real-world economics review, issue no. 107
subscribe for free

Addressing the climate and inequality crises: An emergency market plan simulation

Jorge Buzaglo and Leo Buzaglo Olofsgård
[Sweden]

It is the way of Heaven to take away from those
that have too much
And give to those that have not enough.

Not so with man's way:
He takes from those that have not
And gives it as tribute to those that have too much.

Tao Te Ching. Ch.77. Transl. Lin Yutang

Introduction

The ominous gravity of the climate and inequality crises cannot be glossed over anymore. As declared by United Nations Secretary-General António Guterres: "Humanity is in the hotseat. … Climate change is here. It is terrifying. And it is just the beginning. The era of global warming has ended; the era of global boiling has arrived."[1] He added, "It is still possible to limit global temperature rise to 1.5C [above pre-industrial levels] and avoid the very worst of climate change. But only with dramatic, immediate climate action." That is, decisive, ambitious, and also rational and effective action is urgently needed. Also recently, in an open letter to the United Nations and the World Bank, 320 economists and experts, including Jayati Ghosh and Joseph Stiglitz, describe a "crisis of extreme inequality."[2] The letter expresses deep concern about the violent rise in inequality, which has recently grown more rapidly than at any time since the Second World War:

> We are living through a time of extraordinarily high economic inequality. Extreme poverty and extreme wealth have risen sharply and simultaneously for the first time in 25 years. Between 2019 and 2020, global inequality grew more rapidly than at any time since WW2. The richest 10% of the global population currently takes 52% of global income, whereas the poorest half of the population earns 8.5% of it. Billions of

[1] From a speech at the UN headquarters commenting on data released by the European Union and the World Meteorological Organization, declaring July [2023] set to be the hottest month on record. (https://www.un.org/sg/en/content/sg/speeches/2023-07-27/secretary-generals-opening-remarks-press-conference-climate). The global average temperature for July 2023 is confirmed to be the highest on record for any month (https://climate.copernicus.eu/climate-bulletins).

[2] https://equalshope.org/index.php/2023/07/17/setting-serious-goals-to-combat-inequality/

> people face the terrible hardship of high and rising food prices and hunger, whilst the number of billionaires has doubled in the last decade.

The present study aims to explore the probable effects of a policy aiming to address both the climate and inequality crises simultaneously. The policy consists in the global regulation of the right to pollute the atmosphere through the allocation of individual tradable quotas for the emission of greenhouse gases.

The idea of equal rights to a common resource such as the atmosphere was the basis of Barnes's (2006) proposal of establishing a common asset trust fund whose (net) incomes for the sale of emission permits would be equally distributed among US citizens. Since the 1980s in the US such an institution, the Alaska Permanent Fund, manages that state's oil resources and distributes dividends among its inhabitants.

At first sight, the idea of a common asset fund looks like an equitable and effective managing system for controlling climate warming. Alas no country, even the big emitter US, can by itself notably influence the level of global emissions. The idea of a regulatory common asset fund, however, once generalized to the global level, may indeed be a realistic and viable solution to our present planetary "tragedy of the commons" (Buzaglo 2007). Such a generalized global common asset system was proposed by Peter Barnes and other authors (including "economics Nobel prize" Elinor Ostrom) in Barnes et al. (2008). Their proposed *Earth Atmospheric Trust* would auction off all greenhouse gas emission permits and allow trading among permit holders, progressively reducing the total volume of permits over time. Half of the revenues would be distributed among the earth's inhabitants, and half devoted to green investments. The dividend to be distributed, estimated to be between 100 to 405 dollars (current dollars of 2024) per capita per year (corresponding to lowest and highest assumed carbon prices), would be "… insignificant to the rich but will be enough to be of real benefit to many of the world's poor people."

Barnes et al. (2008) results are based on a rough "back-of-the-envelope calculation." As such, they rely on a few simplified assumptions, which may be closer to the real world than that of artificially sophisticated delusional models.

The present study is also a (somewhat more elaborated) back-of-the-envelope calculation. It does not try to trace all the imaginable repercussions throughout the world economy of introducing an effective and equitable emissions rationing system. It concentrates instead on the effects on the distributional aspects of the problem.

A clear and generally acceptable distributional approach is an unavoidable necessary condition for the political viability of any successful system of control of greenhouse gas emissions.

Analyses of the distributional consequences of different approaches to confronting climate change have been largely lacking in the policy discussion. Avoidance of the "sensitive" and "controversial" distributional aspects – an inconvenient topic for the prevailing interests – has been detrimental to the possibility of advancing toward a globally acceptable solution.

The notion that the atmosphere is a global common resource, a global commons, is a universally acceptable principle. An approach to a solution based on the recognition of such a universally acceptable principle implies the recognition of equal rights to the atmospheric commons by all participants.

Open and clear recognition of equal rights to the atmospheric commons leads naturally to the principle of equal emission rights of greenhouse gases for all. Everybody is entitled to the same share of the world's total sustainable amount of emissions. Every person has the same right to emit a definite amount of greenhouse gases, the same quota.

Desired emission quantities, related to different income levels, differ among persons. Some will emit below, others above the emission quotas. In the system proposed here emission quotas are tradable at a global *Climate Emergency Exchange* (or simply *Carbon Exchange*) market. In the Carbon Exchange high income/emission individuals, emitting more than their allotted quota, are buyers of emission rights (demand). Lower income/emission individuals, emitting less than their allotted quota, are sellers of emission rights (supply). The mission of the emission rights market is to find the equilibrium price, at which supply equals demand.

The fact that the carbon price is based on the personal decisions of individuals is the specific difference of the model proposed here. It differs from its closest relative, the Barnes et al. (2008) scheme, in that emission permits are not auctioned among intermediate emitters (producers, firms), but are traded between final users (individual consumers and public entities according to their constituencies). There is a direct connection between consumption, emission, and cost to the consumer, as every good and service has an "emissions tag" that indicates the cumulative amount of emissions incurred along its production, in a way similar to the cumulative determination of the value added tax.

Presented as economically and ethically superior, this scheme was still considered futuristic in Buzaglo (2009). Since then, the permanent revolution in information and communication technologies has made its implementation perfectly feasible, and not particularly complex or demanding in comparison with existing large systems. One can only hope that this or some other similar system will not need to wait until "… we reach a tipping point that opens a window of opportunity for embracing major changes," as put by Barnes et al. (2008).

Logical structure of the calculation

Our back-of-the-envelope model of global trading of personal emission quotas has a simple structure, made possible by the relatively recent research on the global distribution of incomes and greenhouse gas emissions by Chancel and Piketty (2015), updated and extended by Kartha et al. (2020) and Khalfan et al. (2023).

With global distribution data on emissions, with data on the science-based time path of total emissions that is consistent with keeping global warming below 1,5 degrees, and data on the expected increase in world population, we can take the first step in the logical chain of the recursive model.

Global emissions are (expected to be) 59,1 billion tons CO2e (CO2 equivalent) in 2024 – a more than 30 percent increase since Barnes et al. (2008) 16 years ago. They should decrease by 2/3, to 18,3 billion tons in 2040. The world population is today 8,1 billion, and is expected to be 9,2 billion in 2040. Given the path of sustainable global emissions, and the expected path of demographic growth, the permissible level of the individual quotas is 7,3 tons per capita in 2024; 6,7 in 2025; etc. (More details on the data and its sources in the following section.)

Given the total level of sustainable emissions, knowledge of the world distribution of emissions allows for determining the expected level of emissions by group of emitters (how much do emit the top 10 percent, the middle 40 percent, and the bottom 50 percent). Because of the extreme inequality of world

incomes and emissions, the average top 10 percent person emits much more than his/her quota, the middle group person is more or less in balance, and the bottom 50 percent individual has a large excedent. Persons of the bottom 50 percent group are sellers of emission rights, the top 10 percenters are big buyers, and the 40 percenters are small quantity buyers. Their demands and supplies meet each other at the Carbon Exchange, where the price of a unit CO2e gas emission right is determined.

The initial (2024) price is one of the given initial conditions of the simulation. (In the next section we explain in detail the basis of the choice of 50 USD as the initial price.) When the price is 50 USD, supply/sales by the bottom 50 percent emitters equals demand/purchases by the 10 + 40 percent top and middle emitters. The quantities sold times the price represent the increase in the incomes of the bottom group; the quantities purchased times the price represent the decrease in the incomes of the top and middle groups, motivated by the exchange.

There are thus changes to the initial, known global income distribution. These changes are traced by computing – given the expected trajectory of world income – the total incomes of each income group. The seller's group incomes are increased by the amount of sales, and the buyer's group incomes are decreased by the amount of purchases. These changed amounts, in relation to world income, make the global income distribution of the next period.

We have thus a change in the income distribution: an increase in the income share of the bottom 50 percent, and a decrease in the shares of the 10 and 40 percent top and middle income earners.

Incomes and emissions are related; a change in income causes a change in quantities emitted. A standard assumption about the association between income levels and gas emissions is that a percentual change in income is related to the percentual change in emissions by a constant elasticity. We adopt a plausible value of 1 for the income elasticity of emissions, close to the levels adopted by Chancel and Piketty (2015) and Kartha (2020). This means that the percentual change of group emissions in the period is equal to the percentual change in the group's income.

We have determined in this way the distribution of incomes and emissions of the next period. Together with the given exogenous data on sustainable world emissions, expected population and world income growth, they are the basis for the calculation of the income and emissions changes of the next period. A critical additional variable is the carbon price.

The model assumes a given carbon price as one of the initial conditions in year 2024. We assume that the price of carbon emission rights, starting from a given initial plausible level of 50 USD per ton, is determined in subsequent periods by supplies and demands in a carbon market. Suppliers in that market are the bottom 50 percent of low emitters. Demand is formed by the members of the 10 and 40 percent groups of high and middle emitters. On supply, we assume an inelastic supply (zero elasticity), as the group is close to subsistence and cannot afford to reduce consumption any further to respond to an increase in the carbon price. About demand, we assume that it is relatively elastic, with elasticity equal to (minus) one, as we consider changes over the relatively long period of one year. That is, the percentual decrease in the quantity demanded is equal to the percentual increase in price. From year to year, as their income and emissions increase, the (vertical) supply by the bottom 50 percent decreases, and the price augments (along the minus one elasticity demand curve). More inelastic (closer to zero) values for the elasticity of demand will result in steeper price increases and stronger redistributive effects. (More details on the carbon price mechanism in the next section.)

With known values for the income and emissions distributions, given the expected path of global emissions, population, and income, and given the assumed forms of demand and supply functions, we

are ready to calculate the values for the following year, and the next, and recursively so on for the period 2024 to 2040.

Exogenous variables, initial conditions and parameters

We give now some more details about the chosen values of exogenously given variables, initial conditions and parameters used in the calculation.

Sustainable level of global greenhouse gas emissions.
One of the most alarming conclusions of the Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC 2023) is that adverse climate impacts are already more far-reaching and extreme than anticipated. Even limiting global warming to 1,5 degrees will imply serious hardship for hundreds of millions. Should warming reach between 2 and 3 degrees, the West Antarctic and Greenland ice sheets could melt almost completely and irreversibly over many thousands of years, causing sea levels to rise by several meters. The last time global temperatures exceeded 2,5 degrees above pre-industrial levels was more than 3 million years ago.

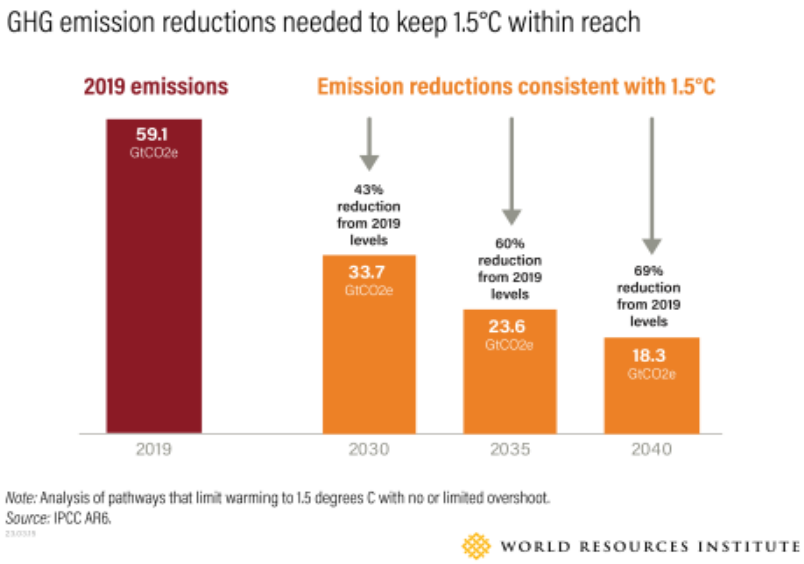
Changing course to limit global warming to 1,5 degrees will require deep emissions reductions in the near-term. Emissions should peak immediately or before 2025 at the latest. They should then drop rapidly, declining by 43 percent by 2030 and 60 percent by 2035 (relative to 2019, expected to be the same as the 2024 level).

In contrast, with the presently existing international approach, if countries achieved their climate pledges (Nationally Determined Contributions), global emissions would be reduced by just 7 percent from 2019 levels by 2030 (Fransen et al. 2022, see also UN 2023) – while a 43 percent reduction is required. A dramatic and immediate change of approach is necessary. By 2040 emissions should have been reduced by 69 percent.

Our simulation adopts the IPCC (2023) science-based emissions trajectory necessary for maintaining global warming below the 1,5 degree's level. The scheme is assumed to be implemented immediately as recommended there. 2024 is the start year, with the allocation of 59,1 billion tons of greenhouse gas emission rights.[3] Permitted global emissions rapidly decline (linearly) to 33,7 billion tons in 2030. They decline thereafter at slower rates, to 23,6 billion tons in 2035, and 18,3 billion in 2040 (see figure 1). 2040 is the final year of our simulation.

[3] Emissions were 59,1 billion tons in 2019 (see figure); they declined during the covid pandemics of 2020, and are expected to be about the 2019 level by 2024.

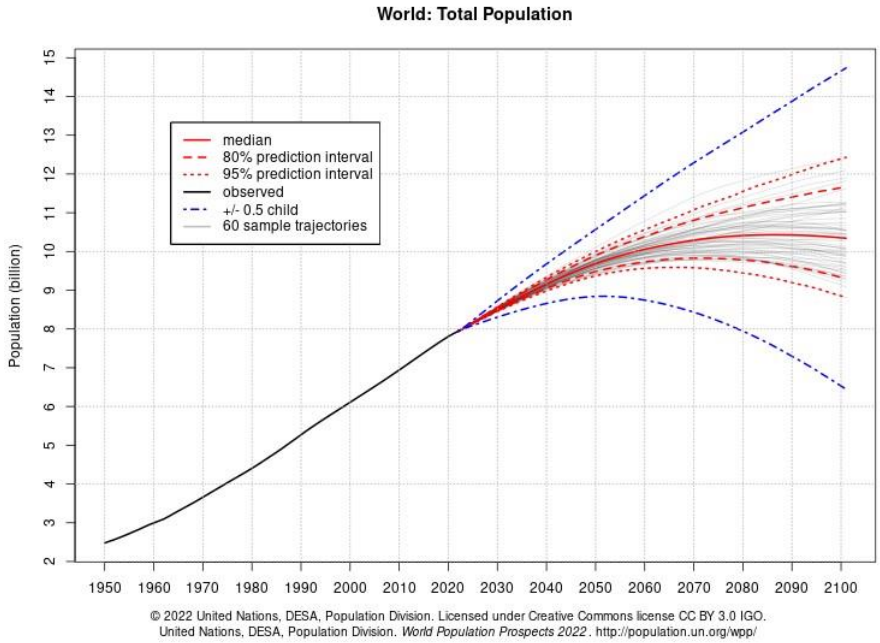
Figure 1.



Evolution of the world population.

World population is another given exogenous variable influencing the behavior of the model over time. Together with the permissible level of emissions, population size determines the quota levels. According to the United Nations World Population Prospects 2022, population in 2024 is 8,1 billion (UN 2022). Given the emission level of 59,1 billion tons in 2024, the resulting emission quota for 2024 should be 7,3 tons per inhabitant.

Figure 2.



From 8,1 billion in 2024 population is expected to increase to 9,2 billion in 2040. Our calculation assumes a linear population growth between those years. With permissible global emissions diminishing, and world population augmenting, emission quotas diminish rather steeply over time.

World income growth.
The pattern of redistribution, together with the global rate of growth, determines the pattern of average income growth of the different income groups. "Paretian redistributions" – that is, redistributions in which there are no declines in average incomes for any income group – require global income growth above a certain threshold.

There are both high and low expectations about future growth in circulation among economists, experts and the general public. There are "pessimistic" expectations of "secular stagnation," and "optimistic" expectations about a high-growth type of technology- and corporations-intensive ecological transformation. The "neutral" assumption of the simulation is that the world rate of growth in 2024-2040 will be the same as the world average growth rate in 2000-2022, that is, 2,9 percent per year (data source: World Bank). Incidentally, this estimate coincides for the first years with the World Economic Outlook: "The baseline forecast is for growth to fall from 3.4 percent in 2022 to 2.8 percent in 2023, before settling at 3.0 percent in 2024." (IMF 2023)

The simulation's initial (2024) expected world income is 105 trillion USD (IMF 2023). World income increases thereafter at the rate of 2,9 percent per year.

Initial carbon price.
Our simulation model posits a known carbon price as one of the initial conditions in year 2024. This initial carbon price has a key influence in the posterior evolution, as it sets the level at which the income redistribution process will proceed over time – the higher the initial price, the larger the value of the quota quantities sold by the bottom 50 percent over time.

In the determination of a plausible initial carbon price, the internationally existing systems, partial and heterogenous as they are, are of no avail: they cover only 15 percent of global emissions and span from less than 1 to 126 USD, and about three-quarters of the emissions that are covered by a carbon price are priced below 10 USD. Of no avail are also the existing "integrated assessment models," as they produce wildly diverse carbon-price trajectories (HLCCP 2017). The High-Level Commission on Carbon Prices chaired by J. Stiglitz and N. Stern however concludes that "…the explicit carbon-price level consistent with achieving the Paris temperature target is at least 40–80 USD by 2020 and 50–100 USD by 2030, provided a supportive policy environment is in place." (HLCCP 2017, p. 3)

For their part, Barnes et al. (2008) had assumed in their calculation a price of between 20 and 80 USD per ton emitted (28 and 113 USD today).

All these considerations taken into account, we choose a price of 50 USD per ton CO2e as the initial value for our central simulation, which aims to be a realistic, or plausible representation of the effects over time (2024-2040) of introducing a global system of individual tradable emission quotas.

The price function.
Our simulation assumes the simplest form of demand and supply functions. Supply is inelastic, that is, quantities supplied by the bottom 50 percent of low emitters, are fixed at the level of their excess emission rights. The demand function is assumed to be a constant elasticity function, of the form:

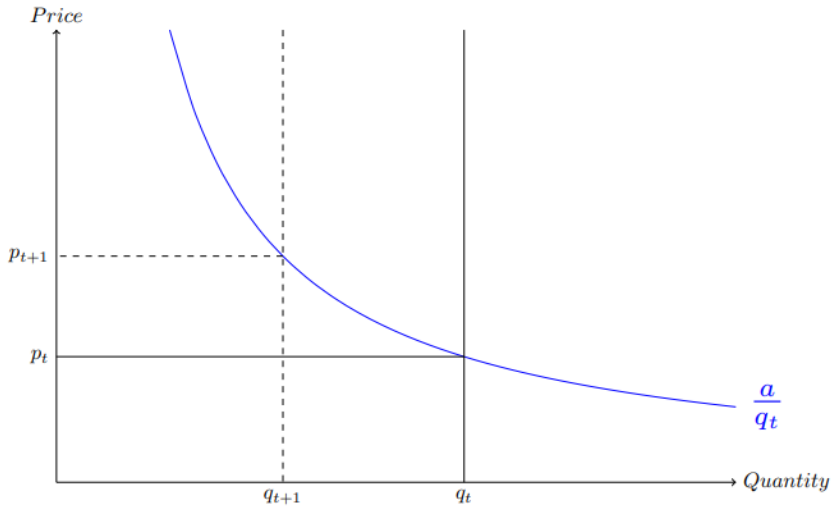
$$q_t = \frac{a}{p_t^{\varepsilon}} ,$$

that is, quantities q_t demanded in period *t* are equal to a constant a times the inverse of the price p in period *t* , raised to the power of ε, the price elasticity. With assumed demand elasticity equal to one, and expressing price as a function of quantity we have:

$$p_t = \frac{a}{q_t} .$$

In each period, given the parameter a, the quantity of rights offered, i.e., the excess emission rights of the bottom 50 percent, determines the price of carbon. With time, quantities supplied decrease, and prices increase (see figure 3).

Figure 3. .



We can see in the carbon price equation that the higher the parameter a, the higher the price. The a parameter indicates the distance of the equilateral demand hyperbola from the origin. If the price in the initial period is as we assume given, and if the supply of rights is given by the model, the parameter a is:

$$a = p_1 q_1 .$$

Given the exogenous initial price of 50 USD and the endogenously generated offered quantity of 25 billion tons in 2024, $a = 1250{,}0$ in the central simulation of the study.

Initial distribution of incomes and emissions.
Initial income and emission shares of the 50 (bottom), 40 (middle), and 10 (top) percent of the world population are provided by Khalfan et al. (2023) for year 2019. We assume that there have not been significant changes in distributions since 2019.

Table 1. Global shares of income and emissions, 2019 (percent)

	Top 10 percent	Middle 40 percent	Bottom 50 percent
Income distribution	55,0	38,0	7,0
Emissions' distribution	49,8	42,5	7,7

Source: Khalfan et al. (2023) (attached document: Data set one).

The world distribution of income is highly concentrated; measured by the Gini coefficient, the world's degree of inequality is close to that of the most unequal country (South Africa). Another intuitive idea of extreme inequality is given by the associated levels of income per capita: the top 10 percent's average income is 39 times the average income of the bottom 50 percent.

The world distribution of emissions among individuals or households follows closely the distribution of incomes. According to Chancel and Piketty (2015), the best way to explain emission variations at the individual or household level is to relate them to variations in income or consumption. They arrive at an average income elasticity of emissions of 0,9 across the studies they review. Kartha et al. (2022) apply the same methodology and arrive to similar results. Our central simulation adopts an elasticity of 1.

Parameters of the central simulation.
We have commented along the text on the adopted values of the different parameters of the calculation model. They are (1) the price elasticities of supply (equal to zero), and demand (minus one), (2) the income elasticity of emissions (equal to one), and (3) the a parameter indicating the level of the demand function (a = 1250). In fact, given the initial carbon price, the a parameter is given.

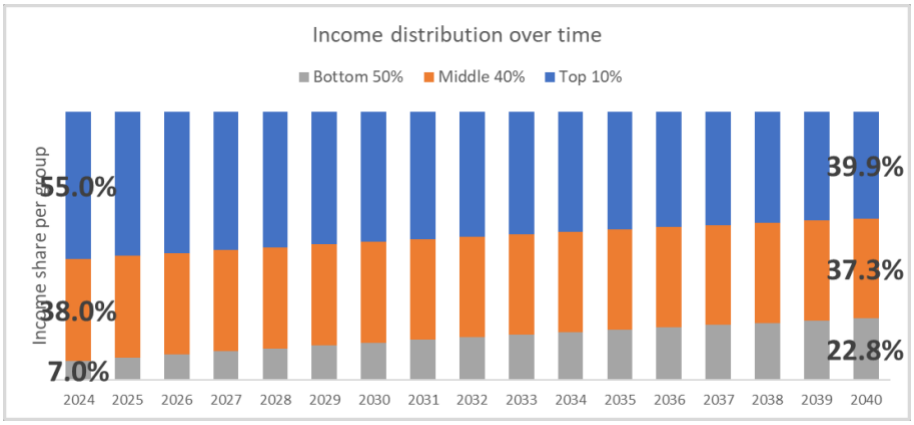
Simulation results

When run with the relations, initial values, and parameters described above, the simulation model gives some encouraging results. The perhaps most interesting result of the individual tradable quota system is the clear effect on the world income distribution.[4]

Global income shares 2024-2040
Global income distribution shows a progressive, clear change away from extreme inequality. If we look at changes from the initial (2024) to the final (2040) distribution we see some interesting characteristics.

[4] The calculation and its results are documented in Excel spreadsheets that can be obtained from the authors by request.

Figure 4.



Source: The authors.

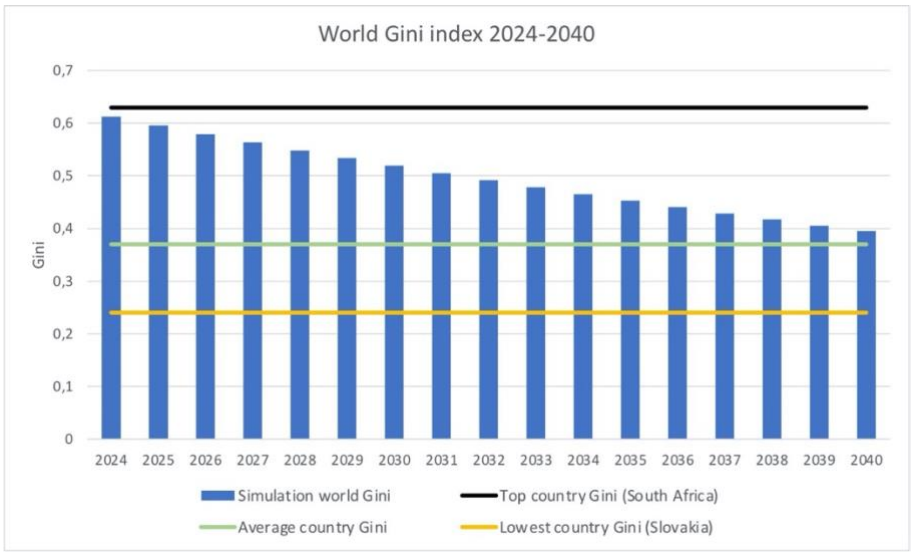
Redistribution proceeds basically between the top 10 percent and the bottom 50 percent group. The 40 percent middle group's share is more or less unchanged.

There are important changes in the shares of the top and bottom groups. The top 10 percent's share decreases by 30 percent, while the share of the bottom 50 percent triplicates. A given percent decrease in the top earners' share implies a much larger percent increase for the low-income group's share. The top 10 percent income group is the main demander of emission rights; the bottom 50 percent group is the only supplier. The middle 40 percent group, a very small demander, keeps its place in the income distribution.

Changes in the global Gini

The Gini index (varying between 0 for total equality and 1 for total inequality) allows for some interesting observations on the changes in the degree of inequality associated with the emergency plan.

Figure 5.



Sources: Authors' calculation of Global Gini, and World Bank for (most recent) country Gini values.

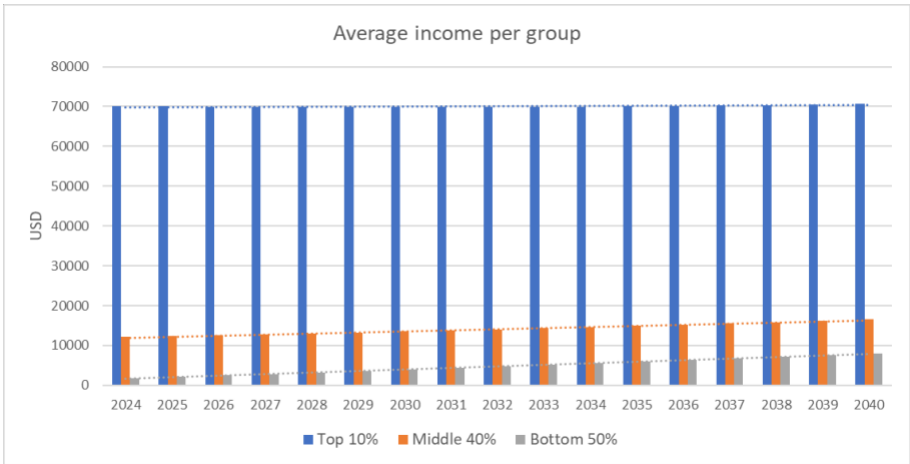
The global Gini of the simulation shows a significant 36 percent decline in inequality between 2024 and 2040. From the present 61 percent, close to the highest country-level of inequality (South Africa, most recent value, 63 percent), it declines to 39 percent in 2040. This later level of inequality is approximately the present country-average level of inequality. Countries such as Latvia, Italy, and Portugal are close to the country-average level of inequality.

Evolution of per capita incomes and quota exchanges

Per capita incomes 2024-2040

The evolution of per capita incomes of the 10, 40, and 50 percent groups over time shows an interesting feature: significant downward redistribution occurs without declines in the average income of any group (see figure). This type of "Paretian redistribution" could potentially increase the acceptability of the scheme among the 10 percent of the world population with the highest incomes. Also, governments in rich countries may be less inclined to oppose tradable quotas schemes than they resist financial support of climate policies in poor countries, understood by them as "aid."[5]

Figure 6.



The importance of the changes in living standards and conditions may be better perceived if we look at the rates of change in per capita incomes for each group from the start to the end of the climate emergency plan.

[5] One could also formulate the converse argument: the implicit subsidization of the emissions of high emitters by low emitters is a form of aid.

Table 2: Average incomes by group

	2024	2040	Annual cumulative growth rate
Top 10 percent	70 074	70 719	0,0 percent
Middle 40 percent	12 102	16 536	1,9 percent
Bottom 50 percent	1 784	8 073	9,9 percent
Ratio top/bottom	39	9	-9,6

Source: The authors

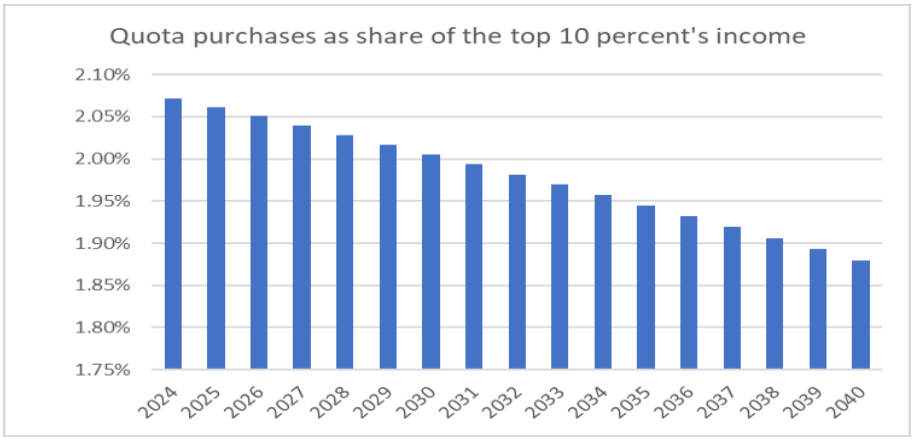
The simulation reveals an important betterment for the poorer half of humankind. The average income of the global 40 percent middle class also increases, although at a somewhat slower rate than the expected world GDP rate of 2,9 percent. The extreme initial disparities in average incomes between the top and bottom groups have been reduced radically (see top/bottom ratios).

The poorer half of world citizens are clear beneficiaries of the individual quota trading system. The 40 percent world middle class also benefits on average – the lower middle class more than the upper middle groups. This makes an important potential majority of at least 50 to 70 percent approval of the scheme. To increase the probability of adoption, it would be necessary that this potential majority becomes a factual majority in the general opinion. It would also be necessary that governments with large majorities pertaining to the world's bottom/middle groups represent the general opinion and interests of their constituencies.

Quota purchases and the top 10 percent incomes

Does this scheme impose an exorbitant, unaffordable cost to the top 10 percent quota buyers? The simulation says no. The purchase of emission rights represents 2,07 percent of the top 10 percent's income in 2024, and decreases gradually to 1,88 percent in the final year of 2040 (see Figure). It does not seem to be an exorbitant price for avoiding the types of scenarios described in the many studies by the climate research community – see for instance one of the latest and largest, IPCC (2023).

Figure 7.

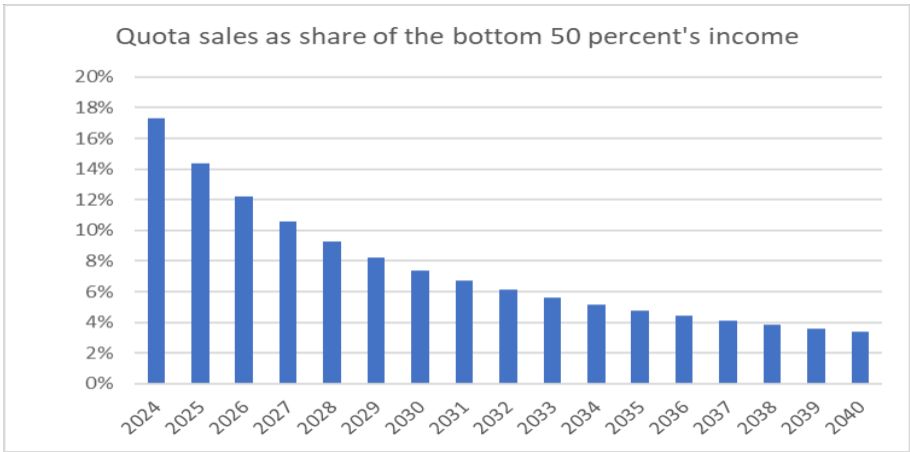


Since 2009, global climate talks have agreed on the mobilization, by 2020, of 100 billion USD a year for developing countries to reduce emissions and adapt to climate change. The 100 billion USD goal has not been reached – in 2020, high income countries provided 83,3 billion USD (IEGCF 2020).[6]
100 billion USD is of course "peanuts" when compared to the (2024) 1 176 billion USD in rights purchases that the 2,07 percent of the top 10 percent's total income (of 56 760 billion USD) represent as income transfer to the bottom 50 percent.

It seems unlikely that the "aid" type of approach by governments permanently confronting "budgetary consolidation" problems may succeed in controlling climate change and/or reducing inequality.

Quota sales and the bottom 50 percent incomes
For the bottom 50 percent group, on the other hand, the sale of emission rights is a relatively important income source.

Figure 8.

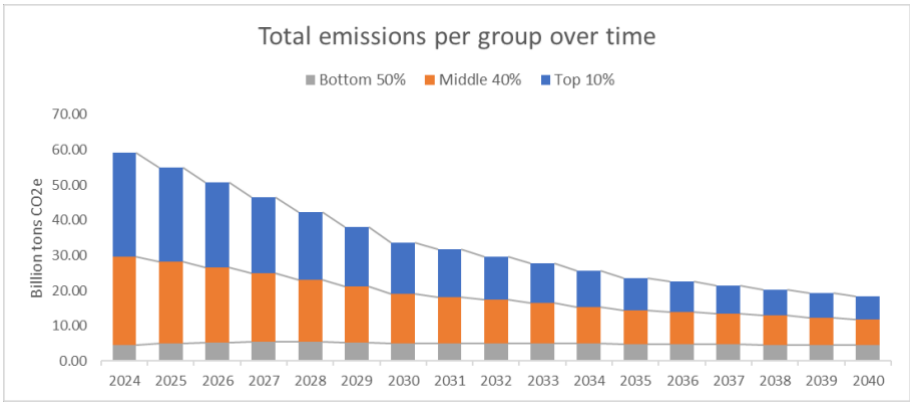


The sale of emission rights by the bottom 50 percent represents an initially important part of their incomes. This share decreases gradually with the increase in their incomes – and emissions.

Emissions over time
Total emissions per group
Total emissions follow the science-based path put forward by IPCC (2023) for emissions to be compatible with the 1,5 degree's target. From present (2024) 59,1 billion tons CO2e, they decline to 33,7 billion in 2030, to 23,6 billion in 2035, and 18,3 in 2040. Of course, this assumes that the quota system has had an intelligent design and was implemented effectively – more on this in the following sections.

[6] Oxfam (2022) estimates the value of climate finance provided was only around a third (USD 21–24,5 billion) of that reported.

Figure 9.



The bottom 50 percent as a group maintains its level of emissions, which means, with a declining permissible total level of emissions, that their share augments over time – from 7 percent in 2024 to 22 percent in 2040 (see table below).

Table 3. Global shares of emissions in 2024 and 2040 (percent)

	Top 10 percent	**Middle 40 percent**	**Bottom 50 percent**
Initial 2024	50	43	8
Final 2040	35	41	24

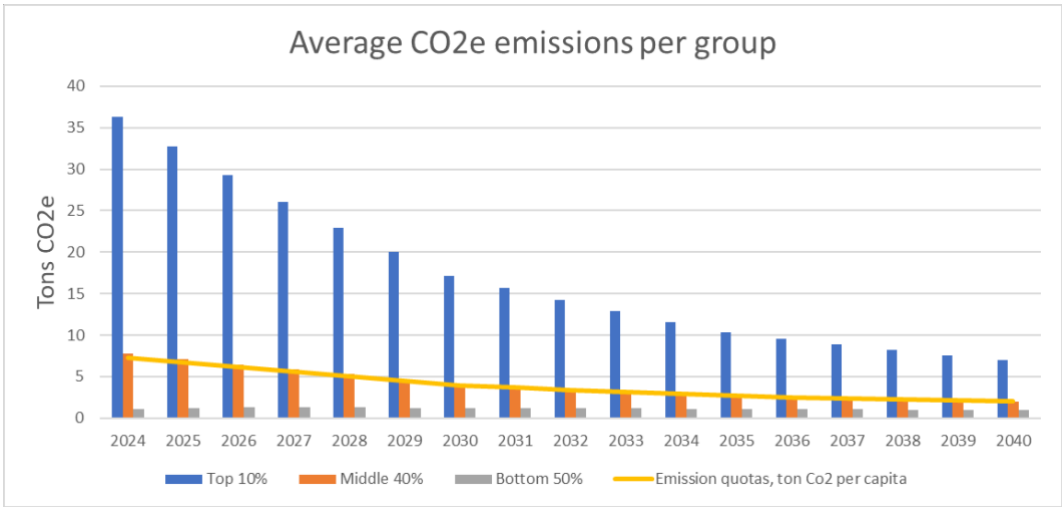
Source: The authors

The level of emissions is closely associated with the income level by the income elasticity of emissions (equal to 1). The distribution among the top, middle and bottom groups of emitters is then similar to the distribution of incomes over time. The middle group's share is more or less unchanged, the bottom group triplicates its share, while the top 10 percent´s share decreases by one-third.

Per capita emissions per group

Most interesting is perhaps to see what happens with the groups' per capita emissions. In 2024 the top 10 percent's per capita emissions are 32 times the average emissions of the bottom group, and 5 times the quota. The emission quota represents the sustainable level of emissions if all individuals were emitting at the same rate. It is a level compatible with the same volume of emissions by all individuals, that is, it is a generalizable level.

Figure 10.



Individual emissions above this level are not generalizable, that is, it is not sustainable, or permissible, for all individuals to emit above this level. Non-generalizable behavior is unethical from the Kantian ethical perspective (the *categorical imperative*). If the (2024) average emission level of the top 10 percent (36,3 tons per person) were to be generalized to the whole world population, the resulting world emissions would be 294 billion tons, five times the present level. Greenhouse gas emissions of 294 billion tons are certainly associated with temperatures incompatible with most life forms on earth.

Such non-generalizable behavior is also unethical from the rather universal "golden rule" perspective: Do not do unto others what you do not want others to do unto you – do not damage the atmosphere of others if you do not want others to damage yours.

The type of quota trade mechanism proposed here solves the ethical dilemma by the consensual exchange of personal quota rights. The top 10 percent emitters are the main purchasers of the emission rights sold by the bottom 50 percent. In the simulation, the 10 percenters' emissions decline steeply, but by 2040 their emissions are still 7 times the average emissions of the bottom group, and more than 3 times the world quota.

Comments on implementation

How probable is the implementation of a climate emergency plan with the characteristics proposed here? Not much, as the opinion of the day is inclined to consider Artificial Intelligence a greater danger for humanity than Artificial Warming or Artificial War. In such conditions, the most probable form of evolution will be dominated by the Hobbesian struggle of states defending what they think are their interests.

This "realist" view, however, can be discarded out of hand. In the present conditions, the Hobbesian path is uninteresting: the triumph of Warming or the victory of War cannot be contemplated, because there is no one there to contemplate. They are paths of annihilation.

That is, we have a certain rational support for the alternative of analyzing the improbable, yet possible and desirable, forms of organizing the establishment of a system capable of rescuing humankind from the danger of climate warming and the scourge of inequality.

The first level of a strategy towards implementation should be the level of research. There is an ample amount of research on the economics of climate warming and how to stop it.[7] This research is currently dominated by narrow national perspectives that do not lead very far. One can even say that this type of research is in part responsible for the lack of progress since climate change became an internationally recognized problem. Global warming is a global problem and the approach should be global. Research of high ethical and scientific standards is needed.

The second level is public opinion. This level is decisive and many movements are flourishing everywhere. These movements are supporting independent research which in turn nourishes advanced and knowledgeable programs for change.

The third level is the level of government. Containing global warming would save all humanity from the risk of catastrophe. Particularly, as we said in a previous section, individual tradable quota systems would economically benefit a clear majority (50-70 percent) of the world population. It would also benefit a majority of the population of a majority of states. A mobilized public opinion in those countries should influence their governments; mobilized governments should influence the United Nations and other international organizations. A vote at the UN General Assembly should demand the introduction of a climate emergency plan with desirable characteristics.

The concrete, implementable form of the system can only be given in sketchy, general lines. Every individual should have a cell phone or electronic card, in which a periodic (daily, weekly or monthly) quota amount (quota x price) is credited. Administrations and public entities are allotted quota amounts in proportion to their constituencies. The price of all final goods and services includes the total accumulated volume of intermediate emissions incurred times carbon price (cumulated emissions incurred in every step of the production process, similar to the value added tax). Individuals with unused quota pay with a discount of the carbon content (CO2e times price). Individuals with exhausted quotas pay the whole price. The price of a unit of CO2e is determined (daily, weekly or monthly) at the global Carbon Exchange, where demand by individuals above their quotas meets supply by individuals below their quotas. The system would also include the supply of negative emissions by different kinds of CO2e absorption investments. The design of the market should block the possibility of speculative manipulation, fraud and the like.

The scheme would induce great changes in economic structures which are outside the scope of our calculations. But increased prices and reduced demand for CO2e-intensive goods and services will induce reductions in those sectors – and the development of new productive alternatives and new technologies. This will create redundancy in contracting sectors and employment opportunities in new branches and expanding sectors. Investment policy should accompany and guide the new structural change, and social and educational policy should help in the reorientation and support of new employment.

The individual tradable quota system will also induce changes in the spatial configuration of the world economy. Redistribution will enlarge the markets of quota net-seller areas, mostly in low- and middle-income economies. A common world price for carbon will induce investment in CO2e absorption in low-cost, impoverished economies, and promote increased efficiency in the spatial allocation of abatement projects.

[7] A broad survey of research in the field (Kangxin et al. 2023) reviews 1002 articles, exclusively based on computable general equilibrium models.

The emergency market plan requires flexible economic structures and institutions. It also assumes effective, enlarged investment policies for structural transformation, and well-designed strategies for supporting redistribution.

Final comments

When presenting their proposal of an Earth Atmospheric Trust (Barnes et al. 2008), the authors were well aware that the control of climate change will require drastic departures from business as usual, and that their idea "may seem idealistic or visionary today, but that could become realistic once we reach a tipping point that opens a window of opportunity for embracing major changes".

It does not seem that a tipping point has been reached yet. Climate warming does not seem to have entered the stage in which the world rapidly evolves into a universal oven. Not yet a tipping point, but very close to it, according to UN Secretary-General António Guterres: "The era of global warming has ended; the era of global boiling has arrived." He says: "Dramatic, immediate climate action is needed." The type of policy analyzed in our study confronts the climate crisis by addressing the inequality crisis. The present "crisis of extreme inequality" described by Jayati Ghosh, Joseph Stiglitz, and others (quoted in the Introduction) must be addressed for the climate crisis to be solved.

In the system proposed in our study, the sustainable world total of emissions is allocated in equal personal quotas to all individuals. All final goods and services have a tag indicating the CO2e content of the item.

In such a system the bottom 50 percent, a very low emitting group, would sell their excess quotas to high emitters and earn an additional income. The top 10 percent of high emitters, would need to buy the quotas above their personal allowances at the for that aim created Carbon Exchange. The middle 40 percent would in most circumstances be more or less in balance.

The system has then potentially the support of the bottom 50 percent, and perhaps also the support of the lower half of the global middle class. It is even possible that many among the richer 10 percent may find that life is more important than privilege, and support the scheme.

The simulation of such an emergency plan against global warming and inequality shows that, if carefully implemented, it would produce some hopeful effects. Global income distribution, initially (2024) as unequal as that of the most unequal among countries, is gradually reduced to the country-average level of inequality – a 36 percent decline in inequality as measured by the Gini coefficient. Also interesting is that the redistribution process can be considered "Pareto sanctioned," as it does not imply the decline of the average income of any group – while the average income of the bottom group increases by a factor of 4,5.

That is, the sale of emission rights implies an important increase in the average earnings of the bottom 50 percent group – it represents (in 2024) 16 percent of their income, or about 309 USD a year per person.[8] As the incomes of the bottom group increase, the sale of emission rights declines over time as a share, but not in absolute terms.

[8] For the 648 million persons below the extreme poverty line of 2,15 USD a day it would represent about 39 percent of their incomes in average (https://www.worldbank.org/en/news/factsheet/2022/05/02/fact-sheet-an-adjustment-to-global-poverty-lines#2).

Our results are based on the reduction path for CO2e emissions compatible with keeping global warming below 1,5 degrees put forward by the Intergovernmental Panel on Climate Change (IPCC 2023), produced by hundreds of scientists and experts. The quotas distributed among the world population are equal shares of that total emissions' path. Our calculations assume that the system put in place – similar to the value added tax – is an effective one, with minimal filtrations. The same applies to the Carbon Exchange, which should not be susceptible to manipulations of any kind.

The quota system, under these effectiveness assumptions, ensures that total CO2e emissions follow the sustainability trajectory. Income redistribution through sales and purchases of emission rights at the Carbon Exchange produces changes in the distribution of emissions. The emission share of the top 10 percent declines gradually, by one-third in 2024-2040, while the bottom 50 percent's share increases by a factor of 3 – although the level of emissions of the group is constant. The reduction of emissions occurs basically among the top 10 percent group – and much less so among the 40 percent's group.

This puts on the emergency plan an ethical seal of approval. Individual emissions above the generalizable level of the emission quota – that is, above sustainable levels of individual emissions – infringe widely accepted ethical rules such as the Kantian *categorical imperative* or the universal "golden rule." The emergency plan's reduction of emissions occurs among the top 10 percent, whose emissions are far over the sustainable quota level – 4 times the quota in 2024, and 3 times in 2040.

Our study did not focus on the effects of the emergency plan on the distribution of incomes and emissions in particular countries. Yet the redistributive process initiated at the global level by the emergency plan produces simultaneous effects at the level of national economies. Individuals belonging to the global top 10 percent of buyers are citizens of diverse countries; the bottom 50 percent of sellers are citizens of many countries. Countries with high inequality levels experience larger reductions in inequality than more equal economies. Large "exports" of emission rights by low-income countries may significantly increase their national incomes. To more precisely determine how the redistributive process proceeds in every country could be the object of further research.

References

Barnes, P. (2006) *Capitalism 3.0. A guide to reclaiming the commons*. Barret-Koehler Publishers, San Francisco.

Barnes, P., R. Costanza, P. Hawken, D. Orr, E. Ostrom, A. Umaña, O. Young (2008) "Creating an Earth Atmospheric Trust," *Science* 2008 Feb 8;319(5864):724. doi: 10.1126/science.319.5864.724b.

Buzaglo, J. (2007) "Climate change, global ethics and the market," *post-autistic economics review*, issue no. 44, 9 December 2007, pp. 19-22, http://www.paecon.net/PAEReview/issue44/Buzaglo44.pdf.

Buzaglo, J. (2009) "Global commons and common sense," *real-world economics review,* issue no. 51, 1 December 2009, pp. 10-27*,* http://www.paecon.net/PAEReview/issue51/Buzaglo51.pdf.

Chancel, L. and T. Piketty (2015). Carbon and Inequality: From Kyoto to Paris – Trends in the global inequality of carbon emissions (1998-2013) and prospects for an equitable adaptation fund. WID.world Working Paper Series 2015/7. http://rgdoi.net/10.13140/RG.2.1.3536.0082.

Fransen, T., C. Henderson, R. O'Connor, N. Alayza, M. Caldwell, S. Chakrabarty, A. Dixit, M. Finch, A. Kustar, P. Langer, F. Stolle, G. Walls, and B. Welle (2022) "The State of Nationally Determined Contributions: 2022." Report. Washington, DC: World Resources Institute. doi.org/10.46830/wrirpt.22.00043.

HLCCP (High-Level Commission on Carbon Prices) (2017) Report of the High-Level Commission on Carbon Prices. Washington, World Bank.

IEGCF (The Independent Expert Group on Climate Finance: A. Bhattacharya, R. Calland, A. Averchenkova, L. González, L. Martínez-Días, J. van Rooij) (2020) Delivering on the $100 billion Climate Finance Commitment and Transforming Climate Finance. https://www.un.org/sites/un2.un.org/files/2020/12/100_billion_climate_finance_report.pdf

IMF (International Monetary Fund) (2023) World Economic Outlook. A Rocky Recovery. Washington.

IPCC (Intergovernmental Panel on Climate Change) (2023). AR6 Synthesis Report. Climate Change 2023. https://www.ipcc.ch/report/ar6/syr/.

Kangxin An, Shihui Zhang, Jiaxin Zhou and Can Wang (2023) "How can computable general equilibrium models serve low-carbon policy? A systematic review," *Environmental Research Letters* 18. https://iopscience.iop.org/article/10.1088/1748-9326/acbbe2/pdf.

Kartha, S., E. Kemp-Benedict, E. Ghosh, A. Nazareth and T. Gore (2020) The Carbon Inequality Era. An assessment of the global distribution of consumption emissions among individuals from 1990 to 2015 and beyond. Joint Research Report: Oxfam and Stockholm Environment Institute. https://www.sei.org/wp-content/uploads/2020/09/research-report-carbon-inequality-era.pdf.

Khalfan, A., A. Nilsson Lewis, C. Aguilar, M. Lawson, S. Jayoussi, J. Persson, N. Dabi, S. Acharya (2023) Climate Equality: A planet for the 99%. Oxfam International. DOI 10.21201/2023.000001.

Oxfam (2022) Climate finance short-changed. The real value of the $100 billion commitment in 2019–20. https://policy-practice.oxfam.org/resources/climate-finance-short-changed-the-real-value-of-the-100-billion-commitment-in-2-621426/.

UN (United Nations) (2022) World Population Prospects 2022. https://population.un.org/wpp/.

UN (United Nations) (2023) Nationally determined contributions under the Paris Agreement. Synthesis report by the secretariat. United Nations Framework Convention on Climate Change. FCCC/PA/CMA/2023/12. https://unfccc.int/sites/default/files/resource/cma2023_12.pdf.

Author contact: j.buzaglo@telia.com

SUGGESTED CITATION:
Jorge Buzaglo and Leo Buzaglo Olofsgård, "Addressing the climate and inequality crises: An emergency market plan simulation", *real-world economics review*, issue no. 107, March 2024, pp. 21–39, http://www.paecon.net/PAEReview/issue107/BuzagloOlofsgard107

You may post and read comments on this paper at http://rwer.wordpress.com/comments-on-rwer-issue-no-107/