

Programa de Pós-Graduação em Economia

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Segunda Fase – Prova Escrita (Inglês)

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Read the articles in annex and the questions below, and answer in Brazilian Portuguese.

Question 1: In “Who pays for climate change?”, Gernot Wagner discusses the financing of climate change initiatives. According to the author, what is the role of carbon credits and how must public and private investments be combined to create momentum?

Question 2: In “Some green technologies are more equal than others”, Gernot Wagner debates the rationale behind decision-making concerning which technologies to push and which to drop. According to the author, what are the three key factors determining economic decision-making? Use his e-fuel example to illustrate your answer.

Question 3: In this interview for the YouTube channel *New Economic Thinking* (<https://youtu.be/apbIP5zutUQ>), Andrew Wyckoff discusses the concepts of invention and innovation and the different frameworks for fostering innovation countries have been pursuing. Watch the video and answer the following:

- a) How are inventions and innovations defined? How do they relate to one another?
- b) Which example does Wyckoff pose to illustrate the process of creative destruction?
- c) What is the role of public policy in fostering innovation?
- d) What is the relationship between uberization and market inefficiencies according to Wyckoff?
- e) The host mentions an initiative conducted by the US Department of Defence in the 1970s that helped build a new model for technological innovation. Which model is that and how is it described? What is the role of public investment in it?
- f) What is the main issue concerning green innovations compared to other technological innovations such as the Internet? From the financing perspective, who is in the best position to lead the transition into green technologies, and what constraints countries have faced since the beginning of the Covid-19 pandemic?



Project Syndicate

Who Pays for Climate Change?

Nov 16, 2022 | GERNOT WAGNER

SHARM EL-SHEIKH – If there is one issue that has taken center stage at this year’s United Nations Climate Change Conference (COP27), it is money. Delegates, climate activists, and the rapidly increasing number of private-sector attendees are discussing who should pay for climate change, and how.

The focus on money is past due. While the annual climate talks are ultimately about cutting greenhouse-gas pollution, the transition to a net-zero economy requires massive financing, as will adapting to a world of rising average temperatures and sea levels, increasingly frequent and severe extreme weather, and all the other costly effects of burning fossil fuels.

Ever since COP15 in Copenhagen in 2009, a key figure in this debate has been “\$100 billion.” That is how much the world’s advanced economies promised to provide to developing countries every year by 2020. But it was never clear whether this target referred only to public money, or whether it could include a mix of public and private flows. While most of the Global South interpreted it as a commitment of public funds, most of the Global North preferred the broader definition. If one takes the latter view, the rich world was already on track to providing \$97 billion in annual climate finance flows back in 2011, according to a widely cited study from the Climate Policy Initiative.

And yet, 13 years on from the 2009 pledge, few would make the mistake of mixing public and private funding, while everyone recognizes that the global energy transition will require not billions but trillions of dollars per year. Ahead of the COP26 talks in Glasgow last year, Mark Carney, the UN’s special envoy for climate action and finance, concluded that at least \$100 trillion of external finance would be “needed for the sustainable energy drive over the next three decades if it is to be effective.” And there is considerable convergence among international bodies, consultancies, and banks around this number. Massive amounts of private spending will need to be directed away from fossil-fuel investments and toward low-carbon infrastructure, energy, and transportation.

But that doesn’t let governments off the hook. Public funds are the lever for rechanneling private money at the necessary pace and scale. The Inflation Reduction Act, Bipartisan Infrastructure Law, and CHIPS and Science Act that the United States has recently enacted are good examples of this lever in action. The idea is that some \$500 billion in government investments will encourage many hundreds of billions more in private flows. Yet while those sums (and similar policies elsewhere) could jump-start a global clean-energy race, all the public investments and most of the private ones will be spent domestically. That leaves the Global South still wanting.

The global picture fits a similar pattern. Since annual foreign direct investment dwarfs development aid, much of the money to cut carbon-dioxide, methane, and other greenhouse-gas pollution will come from private sources, regardless of what governments agree to do. Unlocking these funds will require what climate negotiators call “creative” solutions, which means, “We know that much more money is needed, but we can’t be the ones who provide it.”

Thus, John Kerry, the US climate envoy, came to COP27 with a proposal to use carbon credits to fill at least some of the financing gap. Under this approach, rich countries and companies would

get some credit not just for cutting their own pollution, but for paying others to do so.

The idea is not new. The US proposed a similar system ahead of COP3 in Kyoto in 1997. At the time, much of the rest of the world, including the European Union, opposed the plan. Yet, ironically, the EU now has the world's largest carbon market, while the US, aside from California and a dozen northeastern states, does not. To this day, it is still politically impossible at the national level to make polluters pay for their carbon pollution. That is why President Joe Biden's administration has focused instead on spending money to aid the energy transition at home, and it is why Kerry is proposing a voluntary carbon credit system.

Carbon credits, especially voluntary ones, are no substitute for meaningful efforts by companies and countries to cut their own pollution. For one, carbon-credit systems have plenty of problems of their own. While California's carbon market trades billions worth of credits per year, it also has allowed some \$400 million in apparently fraudulent forest offsets into its system. If California's mandatory market struggles this much with compliance, just imagine the problems that would plague a voluntary global system.

The US and other rich, large polluters still have a responsibility to pony up direct aid on a much larger scale than they are currently doing. That goes both for unconditional aid to help the poor weather climate change, and for funding to help them cut their own pollution. Germany and Austria deserve credit for leading the charge with promises of €170 million (\$175 million) and €50 million, respectively, in aid for the most vulnerable countries. And a new commitment from the US, the EU, and Germany to invest \$500 million in renewables in Egypt is a good step (even though the gas thus freed appears to be set for export to the EU). But given that these sums all fall in the millions, they still miss the mark by orders of magnitude.

There is clearly something to the idea of hitching billions in much-needed aid flows to private financial flows in the trillions. The first order of business is for governments to help guide trillions in private investments toward the Global South. "Creative" solutions should focus on making loans and investments less risky for private investors, with rich governments and multilateral funds providing loan guarantees and other assurances to help reduce sovereign credit and other risks.

Carbon credits could similarly play a role in helping scale up sorely needed investments, provided that voluntary carbon credits are seen only as a stepping stone to making polluters pay to cut their own pollution. Ultimately, building more momentum behind the global clean-energy revolution is what really matters. If allowing rich companies to boast of their green credentials means that they will fund more clean energy in the Global South, that is not a bad thing. Often, the best way to ensure that necessary work is done is not to care too much about who takes the credit.

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Gernot Wagner, a climate economist at Columbia Business School, is the author, most recently, of *Geoengineering: The Gamble* (Polity, 2021).

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Some Green Technologies Are More Equal Than Others

Oct 18, 2022 | GERNOT WAGNER

NEW YORK – The jockeying for position in the global clean-energy race is underway. The United States joined the field just two months ago with the passage of the Inflation Reduction Act. Since then, Austria, for example, has announced a €5.7 billion (\$5.6 billion) subsidy package, which alone mobilizes per capita investments on par with the US effort. But with more governments embracing industrial policies to transform their economies, deciding which green technologies to support will be a key challenge. Picking winners is hard.

Policymakers can start with the relatively simple task of identifying the losers. Carbon dioxide, methane, and other greenhouse gases must be cut to zero or near-zero to stabilize the global climate. That is one reason why economists have long preferred carbon pricing as the primary climate-policy tool. By making polluters pay the full cost of their emissions, the thinking goes, governments can leave it to the market to decide which technologies will win out.

But this is easier said than done. Pervasive market distortions, large vested interests (on both the business and the labor side), and massive infrastructure lock-ins make the economist's tidy solution nearly impossible. Consider, for example, that over 90% of global coal power capacity is insulated from market competition by contracts that often extend 20 or more years into the future. Such entrenched support for dirty, outdated technologies like coal, even when there are otherwise cheaper, cleaner, and better alternatives available, shows that more must be done.

Complicating matters further is the urgency and the sheer scale of the challenge. Energy plays an all-important role in our lives, and achieving carbon neutrality will require an all-encompassing transformation of the economy and society. Given the circumstances, leveraging the power of the public purse is more than appropriate, especially considering how far behind we are in the clean-energy transition. But policymakers with limited public funds must still make hard choices about the right technologies. Margrethe Vestager, the EU Commissioner for Competition, has already voiced concerns about a subsidy race. Beggar-thy-neighbor energy policies could ultimately hinder the global green transition, but “we're nowhere near the global saturation point of needed investments,” as Brian Deese, Director of the National Economic Council, said in far-reaching remarks on the US industrial strategy.

An important early race to watch is the one between greener liquid fuels and all-electric options. Each has its advantages, but there are difficult questions concerning what constitutes an advantage, and for whom.

Liquid fuels might be easier to swap in using the existing infrastructure of pipelines, furnaces, and internal combustion engines. But physics favors electrification in the vast majority of cases, especially in buildings and transportation, which together constitute around 40% of total emissions. Going all-electric with heat pumps and electric-vehicle (EV) engines is clearly the better long-term solution. It is around five times more efficient to heat and cool one's home with electricity directly than it is to use that electricity to produce a liquid fuel; and EVs can go five

times farther than vehicles running on green liquid fuels – often called “e-fuels” or “electrofuels” – using the same energy.

Still, e-fuels might remain a promising option for industry, which accounts for around one-quarter of total emissions. Current manufacturing processes often require combustion to create high temperatures. Hydrogen burns at over 2,000° Celsius (3,600°F), making it potentially well-suited for cement, glass, or steel production. Those designing the leading low-carbon steel technologies are looking to hydrogen as the fuel of choice to replace coal.

But there also may be other solutions on the horizon, owing to competition among entrepreneurs to reinvent long-established industrial processes. The startup Cement has found a way to produce cement at room temperature, and Electra is making use of a process that produces steel at 60°C. True, it remains to be seen whether either company will revolutionize its industry. And their early successes do not necessarily mean that green liquid fuels will not or should not be part of the solution. But the potential for a shakeup in these sectors shows why governments should be wary of supporting incumbent energy or industrial companies that lobby hard for subsidies for their favored technology.

Things gets trickier when a startup claims that it can decarbonize the energy system simply by swapping green liquid fuels for dirty ones. The promise of a seamless technofix can be all too tantalizing. As the founder of the “green gas” producer Tree Energy Solutions said recently, “We can go in the same ships, the same pipes, the same factories.” This kind of one-for-one swap might have significant early advantages, especially for industries that will still need to burn liquid fuels.

But there is also a danger of green moral hazard, whereby the mere promise of a simple technofix weakens the incentive to pursue a more comprehensive and ultimately superior transformation. It is one thing to rely on expensive e-fuels for rare, hard-to-abate industrial processes (or to show off that century-old antique car). But it is quite another thing to use them to heat homes and power daily commutes when technologically and economically preferable alternatives are available.

As so often, the Germans have the perfect neologism to capture the challenge at hand: *Technologieoffenheit*, which connotes both an openness to new technologies and a wariness of prematurely locking in inferior solutions. But openness must not mean wishing away basic physical realities. Amid this year’s energy crisis, vested interests with technologies that might otherwise lose out are pushing the point about openness while waving away the need for longer-term thinking.

The last thing we need is for new policy, regulatory, and investment decisions to lock in another highly inefficient technology for the long term. The most successful entrepreneurs are good at focusing on the main task at hand, rather than being distracted by each shiny new thing. Policymakers will need to do the same in determining which technologies to push, and which to drop.

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