OHE

Innovation Policy Prize 2024
Joint Winner

Andrew Briggs

From Delaware to California: A Road Map for Incentivising Environmentally Sustainable Innovation

From Delaware to California: A Road Map for Incentivising Environmentally Sustainable Innovation

Professor Andrew Briggs

London School of Hygiene and Tropical Medicine

Summary

With Delaware on the East coast of the US and California on the West, a road trip between Delaware and California is, by any stretch of the imagination, a huge undertaking being just shy of 3,000 miles if taking the most direct route. This is perhaps an appropriate metaphor for the enormity of the task of effectively incentivising environmentally sustainable innovation in the life sciences sector. However, the main metaphor here is for a journey away from the Delaware Effect, known for loosening of regulations and reducing corporate oversight, towards the California Effect of leading by example.

The pro-business legislation and tax advantages of the US state of Delaware have encouraged many businesses to incorporate there (indeed there are other well-known jurisdictions of the world that offer similar laissez faire 'advantages' to businesses). This Delaware Effect has been described as a 'race to the bottom' as states compete to attract more businesses by loosening regulations and reducing corporate oversight. By contrast, the California Effect relates to the fact that in the state of California, more stringent regulatory standards for environment emissions have been adopted than the federal government demands, and that many other states have followed suit to adopt those more stringent standards – thereby exerting influence over other states to raise their standards.

Life sciences, encompassing pharmaceuticals, biotechnology, and healthcare technologies, are pivotal in addressing health challenges but also have significant environmental footprints. Current incentives to the life-sciences sector can be summarised pre- and post- launch. At the development stage, life-science companies receive tax credits and research grants to support research & development into innovative potential new products. After the successful launch of a new product, patents and market exclusivity offer the opportunity to recoup the return on investment of not only the successful product but also unsuccessful products. Health Technology Assessments (HTAs), including economic evaluations, conducted after market access is achieved, further refine those incentives towards those products that offer greatest value for money for the system that is paying for those products. To date, however, these value for money assessments have focused largely on health gains for the current generation of patients without adequately considering environmental impacts nor the potential trade-offs with the health of future generations. In response to the increasing urgency of climate change, this proposal advocates for a three-pronged policy approach to align economic incentives for the life-sciences industry to rapidly reduce their environmental impact from the earliest stages of product development.

The first pillar of the proposal recommends moving from an ex-post to an ex-ante model of internalising environmental externalities. Rather than adding environmental costs in an after-market assessment, this approach incorporates these costs upfront as part of the market costs faced by life-sciences companies. This shift would not only promote more environmentally responsible innovations from the outset, aligning market dynamics with environmental sustainability, but also critically ensure a level playing field at the intersectoral level ensuring the life-sciences sector is not disadvantaged vis-à-vis other sectors of the economy (such as tourism, for example).

The second pillar focuses on refining the calculation methods for the Social Cost of Carbon (SCC) to better capture the true economic and environmental costs of carbon emissions. In particular, it is proposed that predicted Gross Domestic Product (GDP) losses due to adverse climate impacts resulting from inaction are included in the SCC calculation. Further, that a lower discount rate is employed in these calculations to better reflect intergenerational equity considerations. These adjustments are expected to raise the SCC leading to a more rapid response of companies to reducing carbon emissions to the bare minimum while automatically increasing the relative cost-effectiveness of less polluting technologies compared to more damaging technologies.

The third pillar links economic incentives directly to the life sciences' contribution to public health, both domestically and globally. It proposes a dual reward system where the life sciences sector receives financial incentives through R&D tax credits domestically, and where richer nations contribute to a global fund to support health interventions in lower-income nations.

This approach aims to reduce global health disparities by providing greater inward- investment in health to lower-income countries, thus promoting more equitable global health distribution while incentivising sustainable economic growth.

The proposal highlights the interconnectedness of economic growth, environmental sustainability, and global public health. It argues that sustainable economic growth should not exacerbate global warming and health inequalities. The three pillars of the proposed policy framework, implemented together, are greater than the sum of their parts. Aligning economic incentives across sectors, is the key to creating an economic environment for sustainable growth. Only when the true cost of environmental harms are internalised can the correct conditions for sustainable economic growth be realised. An intersectoral approach also guarantees that the life-sciences sector will not be disadvantaged compared to other sectors of the economy. Each of the first two pillars of internalising environmental harms and better reflecting the true SCC are necessary but not sufficient conditions to create the correct economic environment for sustainable growth. However, these are still not sufficient to ensure fair and equitable distribution of global health. Thus, the third pillar creates conditions whereby the choice to invest in the health of own population for jurisdictions already above median health is matched by investments to countries below median health.

The three-pronged approach described here for realigning incentives for life sciences innovation could each move the needle in the right direction but implemented together they could be transformative. Nevertheless, successful implementation of the proposed changes outlined here will require courage and conviction on the part of first-movers, and success will depend on achieving the 'tipping point' required to invoke the California Effect.

Proposal

1. Introduction & Background

The life sciences sector, which encompasses pharmaceuticals, biotechnology, and healthcare technologies, is already supported by various economic incentives to stimulate innovation.
The primary incentive structure for innovation is the use of patents and exclusivity rights (US FDA, 2024). Patents offer inventors exclusive rights to manufacture, use, and sell their innovations for a specific period, typically 20 years from the filing date. In addition, regulators such as US Food & Drug Administration (FDA) or the European Medicines Agency (EMA) grant market exclusivity periods from the date of regulatory approval. This exclusivity enables companies to recover the costs associated with bringing their product to market.

Nevertheless, the high cost and associated high risks of bringing a successful new product to the health care market mean that the patent and exclusivity incentives are supplemented by various push and pull incentives to further stimulate innovation, particularly in neglected areas such as orphan diseases or the underdevelopment of antibiotics (Matthey and Hollis, 2024). Push incentives are designed to reduce up-front risks and costs associated with the early stages of research and development (for example grants/subsidies for research; tax deductions for research & development activities, and collaborative partnerships between public and private entities). Pull incentives are designed to reward successful outcomes of R&D aiming to ensure that profitable markets are available once a drug is developed (for example, advance market commitments, regulatory fast-tracking, and the possibility of patent extensions).

Once a product has been successfully developed and been granted an exclusivity period by the regulator, companies are then free to market their product to payers. Although Health Technology Assessment (HTA) systems vary across different countries (Fontrier et al., 2021), generally speaking, health care payers (governments or insurance companies) use HTA to makes decisions about which newly licensed products to fund. Value-based assessments such as economic evaluation can be used to further incentivise companies by offering to pay more for products that generate greater health gains. Value is assessed through a formal HTA that incorporates an economic evaluation of the product. Within a value-based pricing system, some payers will provide further incentives to manufacturers by agreeing to pay higher prices for orphan diseases or for diseases where the severity of the condition indicates a high unmet need. For example, the National Institute for Health and Care Excellence (NICE) in the UK has recently introduced a 'severity modifier' that results in a higher threshold cost- effectiveness for decision making where diseases or conditions meet the modifier conditions (NICE, 2022). Similarly, The Netherlands, Norway, Sweden and the United States all have some consideration of severity included within their respective HTA processes (Skedgel et al., 2022). Likewise, many countries allow for higher cost-effectiveness thresholds/provide for accommodations for orphan diseases, explicitly recognising the difficulty of recovering the cost of clinical development for indications for rare diseases (Stafinski et al., 2022). Where treatments for particular conditions show high promise, but also lack definitive evidence at launch, many payers will agree to some form of risk sharing arrangement whereby reimbursement is linked to further evidence development (Federici et al., 2021).

These different accommodations to existing HTA processes represent varying attempts to capture additional elements of value that fall outside of the conventional health economic evaluation methods. In the US, a high profile attempt to define possible additional value elements that should be captured in values assessments concluded that, although the cost per Quality Adjusted Life Year (QALY) assessments remained central to value assessment, there were a multitude of additional value elements identified that should at least be considered alongside traditional value elements (Neumann et al., 2018).
Environmental issues have increasingly come to the fore in the wake of the Paris Agreement at the 21st Conference of the Parties (COP 21), which aims to limit global warming to 1.5 degrees Celsius above pre-industrial levels through commitments to achieve net-zero emissions by mid-century (UNFCCC, 2015). The first global stocktake, a process for countries and stakeholders to see progress towards the meeting the goals of the Paris Agreement, was presented to the UN Climate Change Conference (COP 28) in December 2023. This first stocktake confirmed what was widely anticipated, that the global community is not on track to meet the 1.5 degrees Celsius target (UNFCCC, 2023).

As a consequence, incentives are emerging to encourage manufacturers to reduce their environmental impact. The predominant method for handing environmental concerns in the life sciences is life cycle analysis/assessment (LCA). This methodology assesses the environmental impacts associated with all the stages of a technology's lifecycle from raw material extraction through materials processing, manufacturing, distribution, use, repair and maintenance, and disposal or recycling (Matthews et al, 2014). In the case of carbon, this involves estimating the carbon footprint of each of these stages in the life cycle of the product. Indeed, the familiarity of estimating the 'carbon footprint' has led to the concept of carbon-dioxide equivalents (CO2e) which quantify the effect of a given amount of a greenhouse gas (GHG) in terms of the amount of CO2 that would have the same global warming potential (GWP) over a specific time period, typically 100 years (Godal and Fuglestvedt, 2002). This common unit simplifies the comparison of emissions from different gases based on their potency and atmospheric lifetime.

Despite the focus on net-zero since the Paris Agreement, which came into force in November 2016, it is perhaps surprising that climate and environmental considerations where not included in the important aspects of value assessment in the aforementioned review of US value frameworks (Neumann et al., 2018) nor have bodies such as NICE in the UK included guidance on incorporating environmental impacts into its process in the latest release of its methods guidance in 2022 (NICE, 2022).

Nevertheless, attention is beginning to shift towards how HTA processes in general, and health economic evaluation in particular, should incorporate environmental and sustainability concerns. A recent editorial in the journal Health Economics discussed the importance of capturing environmental considerations in health economic analyses (Hensher, 2023) and a number of scoping reviews have recently been published reviewing the methods by which HTA might incorporate environmental concerns into its process (Pinho-Gomes et al., 2022)(Guirado-Fuentes et al., 2023)(Williams et al., 2024).

A leading proposal is that LCA is combined with the monetised values of the environmental damage caused by CO2 emissions (the Social Cost of Carbon or SCC) in order that the SCC (including CO2e GHG emissions) can be incorporated into a standard economic evaluation. This could be achieved either within a standard cost-benefit analysis or a standard cost- effectiveness analysis framework with little additional consideration of the methods beyond extending the perspective of the analysis beyond the health sector perspective that is commonly adopted (Drummond et al., 2015)(Siegel et al., 1996). This would have the effect of making more polluting technologies less attractive under a value-based pricing assessment compared to comparatively less polluting technologies. This proposal is also consistent with the principle of capturing the social cost of negative externalities in standard textbooks (Meade, 1973).

2. Three pillars on which to build a framework for aligning policy to incentivise life-sciences innovation and encourage sustainable economic growth

It is against this backdrop that the proposal for a three-pronged policy to align incentives for environmentally sustainable development is made. The focus of the proposal is on promoting sustainable economic growth by internalising climate change externalities to free the invisible hand of the market (Maskin, 1994); ensuring the SCC includes all costs, most importantly the predicted stymieing of GDP; and that innovation in the life-sciences sector is rewarded for attributable health gains while incorporating inequality aversion to differing quality-adjusted life expectancies across the globe.

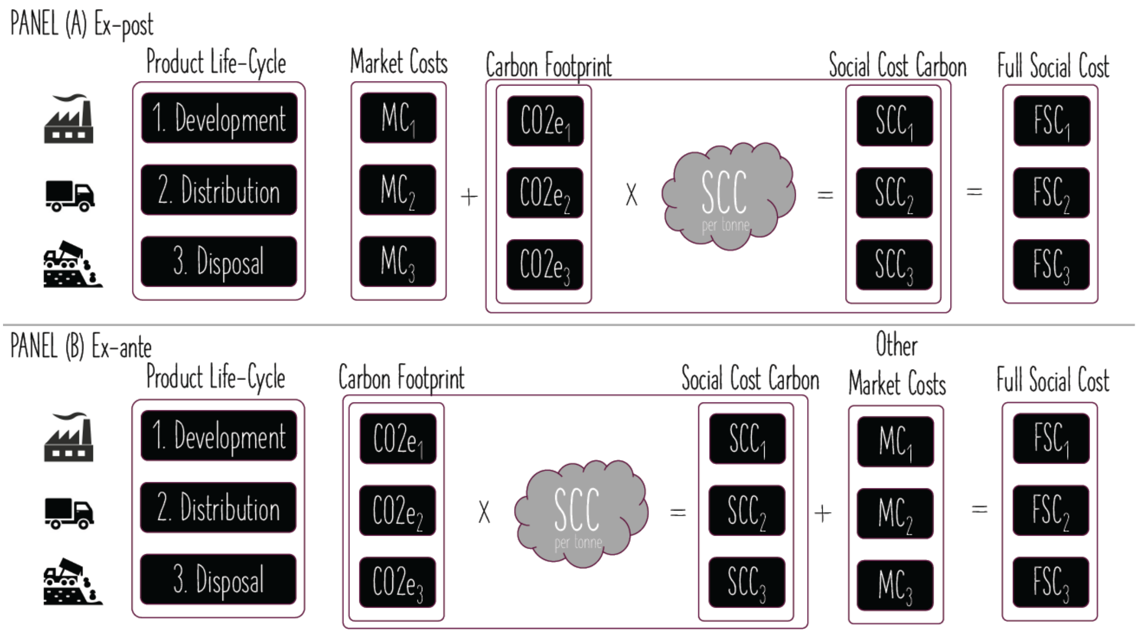
Before taking each of these three pillars in turn to describe the proposed policy changes in more detail, it is worth describing the interplay between important aspects of the problem. At the individual level, the reinforcing relationship between health and wealth is well understood. But at the planetary level, this reinforcing relationship breaks down. Economic growth is good for improving the wealth of the population and lifting the poor out of poverty. Escape from poverty brings with it huge potential health benefits at the individual level.

However, economic growth is not so good for planetary health. Global warming is predicted to have a myriad of adverse consequences: rising sea levels, acidification of the oceans, loss of biodiversity and extreme weather events are likely to have profound negative consequences on both economic productivity and human health. Further, the negative consequences of global warming are likely to fall disproportionately on the poor, who are less able to mitigate the risks associated with climate change and where intersectionality between being poor generally, being among the poor in a lower income country and being in the next generation where the impact of climate change will be worse (unless we take immediate action) compounds the problem. The goal is sustainable economic growth that focuses on achieving the positive and reinforcing elements of growth, while simultaneously avoiding the adverse consequences of global warming, and with a focus on narrowing inequalities in both health & wealth.

2.1 *Ex-ante* versus *ex-post* accounting of externalities

Although we have yet to see any HTA agencies formally adopt a policy on incorporating the social costs of negative externalities from the development, delivery and disposal of innovative health technologies, the direction of travel, based on the recently published scoping reviews is for ex-post adaptations. Most likely this will be based on combining a LCA that identifies CO2e carbon footprints with the SCC within a cost-effectiveness analysis adopting the societal perspective. This downstream correction of environmental externalities is illustrated in Figure 1 panel (A). A stylised three stages of the lifecycle of development (prior to launch), delivery (during active use) and disposal (after use at the individual level) of the technology is conducted at the prevailing market costs and subject to the incentives provided by those market conditions. LCA is then performed to calculate the carbon footprint of each of these stages which is then combined with the SCC per tonne of CO2 to give a monetised cost of the externality at each stage of the lifecycle. Adding the cost of carbon to the market costs gives the full social cost at each stage and summing the stages give the full social cost of the product across the lifecycle.

The proposal here is for a simple change to move this ex-post LCA into an ex-ante assessment which is illustrated in Figure 1 panel (B). The same carbon footprint calculation is undertaken but at an earlier stage such that the prices faced by the manufacturer already incorporate the social cost of the externality. Under the ceteris paribus assumption, it is clear that the ex-ante and ex-post policies would lead to the same assessment of the externality. However, relaxing the assumption reveals a number of advantages to moving the externality adjustment to the ex-ante position.



In the ex-post scenario, market prices excluding the externality are used by companies to bring the product to market and adjustments are handled ex-post. In the ex-ante scenario, the company brings a product to market using the full social costs and no further adjustment is necessary

Figure 1 Illustration of the ex-post (panel A) and ex-ante (panel B) handling of environment externalities

The first advantage is a gain in efficiency. Although under ceteris paribus assumptions the full social cost of each stage of production are the same, in a real-life situation the market dynamics and the operation of the invisible hand will lead to efficiencies as producers naturally substitute away from more expensive, more environmentally damaging factors of production with higher carbon footprints, to lower cost, less environmentally damaging options.

The second advantage comes from the relative ease with which an ex-ante LCA can be implemented compared to making calculations ex-post. Within a LCA, consideration is given to inventorying scope 1, 2 & 3 GHG emissions (US EPA, 2015). Scope 1 GHG emissions occur from sources that are controlled or owned by an organisation. Scope 2 emissions are indirect GHG emissions associated with the purchase of energy for heating and cooling. Scope 3 emissions are also indirect and include all sources not within an organisation's scope 1 and 2 boundary and can consist of both its upstream and downstream activities such as purchased goods and services, employee travel (business and commuting), transportation and distribution, waste disposal of used products. Since scope 3 emissions for one organisation are the scope 1 and 2 emissions of another organisation, providing there is comprehensive accounting across all organisations involved in the supply chain then scope 3 emissions need not be included in the LCA when establishing the carbon footprint in terms of CO2e units. By contrast, if the LCA is undertaken ex-post then an inventory needs to be made not only of the scope 1 & 2 emissions but also of the scope 3 emissions, since these will not have been captured by each organisation. This presents a considerable challenge for the analyst – especially if in the move towards net-zero accounting, some parts of the supply chain for a given technology have been starting to incorporate LCA into their operations – then it would become a challenge to work out how to present the ex-post LCA without double counting.

The third advantage comes from the levelling of the playing field across differing sectors of the economy. If all organisations within the economy are subject to the same principles of LCA in an effort to meet net-zero targets of the Paris Agreement then as well as the efficiency of not having to account for scope 3 GHG emissions ex-post, it means that the life-sciences industry is not disadvantaged compared to other sectors of the economy. For example, recent headlines have described the current discrepancy in fuel tax duty which means that private motorists pay more fuel duty per litre than do operators of private jets as 'baffling' (Topham, 2024). Of course, to the extent that air transportation is part of the supply chain of modern health technologies, the lack of aviation fuel duty keeps the cost of air transportation (artificially low) for the life sciences industry. But the real distorting effect is the comparison between sectors. While life sciences (and other sectors of the economy including health care provision more generally) come under pressure to meet net-zero targets, the tourism sector faces unrealistically low air travel costs which encourage air travel for pleasure and disadvantage other transport options such as train travel.

2.2 A complete accounting for the Social Cost of Carbon (SCC)

The second proposed policy change relates to the methods for calculating the SCC. Indeed, there is no established single method for calculating the SCC, with different organisations using different approaches. The Environmental Protection Agency (EPA) in the US has estimated the SCC as US$46 per metric ton in 2025 rising to $69 per ton in 2050 (US EPA, 2017).

Perhaps unsurprisingly, the SCC is extremely sensitive to the underlying assumptions – in particular the assumptions concerning non-linearities in the relationship between CO2 emissions and temperature change, and the use of discounting. Further, there are concerns that the SCC can be easily manipulated from a political perspective (Aldy et al., 2021). A recent contribution in the journal Nature undertook a comprehensive assessment of the evidence, concluding that a higher social cost of CO2 is warranted. The authors concluded:

> *"Our preferred mean SC-CO2 estimate is $185 per tonne of CO2 ($44–$413 per tCO2: 5%– 95% range, 2020 US dollars) at a near-term risk-free discount rate of 2%, a value 3.6 times higher than the US government's current value of $51 per tCO2."*

(Rennert et al., 2022).

For the purposes of this proposal, two principles are espoused: 1) that the SCC should include estimates of forgone GDP due to adverse climate impacts and 2) that the discount rate used to adjust for differential timing in the model to calculate the SCC should be set to be low/zero on the grounds of intergenerational equity. Both these proposals will substantially raise the SCC, at least compared to commonly employed estimates, to be more in line with the Rennert et al (2022) values quoted above. Raising the SCC calculations in this manner will undoubtedly be painful in the short term but will result in more rapid responses by manufacturers to reduce carbon consumption.

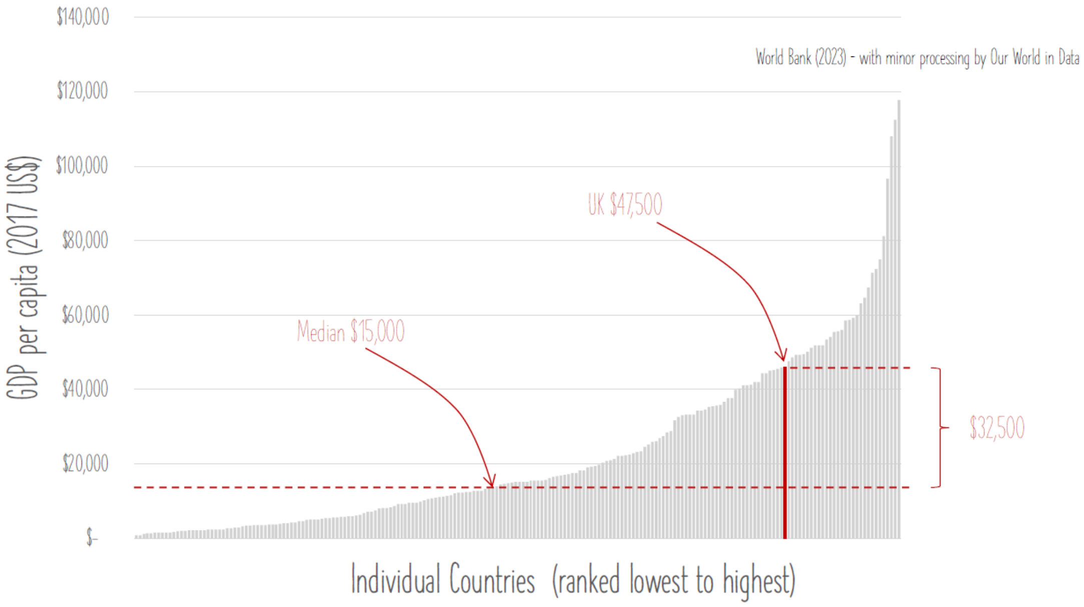
The first principle introduces a real cost of carbon that is currently missing from the equation, meaning that without it society will not be reacting fast enough to reduce its carbon. The opportunity cost of forgone growth of the economy is a real cost of inaction to mitigate the impact of rising temperatures globally. The second brings a focus on intergenerational equity, which is currently overlooked with some models using much higher discount rates for SCC calculations in order to keep the SCC low. Regularly updating of the estimations for SCC would create a self-correcting incentive such that as the GDP lost to climate changes falls so the SCC would also fall.

2.3 Establishing a Global Health Fund to reward innovation and reduce health inequalities

The third and final pillar of the proposal is to link successful innovation to further investment in the life sciences industry and to targeted programmes designed to reduce health inequalities across the globe. The proposal is to do this by looking at the life sciences' contribution to population health at two levels: within the individual jurisdiction and at the global level. Further, that the linked rewards to innovation operate at those same two levels, with a contribution to a domestic fund which could be offered to domestic life-science companies in the form of R&D tax credits and a contribution to a Global Health Fund that would be used to provide health care interventions to countries with the greatest need.

The contribution to the fund could be split around median per-capita income. There is a very real relationship between per-capita GDP and the ability of individual country to pay for health care interventions for their populations. Early suggestions by the WHO that interventions below a threshold of 1 x GDP per capita represent good value for money and interventions above 3 x GDP per capita represent poor value for money have been widely criticised (Robinson et al., 2017)(Shillcutt et al., 2009)(Woods et al., 2016), but the remaining (and necessary) focus on GDP as a measure of a country's ability to pay remains.

Nevertheless, when GDP measures determine the health care expenditures then it is clear that disparities in the wealth of countries will likely be mirrored in the health of their populations. Although not perfect (and mitigated somewhat by the law of diminishing marginal returns to health care interventions) the manifestation of income inequality into health inequality is clear to see at the global level. The aim of the fund therefore is to ensure that existing inequalities are not perpetuated but are at least reduced. Figure 2 below shows all countries of the world rank ordered in terms of their per-capita GDP based on 2023 World Bank data, presented in terms of 2017 US$. Burundi has the lowest per- capita GDP at US$700 with Luxemburg topping the charts with US$117,800. The UK (highlighted in Figure 2) has a per capita GDP of US$47,600 well above the median of US$15,000.



World Bank (2023) – with minor processing by Our World in Data. "GDP per capita – World Bank – In constant 2017 international $" [dataset]. World Bank, "World Bank World Development Indicators" [original data]. from https://ourworldindata.org/grapher/gdp-per-capita-worldbank

Figure 2 Per-capita GDP across the globe (2017 US$)

Ultimately, any threshold could be used as the point at which contributions to the fund would be initiated, but given the focus on reducing inequalities the median income level is a natural choice. The contribution to the fund could then be calculated as the difference between the median income and a given value of GDP per capita that represents the threshold for value assessment in that country. For ease of exposition, in Figure 2, the value of 1 x GDP of the UK is used, though in practice this is a little above the commonly stated £30,000 per QALY threshold that NICE uses for decision making. In this example, the UK would be expected to 'set aside' US$32,500 for each QALY generated with a new technology accepted by NICE into the UK market in a given year. This set-aside could then be split between domestic support for the life-sciences industry in direct recognition of the contribution of the life-sciences sector to innovation that was judged to be value for money for use in the UK system, and contribution to the Global Health Fund to reduce inequalities.

With a split of 50/50 between the domestic support for life sciences in the UK and the global Fund, each QALY generated in the UK would translate into 50% x US$32,500 = US$16,250 for the Global Health Fund to be spent on countries below median income in order to improve the health of their populations. Using the same principles as the net contributors to the fund, the recipients could receive proceeds in proportion to their relative ranking below median income.

While the operation of the scheme would come with a number of arbitrary choices to be made to get it up and running, the design of the scheme follows the principles that:

- reward to (domestic) life sciences industry would be in direct proportion to the success of the live sciences sector in generating innovative technologies that meet the criteria of representing value for money in a given jurisdiction, and;
- contribution to the Global Health Fund, would satisfy the principle that inequalities in health between countries across the globe would be narrowed rather than widening with the introduction of innovative technology.

3. Scalability across countries with differing health systems

The three-pronged policy approach described above has been designed to be applicable across different countries and across different health systems. For those countries that have an explicit cost-effectiveness threshold that represents their marginal willingness to pay for health gain, then this stated threshold could be used to determine the 'set aside' to contribute to domestic investment and the Global Health Fund. For those countries without a stated cost-effectiveness threshold, methods can be employed to calculate such an implied threshold, even for pluralist systems such as the US.

In principle, there should not be any practical challenges to implementation in different jurisdictions, and it may better suit those countries that prefer minimal government intervention – though the implementation of the scheme will involve some government intervention. Negative externalities such as GHG emissions are, by definition, failures of the free-market and require government intervention to correct.

However, that is not to say that all countries would agree to take part. In particular, the SCC increase may attract the criticism that it would simply be unaffordable for some lower- income countries. Yet, if this is truly the case, then this would tell us something about the magnitude of the task ahead. Ultimately it is inaction on climate change that is unaffordable. It could be that some further incentive would have to be offered by higher income countries to get lower income countries to join the scheme. For example, Nobel Laureate Joseph Stiglitz has suggested that the International Monetary Fund (IMF) should give poor countries US$300bn per year to fight climate change, including weaning themselves off of coal-fired power generation (Elliott, 2023). But the overall premise remains intact, that only by including a comprehensive SCC can we put in place the mechanism whereby the invisible hand of the free market can help solve the problems of climate change. The alternative would be to conclude that the free market (capitalism) itself is the problem and that wholesale change of the prevailing economic system is necessary.

4. Perverse incentives and the free-rider problem

International agreements are inherently difficult to build. Despite the apparent success of the Kyoto Accord and the Paris Agreement, the net-zero targets to limit global warming to no more than 1.5 degrees Celsius is by no means assured. The US withdrawal from the Paris Agreement in 2020 (following a presidential executive order in 2017) has fortunately now been reversed and the US rejoined the agreement in 2021. However, this emphasises that such agreements are a potential house of cards that could come crashing down. Despite many positives that have been generated following the COP meetings, the recently published Global Stocktake at COP 28 has thrown doubt on the feasibility of achieving the targets set at COP 21 by mid-century. Much has been made of the fact that China, as one of the most populous countries in the world (for many years the most populous but overtaken in 2022 by India) has been rapidly increasing its fossil fuel emissions in line with the demand of its population for cheap power. Though tempting to think that 'why to bother' if the efforts of richer countries can be wiped out in just a few short years by more populous poorer countries, this encourages a 'race to the bottom' mentality. Richer nations can, by virtue of their increased wealth, afford to take greater mitigating actions than poorer countries.

Furthermore, it is important not to underestimate the power a wholesale shift away from high carbon fossil fuel power production can have in terms of restructuring the global markets for clean energy and providing market incentives for innovation in these areas. Despite the dismal progress towards the Paris agreement, there are reasons to be cheerful. 2024 saw the closure of Britain's last coal-fired power station, with the New York Times reporting that Britain has 'turned its back on coal forever' (Sengupta, 2024) while in the same year, the tide of ever increasing GHG emissions from China is also predicted to turn with the first downturn in CO_2 emissions as China reduces its reliance on cheap, dirty, energy. And the world's most innovative country in producing solar energy? Also China (Bradsher, 2024).

5. Summary

This proposal has highlighted the interconnectedness of economic growth, environmental sustainability, and global public health. It has argued that sustainable economic growth should not exacerbate global warming and health inequalities. The three pillars of the proposed policy framework could be beneficial if implemented independently. But if implemented together, they have the potential to be greater than the sum of their parts.

Aligning economic incentives across sectors, is the key to creating an economic environment for sustainable growth. Only when the true cost of environmental harms are internalised can the correct conditions for sustainable economic growth be realised. An intersectoral approach also guarantees that the life-sciences sector will not be disadvantaged compared to other sectors of the economy. Each of the first two pillars of internalising environmental harms and better reflecting the true SCC are necessary but not sufficient conditions to create the correct economic environment for sustainable growth. However, these are still not sufficient to ensure fair and equitable distribution of global health. Thus, the third pillar creates conditions whereby the choice to invest in the health of their own population for jurisdictions already above median health is matched by investments to countries below median health.

The three-pronged approach described here for realigning incentives for life sciences innovation could each move the needle in the right direction but implemented together they could be transformative. Nevertheless, successful implementation of the proposed changes outlined here will require courage and conviction on the part of first-movers in the richer nations. Yet, if acted upon with courage and conviction, wholesale restructuring of the market conditions for innovation could avoid a 'race to the bottom' and instead achieve the 'tipping point' required to invoke the California Effect.

References

Aldy, J.E., Kotchen, M.J., Stavins, R.N., Stock, J.H., 2021. Keep climate policy focused on the social cost of carbon. Science 373, 850–852. https://doi.org/10.1126/science.abi7813

Woods, B., et al, 2016. Country-Level Cost-Effectiveness Thresholds: Initial Estimates and the Need for Further Research. Value Health J. Int. Soc. Pharmacoeconomics Outcomes Res. 19. https://doi.org/10.1016/j.jval.2016.02.017

Bradsher, K., 2024. How China Came to Dominate the World in Solar Energy. N. Y. Times.

Drummond, M.F., Sculpher, M., Claxton, K., Stoddart, G.L., Torrance, G.W., 2015. Methods for the economic evaluation of health care programmes, Fourth edition. ed. Oxford University Press, Oxford New York.

Elliott, L., 2023. IMF should give poor countries $300bn a year to fight climate crisis, says Joseph Stiglitz. The Guardian.

Federici, C., Reckers-Droog, V., Ciani, O., Dams, F., Grigore, B., Kaló, Z., Kovács, S., Shatrov, K., Brouwer, W., Drummond, M., 2021. Coverage with evidence development schemes for medical devices in Europe: characteristics and challenges. Eur. J. Health Econ. HEPAC Health Econ. Prev. Care 22, 1253–1273. https://doi.org/10.1007/s10198-021-01334-9

Fontrier, A.-M., Visintin, E., Kanavos, P., 2021. Similarities and Differences in Health Technology Assessment Systems and Implications for Coverage Decisions: Evidence from 32 Countries. PharmacoEconomics Open 6, 315–328. https://doi.org/10.1007/s41669-021-00311-5

Godal, O., Fuglestvedt, J., 2002. Testing 100-Year Global Warming Potentials: Impacts on Compliance Costs and Abatement Profile. Clim. Change 52, 93–127. https://doi.org/10.1023/A:1013086803762

Guirado-Fuentes, C., Abt-Sacks, A., Trujillo-Martin, M.D.M., Garcia-Perez, L., Rodriguez- Rodriguez, L., Carrion I Ribas, C., Serrano-Aguilar, P., 2023. Main Challenges of Incorporating Environmental Impacts in the Economic Evaluation of Health Technology Assessment: A Scoping Review. Int. J. Environ. Res. Public. Health 20. https://doi.org/10.3390/ijerph20064949

Hensher, M., 2023. Climate change, health and sustainable healthcare: The role of health economics. Health Econ. 32, 985–992. https://doi.org/10.1002/hec.4656

Meade, J.E. The Theory of Economic Externalities. Leiden, A.W. Sijthoff, 1973, 92 p., DFL 22.00. Recherches économiques de Louvain. 1976;42(1):73-73. doi:10.1017/S0770451800030700
Maskin, E.S., 1994. The Invisible Hand and Externalities. Am. Econ. Rev. 84, 333–337.

Matthews, H.S., Hendrickson, C.T., Matthews, D. Life Cycle Assessment: Quantitative Approaches for Decisions that Matter, 2014. Open access textbook, retrieved from https://lcatextbook.com/

Matthey, M.A., Hollis, A., 2024. Pull me – push you? The disparate financing mechanisms of drug research in global health. Glob. Health 20, 14. https://doi.org/10.1186/s12992- 024-01019-x

Neumann, P.J., Willke, R.J., Garrison, L.P., 2018. A Health Economics Approach to US Value Assessment Frameworks-Introduction: An ISPOR Special Task Force Report [1]. Value Health J. Int. Soc. Pharmacoeconomics Outcomes Res. 21, 119–123. https://doi.org/10.1016/j.jval.2017.12.012

NICE, 2022. NICE health technology evaluations: the manual | Guidance | NICE [WWW Document], 2022. URL https://www.nice.org.uk/process/pmg36 (accessed 10.13.24).

Outcome of the first global stocktake | UNFCCC [WWW Document], n.d. URL https://unfccc.int/topics/global-stocktake/about-the-global-stocktake/outcome-of- the-first-global-stocktake (accessed 10.13.24).

Pinho-Gomes, A.C., Yoo, S.H., Allen, A., Maiden, H., Shah, K., Toolan, M., 2022. Incorporating environmental and sustainability considerations into health technology assessment and clinical and public health guidelines: a scoping review. Int. J. Technol. Assess.
Health Care 38, e84. https://doi.org/10.1017/S0266462322003282

Rennert, K., Errickson, F., Prest, B.C., Rennels, L., Newell, R.G., Pizer, W., Kingdon, C., Wingenroth, J., Cooke, R., Parthum, B., Smith, D., Cromar, K., Diaz, D., Moore, F.C.,

Müller, U.K., Plevin, R.J., Raftery, A.E., Ševčíková, H., Sheets, H., Stock, J.H., Tan, T., Watson, M., Wong, T.E., Anthoff, D., 2022. Comprehensive evidence implies a higher social cost of CO2. Nature 610, 687–692. https://doi.org/10.1038/s41586-022-05224-9

Robinson, L.A., Hammitt, J.K., Chang, A.Y., Resch, S., 2017. Understanding and improving the one and three times GDP per capita cost-effectiveness thresholds. Health Policy Plan. 32, 141–145. https://doi.org/10.1093/heapol/czw096

Sengupta, S., 2024. Britain Shuts Down Last Coal Plant, 'Turning Its Back on Coal Forever.' N. Y. Times.

Shillcutt, S.D., Walker, D.G., Goodman, C.A., Mills, A.J., 2009. Cost effectiveness in low- and middle-income countries: a review of the debates surrounding decision rules.
PharmacoEconomics 27, 903–917. https://doi.org/10.2165/10899580-000000000-00000

Siegel, J.E., Weinstein, M.C., Russell, L.B., Gold, M.R., 1996. Recommendations for reporting cost-effectiveness analyses. Panel on Cost-Effectiveness in Health and Medicine. JAMA 276, 1339–1341. https://doi.org/10.1001/jama.276.16.1339

Skedgel, C., Henderson, N., Towse, A., Mott, D., Green, C., 2022. Considering Severity in Health Technology Assessment: Can We Do Better? Value Health J. Int. Soc.

Pharmacoeconomics Outcomes Res. 25, 1399–1403. https://doi.org/10.1016/j.jval.2022.02.004
Stafinski, T., Glennie, J., Young, A., Menon, D., 2022. HTA decision-making for drugs for rare diseases: comparison of processes across countries. Orphanet J. Rare Dis. 17, 258. https://doi.org/10.1186/s13023-022-02397-4

The Paris Agreement | UNFCCC [WWW Document], n.d. URL https://unfccc.int/process-and- meetings/the-paris-agreement (accessed 6.15.24).
Topham, G., correspondent, G.T.T., 2024. Jet fuel tax could raise £6bn a year in the UK, says thinktank. The Guardian.

US EPA, O., 2015. Scopes 1, 2 and 3 Emissions Inventorying and Guidance [WWW Document]. URL https://www.epa.gov/climateleadership/scopes-1-2-and-3-emissions- inventorying-and-guidance (accessed 7.1.24).

US EPA, O., n.d. The Social Cost of Carbon [WWW Document]. URL https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon (accessed 10.13.24).

US FDA, 2024. Frequently Asked Questions on Patents and Exclusivity. FDA.

Williams, J.T.W., Bell, K.J.L., Morton, R.L., Dieng, M., 2024. Methods to Include Environmental Impacts in Health Economic Evaluations and Health Technology Assessments: A Scoping Review. Value Health J. Int. Soc. Pharmacoeconomics Outcomes Res. 27, 794–804. https://doi.org/10.1016/j.jval.2024.02.019

World Bank (2023) – with minor processing by Our World in Data. "GDP per capita – World Bank – In constant 2017 international $" [dataset]. World Bank, "World Bank World Development Indicators" [original data]. Retrieved October 13, 2024 from https://ourworldindata.org/grapher/gdp-per-capita-worldbank

Innovation Policy Prize 2024

The OHE Innovation Policy Prize supports our charitable goal of improving the quantity and quality of debate on health economics, and has been designed to be a non-exclusive platform which:

- generates novel ideas and solutions
- facilitates sharing of perspectives across disciplines countries
- encourages more research into the economics of the life sciences sector

The OHE Innovation Policy Prize awards £40,000 for the entry that best fulfils our judging criteria; originality, empirical/theoretical foundations, global feasibility/implementation, potential impact, and clarity.

All shortlisted entries also have the opportunity to submit a paper to a special issue or section of PharmacoEconomics based on their entry.

The next OHE Innovation Policy Prize will launch in 2026.

Having been at the forefront of economics and policy of health and life sciences innovation for the past 60 years, OHE has a rich history of supporting and promoting original thinking which solves the problems of the day and the future.