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An Ecological Impact Fund

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Abstract: The Ecological Impact Fund (EIF) is a proposed new international financing facility that would enable originators of innovative green technologies to exchange some of their monopoly privileges in return for impact rewards. The invited exchange would apply only in the lower-income countries: originators choosing to forgo their monopoly markups in this EIF Zone would receive annual premiums based on the emission reductions achieved with deployments of their "greenovation" in that EIF Zone. The EIF's main purpose is greatly to improve the diffusion of impactful green technologies in the Global South. It would do so first by inducing participating originators to waive licensing fees and monopoly markups, and second by giving these originators a financial interest in the wide and effective use of their participating innovations. In addition, the EIF would stimulate development of additional greenovations that – tailored to prevailing needs, cultures, circumstances, and preferences in the EIF Zone – would be especially impactful there. These two effects would produce a third: the EIF would help build capacities to develop, manufacture, distribute, install, operate, and maintain greenovations in the EIF Zone.

Keywords: access, diffusion, impact, incentives, innovation, emissions, monopolies, patents, South, justice

1. Introduction

Our world is in ecological crisis. We are sliding into a climate catastrophe with ever-worsening harms from extreme weather events (floods, storms, droughts, heat waves), expanded reach of tropical diseases, increasing scarcity of food and water, and the extinction of biological species. We are also threatened by other harms from our emissions, such as the health effects of air pollution, including an estimated 8.7 million (15% of) premature deaths each year (Vohra et al., 2021). These problems will not be solved by drastically curtailing the conveniences of modern life or by reducing the human population. If we will solve them at all, then through intensified development and deployment of green technologies. But such a fast technological transition faces substantial collective action problems.

2. Fixed Costs

The development of green innovations ("greenovations") requires substantial R&D investments. Even if everyone accepts that these investments are urgently needed, each prefers them to be financed by others. If such investments are to occur, their cost must be spread, so that beneficial innovations are profitable enough to motivate the substantial R&D investments required. Currently, we address this problem with a global patent regime that requires WTO member states to issue patents of at least 20-year duration on eligible innovations (TRIPS, 2005). This regime ensures that successful innovators can reap substantial markups, royalties, or licensing fees from early users in nearly all countries around the world.

While this regime provides useful incentives toward developing new technologies, it also impedes their diffusion by raising their cost of deployment relative to older technologies that, offered by competing suppliers, are available at competitive prices. Many potential users of the new technology, who would have bought it at a competitive price, end up not buying it at a monopoly price. Such lower uptake is doubly regrettable: it reduces the impact of the new technology, and it also diminishes originator rewards and therefore the incentive to invest in innovation.

3. Externalities

The headwind against uptake is aggravated by another collective action problem that affects the green technology sector especially. The problem arises as deployment of a green technology produces its main benefits not for the buyers and users, who make the deployment decision, but for third parties, including countless present and future living beings all around the planet. Such third-party benefits, even when they are very high, often remain unrealized because neither potential buyers (through a price surcharge) nor potential suppliers (through a price discount) are willing and able to finance them privately. The resulting low turnover is predictable, and many greenovations are therefore not even developed – despite their great third-party benefits.

To illustrate, consider a kind of factory that could be operated with or without a certain filtering device that reduces harmful emissions. Deploying this device is expensive, partly because it requires paying a licensing fee to the patentee. Some plant owners may be willing to bear such costs in order to avert local health damage to themselves and their employees. But hardly any factory owners are willing and able to pay for the device a price

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commensurate to the colossal harms that its deployment would avert from the whole planet, including future generations.

Let us assume that, over time, the deployment of each filtering device has a small effect on the composition of the Earth's atmosphere, increasing the life expectancy of 20 billion present and future people by an average of 63 s, that is 40,000 human life years per device installed. Nevertheless, many factory owners will not pay even $20,000 more for these third-party benefits. Nor will typical patent holders make such a financial sacrifice. As rational market actors, they focus on selling licenses at the profit-maximizing price. Thus, they prefer selling 100 licenses at $20,000 each over selling 150 licenses at $13,000 each – even if the latter decision would avert the loss of over 2 million human life years at a total cost of only $50,000.[1] In this realistic example, the world is losing 40 years of human life for each additional dollar earned by the patentee.

The second collective action problem is then that technologies with high positive externalities are greatly underutilized, which in turn discourages innovators – expecting paltry uptake – from attempting to develop such technologies in the first place. In the green technology sector, this problem is severely depressing the earnings/benefit ratio for R&D investments so that innovations in this sector fall far short of the socially optimal level.

This problem is a classic instance of market failure. It can be solved through political action, specifically through governments instituting environmental regulations, levies on emissions, or green subsidies, all of which incentivize the choice of green technologies by prohibiting, limiting, or discouraging the use of their dirtier alternatives. Among these three options, emission levies – denominated as a certain monetary charge per metric ton of CO_2e emitted ($/t$CO_2e$)[2] – seem especially suitable because they favor the development and deployment of the most cost-effective greenovations while avoiding unfair burdens on non-polluting taxpayers (who would be saddled with some of the cost of green subsidies). By penalizing actors for all the present and future harm caused by their emissions, such levies shift their balance of reasons in favor of deploying greenovations, which in turn strengthens incentives to invest in green R&D.

Environmental regulations might be said to share the advantage of favoring development and deployment of those greenovations that can achieve the most cost-effective compliance. But they ensure only "local" cost-effectiveness, in response to each area of regulation. They do not ensure that all the many regulations (of air traffic, cement production, oil well maintenance, animal feed, etc.) are holistically designed to instantiate the same marginal cost–benefit threshold. Even the best of experts, continuously monitoring and adjusting all the diverse regulations in view of changing technologies and circumstances, would fall well short of maintaining an optimally cost-effective design. Being subject to various political pressures, real-world politicians fall short to an even greater extent. It is better, then, to impose a simple levy on emissions, or an overall emissions limit with market trading, to incentivize most strongly the most cost-effective emission reductions.

4. International Cooperation

National emission levies face the problem that each country imposing such a levy must bear its full economic cost while gaining only a small fraction of its ecological benefit. Because states are disadvantaged when they charge a higher emission levy than other states, there is a competitive pull toward lower levy rates, which makes it difficult for any state to lead by example and makes achieved agreements vulnerable to unravelling into a race to the bottom. This collective action problem helps explain why the total amount of emission levies – $84 billion in 2021 (Twidale, 2022) – is still much too small relative to the great harms that our present emissions do and will continue to do in coming decades. Less than a quarter of all emissions worldwide are subject to any kind of levy, and the levy rates imposed are often much too low to have a meaningful impact on investment decisions (Jessop & Twidale, 2022). More widespread levies on over 40 billion tCO_2e of anthropogenic emissions, at more appropriate rates of $50–100/$tCO_2e$, would have raised somewhere around $3 trillion in 2021, some 36 times more than the actual $84 billion.

This international collective action problem has a straightforward solution: an agreement among all states to impose national emission levies at the same rate. Such an agreement would ensure that no state gains a competitive economic advantage and that every state shares in the cost of reducing emissions. International uniformity also ensures global cost-effectiveness: the cheaper any specific emissions are to avert, the stronger the economic incentive to avert them. Ideally, such a globally uniform levy should be high enough so that the negative externalities of any remaining emissions are fully internalized: those who enjoy the benefits of activities associated with harmful emissions pay, embedded in the cost of their activity, a proportional penalty at a globally uniform rate ($/$tCO_2e$).

Such globally uniform national emission levies are politically difficult to institute in a world of over 200 sovereign states against heavy political resistance from fossil fuel owners, producers, and consumers, who work hard in many countries to prevent or to reduce national emission levies.

5. Fairness to the Global South

And there is another kind of resistance also, which emanates specifically from the Global South. This resistance takes two forms. One is the moral argument that it would be unfair to expect the developing world to impede its own economic development by putting a price on emissions, given that the present high-income countries emitted with abandon when they passed through similar phases in their development. Why should China, India, Brazil, and Nigeria have to subject their development to ecologically sound restraints while the USA, Germany, Britain, and Japan are enjoying far superior wealth accumulated over a development process that lacked such ecological restraints? Here the South is, as it were, saying to the North: "You say that you did nothing wrong when you imposed heavy losses and damages on the rest of the world in the course of your economic development (cf. Milman, 2022). You say that you owe us no part of your accumulated riches as compensation. How then can you demand from us that we refrain from pursuing a similar development path to yours, unhampered by ecological restraints?" This argument has much rhetorical appeal. But it jars with the crucial fact that the people most vulnerable to air pollution and climate change are in the Global South. Constituting an ever-increasing share of the global total, emissions originating in the Global South are harming and killing mostly people in the Global South.[3]

The other source of Southern political resistance to globally uniform national emission levies has to do with the distribution of ownership of green technology patents, which mostly belong to originators in affluent states. The main point of emission levies is to encourage decision makers to adjust their activities to reduce what they must pay. Doing so involves forgoing polluting activities in some cases, but far more often it involves modifying activities to make them less polluting. Putting a price on emissions creates financial incentives and thereby greater willingness to deploy green technologies, of which some 15,000

are newly patented each year in the USA alone.[4] This makes emission levies profitable for patentees: they can increase sales, even at higher prices, because deployment of their green technology now produces large savings in emission levy costs. Such increased monopoly rents have the welcome effect of attracting greater R&D investments to the green-technology sector, thereby accelerating the pace of green innovation.

But there is a snag. Patent holders are heavily concentrated in wealthier countries whose innovative corporations, often with government support, have the capital and human resources to advance the technology frontier. Firms in lower-income countries are less able to compete effectively. This asymmetry in innovation capacities creates an asymmetry in the flow of patent income: far more of it flows South-to-North than North-to-South. Uniform emission levies would aggravate this imbalance, and lower-income countries are understandably reluctant to support such a redistributive mechanism that would further impede their development through increased capital outflows. This reluctance is reinforced by the preceding realization that the now-wealthy states became wealthy on a "dirty" path of economic development. Why should lower-income countries impose on themselves an emission levy that would cause them to bleed wealth to the vastly richer Global North for permission to help avert a global disaster that the North has unleashed through its disproportional production and consumption? This compelling question indicates not merely a political obstacle to globally uniform national emission levies, but a moral obstacle as well. It would be unjust to arm-twist the poorer developing countries into accepting such an agreement and unjust also for the governments of those countries to impose it on their populations.

The arm-twisting just criticized is central to the Climate Club idea that – pioneered by William Nordhaus – is being promoted by some affluent states. The Nordhaus proposal is to create a club of states that meet two requirements:

- Each member state imposes an emission levy within its jurisdiction, starting at a certain level and then gradually increasing on a pre-agreed schedule (Nordhaus uses a base level of \$50/tCO_2 in 2025, set to increase 3% annually in real terms).
- Each member state imposes a flat tariff (Nordhaus envisions 5–10%) on all imports from exactly those states that refuse to be members (Nordhaus, 2021).

This Climate Club proposal appears fair because it treats all countries equally. But in fact, it is profoundly unfair by ignoring great differences among them. Three are especially important.

- Some countries are more than 100 times more affluent than others and can therefore much more easily afford to slow their economic development.[5]
- Those richer countries have become rich in emission-intensive ways, causing great harm especially to poorer populations; emissions of just the USA during the 1990–2014 period have caused damages abroad estimated at nearly \$2 trillion (Milman, 2022).
- Worldwide levies on emissions, by greatly multiplying the use of green technologies, would thereby also massively increase income from green patents, which are mostly owned by Northern corporations. As a result, poorer countries would suffer substantial new capital outflows, slowing their development even further.

Forcing lower-income countries to join such a club on pains of canceling their free-trade privileges would substantially exacerbate the injustice of the global economic order.

One obvious way of avoiding such injustice is to exempt the lower-income countries from the punitive tariffs, allowing them to stay outside the Climate Club without penalty.[6] But this solution damages the urgent struggle to bring climate change under control. It is true that lower-income countries emit at much lower *per-capita* rates – US emissions *per capita* are some eight times higher than India's, for example.[7] But this does not mean that we can afford to ignore India's emissions! Given the size of India's population, these emissions are already quite large and have the potential to grow massively as India's economy continues to expand rapidly. It is crucially important to strengthen, also in the Global South, the incentives to deploy green technologies.

As it is, such incentives are quite weak in the lower-income countries, leading to massive underutilization of green technologies there. An actual example regarding coal-fired power plants may illustrate. Frontier technologies can substantially reduce emissions but cost more because of licensing fees to patentees. Mitsui Babcock charged manufacturers of steam boilers about \$1.5 million per 600 MW boiler for using its patented "ultra-supercritical" technology (Tan & Seligsohn, 2010). Consequently, many plants in India and other lower-income countries deployed less efficient subcritical or supercritical technologies (Barnes, 2016) that will generate up to 30% higher emissions for decades.[8]

Scant deployment of green technologies in the Global South is a big problem. In the remainder of this 21st century, these countries will experience massive economic growth, intensified by large increases in population. The technologies they will use, the practices and habits they will form, and the roles they will be prepared to play in the fight for a livable planet will matter far more than any choices affluent nations will make within their own borders.[9] Rapid emissions reduction requires that highly effective and locally appropriate green technologies be widely and quickly deployed throughout the Global South.

These reflections define our task. We need a structure that

- provides cost-effective incentives toward developing and deploying emission-reducing innovations worldwide,
- treats countries of the Global South fairly, and,
- mainly for reasons of feasibility, preserves the patent regime in its present globalized form.

One obvious way to conceive such a structure would supplement the global Climate Club with side payments that compensate poor countries for the outflow of licensing fees. For each such fee that users of a greenovation in a country of the Global South pay to Northern patentees, Northern states would make a compensating payment to the Southern country concerned. This idea should be further explored.

The next section proposes a different solution that, distributively similar, offers substantial advantages in efficiency and political realizability.[10]

6. Proposed Solution: An Ecological Impact Fund (EIF)

Emission levies have the great merit of substantially increasing deployments of green technologies, thereby also accelerating the pace of green technology progress by drawing investment capital into green R&D. But they do not eliminate the serious drawbacks of green-technology patents. Their main drawback is that they impede the diffusion of patented products by raising their price above the competitive price. Despite the substantial deadweight losses they entail, such inflated prices seem appropriate in many

cases where willing buyers pay a monopoly markup on a novel product they prefer – on a novel watch or toy or cosmetic, perhaps – and thereby ensure that judicious investments in desirable innovations are rewarded and incentivized. In such cases, buyers and originators benefit without directly imposing costs upon third parties.[11] But inflated prices are highly undesirable in the green technology sector, where we must urgently facilitate wide and fast deployment.

Rapid emissions reduction requires that highly effective and locally appropriate green technologies are widely and quickly deployed throughout the Global South. The EIF promotes this goal by inviting originators to EIF-register any new green technology, with two legal effects in all countries below a specified *per-capita* income:

- the originator permanently forgoes, throughout the EIF Zone, any monopoly rents it could earn from its registered technology; and
- the EIF rewards this technology for the emissions averted with it in the EIF Zone through deployments completed within 6 years of market entry.[12]

The EIF would support diffusion of green technologies in the EIF Zone in two ways: by avoiding the headwind of monopoly markups (delinking the sales price from the fixed cost of R&D) and by adding the tailwind of impact rewards. This substitution of impact rewards for monopoly rents transforms originator motivations. While monopoly rewards incite considerable efforts to find, stop, prevent, and deter patent infringements, impact rewards encourage originators actively to promote the rapid, frequent, and effective deployment of their greenovation for increased impact rewards. Even without profiting from its sales price, such originators would nonetheless promote its effective deployment by providing technical support, maintenance, and sometimes even subsidies — insofar as they expect the increase in impact rewards earned through such promotional investments to exceed their cost.

EIF rewards might be paid through preannounced annual disbursements that could be scaled up over time. Any patentable new green technologies could be registered for participation in six consecutive such disbursements, each divided among registered innovations according to emissions averted with them in the EIF Zone in the preceding year. This principle of division ensures fairness among participating originators, who are rewarded in proportion to emissions averted, all at the same reward-to-benefit rate ($/t$CO_2$e).

Because participation is optional, the EIF's reward rate emerges endogenously and equilibrates to a level that makes participating originators content with their EIF Zone-limited trade – permanent waiver of monopoly rents in exchange for 6 years of impact rewards.[13] When originators find the going rate unattractive, registrations dry up and the reward rate rises as older innovations exit at the end of their reward period. When the reward rate is seen as generous, registrations multiply, and the reward rate declines. Such equilibration reassures participating originators and contributors that the reward rate will be fair between them, and stable over time.

The easiest way for registrants to waive their potential monopoly rents in the EIF Zone is not to patent their registered greenovations there. This would save the registrant much effort and expense and would allow competing manufacturers to produce and sell the technology at competitive prices. Alternatively, registrants might meet the condition by patenting the registered greenovation in some or all EIF Zone countries and then, during the patent period, offering cost-free licenses to those who want to produce or sell it there.[14] Either way, the registrant itself would be free to manufacture and sell the registered technology too, but would have to do so, in the EIF Zone, at a competitive price. Deriving its earnings from impact rewards, the registrant would be motivated to ensure that its registered technology is widely and cheaply available throughout the EIF Zone and deployed in an impactful way. To this end, the registrant would collaborate with manufacturers and sellers of its technology and keep its own sales price low, often even below its own cost.

In specifying the EIF, a central guideline is to design it so that its reward rate equilibrates to a low level. The EIF should be as efficient (tCO$_2$e/$) as possible at averting emissions. For this reason, the EIF should not demand too much from registrants. This thought motivates limiting the EIF to the lower-income countries. Because demand for greenovations at monopoly prices is much weaker there, limiting the EIF to those countries greatly reduces the opportunity costs of EIF registration, and therefore the EIF's endogenous reward rate ($/$tCO_2$e), while correspondingly increasing its ecological impact relative to the amounts it disburses (tCO$_2$e/$). The exact qualification for membership in the EIF Zone could then be based on the same desideratum: the EIF Zone should include the countries in which uptake of patented green technologies has been poor. This would likely include at least the ca. 120 countries whose annual *per-capita* gross national incomes fall below $10,000.

Other design question can be approached with the same guideline. Thus, consider the question whether, during the reward period, the registrant should have the option to offer its registered technology at a nonprofit price throughout the EIF Zone without having to permit others to manufacture and sell it as well. If it turned out that many potential registrants strongly value this option, then this would be a reason to give it to them in order to lower their reservation price and thereby to achieve a lower EIF reward rate. With this option one would need to make sure that originators derive their profits only from impact rewards, not from the sales price.

7. Features and Virtues of the EIF

The EIF would organize a wide competition across the whole greenovation sector, including the areas of electricity generation, traffic, residential and office heating and cooling, construction, meat production, agriculture, forestry, industrial manufacture of steel, cement, and other commodities. Across all these areas, the EIF would attract the greenovations that achieve the greatest emission reductions relative to cost as they would be the most profitable ones to register. By increasing the profitability of highly cost-effective innovations, the EIF would also stimulate additional R&D investment into developing such innovations, thereby accelerating technological advance. Here the EIF would not "bet on" specific technologies or subsectors but would rely on the greater expertise of innovators to determine which R&D investments and which additional deployments will yield the greatest ecological benefit. High-impact greenovations from all areas would be competing on one EIF-created market toward the single goal of averting emissions. In this competition, all participants can be winners, that is, earn more in premiums than they have invested. And a registrant with low premium income can still be the most successful, if its income is especially high relative to its investment.

Participation in this market would train originators to holistically organize their research, development, marketing, and delivery operations toward realizing the most cost-effective impact. Covering R&D costs and originator profits as public goods, the EIF would make access to registered greenovations

widely affordable at competitive prices – with registrants highly motivated to promote impactful deployments.

The EIF would boost diffusion of high-impact green technologies in the EIF Zone, with massive reduction of emissions in the Global South. The constrained sales price, supplemented with impact rewards, would further benefit lower-income populations by enabling originators to make good profits from selling to people who cannot pay high markups. This would encourage R&D that targets their specific needs within their specific circumstances: locally appropriate greenovations that are sensitive to socio-cultural context and congruent with equitable access so that they mitigate rather than exacerbate existing socio-economic inequalities. In this way, the EIF would open whole new areas of green R&D (reliable small-scale local energy generation, pollution-free stoves, etc.) and accelerate the overall pace of green innovation. In the competition to develop greenovations geared to the Global South, innovators in the EIF Zone would not face the usual crushing head start by Northern originator firms. The EIF would therefore also help build, in lower-income countries, capacities in R&D, manufacturing, distribution, installment, operation, and maintenance of green technologies.

The evolving EIF reward rate would be indicative of the EIF's efficiency – but would also understate it substantially because the EIF's entire ecological impact greatly exceeds the sum of the assessed and rewarded impacts of all EIF-registered innovations. This is so not only because the EIF confines the rewardable impact of a registered greenovation to deployments during the first 6 years. A more important reason is that, by accelerating the pace of innovation, the EIF raises the standard against which newly registered innovations will be assessed. Over time, this effect will grow to be quite large. A greenovation registered in 2040 will be rewarded for the emission reductions it achieves relative to the alternatives being deployed in that year. But this 2040 state of the art will be far superior to what it would have been if the EIF had not been in operation for the preceding decade or more. This acceleration of green innovation is an achievement the EIF need not pay for. It is likely to be especially significant in classes of green technologies that, under the current regime, suffer neglect because they are suitable for use only in the Global South, are more expensive to manufacture and deploy than their dirtier alternatives, or bring widely diffused benefits that buyers care little about.

An experimental pilot could test and refine the EIF idea and thereby make adoption of the EIF more feasible and likely. This pilot might involve a single reward pool of, say, $100 million, to be split among preselected green originators in proportion to the emission reductions they achieve with their respective innovations, competitively priced, in a self-selected region of the EIF Zone over a 2-year period. The pilot would show concretely how green originators respond to competitive impact rewards and how ecological impact can be assessed in a reliable and timely manner. It would help refine impact assessment and provide an indication of the cost-effectiveness of the new impact rewards. The EIF pilot would also yield its own ecological benefits and policy insights through the pilot projects it monitors and rewards.

The UNFCCC's Green Climate Fund – mandated to "promote the paradigm shift towards low-emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their greenhouse gas emissions"[15] – is well suited to administering the EIF and its pilot. Both should be financially supported by high-income countries, which can most easily afford the cost, have contributed most to the global climate emergency, and continue to benefit from the great wealth they have accumulated through their decades of high pollution. Supporting the EIF would help the high-income countries discharge their responsibilities under Sustainable Development Goals 13 and 17[16] and to fulfill their 2009 promise to devote $100 billion annually to climate change mitigation and adaptation in the developing world (Timperley, 2021). The EIF would benefit high-income countries by reducing emissions and also by augmenting the income that innovative firms in the Global North derive from their greenovations.

The EIF has no optimal size. As its annual reward pools increase, it will attract more registrations, avert more emissions, and have a greater accelerating effect on technological progress. States and other contributors could monitor these effects and gradually grow the EIF in light of these data. They might start with modest annual disbursements of, say, $1 billion.[17] This level could then be gradually raised as contributors decide to increase their contributions or new contributors join the partnership.[18] As the EIF grows, its reward rate will tend to rise as less efficient technologies get registered. But a larger EIF also brings two advantages: greater efficiencies in running the EIF (impact assessment and administration), as well as greater impact on the pace of green innovation which increases that part of its ecological impact that the EIF need not pay for.

Studying the actual operation of the EIF will provide real data toward assessing its effectiveness. Such data can help potential contributors decide whether to contribute and at what rate. Such data might also allow the EIF to raise additional funds in the international offset markets that corporations use to purchase greenhouse-gas offsets that allow them to claim that they are compensating some or all of their emissions and thus approaching or attaining climate neutrality. In any case, the various financing commitments sustaining the EIF must be designed so that it can meet the legitimate expectations of registrants who have developed and registered a greenovation in anticipation of a 6-year reward period.

8. Conclusion

The EIF is politically realistic because it requires no painful concessions. It can be implemented unilaterally by a few willing states and other funders looking for a new method of reducing emissions in a highly cost-effective way. Conferring clear benefits, the EIF would be welcomed by the countries of the EIF Zone whose governments and populations would benefit from better and cheaper options for greening their operations, from domestic capacity building, from substantial declines in air pollution, and from a deceleration of climate change. The EIF proposal will find support also among firms with significant green technology patent portfolios, as it would substantially increase their opportunities to make money from developing and selling greenovations into the EIF Zone while leaving them the choice whether to pursue these opportunities. Green movements around the world would applaud the EIF, as would organizations concerned for living conditions in the Global South. Defenders of intellectual property rights would find the EIF palatable because it applies only to the EIF Zone countries and, with each greenovation, lets its originator choose between the two rewards. Some wealthy states might be initially reluctant to contribute to the EIF's cost, but others could and should readily proceed without them. The EIF would, as intended, reduce demand for obsolete dirty technologies throughout the EIF Zone but would also give the firms selling such technologies ample new opportunities to supply state-of-the-art green substitutes. With support from a few major states or other donors, the EIF could be instituted without significant political resistance.[19]

Conflicts of Interest

Thomas Pogge is an editorial board member for *Green and Low-Carbon Economy*, and was not involved in the editorial review or the decision to publish this article. The author declares that he has no conflicts of interest to this work.

Notes

1 The relative loss amounts to 2 million years of human life because each of the 50 (=150–100) devices not licensed would have averted the loss of 40,000 life years. The patentee's $50,000 in extra earnings is the difference between licensing fees of 100 × $20,000 *versus* 150 × $13,000.

2 "CO_2e" stands for CO_2 equivalent, a measure that converts other greenhouse gases according to their global warming impact over a specific time horizon (such as 20 or 100 years). Specifying the time horizon is important, because different greenhouse gases fade from the atmosphere at different rates. Methane (CH_4), for example, has over 80 times the warming potential of CO_2 over a 20-year horizon, but only about 30 times its warming potential over 100 years. While a 100-year time horizon is commonly used, I favor a 20-year horizon, which assigns higher importance to short-lived gases like methane. This can be justified by the crucial importance of the level at which we can get global warming to peak. The higher this peak, the more deeply the Earth's patterns will be disturbed, with increasing risks of potentially massive positive feedback effects on its future climate.

It is worth pointing out that, while CO_2 and CH_4 contain carbon, other important greenhouse gases – such as N_2O, SF_6, and NF_3 – do not. I therefore avoid expressions like "carbon emissions" and "carbon neutrality."

3 For details, see Vohra et al. (2021) and also the series of essays in the *New England Journal of Medicine* on the topic: Fossil-Fuel Pollution and Climate Change, https://www.nejm.org/doi/full/10.1056/NEJMe2206300. Also disproportionally affecting people in the Global South are the other negative effects of human emissions such as extreme weather events, the expanded reach of tropical diseases, and the increasing scarcity of food and water.

4 https://stats.oecd.org/index.aspx?queryid=29068

5 The World Bank reports that, in 2021, gross national income averaged $722 in the 28 low-income economies and $47,904 in the 81 high-income economies, with the full spectrum reaching from Burundi's $240 to $116,540 in the Bahamas. http://wdi.worldbank.org/table/WV.1

6 Club members could nonetheless institute a carbon border adjustment in order to neutralize the incentive to move polluting activities from Club countries to countries in the Global South.

7 https://data.worldbank.org/indicator/EN.ATM.CO2E.PC

8 If only 35% rather than 45% of the coal's energy content is converted into energy, then one must burn 30% more coal to generate the same amount of electricity (Pearce & Prater 2020).

9 For example, sub-Saharan Africa's electricity production will increase dramatically as its *per capita* consumption – currently well below 2% of the US level – will catch up and its population will increase from the current 1.2 billion to about 4 billion by 2100.

10 For an earlier, somewhat different proposal of this kind, see Pogge (2010) and Walsh (2011).

11 The patent imposes the indirect cost of preventing third parties from making the patented product and from selling it to, or buying it from, one another. This is not important in the case of products one can easily do without. But it is hugely important in regard to essential medicines, for example, as millions have died because they could not afford life-saving products priced hundreds of times higher than their cost of production. In the pharmaceutical sector, patents also spawn research neglect of diseases concentrated among the poor and discourage holistic strategies of containment and eradication of communicable diseases (Pogge, 2022). As the COVID pandemic has shown once again, pharmaceutical firms benefit when poor populations, shut out by high prices, proliferate a disease and become breeding grounds for the evolution of new variants.

12 Thus, if the first specimens of a new technology are put into service on 1 March 2027, then the EIF takes account of all specimens put into operation in the EIF Zone before March 2033.

13 The precise length of the reward period is not very important because the reward rate adjusts to it: with the longer/shorter reward period, the number of registrations will remain roughly the same, but each registered greenovation will receive smaller/larger annual rewards for a larger/smaller number of years. The reward period should not be so short that some registered innovations do not have a decent chance to establish themselves in the EIF Zone – a problem that can also be mitigated by allowing registrants to defer their reward period, for example, to be rewarded in years 3–8, rather than in years 1–6, after market introduction. Nor should it be so long that the EIF rewards some old and obsolete greenovations that are no longer cutting edge. A shorter reward period has the further advantage of reduced assessment expenses.

14 One possible reason for an originator to prefer the latter option is because it affords some control over follow-on innovations. Another reason is to facilitate monitoring of manufacturers and sellers in the interest of tracking all rewardable emission reductions.

15 *Governing Instrument for the Green Climate Fund* (2011), p. 2. https://www.greenclimate.fund/sites/default/files/document/governing-instrument.pdf

16 "Take urgent action to combat climate change and its impacts" and "strengthen the means of implementation and revitalize the global partnership for sustainable development" (UNGA, 2015).

17 With a substantially smaller EIF, the costs of administration and impact assessment might consume too large a percentage of the EIF's budget.

18 Contributing states might agree on a contribution formula that would tie their annual contribution to their *per capita* gross national income (g) and populations size (p). For example:

$p * (g - \$10000)/10000$.

Pursuant to this formula, high-income countries would on average contribute about $4 per year for each of their residents. With $p = 333{,}000{,}000$ and $g = 73{,}000$, the US share would initially amount to $2.1 billion annually, still much smaller than the damage US emission annually inflict on foreigners (Milman, 2022).

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References

Barnes, I. (2016). *The Prospect for HELE Power Plant Uptake in India*. IEA Clean Coal Centre. https://usea.org/sites/default/files/The%20prospects%20for%20HELE%20power%20plant%20uptake%20in%20India%20-%20ccc271.pdf

Jessop, S., & Twidale, S. (2022). Global climate goal could be in peril without carbon price reform. Reuters, 22 June 2022, https://www.reuters.com/business/sustainable-business/global-climate-goal-could-be-peril-without-carbon-price-reform-2022-06-22

Milman, O. (2022). Nearly $2tn of damage inflicted on other countries by US emissions. The Guardian, 12 July 2022, https://www.theguardian.com/environment/2022/jul/12/us-carbon-emissions-greenhouse-gases-climate-crisis

Nordhaus, W. (2021). Dynamic Climate Clubs: on the effectiveness of incentives in global climate agreements. *PNAS*, *118*. https://doi.org/10.1073/pnas.2109988118

Pearce, R., & Prater, T. (2020). *Mapped: The World's Coal Power Plants*. Carbon Brief 2020. https://www.carbonbrief.org/mapped-worlds-coal-power-plants

Pogge, T. (2010). Keynote address: Poverty, climate change, and overpopulation. *Georgia Journal of International and Comparative Law*, *38*, 525–542, https://digitalcommons.law.uga.edu/gjicl/vol38/iss3/4/

Pogge, T. (2022). Just rules for innovative pharmaceuticals. *Philosophies*, *7*, 79–95, https://doi.org/10.3390/philosophies7040079

Tan, X., & Seligsohn, D. (2010). *Scaling up Low-Carbon Technology Deployment: Lessons from China*. World Resources Institute 2010. http://pdf.wri.org/scaling_up_low_carbon_technology_deployment.pdf

Timperley, J. (2021). The broken $100-billion promise of climate finance — and how to fix it. *Nature*, *598*, 400–402. https://www.nature.com/articles/d41586-021-02846-3

TRIPS (Agreement on Trade-Related Aspects of Intellectual Property Rights as Amended by the 2005 Protocol Amending the TRIPS Agreement) (2005). https://www.wto.org/english/docs_e/legal_e/trips_e.htm

Twidale, S. (2022). Global carbon pricing schemes raised $84 Billion in 2021, World Bank Says. Reuters, 24 May 2022, https://www.reuters.com/markets/commodities/global-carbon-pricing-schemes-raised-84-bln-2021-world-bank-2022-05-24/

UNGA (2015). *Transforming our World: The 2030 Sustainable Development Agenda*. United Nations General Assembly, 70th Session, UN Doc, A/Res/70/1, https://sdgs.un.org/2030agenda

Vohra, K., Vodonos, A., Schwartz, J., Marais, E. A., Sulprizio, M. P., & Mickley, L. J. (2021). Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem. *Environmental Research*, *195*: 110754, https://www.sciencedirect.com/science/article/abs/pii/S0013935121000487

Walsh, D. (2011). A new way to reward innovation. Green, New York Times Blog about Energy and the Environment, 20 October 2011, https://archive.nytimes.com/green.blogs.nytimes.com/2011/10/20/a-new-way-to-reward-innovation

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