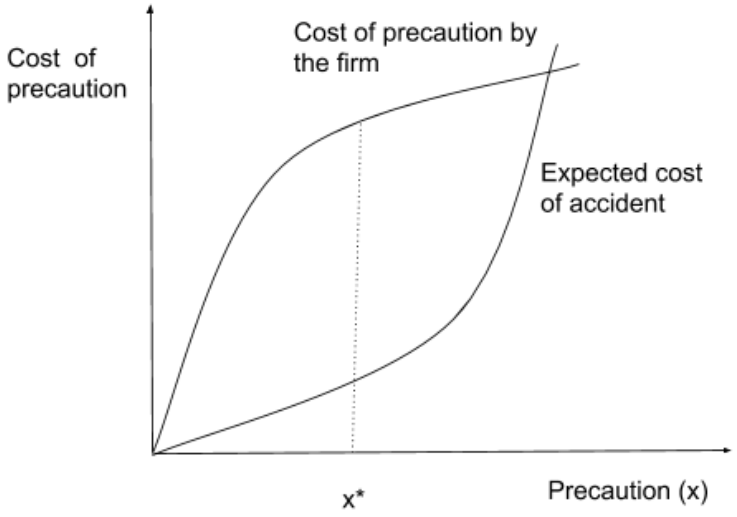


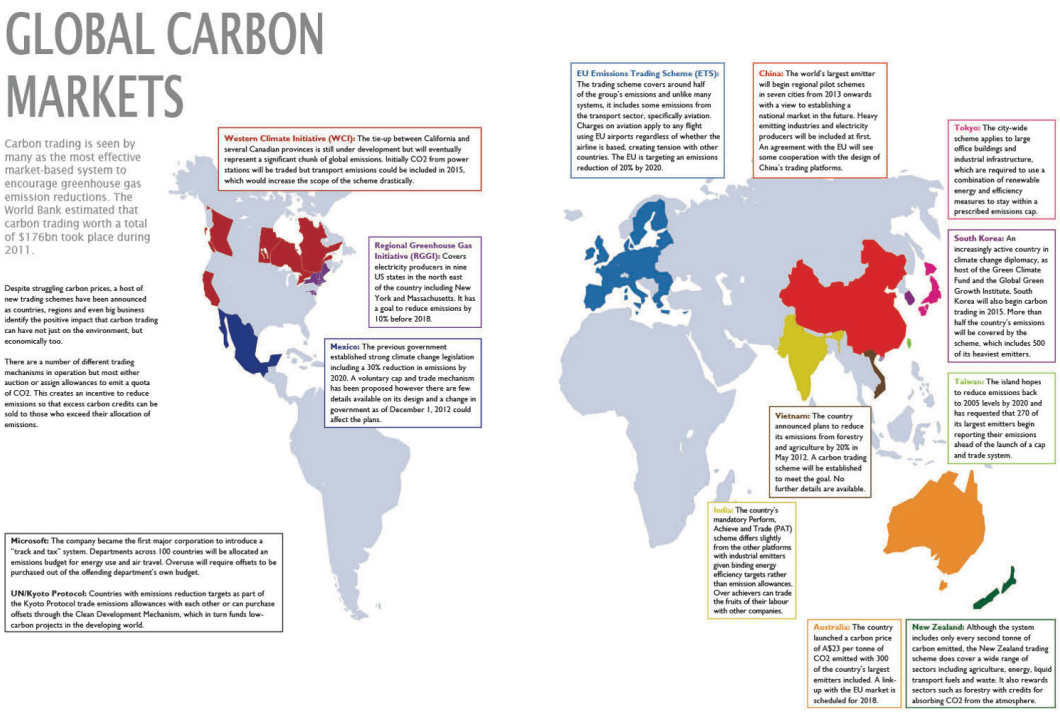
Figure 5: The maximum vertical distance between the marginal cost curve of taking precautions with the marginal benefit from taking the precaution (represented as the expected cost of an accident that is avoided with precaution) maximizes the net benefit.

III
CORPORATE SECTOR READJUSTMENT TO COMPLY WITH SDGs

Businesses and firms are responsible for a significant portion of the historical emissions that have been released, much more than individual countries. Twenty firms (mainly in the energy sector) alone release about 1/3rd of all emissions just in the production process. Most of these firms also operate primarily on the profitability of their end product and keeping production costs as low as possible in the present day. However, many of these 20 industries, and other sectors, fail to realise that not taking care of externalities, particularly around environmental degradation, will result in long term market failure due to lack of resources.

To ensure that these businesses take appropriate action, it is not enough to rely on them to be environmentally sustainable and take on additional costs. Still, there needs to be some financial incentive to do so. This comes in a range of tactics- from government subsidy to fund research into technological advancements to using a traditional economic measure like a green tax. In essence, it seeks to disrupt the free hand of the market by using criteria like taxation and commodifying previously "free" resources- in this case, the environment for them to reduce their emissions.

Emissions trading: Emissions trading (or carbon trading or cap and trade schemes) have been considered some of the most successful large scale ways of helping to reduce carbon, and a significant amount of this information has come from the European Union Emissions Trading Scheme (EU ETS) which from 2005 to 2013 has stopped over 200 million tonnes of carbon from ever being released. Carbon trading schemes depend on commodifying CO2 (or other emissions) by metric tonne released and often set caps on various industries on how much they can release. Those who exceed this cap can then either buy excess carbon budgets off other firms or, more commonly, sell emissions of the commodities market. This has expanded since the early 2000s to form global carbon markets around the world.



Some key emissions trading programmes across the world

To allow carbon to be traded according to international regulations and also for external parties arriving in the area. For instance, under the EU ETS, airlines have to pay a substantial carbon tax when they fly from one EU nation to another, even if the flight is registered elsewhere. However, the key issue with carbon trading as the only measure of internalising externalities is that the carbon market is dependent on having a steady demand for firms buying carbon to continue to survive. These consumers, for the most part, those consumers are airline firms, who can afford to purchase significant amounts of carbon to offset their emissions. Due to this, many can skirt around environmental innovation, which could reduce emissions since they can afford to emit significantly.

Environmental innovation is another key topic that is necessary for the future of our planet and needs to be economically efficient and environmentally sound. While governments can invest R&D money into this field, many feel that existing tech companies, along with the start-up space, are best suited to create more environmentally sound technology. Incentivising sustainable technology growth will also encourage firms to shift focus and grow in a new market, but also promote its use and proliferation. The role of subsidies is to remove barriers and address market failures to allow an industry or a product to succeed. As discussed above, undertaking new technologies or practices that are more sustainable are often seen as too expensive compared to their less sustainable alternatives, and subsidies can help alleviate that barrier.

There has been a $140bn subsidy in 2016 in favour of renewable energy innovation and spread in the US. These subsidies have been credited for fueling innovation across this sector by private companies, resulting in it becoming cost-competitive with traditional energy sources, which would ultimately reduce subsidies. By having subsidies for building more efficient renewable providers (at the production end) or for adopting certain technologies like installing solar panels on your home, it allows for the overall industry to become more sustainable despite not being as profitable on its own. The successes of renewable energy subsidy demonstrate that subsidising innovation can be profitable for not only that industry but also the long term successes of other industries that rely on the resources that would be otherwise used up.

CONCLUSION

As climate change increasingly becomes a priority for countries and businesses everywhere and a threat to our way of life, it is important to understand how we can seek to mitigate and adapt to its impacts. Understanding the economics behind regulation and incentivisation is one of the ways to encourage large scale and action at every level, from the international range with carbon offsetting, national measures like green taxes and subsidy, and business-based measures like emissions trading. Using financial incentives and regulation helps steer climate action by making it profitable and tying it with other priorities of various players (i.e., profit). It has proven in multiple examples to be active and benefit all stakeholders positively. In the era where we have a decade to mitigate climate change and drastically reduce our emissions, using economic measures can help enact significant change.

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