An equitable and effective climate regime

Abstract

Sharing the burden of emissions reduction has turned into a permanent impasse between developed and developing parties to the Climate Convention which is crippling its effectiveness; performance of the post-Kyoto climate regime must improve dramatically if climate is to be timely stabilized. This analysis shows that there is no essential reason for the impasse as emissions are mostly driven by richer individuals globally and not by developed countries per se. Signatory governments should focus instead on approaches for reducing emissions by richer populations globally, irrespective of countries. A system of per-capita emissions allowance is proposed to directly limiting emissions at individual level. Inherent advantages are effectiveness, equity and transparency. The scale and complexity of managing individual emissions could be streamlined such that its practicability favorably compares to that of the Kyoto flexibility mechanisms and possible successors.

Keywords: climate regime; negotiations; renewable energy; technological innovation; emission allowances; equity

1. An enormous gap

Greenhouse gas emissions are still out of control, despite the Climate Convention that entered into force 15 years ago. The very essence of the Convention and its Kyoto Protocol is reducing emissions to safer levels. However, how to share the burden between countries (or rather, between signatory governments) has been a permanent impasse for achieving any significant progress in emissions reductions. So far binding commitments are hardly more than symbolic and apply to developed countries only.

Stabilizing atmospheric CO2 concentrations today would require reducing anthropogenic carbon emissions from the current 10 billion tons per year (Global Carbon Project, 2008) to less than 5 billion, assuming that the rest is absorbed by natural sinks with no further environmental consequences. A perfect compliance of the Kyoto Protocol would reduce annual carbon emissions by 165 million tons at most (own estimate based on UNFCCC Secretariat, 2007). Clearly, the gap between what Kyoto could achieve in practice and real reduction needs is enormous. Performance of any post-Kyoto climate regime must improve dramatically if greenhouse concentrations are to be timely stabilized.

2. Renewable energy and technology not enough

Curbing emissions at its root –the consumers– is becoming crucial as more evidence emerges on the serious limitations of renewable energy and new technologies in supporting current consumption patterns while reducing emissions to the required levels.

One of the best case studies concludes that decarbonising the British economy in a sustainable way seems almost impracticable (MacKay, 2008). The average per-capita consumption of the United Kingdom (195 kWh/p/d[1]) could in principle be almost matched with about 180 kWh/p/d of renewable energy supply as follows, social and economic constrains aside:

Onshore wind energy: covering the windiest 10% of the country's land with windmills would generate 20 kWh/p/d (11% of the demand).

Solar thermal energy: covering all south-facing roofs in the country with solar panels to produce hot water would deliver 13 kWh/p/d (7% of demand).

Solar photovoltaic panels: assuming that all the above south-facing roofs could accommodate photovoltaic panels at the same time, these would produce 5 kWh/p/d (3% of the demand).

Solar photovoltaic farm: covering 5% of the country's land with photovoltaic panels would generate 50 kWh/p/d (28% of demand).

Solar biomass energy: growing biomass in 75% of the land would produce 24 kWh/p/d (14% of demand).

Hydropower: assuming an exploitation of rainfall with 20% efficiency, the British hydropower production would be boosted from the present 0.2 kWh/p/d to 1.5 kWh/p/d (1% of demand).

[1] Kilowatt-hours per person per day. Note that this measure not only includes electricity but all forms of energy.

Shallow offshore wind energy: covering 33% of British shallow waters (13.000 km^2) with windmills would generate 16 kWh/p/d (9% of demand).

Deep offshore wind energy: covering 33% of British deep waters (26.000 km^2) with windmills would generate 32 kWh/p/d (18% of demand).

Wave power: packing wave-machines along 500 km of the British Atlantic-facing coastline would generate 4 kWh/p/d (2% of demand).

Tidal power: the estimated output of preliminary proposals for tidal barrage, lagoon and stream farms is 11 kWh/p/d (6% of demand).

Geothermal energy: although most of the dry-rock resource in the UK is considered technically unfeasible, its contribution was estimated at 1.1 kWh/p/d (1% of demand).

In summary, the above initial approach would take 10% of UK land for windfarms, 5% for photovoltaic panels, 75% for biomass plantations, and all south-facing roofs for solar panels. Another 39,000 km^2 of sea are required for offshore windfarms, and 500 km of coastline for wave power. Huge areas are also needed for tidal power (above 10,000 km2) and for geothermal energy facilities. This enormous demand for space is inherent to renewable energies and originates in their very low "areal" density (e.g. watts per square meter); in other words, although the technology of extracting energy may eventually improve, the very low energy density will ultimately demand huge areas anyway.

MacKay describes six plans to make the above approach technically realistic by 2050, each trying to satisfy a different sector of the British society. All the plans include technological improvements on the consumption side. Individual and public transport is largely electrified, and liquid biofuels are used for vehicles that cannot operate on electricity. Heating demand is reduced by improving insulation in houses and buildings, and by using heat pumps, solar heating and biomass. Efficiency improvements in lighting and domestic appliances are considered, but offset by consumption of new consumer devices. The latter assumption is in line with the finding that new electronic devices have wiped out gains in energy efficiency achieved in residential appliances and lighting (International Energy Agency, 2009).

Areas and rough costs of energy facilities were estimated only for Plan M ("middle") as follows:

Onshore wind	5,200 km2, £27 billion
Offshore wind	2,900 km2, £36 billion
Pumped storage	15 facilities, £15 billion
Photovoltaic	1,000 km2, £190 billion
Solar water heaters	60km2, £72 billion
Waste incinerators	100 units, £8.5 billion
Heat pumps	£60 billion
Wave	130 km, £6 billion
Barrage	550 km2, £15 billion
Tidal lagoons	800 km2, £2.6
Tidal stream	2,000 km2, £21 billion
Nuclear fission power	40 stations, £60 billion

Clean coal[2]	£16 billion
Solar power	2,700 km2 North Africa, £340 billion
Power line	3,200 km (for solar power), £2 billion
Biofuel plantations	30,000 km2, --
Wood plantations	31,000 km2, --
Total cost	£871 billion

The size of renewable energy facilities remains enormous, even when combined with controversial "clean" technologies like nuclear fission and clean coal, and despite technological improvements in the consumption side. The cost of Plan M is equally enormous.

While a complete replacement of fossil fuels by nuclear fission power is in principle practicable (MacKay, 2008), the safety and security implications of such switch are very controversial. In any case, the fact remains that any episode, either accidental or intentional, leading to radioactive release has severe long-term impacts on the environment.

Evidently, the only environmentally sound option left to fill in the gap is a change in lifestyle by richer consumers; but the gap is so significant that direct limitation of emissions seems the only practicable way to achieving the required emission reductions.

3. An unjustified impasse

There are no strong indications at present climate negotiations that the burden-sharing impasse will be overcome for the post-Kyoto regime. Developed countries are not willing to accept the required major commitments unless developing countries take some initial binding commitments. But developing countries are reluctant given their hitherto minor contribution to global warming and the lack of progress by developed countries.

Regrettably, the rationale behind the impasse is not well sustained by reality on the ground. It is richer individuals from both developed and developing countries, and not developed countries per se, who have major historical responsibility and contribute most to global warming.

Moreover, it is not governments but individuals who are driving emissions by emitting directly (e.g. by burning fossil fuels), and/or indirectly by consuming a myriad of goods and services (e.g. electricity, transportation, food, water) that cause emissions during their production and supply.

From this perspective, the direct burden of significantly reducing emissions should be on the individuals driving the emissions and not on the Convention's signatory governments. The role of governments should be to implement and regulate systems to directly limit emissions by individuals.

4. Emissions and equity

The Kyoto Protocol sets reduction commitments for developed (Annex 1) parties relative to their emissions in 1990. The commitment varies from party to party in the

[2] Clean coal in this context means coal power stations with carbon capture and storage.

range of -10% to 8%, and should be achieved in the period 2008-2012. Developing (non-Annex 1) parties have no reduction commitments under the Kyoto Protocol.

It is important to realize that commitments set in the Kyoto Protocol imply in fact emission rights for developed parties, ranging from 92% to 110% of their 1990 emissions. By setting reductions on absolute emissions, the Protocol is implicitly granting inequitable per-capita emission rights, not only between developed parties but especially to most developing parties. Such distribution not only contradicts the Universal Declaration of Human Rights (United Nations, 1948), which proclaims that all human beings are equal in rights, but also the Climate Convention, which states that the parties should protect the climate system on the basis of equity.

The inequity and its related debt are better illustrated through figures (own estimates based on IEA 2008, IEA 2009, IMF 2009, UNFCCC 2009 and U.S. Congress 2009). Unless noted otherwise, the following figures correspond to CO2 emissions from non-LULUCF[3] sources for developed countries, and from combustion of fossil fuels for developing countries.

For the period 2008-2012, annual emission rights of developed parties are 9.7 tonnes per capita. By comparison, annual emissions of the United States (not a Kyoto party) are 22.6 tonnes per capita, and equitable emission rights (i.e. total emissions of all parties divided by total population of all parties) are only 4.8 tonnes. Annual emissions of the 95 developing parties included in the estimation are 2.8 tonnes per capita.

A new climate treaty for the period 2013-2020 based on the Kyoto Protocol's architecture, be it the Copenhagen Accord or an extension of the Kyoto Protocol, would grant Annex 1 parties (United States included) annual emission rights of 10.7 tonnes per capita, while equitable emission rights are only 4.7 tonnes. Annual emissions of the 95 developing parties are 3.3 tonnes per capita.

As a result of this inequitable allocation of emission rights, in the period 2013-2020 developing parties would lose 61 billion tonnes in CO2 trading.

In summary, the Kyoto Protocol and any new climate treaty based on its architecture are inherently inequitable in terms of per-capita emissions.

While the Kyoto Protocol formally grants inequitable emission rights to developed parties, inequity in per-capita emissions has persisted for many years.

For the sake of illustration, emission debts and credits between the parties were estimated for CO2 emissions from combustion of fossil fuels since the entry in force of the Climate Convention (~1995) until 2007, just before the start of the Kyoto Protocol's commitment period (own estimates based on IEA 2008).

The net debt of developed parties for the period 1995-2007 reaches 116 billion tonnes, amount which of course corresponds to the net credits developing parties are entitled to.

Developed parties will also acquire an emission debt originated in the inequitable emission rights granted by the Kyoto Protocol. The debt acquired by the United States (not a Kyoto party) originates in its emissions over the equitable right.

[3] LULUCF: land use, land-use change and forestry.

The resulting net debt of developed parties for the period 2008-2012 is estimated at 52.8 billion tonnes while net credits developing parties are entitled to amount to 52.6 billion tonnes. (Own estimate based on IEA 2008, IEA 2009, IMF 2009, UNFCCC 2009 and U.S. Congress 2009).

5. An equitable and effective climate regime

Governments, and climate negotiators in particular, should realize that there is no point in blaming other countries for emitting more or doing less, and that efforts should focus on reducing emissions by richer populations, irrespective of countries.

Besides causing an impasse on how to share the burden, the architecture of the Kyoto climate regime has other unwanted side effects, inter alia:

- Implicit allocation of emission rights on an inequitable basis (as discussed in section 4 above).
- Unfair emissions-reduction burden on poorer people in developed countries, and conversely carte blanche to richer individuals in developing countries.
- Unfair emissions-reduction burden on producers of exported goods, and carte blanche to consumers of such goods in third countries.
- Ineffectiveness in reducing emissions on the ground: governments are left on their own to achieving the committed reductions.

The above problems could be overcome by transitioning to a climate regime based on per-capita emissions allowances. For the sake of equity henceforth, every human being should be granted the right to generate the same amount of (direct plus indirect) emissions, irrespective of the country she/he lives in.

An equitable climate regime requires two components: an international climate treaty where emissions allowances of all parties are proportional to their population –the proportion being a unique global per-capita allowance–, instead of historical emissions decreased by reduction commitments for developed parties only; and national systems where emissions of individuals are managed to comply with said global per-capita allowance.

While an equal emissions allowance may not be immediately practicable across developing and developed parties, this should be the equitable goal in the near future.

Any initially agreed global per-capita emissions allowance could be gradually reduced over time as required by any stabilization trajectory of greenhouse gas concentrations adopted by the Climate Convention's parties.

For the sake of equity and transparency, allocation of emissions allowances should by definition be fixed and equal for all individuals in any country. Better fit to every person's needs should be provided by national trading of unused allowances among individuals.

Similarly, allowance trading between countries should provide flexible distribution of the allocated allowances. It is to be expected that developed countries will require more allowances, and developing countries less allowances, than those allocated on a per-capita basis. The total amount of allowances globally should of course remain constant, despite of trading among countries, and trading among individuals in any country.

Since most emissions are caused by the richer minority, allocating emissions allowances only to richer individuals would deliver most of the reductions. The downside however is inequity against the poorer majority, and short supply of unused allowances for trading. Widening the allocation to poorer individuals would secure sufficient supply of unused allowances, and even provide a source of additional income or finance better life conditions for the poorer.

It is important to note that national systems for managing individual emissions do require that an equitable climate treaty is in place, and equitable allowance trading between parties is operational. Otherwise, developed parties would not be able to supply enough unused allowances as the majority of population has emissions well above the equitable level; conversely, developing parties would not be in position of selling all the allowances that most of their population is not able to use.

The imbalanced benefits of historical emissions by countries that exceeded their equitable share could be converted into emission credits for countries that emitted less than the equitable level. Historical emission credits could have an important role in compensating the declining amount of unused allowances. Every party having credits would decide on a crediting period long enough to prepare itself for major cuts in global emissions, with yearly increases that compensate the expected reduction of unused emissions allowances.

6. Implementing per-capita emissions allowances

It could be argued that implementing a system for managing emissions from every individual in a country is hardly practicable. There are two main aspects to consider: the scale of the system (millions of individuals) and the complexity of tracked variables (a myriad of uses, goods and services with different emission factors). However, if emissions allowances are monetized, crediting and debiting allowances could be easily achieved through money accounts, in the same way as money is credited to and debited from normal personal accounts; an early outline of such system is presented below. The complexity of tracked variables could be streamlined by targeting the minority of uses, goods and services that accounts for most of the emissions. A concerted common effort by signatory governments could also significantly contribute to making the implementation of said system practicable and affordable, especially for less developed countries.

It should be noted that a climate regime built on the Kyoto Protocol’s architecture has also implementation complexities of its own. In fact successfully implementing the Kyoto flexibility mechanisms, or their possible successors, is seemingly more difficult than implementing the more straightforward and transparent per-capita allowances system once streamlined as suggested above.

The implementation and running costs of national systems for managing individual emissions, including national designated authorities, could be paid from the trading of allowances, for example through a fee on each transaction.

The designated national authority for the national system should be designated by the government of the country. This role could be taken by existing agencies or authorities already dealing with operational matters of the Climate Convention in the country. In developing countries hosting projects within the Clean Development Mechanism

(CDM), already existing Designated National Authorities (DNAs) for the CDM could operate the national systems. Since new CDM projects would become redundant under the proposed allowance trading system, this new role would permit keeping the DNAs while using their existing expertise.

In order to avoid unwanted political effects, the introduction of per-capita emissions allowances in a country should be preceded by a public information campaign explaining the reasons for and the operation of the system. Even as important is raising awareness and conducting debates among politicians, public opinion leaders, and representatives of main sectors of the society as to gain early acceptance for the system.

The implementation of per-capita emissions allowances needs further research, while building on relevant results of previous research (see for example Centre of Science and Environment, 1998; Meyer, 2000).

The following is an early outline of how the system would work in a developed country:

1) A total emissions allowance is allocated to the country at the beginning of each commitment period by a competent international authority (such as the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC)), according to the global emissions reduction target and the resulting global per-capita allowance agreed by the parties for said commitment period. The total allowance for the country is simply the global per-capita allowance multiplied by the number of inhabitants of the country.

2) The international price of emissions allowances is agreed annually by the parties, as to provide sufficient incentive to countries to reduce emissions without placing excessive burden on the world economy. Similarly, the national price of emissions allowances is set by the designated national authority, as to provide sufficient incentive for consumers to switch to less emitting uses, products and services; for producers and suppliers to lowering emissions content in their products and services; and for technology developers to come with new low-emissions solutions; while avoiding excessive burden on the national economy.

   It could be argued that prices of emissions should be set by the market in order to avoid trade distortions. The author is of the opinion that free markets are not the best way to address emergencies. Since trading of emissions allowances is just a mechanism to share equitably the significant burden of avoiding an imminent environmental emergency, emissions allowances are not ordinary goods traded in free markets. Trading of emissions allowances must be closely regulated to avoid abuses free markets are prone to.

3) Every individual has an emissions allowance account, akin to a bank money account. A sum of money, representing the total price of the allocated emissions allowance for a given allowance period –in principle one year or one quarter–, is credited by the State at the beginning of each allowance period.

4) Producers and suppliers have also emissions allowance accounts but no emissions allowances per se, as they are not directly responsible for any emissions released during production of goods or supply of services for consumers. Economic signals

for reducing emissions contents come from final consumers as explained in sections 11) and 12) of this outline.

5) Prices of goods and services include an emissions surcharge that represents its emissions contents at the current price of emissions allowances. Emissions contents include the emissions already incurred during production and/or supply, and any direct emissions released when used by the consumer.

   Emissions contents of any good or service are added up along the production/supply chain as producers/suppliers pass along the emissions contents of the resources they use for producing/supplying said good or service. Those goods that generate direct emissions during use/consumption by the final user (mostly fuels) must have these added at the first point of entry in the production/supply chain, in which case the designated national authority determines the corresponding value. Most of these values can be directly taken from standard values provided by guidelines of the Intergovernmental Panel on Climate Change (IPCCC), already used by countries for preparing inventories of greenhouse gases within their National Communications to the UNFCCC Secretariat.

6) Emissions contents and the resulting price surcharge apply regardless of the place (in-country or abroad) where emissions were incurred. Emissions contents of imported fuels, goods and services are taken from the allowance system of the country of origin. In case the country of origin has no allowance system in place, imported emissions contents are determined by the designated national authority.

   Emissions of international transport are charged to the carriers when buying local fuel, goods and services. These emissions are eventually passed along as indirect emissions to passengers or goods transported, in the latter case as indicated in the next section of this outline.

7) Emissions contents of exported fuels, goods and services are provided to the allowance system of the country of destination.

8) The emissions surcharge of any fuel, good or service bought by an individual is withdrawn from his/her allowance account, and repaid to the State.

9) Emptying the individual’s allowance account before the end of the allowance period has the same economic consequences as running out of money. The individual cannot buy further any fuel, good or service with emissions contents until the allowance account is replenished by buying unused allowances from other individuals.

10) Producers and suppliers also pay emissions surcharges for the goods and supplies they buy from others; these surcharges are initially debited from the allowance account until they are passed along to the consumers via the corresponding emissions surcharges; any emissions surcharges not passed to customers show as an overdraft in the allowance account and must be balanced by buying unused emissions allowances; persistent negative balance in the allowance account has the same economic consequences as temporary insolvency, which prevents buying further goods or supplies with emissions contents.

11) The limited amount of allowances induces individuals to use fuels, goods and services with lower emissions content, thus giving the corresponding producers and suppliers advantage over more emissions-intensive competitors.

12) Competition on offering fuels, goods and services with lower emissions contents creates demand for improved or new technologies from developers.

13) The price of allowances send signals to individuals on the cost of overspending the allocated allowances. The limited amount of allowances available either globally or nationally, and the consequent scarcity of unused allowances should prevent rich individuals from emitting liberally regardless of the cost. Very rich individuals may be tempted to buy as many allowances as they need regardless of the cost, thus close regulation should prevent monopolization. If “smart” individuals manage to monopolize the desired amount of allowances anyway, the overall effect is still the expected emissions target corresponding to the total amount of allowances available globally.

The implementation of the above outlined system in developing countries would need modification. Emissions from richer individuals are mostly manageable as described above, and would very probably deliver most of the emissions reduction. Involving poorer segments of population is however important, both for equity considerations and for a fully performing allowance trading.

As mentioned earlier, allowance trading could provide the poor a source of additional income or even finance better life conditions (e.g. access to energy, sanitation and potable water). Smart ways for allocating allowances, estimating (rather than tracking) emissions, and facilitating trading of unused allowances for the poor need to be developed. Methods used by mobile phone providers for example may bring some early inspiration.

7. Equitable sharing of resources

The ever increasing concentration of CO2 in the atmosphere is just one of the many manifestations of over-consumption of natural resources by the world’s richer population. These resources include inter alia water, minerals, forests, land, sea and atmosphere.

The above outlined system of per-capita carbon emissions allowances could be eventually extended to other natural resources, the over-consumption of which is threatening the environment. The ultimate goal should be to regulate the consumption of these resources within sustainable levels, while guaranteeing their equitable sharing between every human being on Earth.

Conclusions

The current climate regime has proven largely insufficient to stabilize global climate. The root of the shortfall is in the system adopted to reduce emissions: meager binding targets for developed countries based on absolute 1990 levels. How to adopt more realistic targets has been a permanent impasse with developing countries.

There are two essential considerations that should break the impasse, and deliver an effective and equitable post-Kyoto climate regime:
(1) The emissions rights implicit in the Kyoto Protocol are ultimately inequitable. If per-capita global emissions must be halved on an equitable basis to stabilize climate, then most developing countries have always been under this sustainable target.
(2) It is richer individuals globally, and not developed countries per se, who have contributed most to global warming. Equity should transcend national borders: the poor in developed countries have the same rights to emit as anybody else; conversely, richer individuals in developing countries have the same obligation to reduce emissions as their counterparts in developed countries.

To be equitable, any new climate regime should be based on per-capita emissions. To be effective, the new regime should limit emissions directly at its roots –the consumers–, as new evidence emerges that renewables, nuclear fission and technologies per se cannot support current consumption patterns in a sustainable way.

While every individual in a country should receive the same equitable emissions allowance, flexibility in fitting different needs should be provided by national trading of unused allowances. Every signatory country should receive an equitable share of allowances proportional to its population. While trading between countries should provide flexible distribution of allocated allowances, the total amount of allowances globally should remain constant as per the agreed global reduction target.

At first glance, a system for managing individual emissions could appear unfeasible. Monetizing emissions allowances and prioritizing tracked variables should make the system practicable. A concerted international effort could also contribute to making the system affordable by less developed countries.

The implementation difficulties of a per-capita allowances system should be assessed in comparison to the difficulties in implementing an alternative climate regime built on the Kyoto architecture. Successfully implementing any successors to the Kyoto flexibility mechanisms is seemingly more difficult than implementing the more straightforward and transparent per-capita allowances system.

This article provides an early outline of how a system of per-capita allowances would work. More research is needed on the detailed design and implementation issues of a new climate regime based on this system.

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Note

The views and opinions presented in this article are strictly personal, for which the author assumes full responsibility.

Mhai Selph, January 2010