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A Price Tag on Pollution: The Case on Carbon Pricing

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Last December in Dubai, United Arab Emirates (UAE), during the United Nations Climate Change Conference or COP 28, a new agreement was adopted, the UAE Consensus. It was described as an accord that would commence the end of the fossil fuel era (UN Climate Change, 2023). But how soon can we witness that new beginning?

There are many ways to do it and nations are starting that journey. However, time is not on our side now. Unless we pursue carbon pricing, all our hopes of keeping global warming to below 1.5 degrees Celsius above pre-industrial levels, will only turn into frustration—and worse, it would mean death to many species and unlivable conditions within our lifetime (IPCC, 2018).

At this point when we are already at 1.1 degrees Celsius (IPCC, 2021), our baby steps would not bring us anywhere closer to our goals. We need huge leaps, collective effort, and actions that are equal to the magnitude of the deadly impacts of the climate crisis that we are all experiencing.

Carbon pricing, which is a price paid on carbon dioxide (CO2) and other greenhouse gas (GHG) emissions, is a certain solution to limiting fossil fuel use (Klenert, Mattauch, Combat, et. al., 2018). It will compel markets and industries to shift to clean energy sooner rather than later (De Rothschild, 2023). It can also become a provisional source of funding for climate adaptation and mitigation (World Bank, 2023).

3.2 degrees Celsius by 2100

According to the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6), with the current climate policies, it is likely that global warming will reach 1.5 degrees Celsius between 2030 and 2035, and reach 3.2 degrees Celsius by 2100 (IPCC, 2023). This prediction is consistent with a 2023 study, which analysed temperature observations from diverse regions across the globe using artificial intelligence (Diffenbaugh and Barnes, 2023).

As global warming increases, so do the risks and adverse impacts of climate change. So unless we want our progeny to experience catastrophic living conditions, we all need to be doing something now to mitigate this crisis (IPCC, 2023).

If global temperatures reach 1.5°C, 14% of the global population will be exposed to severe heat at least once

every five years (Buis, 2019). Agricultural systems will face significant challenges, with anticipated declines in crop yields of up to seven percent in major crops including rice, maize, soybean, and wheat (Wang, Zhao, and Muller, 2020). Global annual catch for marine fish is also expected to decline by 1.5 million tonnes (IPCC, 2018).

The impact of climate change on the planet's diverse ecosystem is also concerning, as studies have revealed that of the 105,000 species examined, 6% of insects, 8% of plants, and 4% of vertebrates are “expected to lose more than half of their climatically determined geographic range” (IPCC, 2018). This significant reduction in suitable habitats could have far-reaching consequences, including the disruption of ecosystems (Scholes, 2016), potential extinction risks for vulnerable species (Thomas, Cameron, and Green, et. al, 2004), and the loss of critical biodiversity (Mantyka-Pringle, Visconti, and Di Marco, et. al, 2015). All of these will be at least two times worse under a 2 degrees Celsius scenario (IPCC, 2018).

Moreover, at 1.5 degrees Celsius, the global mean sea level will rise by 1.6 feet (Rasmussen, D. Bitterman, K. Buchanan, M, et. al, 2018), the Arctic Ocean will be sea ice-free one summer per century, and coral reefs will decline by 70-90% (IPCC, 2018). But at 2 degrees Celsius, the sea level rise will be at 1.8 feet (Rasmussen, D. Bitterman, K. Buchanan, M, et. al, 2018), and there will be at least one ice-free summer every decade (Kim, Min, and Gillett, et.al, 2023), and coral reefs will decline by 99%.

Imagine the scenario if global warming reaches 3.2 degrees Celsius (IPCC, 2023). Who can still survive? I can still remember clearly the images of devastation, death, and decay in Tacloban City in the Philippines, the ground zero of Typhoon Haiyan in November 2013 (Lamentillo, 2021). The typhoon caused a 7.5-meter-high storm surge that decimated the coastal city and other nearby towns. At least 6,000 were confirmed dead in the country due to the typhoon (CNN, 2013).

I visited Tacloban several times as I was then working with the United Nations Development Program (UNDP) and the Food and Agriculture Organization of the UN (FAO) on their Typhoon Haiyan response (Lamentillo, 2023). At that time, even if we were providing help, I felt helpless. I knew that even after communities have rebuilt after a storm, another one can destroy them again in just a flash. It was more than just building back better. The root cause of such an extreme weather event must be addressed soon.

Studies indicate that storms have become stronger, producing more rainfall, because of climate change (Meehl, Zwiers, Evans, et. al, 2023). This is because a warmer atmosphere holds more water vapor. If the world gets warmer, future storms could even be more intense than Typhoon Haiyan, which happened a decade ago already (Fuller-Wright, 2018).

Climate change has long been a global emergency. Every year that climate action is stalled or becomes lacking, brings us closer to the dreaded 1.5 to 2 degrees Celsius temperature increase (IPCC, 2023). But just how much GHG emissions must be reduced so as not to surpass the 1.5 degrees Celsius limit? The IPCC says, at least a 43% reduction by 2030 and at least

60% by 2035, compared to 2019 levels (2023). We only have the next seven years to reduce emissions by at least 43% (UNFCC, 2022). Carbon pricing can help turbocharge decarbonization and achieve nationally determined contribution (NDC) targets as those who continue to emit GHG will have to pay for their excessive emissions, which can then be used to support climate action (IPCC, 2023). Countries that are still hesitant to deploy this strategy fear that it will affect their international competitiveness (Chateau, Jaumotte, and Schwerhoff, 2022).

International Carbon Pricing

To allay fears about carbon pricing and to incentivize greater participation, the International Monetary Fund (IMF) introduced an International Carbon Price Floor (ICPF) that proposes different price points for emissions for economies at different stages of development (Parry, Black, and Roaf, 2021).

The proposal called on the world's largest emitters to be subjected to a floor price that would reach between $25 and $75 per tonne of carbon by 2030, depending on their level of economic development—$25 per tonne for low-income countries, $50 per tonne for middle-income countries, and $75 per tonne for high-income countries (Parry, Black and Roaf, 2021). The IMF recognizes that there could be difficulties in some economies due to political issues, thus, alternative policies are welcome as long as these alternatives achieve at least the same emissions reductions as the carbon price floor (Merril, Muller, and Stubbings, 2021).

The World Economic Forum (WEF) and PwC collaborated on an assessment of the IMF's proposal (Merrill, Muller, and Stubbings, 2021). They found out that introducing an ICPF can significantly reduce emissions and it can be done without severe economic damage to livelihoods and businesses (Merrill, Muller, and Stubbings, 2021). Furthermore, the ICPF can be done without shifting economic activity and associated GHG emissions from one part of the planet to another (Merrill, Muller, and Stubbings, 2021).

The analysis also indicated that the revenues generated by an ICPF could be used to support those most disadvantaged (Merrill, Muller, and Stubbings, 2021). Moreover, the reduction in emissions, together with revenues raised, could offset the global reduction in GDP caused by an ICPF, which could be somewhere between 0.1% (if only high-income countries and high-emitting industries are included in the ICPF) and 0.6% (if all countries and all sectors are included) (Merrill, Muller and Stubbings, 2021).

Carbon pricing instruments

Choosing which design of carbon pricing instrument is also a crucial decision for policymakers (Narrassimhan, Gallagher, and Koester, 2017). Among the considerations are price levels (Narrassimhan, Gallagher, and Koester, 2017), emissions coverage (Baranzini, Van den Bergh, Carattini, et. Al., 2017), relation to other mitigation instruments (European Commission, 2016), use of revenues to address efficiency and distributional objectives (Haug, Eden and de Oca, 2018), supporting measures to address competitiveness concerns (Mukhtarov, 2022), political economy aspects (Levi,

Flachsland, and Jakob, 2020), among other factors.

It is important to scrutinize and see what will work best for a certain economy. Best practices from other markets can be helpful. Usually, for governments, it is just between the emissions trading system (ETS) or carbon tax (Haites, Maosheng, Gallagher, et. al, 2018). But others utilise a hybrid system.

Under the ETS, or cap and trade, the government sets a cap on emissions and issues an emission allowance to entities (Ellerman and Buchner, 2007), who can trade emission units to meet their emission targets (UNFCCC, 1997). When an entity does not use up its emission allowance, it can either save it for later or sell it to another entity (UNFCCC, 1997). The supply and demand for emission allowance dictate the market price, but what is definite here is the emissions target (Tietenberg, 2010). The cap is reduced continuously to ensure emissions decrease over time (Zaklan, Wachsmuth, and Duscha, 2021).

The European Union's (EU) ETS is the world's first major and biggest carbon market (European Commission, 2016). It is a centerpiece of the EU's policy to combat climate change and has been integral in their efforts to reduce GHG emissions significantly and cost-effectively (Kruger, Oates, and Pizer, 2007).

The EU ETS started 18 years ago and applies in all EU Member States, the European Free Trade Association countries—Iceland, Liechtenstein, and Norway—as well as Northern Ireland for electricity generation, and covers GHG emissions from around 10,000 installations in the energy sector and manufacturing industry, and aircraft operators flying within the EU and departing to Switzerland and the United Kingdom (Trotignon, 2012). Starting this year 2024, the EU ETS will also cover emissions from maritime transport (International Carbon Action Partnership, 2023), and later on to fuels for buildings, road transport, and additional sectors (International Carbon Action Partnership, 2023).

Over the years, it has already resulted in over 37% reduction in the GHG emissions of the sectors covered while the EU's economy was also continuously growing (European Environment Agency, 2023). They have also raised EUR 175 billion in revenues (European Commission, 2023).

South Korea also adopted an ETS. It was launched in 2015 and was the first national ETS in Asia (Chae and Park, 2016). It covers around 74% of South Korea's national GHG emissions and will help the country in its objective to reduce 40% of emissions by 2030 (compared to 2018 levels), and to become carbon neutral by 2050 (International Carbon Action Partnership, 2022). South Korea's ETS (K-ETS) includes 684 significant emitters across sectors, including power, industrial, buildings, waste, transport, and domestic aviation sectors (International Carbon Action Partnership, 2022). In 2022 alone, revenues from the K-ETS amounted to KRW 317.1 billion (USD 245.4 million). Since the beginning of the program, total revenue has been KRW 1,092.6 billion (USD 845.2 million). Meanwhile, under a carbon tax, the government sets a price or tax on the use of fossil fuel and other sources of emissions (Metcalf and Weisbach, 2009). The big

difference with ETS is that under a carbon tax, there is a pre-defined price of carbon, but the emission reduction outcome is not definite (Goulder and Schein, 2013).

Singapore employs a carbon tax system that will gradually increase to allow businesses to adjust. It applies to all facilities producing 25,000 tonnes or more of GHG emissions in a year (National Climate Change Secretariat Singapore, 2019). The country's carbon tax level is set at S$5 per tonne of carbon dioxide equivalent (tCO2e) from 2019 to 2023 (National Climate Change Secretariat Singapore, 2019). It will be raised to $25/tCO2e in 2024 and 2025, to $45/tCO2e in 2026 and 2027, until it reaches $50-80/tCO2e by 2030 (National Climate Change Secretariat Singapore, 2019).

A hybrid approach can also be considered depending on the needs of an entity or state (Can, Ho, Jorgensen, et. Al., 2019). But the vital step here is to utilize this as a strategy to significantly lower emissions. In AR6, the IPCC highlighted the progress in carbon pricing (IPCC, 2023). With increased global coverage of mandatory policies and expanded sectoral coverage of mitigation policies, ETS and carbon taxes now cover over 20% of global CO2 emissions (Haites, 2018). A lot of countries have also started sectoral regulations that block new investment in fossil fuel technologies (Harvey, 2022).

Likewise, it underscored the continuing challenges, such as the incomplete global policy coverage of non-CO2 gases, CO2 from industrial processes, and emissions outside the energy sector. (IPCC, 2023) Moreover, few of the world's carbon prices are at a level consistent with various estimates of the carbon price needed to limit warming to a safe threshold (Black, Parry, and Zhunussova, 2022).

The Asian Development Bank (ADB) said that well-designed carbon pricing instruments help governments achieve their NDC targets cost-effectively while also encouraging raising ambitions (Duggal, 2023). It is not only a cost-effective driver for decarbonization but also supports a just transition (Duggal, 2023). Moreover, it raises much-needed revenues for national governments (Duggal). According to the World Bank's State and Trends of Carbon Pricing 2023, total carbon revenues from ETS and taxes jump by over 10% in 2022, hitting about $95 billion (World Bank, 2023).

Carbon pricing as a tool for climate finance

Most governments use revenues from carbon pricing to augment their national funds (Bowen, 2015). Many also allow for environment spending (Yunis and Aliakbari, 2020). The World Bank's report stated that almost 40% of the revenue from carbon pricing is earmarked for green spending, and 10% is used to compensate households or businesses (World Bank 2023). EU Member States use revenues from their ETS to support investments in renewable energy (Marcantonini and Ellerman, 2015), energy efficiency improvements (Wiese, Coward and Rosenow, 2020), and low-carbon technologies that help reduce emissions further (Teixidó, Verde and Nicolli, 2019). South Korea utilizes it for climate response funding, including support for mitigation equipment, low-carbon innovation, and technology development for small- and mid-sized companies covered by the K-ETS (Kim, Kim, and Sue, 2024). Singapore gives back to the

economy through support to companies in implementing energy-efficiency measures (Li and Su, 2017).

Carbon pricing can unlock more sources of climate finance (Grubb, 2017). Revenues from carbon pricing mechanisms can be used in various mitigation and adaptation activities. This can be in the form of grants, subsidies, loans, loan guarantees, equity investment, and payment for results-based finance, among others (Marten and Van Sender, 2019).

With high-income countries taking the lead and sharing best practices, emerging economies are beginning to see the viability of carbon pricing (Lamentillo, 2024). The World Bank said the uptake of ETS and carbon taxes is rising in emerging economies, primarily driven by the need for climate change mitigation policy, managing transition risks, and exploring revenue opportunities (World Bank, 2023).

There are now 73 carbon pricing schemes in nearly 50 countries covering a quarter of emissions (World Bank, 2023). Several jurisdictions in the Asia-Pacific region, like Japan (Arimura and Matsumoto, 2021), and China (Yan and Yang, 2021) have already adopted carbon pricing mechanisms.

In the Philippines, there are initiatives in the legislative, as well as ongoing consultations in the executive to determine the most viable carbon pricing mechanism for the country for it to achieve its NDC commitment of reducing GHG emissions by 75% by 2030 (Department of Finance, 2024). However, the Philippines does not levy an explicit carbon price (Arimura, and Matsumoto, 2021).

We have more to gain when we put a price on the use of fossil fuels. Our hopes of achieving the goals we have set in the Paris and UAE accords can be within our reach with carbon pricing mechanisms in place—because industries that produce GHG will then be faced with only two options, either reduce their emissions to avoid paying a high price, or continue emitting and pay for their emissions with a price that will continuously become costly.

Now more than ever, our actions need to be bold, decisive, and immediate. Because in this significant fight for the survival of our planet and humanity’s future, it can no longer be business as usual.

References

Arimura, T.H. and Matsumoto, S., 2021. Carbon pricing in Japan (p. 265). Springer Nature.

Baranzini, A., Van den Bergh, J.C., Carattini, S., Howarth, R.B., Padilla, E. and Roca, J., 2017. Carbon pricing in climate policy: seven reasons, complementary instruments, and political economy considerations. Wiley Interdisciplinary Reviews: Climate Change, 8(4), p.e462.

Black, S., Parry, I. Zhunussova, K. (2022). More Countries Are Pricing Carbon, but Emissions Are Still Too Cheap. International Monetary Fund. Available at: https://www.imf.org/en/Blogs/Articles/2022/07/21/blog-more-countries-are-pricing-carbon-but-emissions-are-still-too-cheap

Bowen, A., 2015. Carbon pricing: how best to use the revenue. Policy Brief, Grantham Research Institute on Climate Change and the Environment. London School of Economics. Available at: https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/11/Bowen-policy-brief-2015.pdf

Buis, A. (2019). A Degree of Concern: Why Global Temperatures Matter. NASA. Available at https://climate.nasa.gov/news/2865/a-degree-of-concern-why-global-temperatures-matter/

Cao, J., Ho, M.S., Jorgenson, D.W. and Nielsen, C.P., 2019. China's emissions trading system and an ETS-carbon tax hybrid. Energy Economics, 81, pp.741-753

Chae, J.O. and Park, S.K., 2016. Status of Korea ETS and Strategies to improve in One Year After Launching-Through Comparing with EU ETS. Journal of Climate Change Research, 7(1), pp.41-48.

Chateau, J., Jaumotte, F. and Schwerhoff, G., 2022: Why Countries Must Cooperate on Carbon Prices. International Monetary Fund, US, Available at: https://www.imf.org/en/Blogs/Articles/2022/05/19/blog-why-countries-must-cooperate-on-carbon-prices

CNN (2013). Typhoon Haiyan death toll tops 6,000 in the Philippines. Available at https://edition.cnn.com/2013/12/13/world/asia/philippines-typhoon-haiyan/index.html

De Rothschild, L., 2023. Why The World Must Set a Price on Carbon. TIME, Available at https://time.com/6549163/why-world-needs-a-carbon-price/

Diffenbaugh, N. and Barnes, E. (2023). Data-driven predictions of the time remaining until critical global warming thresholds are reached. Proceedings of the National Academy of Sciences (PNAS) of the United States of America. Available at https://doi.org/10.1073/pnas.2207183120

Duggal, V., 2023. Carbon Pricing Development and Dynamics: Implications for Developing Asia. Asian Development Bank. Available at: https://www.adb.org/sites/default/files/institutional-document/874256/adotr2023bp-carbon-pricing-developing-asia.pdf

Ellerman, A.D. and Buchner, B.K., 2007. The European Union emissions trading scheme: origins, allocation, and early results. The University of Chicago Press Journals, USA.

Available at:
https://www.journals.uchicago.edu/doi/abs/10.1093/reep/rem003?journalCode=reep

European Environment Agency., 2023., Greenhouse gas emissions under the EU Emissions Trading System. Available at: https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-under-the

European Commission., 2016. The EU Emissions Trading System (EU ETS). Available at: https://climate.ec.europa.eu/document/download/5dee0b48-a38f-4d10-bf1a-14d0c1d6febd_en?filename=factsheet_ets_en.pdf

European Commission., 2023. Commission President advances global cooperation on carbon pricing in high-level event at COP28. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6092

Fuller-Wright, L., 2018. Half a degree more global warming could flood out 5 million more people. High Meadows Environmental Institute, USA. Available at https://environment.princeton.edu/news/half-a-degree-more-global-warming-could-flood-out-5-million-more-people/#:~:text=Overall, the researchers predicted that,sea level by an estimated

Goulder, L.H. and Schein, A.R., 2013. Carbon taxes versus cap and trade: a critical review. Climate Change Economics, 4(03), p.1350010.

Grubb, M., 2011. International climate finance from border carbon cost levelling. Climate Policy, 11(3), pp.1050-1057.

Haites, E., 2018. Carbon taxes and greenhouse gas emissions trading systems: what have we learned?. Climate policy, 18(8), pp.955-966.

Haites, E., Maosheng, D., Gallagher, K.S., Mascher, S., Narassimhan, E., Richards, K.R. and Wakabayashi, M., 2018. Experience with carbon taxes and greenhouse gas emissions trading systems. Duke Envtl. L. & Pol'y F., 29, p.109.

Harvey, F., 2022., G7 countries to stop funding fossil fuel development overseas. Available at https://www.theguardian.com/environment/2022/may/30/g7-countries-to-stop-funding-fossil-fuel-development-overseas

Haug, C., Eden, A. and de Oca, M.M., 2018. Addressing the distributional impacts of carbon pricing policies. Berlin: adelphi.

International Carbon Action Partnership (ICAP), 2022. Korea Emissions Trading Scheme. Available at: https://icapcarbonaction.com/system/files/ets_pdfs/icap-etsmap-factsheet-47.pdf#:~:text=The K-ETS covers 684,and trade intensity benchmarks

International Carbon Action Partnership (ICAP), 2023. Emissions Trading Worldwide: Status Report 2023. Berlin: International Carbon Action Partnership.

International Carbon Action Partnership (ICAP), 2023., EU Emissions Trading System for buildings and road transport ("EU ETS 2”). Available at https://icapcarbonaction.com/system/files/ets_pdfs/icap-etsmap-factsheet-118.pdf

IPCC., 2018., Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3-24. Available at: https://doi.org/10.1017/9781009157940.001.

IPCC., 2021., Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. In Press.

IPCC., 2023., Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647

IPCC., 2023. Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

Kim, S.E., Kim, S.Y. and Suh, J., 2024. Public support for carbon tax in South Korea: The role of tax design and revenue recycling. Asia & the Pacific Policy Studies, 11(2), p.e385.

Kim, YH., Min, SK., Gillett, N.P. et al. Observationally-constrained projections of an ice-free Arctic even under a low emission scenario. Nat Commun 14, 3139 (2023). https://doi.org/10.1038/s41467-023-38511-8

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R. and Stern, N., 2018. Making carbon pricing work for citizens. Nature Climate Change, 8(8), pp.669-677.

Kruger, J., Oates, W.E. and Pizer, W.A., 2007. Decentralization in the EU emissions trading scheme and lessons for global policy. University of Chicago Press Journals, USA. Available at: https://www.journals.uchicago.edu/doi/abs/10.1093/reep/rem009?journalCode=reep

Lamentillo, A.M.Y. (2021). 10 ‘Build, Build, Build’ projects in Eastern Visayas. Manila Bulletin, Philippines. Available at https://mb.com.ph/2021/6/11/10-build-build-build-projects-in-eastern-visayas

Lamentillo, A.M.Y. (2023). Why the youth must lead climate action. Manila Bulletin, Philippines. Available at https://mb.com.ph/2023/5/23/why-the-youth-must-lead-climate-action

Lamentillo, A. (2024). Carbon pricing is crucial to attain Paris Agreement goal. Manila Bulletin: Philippines. Available at: https://mb.com.ph/2024/1/17/carbon-pricing-is-crucial-to-attain-paris-agreement-goal

Levi, S., Flachsland, C. and Jakob, M., 2020. Political economy determinants of carbon pricing. Global Environmental Politics, 20(2), pp.128-156

Li, Y. and Su, B., 2017. The impacts of carbon pricing on coastal megacities: A CGE analysis of Singapore. Journal of Cleaner Production, 165, pp.1239-1248.

Mantyka-Pringle, C.S., Visconti, P., Di Marco, M., Martin, T.G., Rondinini, C. and Rhodes, J.R., 2015. Climate change modifies risk of global biodiversity loss due to land-cover change. Biological Conservation, 187, pp.103-111.

Marcantonini, C. and Ellerman, A.D., 2015. The implicit carbon price of renewable energy incentives in Germany. The Energy Journal, 36(4), pp.205-240

Marten, M. and K. van Dender., 2019., "The use of revenues from carbon pricing", OECD Taxation Working Papers, No. 43, OECD Publishing, Paris, https://doi.org/10.1787/3cb265e4-en.

Meehl, G.A., Zwiers, F., Evans, J., Knutson, T., Mearns, L. and Whetton, P., 2000. Trends in extreme weather and climate events: issues related to modeling extremes in projections of future climate change. Bulletin of the American Meteorological Society, 81(3), pp.427-436.

Merril, P., Muller, N., and Stubbings, C., 2021. Increasing Climate Ambition: Analysis of an International Carbon Price Floor. World Economic Forum, Cologny, Switzerland. Available at: https://www.pwc.com/gx/en/services/sustainability/assets/economic-impact-of-a-carbon-price-floor.pdf

Metcalf, G.E. and Weisbach, D., 2009. The design of a carbon tax. Harv. Envtl. L. Rev., 33, p.499

Mukhtarov, S., 2022. The impact of carbon pricing on international competitiveness in the case of Azerbaijan. Environmental Science and Pollution Research, 29(22), pp.33587-33594.

Narassimhan, E., Gallagher, K.S., Koester, S. and Alejo, J.R., 2017. Carbon pricing in practice: a review of the evidence. Climate Policy Lab: Medford, MA, USA

National Climate Change Secretariat Singapore., 2019. Carbon Tax. Available at https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/carbontax/

Osipova, L. And Carraro, C., 2023. The maritime sector in the European Union Emissions Trading System. POLICY. Available at https://theicct.org/wp-content/uploads/2023/12/ID-52-–-EU-ETS-Policy-Update-A4-60060-v2.pdf

OECD, 2022. Pricing Greenhouse Gas Emissions: Key Findings for the Philippines. Available at: https://www.oecd.org/tax/tax-policy/carbon-pricing-philippines.pdf

Parry, I., Black, S, and Roaf, J.. 2021. Proposal for an International Carbon Price Floor among Large Emitters. IMF Staff Climate Notes 2021/001, International Monetary Fund, Washington, DC.

Rasmussen, D.J., Bittermann, K., Buchanan, M.K., Kulp, S., Strauss, B.H., Kopp, R.E. and Oppenheimer, M., 2018. Extreme sea level implications of 1.5 C, 2.0 C, and 2.5 C

temperature stabilization targets in the 21st and 22nd centuries. Environmental Research Letters, 13(3), p.034040.

Scholes, R.J., 2016. Climate change and ecosystem services. Wiley Interdisciplinary Reviews: Climate Change, 7(4), pp.537-550.

Teixidó, J., Verde, S.F. and Nicolli, F., 2019. The impact of the EU Emissions Trading System on low-carbon technological change: The empirical evidence. Ecological Economics, 164, p.106347.

Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F., De Siqueira, M.F., Grainger, A., Hannah, L. and Hughes, L., 2004. Extinction risk from climate change. Nature, 427(6970), pp.145-148.

Tietenberg, T., 2010. Emissions trading: principles and practice. Routledge, USA. Available at https://www.taylorfrancis.com/books/mono/10.4324/9781936331284/emissions-trading-thomas-tietenberg

Trotignon, R., 2012. Combining cap-and-trade with offsets: lessons from the EU-ETS. *Climate Policy*, *12*(3), pp.273-287.

UN Climate Change. (2023). COP28 Agreement Signals “Beginning of the End” of the Fossil Fuel Era. Available at https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era#:~:text=COP28%20Agreement%20Signals%20“Beginning%20of,the%20Fossil%20Fuel%20Era%20|%20UNFCCC (Accessed 19 December 2023)

United Nations Framework Convention on Climate Change (UNFCCC)., 1997. Article 16, Kyoto Protocol to the United Nations Framework Convention on Climate Change. Available at https://unfccc.int/documents/2409

United Nations Framework Convention on Climate Change, 2022. Climate Plans Remain Insufficient: More Ambitious Action Needed Now. Available at https://unfccc.int/news/climate-plans-remain-insufficient-more-ambitious-action-needed-now

Wang, X., Zhao, C., Müller, C. et al. 2020. Emergent constraint on crop yield response to warmer temperature from field experiments. Nat Sustain 3, 908–916. https://doi.org/10.1038/s41893-020-0569-7

Wiese, C., Cowart, R. and Rosenow, J., 2020. The strategic use of auctioning revenues to foster energy efficiency: status quo and potential within the European Union Emissions Trading System. Energy efficiency, 13(8), pp.1677-1688.

World Bank, 2023. Record High Revenues From Global Carbon Pricing Near $100 Billion. Available at: https://www.worldbank.org/en/news/press-release/2023/05/23/record-high-revenues-from-global-carbon-pricing-near-100-billion

World Bank. 2023. State and Trends of Carbon Pricing 2023. Available at http://hdl.handle.net/10986/39796

Yan, J. and Yang, J., 2021. Carbon pricing and income inequality: A case study of Guangdong Province, China. Journal of Cleaner Production. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0959652621007113

Yunis, J. & Aliakbari, E., 2020. Carbon Pricing in High-Income OECD Countries, Fraser Institute. Canada. Retrieved from https://policycommons.net/artifacts/1427114/carbon-pricing-in-high-income-oecd-countries/2041848/ on 23 Feb 2024. CID: 20.500.12592/bgptzh.

Zaklan, A., Wachsmuth, J. and Duscha, V., 2021. The EU ETS to 2030 and beyond: adjusting the cap in light of the 1.5° C target and current energy policies. Climate Policy, 21(6), pp.778-791.